## ABSTRACT

BODZIN, ALEC MICHAEL. Purposeful Use of a Non-Restrictive, Asynchronous Public Web-Based Forum for Facilitating Reflective Discourse with Preservice Science Teachers. (Under the direction of John C. Park.)

The purpose of this research has been 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 for facilitating reflective discourse with preservice science teachers. Thirty-two preservice secondary school science teachers participated in a public science teaching forum on the World Wide Web during their student teaching internship. The forum was designed with NetForum software 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. A combination of quantitative and qualitative research methods were used to explore interaction patterns that facilitated collaborative preservice teacher reflective discourse on the forum and participants' attitudes towards using asynchronous telecommunications during their student teaching internship. Data from forum discourse analysis, interviews, and survey instruments illustrate that the use of this asynchronous Web-based forum provided the participants the opportunity to discuss and examine science concepts and reflect on classroom issues that were directly relevant to their student teaching experiences. The findings revealed that most participants had positive attitudes with respect to interacting with the Web-based forum. Furthermore, there were no significant differences in attitude between participants who had access to a networked computer and those who did not have access. An analysis of the forum postings showed that saturation

in the discourse can occur with large groups participating in online asynchronous conversations.

# PURPOSEFUL USE OF A NON-RESTRICTIVE, ASYNCHRONOUS PUBLIC WEB-BASED FORUM FOR FACILITATING REFLECTIVE DISCOURSE WITH PRESERVICE SCIENCE TEACHERS

by

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# DEDICATION

This dissertation is dedicated to my loving wife Sheryl. Her unconditional love and support was instrumental for me to complete this dissertation. I appreciate most dearly the sacrifices she made in her life so I could return to school and fulfill a life goal. It is a bit difficult to work on a dissertation and not forget about other important things in the world. Sheryl has been and is the most important part of my life. I am grateful for those times when the long hours and mental demand of this research have made it seem as though she was perhaps second. Through these times she patiently and consistently understood and helped me in anyway she could. I could not have made it through the last three years without her at my side.

# BIOGRAPHY

Alec Michael Bodzin was born in Washington, DC., United States of America. He lived in Northern Virginia for the first 17 years of his life. He attended the University of Michigan in Ann Arbor, Michigan from 1984 to 1988 where he graduated with a Bachelor's of Science in Biology and Psychology. He then entered the Peace Corps and became a science and mathematics teacher in Kiribati. After returning to the USA, he received a fellowship at the George Washington University, where he obtained a Master's in Education. While attending the George Washington University, he worked as a science teacher in Fairfax County, Virginia. After 3 years of teaching in Fairfax County schools, he married Sheryl and spent the next year traveling in the Mid-East and Europe. He returned to the USA, and spent the next two years teaching high school science in Columbia, South Carolina. In 1996, Alec M. Bodzin was awarded a fellowship from the National Science Foundation in Instructional Technology in Science Education at North Carolina State University which supported the research contained in this dissertation. While attending N.C. State, Alec has been a member of the SERVIT (Science Education Research in Visual Instructional Technologies) Group, created science education Web sites, and compiled CD-ROMs of instructional materials for science educators.

Alec was born to Stephen and Tanya. He has one sister, Samantha-Joy. Alec is married to Sheryl Lynn Neuenkirch daughter of Tom and Carolyn.

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# INTRODUCTION

"In our schools, every classroom in America must be connected to the information superhighway, with computers and good software, and well-trained teachers."

-- President William J. Clinton, from his State of the Union Address, 1996.

The American educational system is currently undergoing a major reform initiative as a result of new telecommunications technology. A massive connectivity movement is occurring throughout American schools in response to a new national mission for students to enter the work force technologically literate in the 21st Century. Preparing students to meet the increasing demand for "knowledge workers" versed in telecommunications is the most commonly given reason for bringing telecommunications in the classroom (Shrum & Berenfeld, 1997). Advanced telecommunication skills are important in many occupations in today's workplace and these skills will become more essential in the near future. Preparing teachers to use instructional technologies effectively in the classroom is essential for student learning in today's society. Researchers conclude (U.S. Congress, 1995) that teachers are being inadequately prepared to use instructional technology and consequently are unable to effectively integrate technology into classroom teaching practices. Given the critical role of technology in the social and economical future of the nation, preparing teachers to effectively use instructional technology is critical (Northrup & Little, 1996).

## Benchmarks and Standards

There is a need to identify specific benchmarks defining the instructional technology skills preservice and practicing teachers should be able to use in their classrooms. In response to this need, national and state guidelines and standards are emerging to provide direction to preservice teacher education programs for developing basic technological competency skills. The National Council for Accreditation of Teacher Education (NCATE) is the official body for accrediting U.S. teacher preparation programs. The International Society for Technology in Education (ISTE) is the professional education organization responsible for recommending guidelines for accreditation to NCATE for programs in educational computing and technology teacher preparation. NCATE has adopted the following telecommunications-related guidelines for use in accreditation (International Society for Technology in Education, 1997): Candidates will ...

- access and use telecommunication tools and resources for information sharing, remote information access and retrieval, and multimedia/hypermedia publishing.
- use electronic mail and web browser applications for communications and for research to support instruction
- use automated on-line search tools and intelligent agents to identify and index desired information resources.
- collaborate in on-line work groups to build bodies of knowledge around specific topics.
- conduct research and evaluate on-line sources of information that support and enhance the curriculum.

• use computer-based technologies including telecommunications to access information and enhance personal and professional productivity.
• use computers to support problem solving, data collection, information management, communications, presentations, and decision-making.
• identify computer and related technology resources for facilitating lifelong learning and emerging roles of the learner and the educator.

The National Science Education Standards present a vision of developing a scientifically literate populace in the United States. (National Research Council, 1996). In order to achieve this goal, “an educational system in which all students demonstrate high levels of performance, in which teachers are empowered to make the decisions essential for effective learning, in which interlocking communities of teachers and students are focused on learning science, and in which supportive educational programs and systems nurture achievement” is required (p.2). Doing science requires communication. Students learning science have the same need to communicate and collaborate as professional scientists. Professional scientists are relying on telecommunications to share information, discuss ideas, disseminate results, and collaborate on research projects. By sharing data, knowledge, and ideas with peers from different geographical locations, students can actually do what scientists do, building their own understanding of the world around them. Electronic mail, listservs, bulletin board systems, electronic conferences, and Web-based forums, are all ways telecommunications are being used to share information and data, and to support teachers and students participating in collaborative science projects. Telecommunications can greatly enhance science curricula by providing far more access to current data and information than what is found in most libraries. Furthermore, by expanding communications beyond our classrooms, teachers can access people with expert knowledge on different science topics.

## Telecommunication Networks

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 and to the outside world and for teachers to be ready to use and teach using 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 also reported that the percentage of schools with Internet access in five or more instructional rooms per school 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.

In recent years there has been a significant increase in the number of educators who use telecommunications networks, as well as growth in the number and quality of networked educational resources (Anderson & Harris, 1997). There are many common rationales for using advanced telecommunications to meet pedagogical goals. Frequently cited in current research are: Bringing real-world relevance into the classroom; helping students perceive knowledge as constructed rather than delivered from a book or teacher; providing students with an effective model for lifelong learning; strengthening social, communication, and critical thinking skills; meeting standards for inquiry-based learning; increasing the authenticity of the learning environment; changing the definition of the learning community to extend beyond classroom walls; finding role models for students; and promoting equity by providing all schools access to the same resources (Schrum & Berenfeld, 1997; SRI International, 1997).

Network use can help educators stay current with best practices in their field and help them to overcome problems such as teacher isolation. As with any profession, teachers need opportunities to expand their knowledge, keep pace with developments in their field, try out new innovative teaching methods, exchange ideas with peers and experts, and refine their skills. Network exchanges present a prime opportunity for collaboration among teachers (Merseth, 1991). Teachers with access to telecommunications networks can contact other educators to discuss issues relating to their teaching practice, developments in their field, and classroom experiences.

Computer telecommunication networks have tremendous potential to facilitate teachers' learning and professional development. Computer networks can serve as a vehicle for teacher education by providing information on educational issues and trends. Computer network technology has the potential to support a great degree of communication and collaboration between teachers and others outside the school walls. Although many claims have been made regarding the benefits of networks,  there has 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).

### Preservice Teacher Education

As more American 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 utilize 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, and when combined with good on-site support greatly improves the quality of supervision in teacher education (Casey & Vogt, 1994).

A new area of research has emerged to study the potential of preservice teachers engaging as an electronic network of educators. These networks are virtual communities of teachers who share teaching experiences, problems, new ideas, and pedagogical resources. 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). Networks can provide emotional support, curriculum support, and a place to reflect on issues of teaching with peers in the same situation (Angeli, Supplee, Bonk, & Malikowski, 1998; Bull et al., 1989; Casey, 1997; Merseth, 1991; Schlagal et al., 1996; 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).

It is much less likely for any member or group of members to dominate discussion in an online discussion group. Everyone can contribute to whatever 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, which 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 network of educators is distinguished by the social nature of the learning environment it offers. As with 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, seeking common meanings in teaching practice, or constructing ideas in collaboration with other teachers.

### Web-Based Communication

The World Wide Web (Web) is familiar to students and 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 with a Web browser software such as

Netscape or Internet Explorer. Recent developments on the Web have made opportunities available for preservice teachers to have access to university supervisors and mentors from locations away from the university campus. Using the Web, college instructors can support preservice teacher learning by modeling expert-like answers, providing feedback on student misconceptions, and offering key instructional help and task structuring.

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. This new computer technology presents a more appropriate environment for online learning than e-mail listservs or bulletin board systems by providing users a more friendly interface to navigate within the online system and by providing users easier access to the system from remote locations. All that is needed to participate in a Web-based forum is access to the World Wide Web. Web-based forum discussions can occur asynchronously (in delayed time), permitting the user to read, browse, or add to multiple discussions at his or her 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 to 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.

### Need for this Study

Although new teacher communications networks continue to be established in higher institutions 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 and others failed due to lack of use (Thompson & Hamilton, 1991). Few studies have been conducted in which student teacher postings to electronic networks have been analyzed for types of discourse. These studies have described only broad, general categories of types of discourse occurring on networks of preservice teachers. None of the existing studies have analyzed if the discourse is thoughtful and promotes a reflective practice in which a cohort group of preservice teachers engage in discourse that involves the asking of focused questions, seeking common meanings in teaching practice, or constructing ideas in collaboration with other preservice teachers and university faculty.

As telecommunications technology becomes more commonplace in educational settings, it is increasingly important to understand what preservice teachers' self-beliefs are concerning their ability to use telecommunications 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 the 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 use of a Web-based forum for facilitating reflective discourse. Very few research studies exist involving preservice teachers using telecommunications for purposeful discourse in any preservice education program. Those that have been conducted were designed to evaluate the impact of the use of electronic mail and bulletin board systems on preservice teachers' attitudes dealing with the utility and use of the electronic medium during student teaching internships. These studies were conducted within the context of restricted networks of preservice teachers. There have been no studies conducted involving preservice education students using Web-based forums during their student teaching internships in which a public Web-forum served as the online community network space.

The current educational reform movement calls for research to determine mechanisms for preservice teachers to use telecommunications for reflective conversations embedded with critical thinking. Since the 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 applicability 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 is 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 for facilitating reflective discourse with preservice science teachers.

1. What effects do the purposeful use of asynchronous Web-based telecommunications in a science education methods/curriculum course have on student attitudes towards electronic communications and computers?

A. 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?

B. What are the students' attitudes toward using a Web-based forum during their student teaching field internship?

C. Will students claim that they feel less isolated in the field by participation in the Web-based forum?

D. What aspects of the Web-based forum do preservice science teachers feel foster their sense of an electronic community of educators?

2. In which of the following ways do preservice science teachers use a non-restrictive, public Web-based forum during their student teaching internship:

A. Does a Web-based forum serve as an effective means of support for a cohort group of preservice science teachers? How do students define their cohort?

B. Which conference topics promote the most exchanges of ideas?

C. Which conference topics promote the most reflective discourse?

D. What is the average length of dialogue thread in the Web-based forum?

E. How does peer responsiveness affect the depth of the dialogue?

F. Does the forum discourse extend beyond the computer medium?

3. Does the discourse of preservice science teachers on a non-restrictive, public Web-based forum promote a reflective practice of teaching?

A. Does interacting with a Web-based forum promote reflection on what the students are learning, including teaching approaches and decision-making?

B. What types of mentor scaffolding do university instructors provide on a Web-based forum?

4. What benefits and barriers do preservice science teachers encounter when using a Web-based forum on the Internet?

5. How does the Web-based medium influence a discussion?

A. What differences do preservice teachers perceive between Web-based communication and face-to-face-communication?

B. How does the Web-based medium promote or inhibit online discussion?

## Definitions of Terms

Asynchronous communication: Time-delayed communication. A method of sending and receiving information to be read at the user's convenience.

Browser: A software device that enables users to view and navigate Web pages and access text, graphics, video, audio on the Internet. Netscape Navigator, Mosaic, and Internet Explorer are common browsers.

Bulletin board system (BBS): A telecommunications service for sharing information. BBSs contain areas called "conferences", "topic areas", or "rooms" where a user sends a message to. Messages can be read sequentially, or in "threads". A subject line is used as a guide to label the topic of the message. Responses to messages can be posted to the appropriate thread and left for other readers.

Computer conferencing: A form of online dialogue around a given topic. Listservs, Web-based forums, bulletin board systems are forms of computer conferencing.

Computer-mediated communication (CMC): A term used to describe communications through electronic exchanges using a network computers linked to a central host computer by a variety of means including local networks,

telephone lines, and special data networks. It involves delayed-time, text-based messages and may include a variety of facilities ranging from electronic mail to accessing remote databases.
Examples include e-mail, listservs, bulletin board systems, Web-based forums, and computer conferencing.

Electronic community network of educators: A virtual community of teachers who share teaching experiences, problems, new ideas, and pedagogical resources.

E-mail (electronic mail): The ability to send messages from one person to another through a computer network.

Inservice teacher: A practicing classroom teacher.

Internet: A collection of networks which interconnect world-wide using the same communication protocol called Transmission Control Protocol (TCP/IP).

Listserv: A specific automatic mailing program which distributes e-mail messages to users who share a common interest. Any mail sent to a listserv is automatically distributed to all members of that list.

Local Area Network (LAN): Computers linked together for communications purposes in a limited geographical area.

Modem:  An electronic device that allows two computers to communicate over phone lines.  A modem converts the digital data output of a computer to audio tones that are transmitted across telephone lines.  This output can be text, graphics, audio and video.  At the other end, a modem converts the audio signal back to a digital format so it can be read by the receiving computer.

NetForum:  A Web-based forum software.  NetForum structures discussion topics in any order the user desires.  The software enables users to add new discussion topics 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.

Network:  The connection of two or more computers through telephone lines or cables so that people can exchange information using a shared communication system.

Online:  The act of a user being connected to a network system of computers.

Preservice teacher:  A student enrolled in a teacher preparation program.  Often referred to as student teacher.

Reflective practice:  Ability to make sound decisions using available information, and the knowledge, skills, and attitudes necessary to gather and apply pertinent information.   May involve asking focused questions, seeking common meanings, or constructing ideas in collaboration with others.

Student teaching: The ten week field experience which is usually the completion of the  preparation in a teacher education program.

Telecommunications:  Communicating across distances.  In its broadest sense, this definition includes communicating by any medium including radio, television, telephone, and computers.  This writing will use the definition in the context of of computer data communications.

Thread:  A specific topical message and its replies within a Web-based forum topic.

University supervisor:  A university official who observes and evaluates preservice teachers' skills during their student teaching internship.

Web-based forum: A general name for software which enables users to post topical messages on the World Wide web.

World Wide Web (Web):  A hypermedia information retrieval system linking a variety of Internet accessible documents and data files (texts, graphics, audio, and video.  Often referred to as "WWW".  Uses Hypertext Transfer Protocol (HTTP) in conjunction with TCP/IP protocols  to transport documents and files across the Internet.

# REVIEW OF THE LITERATURE

## Online Systems Background

Online education emerged from systems that focused on enhancing intellectual processes through collaboration among knowledge workers (Harasim, 1990). In 1968, Douglas Engelbart was concerned with augmenting the intellectual capacity of computer users. He prototyped his NLS (On-Line System), later marketed as Augment, at the Augmented Human Intellect Research Center at Stanford Research Institute. One of the most notable design features of Augment was the emphasis on providing tools to support collaborative work. According to Engelbart and English (1968), the Augment project placed a great emphasis on collaboration among people doing their work in an asynchronous, geographically distributed manner.

A direct ancestry of online education lies in computer conferencing. Computer conferencing, a communication system for dispersed human groups, was invented and implemented by Murray Turoff in 1970. Turoff designed conferencing to be a “collective intelligence” environment, which would use the computer to structure human communication for information exchange and effective problem solving (Turoff, 1970). Computer conferencing was first adopted within government, then by the corporate and scientific sectors, and more recently within the educational community.

In 1969, the first network, ARPANET (Advance Research Projects Agency Network), was developed to link four Department of Defense computers (Schrum & Berenfeld, 1997) . ARPANET was developed largely as a facility to allow researchers in one part of the country to use computers located in other parts of the country. Users of these networks opened up a new mode of communications, electronic mail - the ability to send messages from one computer to another. The ability to communicate easily and quickly with other researchers led to discussions, sharing data, and collaboration on research projects.

In 1983, new advanced protocols, Transmission Control Protocol (TCP) and the Internet Protocol (IP) were implemented. TCP/IP permitted all computers to communicate regardless of size, manufacturer, hardware specifications or location. By 1984, over 1,000 host computers used ARPANET. By 1987, that number grew to 10,000 (Schrum & Berenfeld, 1997).

In 1983, using TCP/IP protocols, the National Science Foundation (NSF) created its own network, NSFNET, to link universities and research facilities. Users could access NSFNET with a telephone modem. Regional networks linked by NSFNET formed the initial infrastructure for today's Internet. By 1985, about 100 networks were connected. By 1990, 2,000 networks were connected and as of 1996, the Internet connected almost 5,000 networks.

The World Wide Web (Web) is a set of protocols that work in conjunction with TCP/IP protocols. They were developed in 1989 by Tim Bernes-Lee at the European Laboratory for Particle Physics (CERN) (Schrum & Berenfeld, 1997). On April 30, 1993, CERN placed the Web software in the public domain. Soon afterwards, a team of computer programmers at the University of Illinois developed a "browser" called Mosaic that enabled users to view and navigate Web pages and access text, graphics, video, audio on the Internet. Web pages are found by using a naming convention that provides a Uniform Resource Location (URL) for each document. The Web uses HyperText Transfer Protocol

(HTTP) in conjunction with TCP/IP protocols to transport documents and files across the Internet. Web pages are written using HyperText Markup Language (HTML). HTML allows Web documents to link to other documents using hypertext links. Web documents can be viewed from multiple computer platforms (Macintosh, Unix, or PC).

## Social Context

Previous research by Vygotsky (1962), although not referring to online environments, offers insight into how writing can contribute to knowing. He contends that the process of articulating thoughts into written speech involves deliberate analytical action. Language enables us to think about our thinking. According to Vygotsky, individuals find meaning not only through individual experiences but also through social interactions. Learners actively construct knowledge by formulating ideas into words, and these ideas/concepts are built upon through reactions and responses of others to the formulations. According to Vygotsky (1978), knowledge is socially constructed. Individuals find meaning not only through individual experiences but also through social interactions.

According to diffusion of innovation theory, social integration (or the extent to which potential adopters participate in a social network of other users) plays an important role in the adoption of innovations (McQuarrie, 1989; Rogers, 1995). Rogers defined compatibility as the degree to which an innovation is perceived to be consistent with the existing values, past experiences, and needs of potential adopters. As individuals become more integrated into a social network of computer users, they may increasingly integrate computers into their lives by using them more regularly and for more different applications (McQuarrie, 1989).

## Self-Efficacy Theory

Research suggests that Bandura's (1977) theory of self-efficacy provides a useful framework for understanding the behavior of individuals with respect to the acceptance or rejection of technology.  It is increasingly important to understand what educators' self-beliefs are concerning their ability to use telecommunications in an instructional setting.  Those who judge themselves to be efficacious in using the telecommunications will anticipate positive and challenging telecommunications experiences.  Those who see themselves as inefficacious are likely to expect negative experiences with using telecommunications.

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.

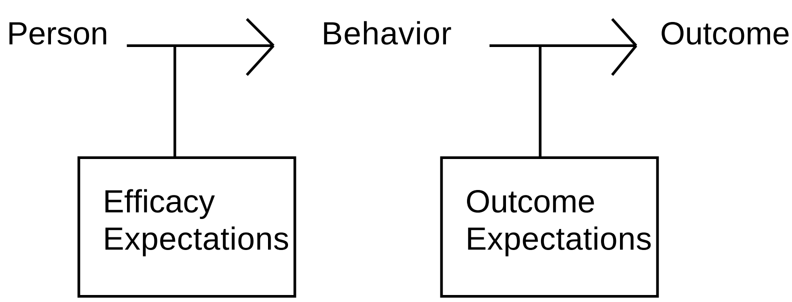



Figure 1:  Differences between efficacy expectations and outcome expectations (Bandura, 1977).

Figure 1 depicts the differences between efficacy expectations and outcome expectations. 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. The difference is that individuals may lead themselves to believe that a given course of action will cause a given outcome (outcome expectation), yet question whether or not they can carry out the action (efficacy).

According to Bandura (1982), perceived self-efficacy could be defined as a person's judgments of their capabilities to organize and execute courses of action required to attain designated types of performance. Motivation is affected by both outcome and efficacy expectations. Perceived self-efficacy influences people's choice of behavioral settings. People fear and tend to avoid threatening situations they believe exceed their coping skills, whereas they get involved in activities and behave assuredly when they judge themselves capable of handling situations that would otherwise be intimidating.

Not only can perceived self-efficacy have directive influence on choice of activities and settings, but, through expectations of eventual success, it can affect coping efforts once they are initiated. Efficacy expectations determine how much effort people will expend and how long they will persist in the face of obstacles and negative experiences. The stronger the perceived self-efficacy, the more active the efforts which result in greater performance accomplishments. Strength of efficacy also predicts behavior change. The stronger the perceived efficacy, the more likely are people to persist in their efforts until they succeed.

Bandura's (1982) self-efficacy theory distinguishes between two judgmental sources of futility. People can give up trying because they seriously doubt that they can do what is required, or they may be assured of their capabilities but give up trying because they expect their efforts to produce no results due to the unresponsiveness, negative bias, or punitiveness of the environment.

Bandura (1977) states that personal efficacy expectations are based on four sources of information: performance accomplishments, vicarious experiences, verbal persuasion, and emotional arousal. Performance accomplishment is the most influential source of efficacy information because it is based on personal mastery experiences. Repeated success in a particular task raises one's self-efficacy level. After strong efficacy expectations are developed through repeated success, the negative impact of occasional failures is likely to be reduced. With regard to vicarious experiences, seeing others perform threatening activities without adverse consequences can generate expectations in observers that they too will improve if they intensify and persist in their efforts. Verbal persuasion involves leading individuals, through suggestion, to the belief that they possess certain capabilities and that they can overcome any difficulties. Emotional arousal is another constituent source of information which is become elicited during stressful and taxing situations. Anxiety producing situations elicit emotional reactions of varying intensities.

Olivier & Sadowski (1986) investigated the question of which course experiences and prior attitudes affect how confident teachers feel about working with computers after completing different introductory courses. Their findings were consistent with Bandura's theory of self-efficacy being affected by temporal patterns of successes and failures.

Hill, Smith, and Mann (1987) found that previous experience with computers is related to beliefs of efficacy with respect to computers, but it does not exert a direct independent influence on the decision to use computers. This is consistent with Bandura's research on personal self-efficacy. Only through changes in perceived efficacy does experience with computer technology lead to a higher likelihood of technology adoption.

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.

## Student Teaching Characteristics

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, and discuss their experiences, and from whom they might find support.

Goodlad (1998) proposes two fundamental conditions needed for collaboration to be effective: (1) frequent opportunities to share experiences with other persons in similar roles, and (2) opportunities to reflect upon how theory and research can inform practice. Goodlad states that developing and maintaining a method for ongoing communication between the school district and the university should be give the highest priority if collaboration is to have a chance of succeeding.

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).

Teacher educators can enhance the induction process by extending professional preservice training into inservice classroom support (Singletary & Anderson, 1992). Universities can provide a forum for teachers to confer openly about problems without fear of repercussions. In addition, universities are capable of multi-school networking, which is especially important when teacher isolation is compounded by rural settings.

Recent developments in computer telecommunications technology have emerged as a means for providing support to beginning teachers. Telecommunications have made possible computer-mediated communication such as e-mail listservs, bulletin board systems, and Web-based forums. 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.

Computer telecommunications technology has tremendous potential to facilitate teachers' learning and professional development, and the opportunities are increasing as new telecommunication conferencing programs are being developed. Computer telecommunications can serve as a vehicle for professional development by providing information on educational issues and trends. In addition, communication systems can provide support and assistance through the sharing of ideas and concerns and can help overcome feelings of classroom isolation.

## Network Aspects

The term network describes the electronic transfer of text messages from one person to another or to a group of individuals where the form of exchange is printed text on a computer screen (Eurich-Fulcher & Schofield,1995). Participants on a network use personal computers that are linked through modems and telephone lines to a host computer. Network growth has been exponential. This trend continues today as new telecommunications technology enables more and more users to gain access with a variety of different online service providers.

According to Weir (1992), the organization of a network group includes the participants in a network, as well as the attributes they bring such as their experiences, interests, and expertise which affect the relationships that evolve in the group. Another aspect of the network group is the task organization, or the context, which could be as broad as sharing ideas or as specific as contributing toward a goal. However, there are other aspects to consider, which include access not only to the network but also equipment, the medium for communication, the response opportunities for the networked groups, the wait time between responding to messages, and the quality and quantity of the interactions.

The potential of online education can be explored through five attributes that taken together both delineate its differences from existing modes of education and characterize online education as a unique mode: (1) many-to-many communication; (2) place independence; (3) time independence; (4) text-based; and (5) computer-mediated interaction (Harasim, 1990). Network exchanges present a prime opportunity for collaboration among teachers. In principle, teachers join a community of learners where the network becomes the framework for cooperative learning and the scaffolding for teacher learning (Merseth, 1991). The network serves as a forum to share expertise, to try out new ideas, to reflect on practices, and to develop new curricular ideas. Making a classroom experience public on a network enables participating teachers and students to share a teaching and learning experience (Roberts, Blakeslee, Brown, & Lenk, 1990). In this way, good teachers can serve as models for others by describing the way they handle particular aspects of a teaching experience.

## Computer-Mediated Communications (CMC)

Computer-mediated communications (CMC) is often used interchangeably with other terms such as electronic seminars, computer conferencing, and online class discussion. CMC refers to the use of a network of microcomputers linked to a central host computer by a variety of means including local networks, telephone lines, and special data networks (Cifuentes, Murphy, Segur, & Kodali, 1997). It involves delayed-time, text-based messages and may include a variety of facilities ranging from electronic mail to accessing remote databases.

CMC is essentially a many-to-many communication tool that structures information exchange and group interactions. Computer conferencing software, which automatically files notes into topical discussions and updates users on any new comments in a topic presents an appropriate environment for online learning (Harasim, 1990). According to Harasim, computer conferencing was designed to support "collective intelligence" and meetings of minds through the topical structure of the system. This structure provides the shared space essential to group interaction: all members of an online group can read the same messages about a particular topic in the same order. Each participant of a conference has access to each message for reading and response. The shared electronic area enables a dialogue to take place. The conferencing software also generates a record of the interactions that take place. This record becomes a common resource for later reference, manipulation, and further discussion (Eastmond, 1992). Computer conferences frequently have an area where participants can introduce themselves.

According to Berge (1997), The main characteristics of CMC are:

• provides asynchronous communication (a method of sending and receiving information to be read at the user's convenience);

• provides a virtual space for interpersonal interaction, social networking, changing roles and dimensions of students, teachers, curriculum, and institution; and

• provides a technological environment combining telecommunication systems and computer networks to solve problems of access, quality, and productivity.

Computer conferences can be conducted using electronic mail (e-mail) listservs. Participants use a computer to compose, send, and receive e-mail messages to an ongoing discussion, which may or may not be moderated. Messages arrive back to the listserv participant in a sequential order and are not organized by topics or “threads”. The organization of the messages is the responsibility of the receiver. This can be a confusing task for a new user (Morrison, 1993; Romiszowski & deHaas, 1989). Archives of listserv postings can be created, and these compilations of the listserv’s e-mail postings can be sent to the participant.

Bulletin Board Systems (BBS) are conferencing programs designed to provide an environment constructed in software and available via the Internet. BBSs contain areas called “conferences”, “topic areas”, or “rooms” where a user sends a message. Messages can be read sequentially, or in “threads”. A subject line is used as a guide to label the topic of the message. Responses to messages can be posted to the appropriate thread and left for other readers.

A main difference between e-mail and CMC is that CMC structures communications around specific topics and e-mail does not. CMC have distinct conference areas where participants may discuss issues related to specific topics specified by moderators who usually administer and coordinate the discussion or by the participating members themselves.

In distance education conducted through CMC, students and instructors use personal computers and phone lines to communicate with a central host mainframe computer running a computer-conferencing program (Davie & Wells, 1991; Eastmond, 1992). The choice of when to distribute to the discussion is the sole discretion of the participants. Online course activities can be structured to require student initiative, discussion, and reflection. The environment of the physical interface can vary from user to user and affect accessibility, interaction, and motivation, and therefore the learning process (Murphy, Drabier, and Epps, 1998).

Berge (1997) identifies the following advantages of computer conferencing based on a detailed review of available literature on CMC use in instructional settings:

• time and place independence permits 24-hour access to other people and resources;
• allows for self-paced learning;
• allows user time to compose responses;
• facilitates course management (e.g. advising);
• allows for self-directed learning;
• cultivates multiple perspective approaches;
• can accommodate authentic problem solving activities;
• promotes collaborative learning and can use peer review/support activities;
• students and teachers become part of a virtual community of learners;
• provides a means for professional development;
• can facilitate mentoring activities;
• has relatively low social context cues;
• often fosters less inhibited behavior; and
• relatively fast communication channel.

New technology has made computer conferencing possible on the World Wide Web today. Web-based conferencing allows users to read, browse, and add to multiple discussions by using a Web browser anywhere in the world with an online connection. One does not need access to networks or systems at a particular university to participate in a Web-based discussion. All that is needed is access to the World Wide Web. Web-based discussions occur asynchronously, permitting the user to read, browse, or add to them at his or her convenience. Web-based computer conferencing software has the following characteristics:

- some manner for identifying participants and e-mail addresses on the system;
- topical conference areas for group discussion with a permanent record of interactions;
- a writing work space for users to draft thoughts and ideas;
- 24 hour accessibility;
- not dependent on the user's location; and
- fast mode of communication.

## Non-Facial Communication

One major area of research regarding CMC concerns non-facial (text-based) aspects of communication. With computer-mediated communication (CMC) there is an absence of social, contextual, and nonverbal cues which normally regulate and influence social interactions (Berge, 1997; Harasim, 1990). Information about individuals' job titles or positions, social status, race, age, and physical appearance, and facial expressions, voice dynamics, and body language are all usually lacking with CMC. This lack of social context cues available on a computer network can allow individuals to experiment with different roles and identities.

According to Berge (1997), since computer conferencing provides a text-based environment with low levels of social context cues compared to face-to-face interactions, it can have both negative and positive consequences in an instructional setting. Low levels of social context cues can lead to more uninhibited behavior on the part of the computer conferencing users than would occur with face-to-face interactions. This has the possibility of leading to misunderstandings and intense arguments, but it can facilitate more interpersonal interaction in a virtual class setting and involve persons who are normally shy or wary in a face-to-face classroom (Bellman, 1992, as cited in Berge, 1997).

There are cognitive benefits to text-based interaction. Non-facial communication allows participants time to reflect and consider their response (Berge, 1997; Harasim, 1990). The time lag associated with computer conferencing is well suited to shy, thoughtful, or hesitant conversationalists where answers and responses are considered and carefully framed before presentation. Written communication is perceived by learners as contributing to more reflective interaction than talking in a face-to-face class or telephone conference. The textual mode of communication provides opportunities for students to pace their processing of information, review and skip ahead, and easily refer to discussion comments later (Eastmond, 1992). Student discourse with non-facial communication provides the opportunity either to respond immediately or first to reflect, compose, and edit one's response. Vygotsky (1962) asserts that the process of articulating thoughts into written speech involves deliberate analytical action.

According to Harasim (1990), asynchronous group learning can also reduce competition for air-time among participants. There is no concern that time restrictions or turn taking will limit expression or opportunities to speak.

Participants who require additional time to present their ideas are not interrupted by more assertive individuals.

Text-based communication has no social or physical cues to distract one from the cognitive content of a message (Harasim, 1990). The focus of the message is on the content and not the presenter. A text-based medium lacks mechanisms for displaying or enforcing social differentiation by such factors as social status cues or physical cues such as race, gender, or physical handicap, which in other communication contexts interfere with group interaction. Online learners report that text-based interactions diminish the stereotyping associated with high external social status or physical appearance, thereby removing a significant barrier to equal participation (Davie & Wells, 1991; Harasim, 1986).

Asynchronous collaboration also has its drawbacks. Communication anxiety (the feeling of speaking into a vacuum) can occur when a participant receives no immediate response to ideas and comments (Feenberg 1987). Physical cues such as facial expressions, voice intonations, and gestures are eliminated. Participants may also feel inhibited within online discussions because their words will be preserved in a database (Davie & Wells, 1991; Harasim, 1990).

Text-based communication preserves 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 to 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.

## Inservice Teacher Use Of Telecommunications

During this past decade, some statewide and regional educational telecomputing networks have been established in the USA. Typically, these networks are offered at no monetary costs for teachers and offer a variety of telecommunications services including electronic mail, discussion forms, access to educational databases, access to remote Internet services (via Telnet), and the ability to locate information with a menu-driven information system called Gopher. Access to these networks usually occurs by dialing a designated phone number with a modem. There are studies in the literature that analyze teachers' perceptions of educational networks, with much emphasis placed on perceived benefits and barriers of the networks (Anderson & Harris, 1997; Danin, 1993; Davenport, 1995; Murfin, 1995; Ruopp, Gal, Drayton & Pfister, 1993; SRI International, 1997; Starr & Milheim, 1997). There have only been a limited number of research studies conducted that analyze how teachers have used networks to change their pedagogical approaches in the classroom (Hakarem, Dobrynina, Hurwitz, Shann, & Shore,1993; Muscella & DiMauro, 1995; SRI International, 1997; Topp, Grandgenett, & Mortenson,1995; Weir, 1992).

Science teachers have used different modes of telecommunications in their classrooms with students and for professional development. Some research has been conducted on network science projects during the past decade in which teachers used e-mail, listservs, BBSs, and the World Wide Web to participate in collaborative experiments. Most of these projects involved the sharing of scientific data. In most cases, participating classrooms connected to the Internet with a modem. Teachers and students used e-mail and listservs to communicate with professional contacts, science museums and other classrooms outside of their school (Science Learning Network, 1996). Research has shown that a school's technological infrastructure plays a significant role in the success or failure of such a project (Coulter & Walters, 1997). Participants in the Science Teachers' Area Resource Swap (1989) were more persistent in their attempts to participate if they perceived beneficial outcomes from what they were doing. Rogan's (1995) study on five network science telecommunication projects found that teachers with computers at home were able to use the Internet for communication purposes much more easily than those that did not have computers at home.

The use of networks by science teachers can provide safe, convenient opportunities for reflection and conversation, moral support, and assistance in breaking down institutional hierarchies and barriers that teachers experience in their classroom settings (Hester & Songer, 1997). Rogan (1995) reported three major themes regarding science teacher involvement in network science projects: exhilarating experience of having access to unlimited information and resources, overcoming isolation and feeling part of a global community, and feeling of excitement and renewal. DiMauro and Jacobs (1995a) found that participating teachers received much peer-peer support and validation about their teaching practice from other members of the LabNet network. Teachers that have low active participation on networks also professionally benefit by reading the postings of others (Hester & Songer, 1997; Jacobs & DiMauro, 1995). Network-based discussions can offer opportunities for teachers to voice professional dissent and engage in dialogues about classroom practice, educational reform issues, and subject specific issues (Muscella & DiMauro,1995).

Classroom teachers use telecommunications for a variety of reasons. A study conducted by Honey and Henriquez (1993) reported the most frequent activities were those used for collegial exchange, including sending e-mail to colleagues and posting questions or exchanging ideas on forums and bulletin boards. Benefits of network participation include exchanging ideas about projects, requesting and giving technical support, social exchanges, and discussing general teaching approaches (Ruopp, Gal, Drayton & Pfister, 1993). Increased use of outside resources is a major benefit teachers perceive from implementing telecommunications resources into their professional development (SRI International, 1997). Davenport (1995) reported 33.8% of her survey respondents used the Internet for classroom activities and 60.6% indicated they used the Internet for professional development, including research for personal use, exchanging ideas with other educators, and information retrieval. Similar findings were reported in a study by Anderson and Harris (1997) of active network users with high levels of teaching tenure, schooling, and computer experience with convenient access to equipment needed to use the Internet.

A number of factors that influenced the ability of participants in a telecommunications network to get online include learning style, expectations and priorities, the level of motivation or obligation to use the system regularly, the user's level of computer and technology anxiety, computer networking experience, and motivation; and external factors such as hardware/software physical access issues, and constraints related to time, instruction, and support from one's school system (Anderson and Harris, 1997; Davenport, 1995; Eurich-Fulcher and Schofield, 1995; Murfin, 1995; Rogan, 1995; Schrum, 1995; Science Teachers' Area Resource Swap,1989; Weir, 1992). Unless time is built into the school day, or educators have access to telecommunications equipment at home, telecommunications is most likely not to be used by an educator (Schrum, 1995). Educators must have resources if they are going to begin to use and incorporate information technologies into their professional and instructional activities. Other technical logistical issues in shaping network adoption and use include user friendliness, system reliability, and technological infrastructure (Eurich-Fulcher and Schofield, 1995).

A significant amount of time and effort seems to be required for inservice teachers to learn about and use telecommunications (Eurich-Fulcher and Schofield, 1995; Rogan, 1995). Teacher and classroom time is limited. School schedules have traditionally been rigid and structured, making it likely that teachers will have difficulty finding adequate time during their day to engage in networking-related professional development activities.

Various studies in the literature reveal barriers and problems inservice teachers must overcome to implement telecommunications into their professional activities. Barriers to effective telecommunication integration into professional development or into the classroom include lack of teacher instruction and support, inadequate access to hardware and software equipment, lack of time for learning and using the Internet, lack of administrative support, and lack of school/district planning for use of telecommunications in instruction and administration (Bos et al., 1995; Davenport, 1995; Harasim, Hiltz, Teles, & Turoff, 1995; Honey & Henriquez, 1993; Rogan, 1995). Research has also reported teacher frustrations connecting to a local carrier, setting up the modem, accessing telecommunications networks and databases, and becoming lost in an online system (Harasim et al., 1995). These types of accessing problems were due to busy phone lines, software conflicts, busy signals, and forgotten passwords. (Bos et al., 1995; Coulter & Walters,1997: Danin, S. 1993; Rogan, 1995). When teachers understand that telecommunications problems are solvable, high success rates with implementing telecommunications into teaching professional activities are attainable. (Science Teachers' Area Resource Swap,1989).

## 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) describe 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) define 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, 1990).

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. Caggiano et al., state that there are three types of active network participation possible in an electronic community network: putting forward topics for discussion, posting messages in a discussion, and reading messages. DiMauro and Jacobs (1995b) contend 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).

Two studies have analyzed science teacher discourse on bulletin board systems in an attempt to understand and describe the nature of a professional community of interdisciplinary science teachers linked together through a telecommunications network after an inservice workshop. Ruopp et al., (1993) categorized the discourse on the LabNet BBS into the following categories: teaching activities, teaching resources, planning curriculum and teaching, technical assistance, administration, and personal. Cagianno et al., (1995) categorized the discourse that appeared on a BBS into the following categories: planning events, interpersonal thoughts, talk between two or more people, sharing ideas and advice (resources), sharing experiences or reflections about experiences, and inquiring or stating school needs.

## Instructional Uses of Telecommunications in Preservice Education

### Journaling

Journals are currently being used in many preservice teacher education programs as a way to facilitate the development of reflective thinking. Few studies exist in the literature describing the use of electronic journals with teacher education students.

Russett (1994; 1995) describes the Secondary Science Education program at the University of Nebraska-Lincoln. This program loaned each secondary science methods student and student teachers IBM computers with modems. The students submitted journal entries (minimum of one per week) by e-mail. The journal entries were replied to by the instructor within 24 hours and returned to the students via e-mail. Journaling included thoughts, comments, and reflections concerning readings, class discussion, and practicum experiences. Russett (1995) found time and access to computers to be important considerations for student use of telecommunications. Students experienced problems with software and hardware. Russett contends that the technical problems student encountered influenced their attitudes.

Hutchinson and Gardner (1997) describe a program at the University of Central Florida in which a group of student teachers were asked to use the university-wide Pegasus e-mail system to keep in contact with the college coordinators who supervised their internship. Student teachers had free access to their university e-mail through the Florida Information Resource Network (FIRN), a free dial-up access Internet resource for Florida teachers. Students used e-mail to send daily reports, daily schedules, first impression papers and reflection journals/continuous logs to their college coordinator. Hutchinson and Gardner found that the use of e-mail has been most successful with the reflection journals/continuous logs. Students and college coordinators attested to the ease of e-mail use over the traditional forms of telephone and regular mail for communication.

Kovalchick, Milman, and Elizabeth (1998) describe a required preservice teacher education course offered at the Curry School School of Education at the University of Virginia in which students use “e-journals” to examine the students’ learning throughout the semester and model a strategy they can later utilize in their own classrooms. E-journals were sent to instructors three times during the semester. E-journals provided students with opportunities for reflection and a means to link what students are learning in the classroom with their future roles as technology-using teachers.  According to Kovalchick et al., e-journals benefit the instructor by helping to understand the student better as well as helping him/her gauge and modify the class, which can have an impact on current and future students' needs.

### Mentoring

There are some studies that can be found in the literature on instructional programs using telecommunications for mentoring preservice teachers in teacher preparation programs.  These studies involve using e-mail with one-to-one communication between a university supervisor and preservice teacher (Casey, 1994; 1997; 1998; Thompson and Hamilton,1991), e-mail with one-to-one communication between a preservice teacher and an inservice teacher (Johnson, 1997), e-mail listservs with one-to-many communication between a group of preservice teachers and university supervisors (Loiselle, Dupuy-Walker, Gingras, and Gagnon, 1996; White, 1996; Zimmerman and Greene, 1998 ), and bulletin board systems with one-to-many communication between a group of preservice teachers and university supervisors (Thompson and Hamilton, 1991).

In September 1989, Jean Casey at California State University, Long Beach created TeacherNet, a program designed to integrate technology use during the student teaching phase of teacher training.   TeacherNet's pilot project involved the researcher, six student teachers, and six master teachers.

A study conducted in Fall 1993 pertained to the amount and types of communicating engaged in by student teachers.  Casey (1994) reported that by using telecommunications, student teachers communicated with their university supervisors during this period more frequently than in the previous 18 years without telecommunications. The added time to respond to messages, reflect on the day's teaching events, and formulate appropriate questions was noted in the quality of the types of communication written by the participants. Casey (1994) reported that the most notable outcome of the e-mail approach is the immediacy with which students can establish contact with the university supervisor, their peers, or their master teacher.

Casey (1994; 1997; 1998) reported the following benefits of telecommunications use during student teaching:

1. Increased reflectivity. Use of e-mail writing helped foster probing to promote deep understanding of teaching, to engage in a written conversation about experiences associated with their making meaning of teaching.
2. Increased feeling of rapport and support from university supervisor, access to other supervisors and university personnel.
3. Increased team support, decreased feeling of isolation.
4. Increased self-esteem due to mastering technology and receiving positive support through e-mail messages, increased pride from the professional documents they could create at home.
5. Increased knowledge and use of information access and retrieval as well as various types of technology such as multimedia.

Thompson and Hamilton's (1991) evaluation of the Electronic Education Exchange (EEE) project at Iowa State University revealed that merely making a telecommunications system available to the student teachers was not enough to get students to use the system. After students signed on to the network, they were each assigned a partner. The partner was another student teacher who was teaching at about the same grade level. Students were also assigned a faculty partner at this time. Special conferences were also initiated on this system whose purpose was to provide a place on the system where student teachers could talk about particular ideas in the areas of classroom management and parent interactions. Pre- and post- survey data revealed that student teacher attitudes toward technology were significantly more positive after their network experience. Thompson and Hamilton (1991) concluded that further structured intervention may be necessary to encourage student teachers to communicate with faculty and experienced teachers in a telecommunications network.

Loiselle et al., (1996) describe an exploratory experiment which took place in two Canadian universities, Universite du Quebec a Trois-Riveres (UQTR) and Universite du Quebec a Montreal (UQAM) in which preservice teachers used e-mail listservs to discuss critical incidents occurring during their student teaching practicum. Students had to describe and analyze at least two experiences weekly and were required to react twice a week to other messages. Preservice teachers appreciated the fact that they had, without delay, useful advise and feedback related to the situations they encountered. They also considered the diversity of points of view given by peers or supervisors as a positive aspect . University supervisors viewed the experiment as an opportunity to develop new supervision methods as well as experiencing different ways of helping student teachers at the moment they are experiencing difficulties.

Loiselle et al., (1996) contend that the CMC medium of electronic mail provided an effective means for developing collaboration between colleagues, peers, and mentors. Participants used e-mail as a way to express concerns and satisfactions with their accomplishments. E-mail was also used by participants to ask for help and exchange “tricks of the trade” from peers or expert teachers. In order to transform the use of electronic mail to develop and sustain reflective thinking, the help of the university supervisor is required. Supervisors can become models by showing ways to go deeper than superficial descriptions of daily events. They often enrich their reactions with pedagogical theories and practical knowledge. Using the electronic network, supervisors have the opportunity to question the students’ assertions, open different aspects of a problem or apply reflective thinking on the case presented. Because e-mail permits immediate feedback, it contributes very effectively to the shaping of reflective thinking. These findings were also substantiated by Zimmerman and Greene (1998), who found that the use of listservs guided by faculty provided opportunities for student teachers to engage in reflections and dialogue, providing ongoing opportunities for pedagogical concepts to be discussed and examined.

Johnson (1997) describes a project designed to provide an avenue for preservice teachers to gain a greater understanding of different philosophies of reading through collaboration with practicing teachers across the country via electronic dialoguing. Each preservice teacher in a reading methods course was provided an e-mail account through the university and was assigned mentor “e-pals” who were practicing elementary teachers located in various regions of the USA. There was no requirement as to how many times a student had to collaborate with the mentor e-pal. As a result, communications ranged from weekly to once or twice for the entire semester. By incorporating electronic dialoguing into the reading methods course, students were able to see telecommunications as a multi-faceted resource and used telecommunications technology as a tool for communicating, problem solving, brainstorming, and information gathering. This project provided students with a broader set of experiences during their field placement by extending the face-to-face collaboration through electronic dialoguing. The mentors were able to share their experiences as classroom teachers as well as encourage students to view technology as a tool to improve their professional lives. In a similar study, Taylor (1998) contends that students were motivated by active learning that had an authentic purpose.

### E-mail and E-mail Listservs

An emerging area of research in telecommunications use in educational settings deals with the use of e-mail listservs in instructional settings. These studies have examined the types of interactions possible among correspondents on an e-mail listserv, the validity of using the medium for meaningful instructional interactions, factors that enable university-based instructors and novice teachers to integrate electronic mail into teacher education, and attitudes of preservice teachers toward technology.

Sunal and Sunal (1992) investigated the adaptation and use of LAN (local area network) technology as an educational enhancement and as a social process in a university teacher education program. The subjects were grouped into one control group (no LAN access) and two experimental groups (restrictive LAN access and facilitated LAN access) determined by placement in schools with varying facilitative and administrative support for incorporating LAN technology. In sites where LAN use was facilitated, novice teachers averaged more than five contacts each week using LAN communication types (e-mail and facsimile machines). Most communications between participants involved seeking help and approval in lesson planning, selection of alternative classroom activities, and decisions about classroom management. Other less frequently encountered communications dealt with identifying sources of materials, discussing ideas for lessons, clarifying assignments, and reporting novice teacher progress. The experimental facilitated group had a higher frequency of message content related to alternative classroom activities and classroom management than did the experimental restricted group. Sunal and Sunal (1992) concluded that ease of contact, favorable attitudes toward use of technology in schools, types of message content, and frequency of the communications increased for participants in settings with facilitative administrative support. Furthermore, these effects were related to novice teacher science lesson-plan performance in classrooms.

Zimmerman and Greene (1998) summarized five years of telecommunications use with preservice teachers during their student teacher internship at the Reich College of Education at Appalachian State University. During the 1993-94 school year, 16 students and 5 faculty communicated with one another using an e-mail listserv for a year one project. A listserv was designated for the discussion of concepts, issues, and reflections related to communication skills, social studies, math, and classroom management during the student teacher internship. Listserv entries were analyzed for discussion of critical concepts taught in the methods courses. Connections between concepts and application in the classroom were noted during this study. Unstructured listservs were used by student teachers mostly for social and emotional support. The use of listservs guided by faculty provided opportunities for student teachers to engage in reflections and dialogue, providing ongoing opportunities for pedagogical concepts to be discussed and examined.

Dow and Geer (1996) described the use of a listserv to implement a tutorial program in a preservice teacher education subject called “Becoming Information Literate” and taught to first year tertiary students in the Bachelor of Education program at the University of South Australia. The listserv was used to introduce students to an online environment, enable teaching staff to monitor students’ understanding of theoretical components of subject content, encourage deeper engagement with subject content, and increase dialogue about issues of concern to teachers about using technology. The students recognized the advantages of the listserv as a means for sharing information and discussing ideas. The listserv gave the instructors opportunities to comment on students’ interpretations of theory in ways that were not possible in face to face tutorials.

Piburn and Middleton (1998) examined interaction patterns between preservice mathematics and science teachers and university faculty on an e-mail listserv. They reported that conversations that promoted the most reflection for the longest periods of time were centered around content and pedagogy. Procedural queries and technical questions on the listserv were short to the point, and limited to a specific event or activity. Piburn and Middleton contend that an unstructured listserv exists as a true conversation in which students are able to question, reflect, plan, and respond to topics of mutual interest.

## Case-Based Collaborative Activities

A case is a situation-based narrative that requires an analysis of context and an understanding of the attributes associated with real-world practicalities, presented to prompt a suggested activity or practice. Case scenarios challenge students to examine theories they have learned and apply them to situations they may encounter in the future (Bronack & Kilbane, 1998). Application of this method in preservice teacher preparation programs has been shown to bridge the gap between theory and practice (Sudzina & Kilbane, 1992). Although it is impossible for a case to address the complexity in teachers' lives, case methods may provide realistic environments through which various decision-making tactics can be applied and investigated (McNergney et al., 1994).

Campbell and Zhao (1996) designed a case-based collaborative activity in which participants were asked to write essays analyzing a classroom case from different perspectives and post them to a listserv. Three case analyses were analyzed. The research found that the case-base projects promoted critical thinking and knowledge revision; collaborative thinking and critiquing were affected by many factors including technology; and technology was learned more effectively when embedded in content-based projects. Campbell and Zhao also state that unfamiliarity with the technology was a factor that negatively affected collaboration.

A study (Angeli et al., 1998) was conducted using student-generated cases with an asynchronous Web-based conferencing tool called Conferencing on the Web (COW) with a group of preservice teachers during early observational field experiences. Conferences on COW were organized into topics. Each student was asked to generate two problematic teaching cases based on his or her observation in the field, as well as provide plausible case resolutions based on course readings and lectures. Students were asked to give feedback to at least four peers on their cases and to summarize the electronic discussion generated by his or her respective case as well as at least one peer's case. A sample of 60 case discussion threads were analyzed for dialogue content, case quality, and forms of mentoring. A content analysis scheme recorded the following forms of electronic discourse: social acknowledgments, unsupported claims and opinions, justified comments, questions and dialogue extension prompts raised, and mentor scaffolding. According to Angeli et al. (1998), few of the students' case responses were grounded or justified in educational psychology theory and concepts. Students often responded to postings with many simplistic and naive ideas.

### Electronic Communities of Networked Educators

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 offer preservice science teachers a vehicle to engage in reflective discourse with university supervisors and faculty from their remote student teaching locations. Some studies have been conducted using e-mail listservs and bulletin board systems with a cohort group of preservice teachers during their student teaching internships (Bull et al., 1989; Merseth, 1991; Schlagal et al.,1996; Thomas et al., 1996; Waugh, 1996).

Of these studies, three have analyzed e-mail postings for the type of discourse generated on listservs used in preservice teacher education instructional courses (Schlagal et al., 1996; Thomas et al., 1996; Waugh, 1996).

The first published study of an electronic community network of educators with preservice teachers was conducted by Glen Bull at the Curry School of Education at the University of Virginia (Bull et al., 1989). In 1987, a joint study called Teacher-LINK was initiated by IBM Academic Information Systems and the Curry School School of Education to study the process of establishing a network to support the student teaching process. Eighty inservice teachers and 40 student teachers in two school districts were given IBM laptop computers with built-in modems to use in their classrooms to access the Teacher-LINK network via telephone lines. Classroom teachers were able to interact with each other, student teachers, and university faculty using either electronic mail or an electronic conferencing system. Teacher-LINK's electronic conferencing system allowed discussions centered around a given topic to be gathered into a single conversational thread for an on-going electronic conversation.

Preservice teachers could use the Teacher-LINK network during their student teaching internships to share lesson plans with their advisor, obtain support from peers during a stressful period, and share ideas with one another. Bull et al. (1989) cites examples of pedagogical uses of the network by preservice teachers that include using the network to respond to questions about teaching ideas, requests for teaching suggestions, and questions about content to be taught.

Bull et al. (1989) stated that the overall quality of network interactions depends upon many factors including connections between different networks, the technological complexity of the user interface, and technical support to maintain the network. Electronic networks provide a useful tool for school-university collaboration. However, provisions of hardware, telephone lines, and accounts on university networks do not ensure that teachers in the public school will use the system. Bull et al. states that if networks are to succeed, then benefits must also accrue to the users.

Merseth (1991) investigated the nature and type of support delivered to 39 beginning teachers who participated on the Beginning Teacher Computer Network (BTCN) at Harvard University. Each participant received a computer and a modem for one year. The primary research question was whether a computer network linking beginning teachers would deliver personal, emotional, and technical support to beginning teachers in diverse geographical settings. BTCN offered participants both private and public message capacity. The public bulletin boards included a list of nine different topic areas. Network members sent and received private and public messages and participated in group discussions on topics related to their teaching experiences.

Merseth (1991) found that network use was fairly constant throughout the academic year averaging 108 messages sent each week. Nearly 22% of the subjects reported using the network almost daily, and another 48% reported that they logged on between 1 to 3 times per week. The remaining 30% of the subjects used the network 1 or 2 times per month. Participants reported that the network was most effective in providing participants with moral support. Needs relating to formal teaching techniques including lesson and curricular planning, improving classroom management, and sharing teaching techniques were rated significantly lower than the network's effectiveness in providing moral support. Daily users ranked the network most effective in receiving moral support, whereas those logging on only once a week ranked providing moral support significantly lower. Also, daily users rated the network's ability to support reflection on philosophy of educational issues significantly higher than did those logging on only once or twice a month.

BCTN participants commented in interviews on the convenience of the network and its ability to reduce feelings of isolation. Because the BTCN was available 24 hours a day, it offered a place where busy teachers could contact colleagues at their convenience. According to Merseth (1991), the factors which appeared to enhance the ability of the network to provide support include the convenience of the network, its ability to reduce feelings of isolation, and the safe, non-evaluative environment it created.

The Educational Technology Center at the Harvard Graduate School of Education established a telecommunications network in December 1985 that focused on teachers in an effort to reduce teacher isolation and provide a vehicle for staff development (Weir, 1992). Forty-five secondary science teachers from eastern Massachusetts were recruited, including a group of recent graduates who knew each other well. Messages could be sent privately or placed on public forums, organized by function or topic. The findings in this study were analyzed in terms of technical and logistical difficulties experienced by the participating teachers, social issues of managing and facilitating group processes on the system, and substantiative content issues concerning contributions to the designated topics of the conference. Weir reported that having a computer at home significantly affected the frequency of participants logging on to the network. The pattern of communication varied depending on the extent to which participants knew one another. Teachers who were unacquainted with each other wrote messages about very specific topics rather than about classroom science teaching in general. According to Weir, networking appealed more to professionally isolated teachers.

Schlagal et al. (1996) analyzed e-mail and listserv messages from 15 elementary preservice teachers and five professors during their student teaching internship. Data was divided into four categories: responses to class assignments, socioemotional exchanges, housekeeping queries and bulletins, and spontaneous, sustained exchanges of ideas. Messages in the "spontaneous, sustained exchanges of ideas" category were examined for evidence of reflection, sustained dialogue, and exchange of ideas. Most exchanges were between students and professors, although occasionally students jumped in, volunteering responses to one another's problems. The researchers noted that some students viewed using the electronic mail merely as a response to an assigned task. Data analysis pointed to the structure of e-mail use as an important factor in eliciting spontaneous exchanges of ideas. Three factors in their structure promoted reflective dialogue: open, thematic prompts, the direction and focus of messages, and time to write.

Waugh (1996) examined the nature of student questions that arose during e-mail interactions among participants involved in a semester-long university course that prepare teachers and future teachers to use an electronic network as an instructional medium. An analysis of the data resulted in four categories of questions students posted to the listserv. These included:

• Personal - Personal questions - Questions that ask about something other than networking activities related to the course. Friendly questions concerning the expression of emotion or rhetorical questions also fitted into this category.

• Technical - Questions concerned with networking hardware and software.

• Network strategies - Questions concerned with instructional applications and techniques.

• Course requirement - Questions that specifically address aspects of the course assignments.

Early in the course, the students tended to be concerned with technical issues and establishing friendly relationships. Only later in the course did concern shift to networking strategies and course requirements. The largest category of questions asked concerned technical issues. Waugh (1996) concludes by stating both technical and networking experience are important in helping individuals learn to effectively use electronic networks for instructional purposes.

Thomas et al., (1996) explored a concept called “Teaching Teleapprenticeships” at the University of Illinois. Eleven English preservice teachers and two professors participated in this project. As part of course assignments, students completed a two-paragraph response to assigned articles and shared their responses via class listserv, raised one question on the chapter or article to be discussed in future classroom discussions, and sent three written lesson plans, two weekly reflective journals, classroom observations, and a personal statement on the literary process to the two instructors by e-mail.

The student’s listserv messages resulted in the formation of six categories:

• Course Related: The messages relate specifically to the class requirements.

• Personal: The messages are sent to one or more people with the content having no relation to the specific requirements of the methods course.

• Request for information: Questions are about the course requirements, pedagogical issues, content, or personal issues.

• Pedagogical: The message contains information relating to classroom instruction, methods, or management in general without specific reference to the teaching of reading, writing, literature, or spelling.

• Content: The message refers to specific questions or comments about reading, writing, literature, or spelling.

• Confirmatory: The message refers to a response initiated by another person where the student is answering in some manner a question or comment previously made.

Thomas et al., (1996) found that students in their study often read messages selectively. Many checked to see who sent the messages and scanned the content for issues of interest, disregarding or skimming others. The researchers contend that using a listserv was an asset for meeting course requirements and maintaining contact between students and instructors. Course requirements served as the dominant purpose for using the listserv. Electronic networking can provide a communication bridge that increases the frequency of interactions among student teachers and university personnel. Individuals vary, however, in the ways that telecommunication and technology facilitate learning to teach.

Curry CONNECT was a Web-based discussion group that linked preservice teachers with graduate inservice teachers and apprenticing administrators to engage in online discussion about issues relating to the use of technology in education (Hrabe, Adamy, Milman, Washington, & Howard, 1998). The goal of Curry CONNECT was to create an environment for open communication on topics of common interest for the students involved in a number of educational technology courses (Nonis, Bronack, & Haton, 1998). Curry CONNECT consisted of participating classes of 140 students and seven instructors. After an initial practice discussion, three discussions were held based on common readings. According to Hrabe et al. (1998), the following categories were determined to be important indicators that respondents were describing a sense of participating in a shared community: motivation for participation which is primarily internal, awareness of the social context of the discussion group and perception of other participants as peer members, and the ability to acknowledge and appreciate multiple perspectives.

As part of the Preparing Educators for the 21st Century (PIE-21) program, Illinois State University used the Internet as a collaborative environment by utilizing netWorkPlace, a program developed by the National Center for Supercomputing Applications (NCSA), to expand the field experience of junior elementary education majors (Handler, Andris, Brehm, Levin, Payne, Waugh, Bievenue, & Moran, 1998). netWorkPlace provided a visual environment for threaded discussion groups, a chat area for synchronous communications, and a library for downloads. Students used netWorkPlace to discuss the application of theories that they learned and to convey information and answer questions for future participants. From a campus location, Illinois State students posed questions and discussed theory with teachers in the field to better prepare for field experiences and student teaching.

## Facets of Preservice Electronic Communities

Electronic community networks of preservice teachers can provide socioemotional support to a cohort group (Angeli et al., 1998; Bull et al., 1989; Casey, 1997; Merseth, 1991; Schlagal et al., 1996; Thomas et al., 1996). 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 et al., 1995).

Barriers and obstacles exists 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 a 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, but 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 et al., 1998). Students perceive not owning a personal computer as a barrier to using an electronic network (White, 1997; Zimmerman & Greene, 1988). Furthermore, students perceive using computer networks as being inconvenient (Angeli et al., 1998; Waugh and Rath, 1995). Students may send messages to wrong conference topic areas that create confusion for participants (Harasim et al., 1995).

Although new teacher communications networks continue to be established in universities 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 and others failed due to lack of use (Thompson & Hamilton, 1991). 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 for preservice science teachers (Koschmann, Myers, Feltovitch, & Barrows, 1994). The current educational reform movement calls for research to determine mechanisms for preservice teachers to use telecommunications for reflective conversations embedded with critical thinking. 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 towards the use of electronic community networks, as well as their feelings about this new technology.

# Methodology

## Participants

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 the fall of 1998. 21 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 telecommunication 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 each day during these five weeks. These students were divided into different Methods of Teaching Science courses based on their science concentration area. These courses were instructed by different science education faculty members than those who taught the Instructional Materials in Science course.  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.

## Survey Instruments

### Teachers Attitudes Toward Information Technology Questionnaire

The Teachers Attitudes Toward Information Technology Questionnaire (TAT) (Appendix A) 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 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 newly 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) are 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-test 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.

TAT score means of the subjects on subsections 1, 2, 3, 5, 7 and 9 prior to student teaching was compared with TAT score means after the subjects had completed their student teaching internships. A t-test for dependent samples was conducted for 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.

Likert type questions to measure the participants' comfort level with computers and telecommunications tools were also added to the TAT survey.

### SciTeach Forum Survey

The SciTeach Forum survey (Appendix B) 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 and the barriers preservice science teachers encounter when using a Web-based forum on the Internet during their student teaching internship. The SciTeach forum survey was developed and field tested during 1997-1998.

## 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 (Science Teaching) Forum was constructed (Figure 2) in July, 1997. The SciTeach Forum was placed in the context of a larger public web site on the World Wide Web called IMSEnet, a network of Instructional Materials for Science Educators (online at http://www.ncsu/imse). IMSEnet is a science education clearinghouse for resources on the World Wide Web. The SciTeach Forum serves as an online support network for both inservice and preservice science educators. In April 1998, both IMSEnet and the SciTeach Forum became integrated within NC State's Science Junction web site (online at http://www.ncsu.edu/sciencejunction).

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 is 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.

The NetForum software was selected to create the SciTeach Forum because it is available at no monetary cost since North Carolina State University 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 user 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.  The author 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 was initially structured to contain discussion topics relating to teaching science content, incorporating instructional technology into the curriculum, and topics relating to teaching pedagogy in general.  A complete list of each discussion topic is listed in Appendix C.  A special topic in the SciTeach Forum called "Preservice Science Teachers" was created as a designated discussion area for preservice science teachers.  Student teachers were encouraged to use this area to speak freely about their experiences.

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 at North Carolina State University during the 1998 Fall 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. These courses met each day on campus for the first five weeks of the semester. The students began their student teaching placements during the sixth week of the semester. 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. The following is an example of a critical incident:

> Students are working with microscopes and you want them to observe and draw onion skin cells. They accurately set up the slides and microscopes, focus correctly, and begin observing and drawing. As you walk around the room you see some drawings that reflect the accepted image of onion cells, but approximately 1/3 to 1/2 the students are drawing sketches that look nothing like the accepted image of onion cells. What kinds of things would you say and do at this point?

## Role of the Researcher

The researcher in this study was involved with the Middle School Methods course on a daily basis and the Instructional Materials in Science course during the first and last week of the on-campus instruction. He introduced the forum to all participants during their course and was responsible for maintaining the forum and answering any technical questions or problems. He was also responsible for posting a critical incident to the forum each week. The critical incidents were written prior to the beginning of the semester. To reduce any bias he might introduce to the study, additional responses and comments to the forum were not posted.

This study was conducted as a blind study. The preservice teachers did not know that they were participants in a research study. Using the Web-based forum was not a coercive thing. It was a normal course requirement for all students in the Materials and Middle School Methods course during the the semester. None of the students complained about their participation in the study.

## Analyzing the Forum Discourse

Qualitative analysis was used to explore interaction patterns that facilitated collaborative student teacher reflective discourse on the SciTeach Forum. The student teachers' discourse on the SciTeach Forum was analyzed using a qualitative data analysis method called the constant comparative method. According to Glasser (1978), the steps in the constant comparative method of developing theory are as follows:

1. Begin collecting data.
2. Look for key issues, recurrent events, or activities in the data that become categories of focus.
3. Collect data that provide many incidents of the categories of focus with an eye to seeing the diversity of the dimensions under the categories.
4. Write about the categories you are exploring, attempting to describe and account for all the incidents you have in your data while continually searching for new incidents.
5. Work with the data and emerging model to discover basic social processes and relationships.
6. Engage in sampling, coding, and writing as the analysis focuses on the core categories.

Although one can talk about the constant comparative method as a series of steps, what has just been described proceeds non-linearly, and the analysis keeps doubling back to more data collection and coding (Bogdan & Bilken, 1992).

The critical incidents message threads were downloaded and entered into the QSR NUD*IST 4 software system for data analysis. This software package assisted the researcher in managing and coding the preservice teachers' discourse on the SciTeach Forum. In this qualitative analysis of the data, it was often important to record reflections, discoveries, and thoughts about the data. NUD*IST enabled the researcher to do this during the data analysis and also facilitated modifying the coding categories and adding to them as the need arose.

The following empirical data was gathered for each discussion topic:

- Number of threads in each discussion topic.
- Percentage of messages without replies.

The following empirical data was gathered for each discussion thread:

- Number of message postings in thread.
- Length (in days) of the thread.
- Number of peer responses in thread.
- Number of instructor responses in thread.
- Time of day of each message posting was noted. School day hours (7am - 5pm), school evening hours, and weekend hours.

The research literature on computer-mediated communication use with preservice and inservice teachers was reviewed in order to identify data categories of previous research to initially code the preservice teachers' message postings. A sample of NCSU preservice teacher message postings from the SciTeach Forum from the Fall 1997 semester was analyzed to determine an initial content analysis scheme for this study. Based on this analysis, each student discussion message for the Fall 1998 semester was coded using the following content analysis scheme:

1. Socio-emotional - Messages pertaining to sharing classroom experiences, personal issues (e.g., managing time), student teacher needs, social acknowledgements.
2. Science pedagogy - Questions or comments relating specifically to teaching science content including instructional laboratories, lessons, and curriculum planning.

3. Nature of teaching - Message postings relating to classroom instruction, methods, or management in general; issues pertaining to students with special needs.

4. Course work related - Requests for information and questions specifically related to NCSU course assignments.

It should be noted that some message postings could be placed into more than one category.

Each student message was coded for evidence of reflective discourse. The initial criteria for a message to be considered that of reflective discourse consists of one of the following: asking focused questions, seeking common meanings in teaching practice, and constructing ideas in collaboration with other preservice teachers and university instructors (scaffolding).

The data from the forum was coded and categorized by evaluating each message based upon the type of information or communication contained in the transcript. Emergent categories were assigned to identify the types of messages and interactions taking place. By using the constant comparative method, the initial coding scheme became modified rather quickly. Another science educator reviewed the coding categories as a measure of coding reliability. The emergent message type categories were:

- Classroom experiences: Statements referring to an event that occurs in the classroom.
- Science Pedagogy: Statements pertaining to science-specific pedagogy and not general pedagogy.
- Nature of Teaching: Statements relating to classroom instruction, methods, or classroom management issues, the role of the teacher, and

specific teacher-student interactions.

• Support: Statements referring to support, including receiving or giving support, and supporting one's ideas.

• Concern for students: Statements pertaining to the welfare of classroom students.

• Requests for information: Statements or specific questions which ask for information, advice, or ideas.

• Resources: Statements in which students share resources including teaching ideas, general information, or instructional strategies.

• Recognition: Statements in which a student acknowledges an idea presented on the forum.

The emergent reflective discourse categories were:

• Perceptions: Insight, intuition, knowledge gained by observing, becoming aware in one's mind.

• Asking focused questions: Asking focused questions to build on ideas previously presented in the message thread.

• Peer scaffolding: A statement that builds on a previous posting in the message thread.

Peer scaffolding was further subdivided into the following themes:

• Guidance and feedback: Messages that build on a previous response in the thread that offer some type of guidance and feedback on the issue discussed. This can include a response to a stated activity or provide movement of an issue into a new direction.

- General advice:  Messages that offer general advice or personal views to further develop an idea in the message thread.
- Modeling pedagogical practices:  Messages that augment an idea by illustrating a pedagogical practice.

Examples of each coded category are listed in Appendix D.

Each message thread within each discussion topic was coded for evidence of “exchanges of ideas”.   The thread had to have at least four messages posted from four different people to be coded as an exchange of ideas.

The messages posted by university instructors were also coded for emerging message types and types of instructor scaffolding.  The emergent message type categories for instructors were:

- Resources:  Statements in which instructor provide instructional resources including materials, equipment, software, and Web sites.
- General advice:  A message which offers general advice.  It can be the first topic in a message thread in which no scaffolding occurs in the posting.
- Response to Questions:  Statements that are responses to specific questions.
- Instructional pedagogy:  Statements of general teaching methods or instruction.
- Purposeful questions:  Purposeful questions asked regarding a student posting.
- Support:  Statements referring to supporting the preservice teachers in their student teaching placements.

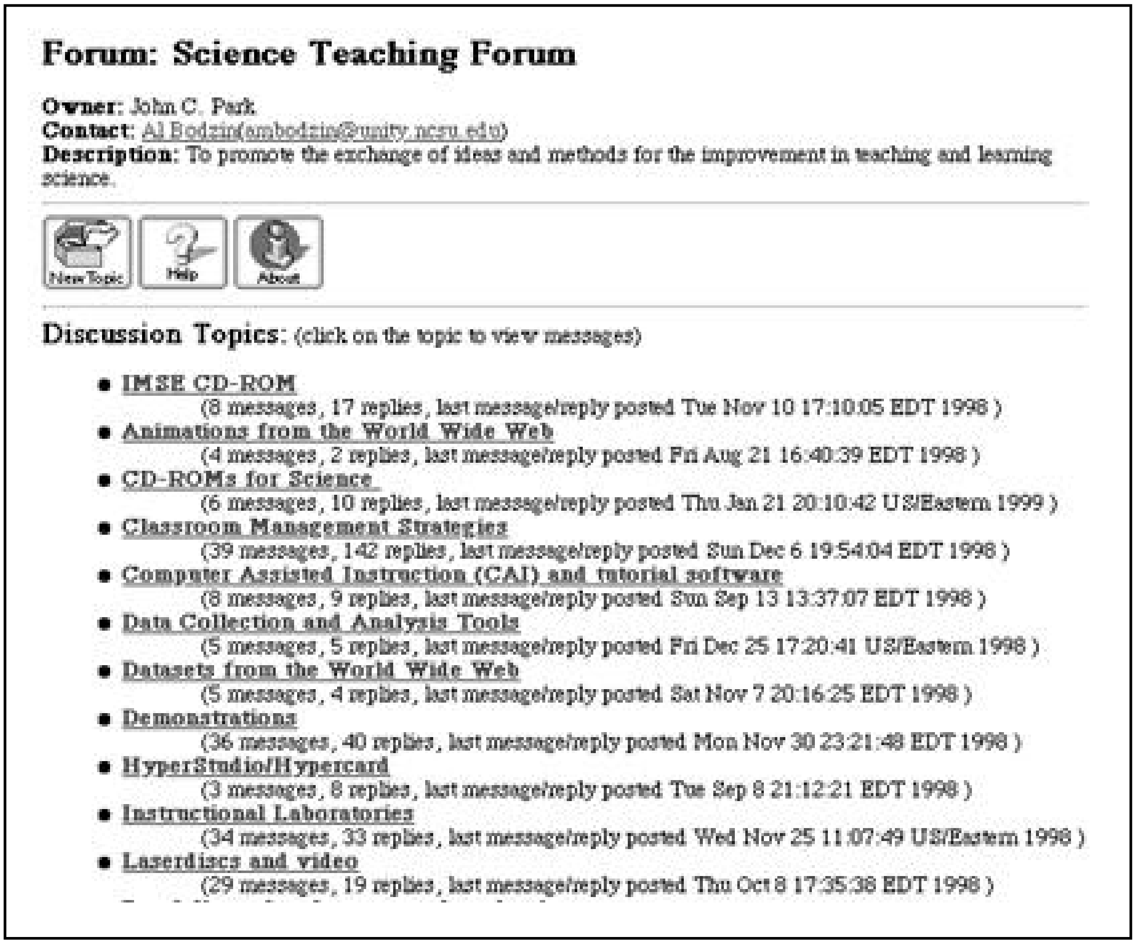
The emergent instructor scaffolding categories were:

- Guidance and feedback: Messages that build on a previous response in the thread that offer some type of guidance and feedback on the issue discussed. This can include a response to a stated activity or provide movement of an issue into a new direction.
- General advice: Messages that offer general advice to further develop an idea in the message thread.
- Modeling pedagogical practices: Messages that augment an idea by illustrating a pedagogical practice.

Technical questions relating to the Web-based forum's software and other general questions on forum use by the participants were also noted. These were sent to the forum moderator via private e-mail.

### 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. Appendix E displays the interview questions.



## Forum: Science Teaching Forum

**Owner:** John C. Park
**Contact:** Al Bodzin(ambodzin@unity.ncsu.edu)
**Description:** To promote the exchange of ideas and methods for the improvement in teaching and learning science.

New Topic Help About

**Discussion Topics:** (click on the topic to view messages)

- **IMSE CD-ROM**
  (8 messages , 17 replies , last message/reply posted Tue Nov 10 17:10:05 EDT 1998 )
- **Animations from the World Wide Web**
  (4 messages , 2 replies , last message/reply posted Fri Aug 21 16:40:39 EDT 1998 )
- **CD-ROMs for Science**
  (6 messages , 10 replies , last message/reply posted Thu Jan 21 20:10:42 US/Eastern 1999 )
- **Classroom Management Strategies**
  (39 messages , 142 replies , last message/reply posted Sun Dec 6 19:54:04 EDT 1998 )
- **Computer Assisted Instruction (CAI) and tutorial software**
  (8 messages , 9 replies , last message/reply posted Sun Sep 13 13:37:07 EDT 1998 )
- **Data Collection and Analysis Tools**
  (5 messages , 5 replies , last message/reply posted Fri Dec 25 17:20:41 US/Eastern 1998 )
- **Datasets from the World Wide Web**
  (5 messages , 4 replies , last message/reply posted Sat Nov 7 20:16:25 EDT 1998 )
- **Demonstrations**
  (36 messages , 40 replies , last message/reply posted Mon Nov 30 23:21:48 EDT 1998 )
- **HyperStudio/Hypercard**
  (3 messages , 8 replies , last message/reply posted Tue Sep 8 21:12:21 EDT 1998 )
- **Instructional Laboratories**
  (34 messages , 33 replies , last message/reply posted Wed Nov 25 11:07:49 US/Eastern 1998 )
- **Laserdiscs and video**
  (29 messages , 19 replies , last message/reply posted Thu Oct 8 17:35:38 EDT 1998 )

Figure 2. The Science Teaching Forum

# A Study of Preservice Science Teachers' Interactions with a Web-Based Forum


## Abstract

In order to examine the potential benefits and existing barriers of preservice science teachers engaging in an electronic professional community on the World Wide Web, we have constructed a Web-based forum called the SciTeach forum. A survey was given to each of our 22 preservice science teachers at the end of their student teaching semester to identify the barriers they encounter when using a Web-based forum on the Internet during their student teaching experience. Our results indicate that the predominant barriers that preservice science teachers encounter when using the SciTeach forum appear to be a lack of adequate access to a networked computer and structuring time to engage in the web forum dialogue. Our preliminary findings also suggest that by using telecommunications with a "Web forum" structure, preservice science teachers can provide each other with socio-emotional support. Much variance exists with regard to our students teachers' attitudes and perceptions of their experiences with interacting with the SciTeach forum. This variance might be attributed to learning styles, personality characteristics, students' comfort level and previous experience using telecommunications technology, or their attitudes towards using information technology. Although there are barriers to overcome, a Web-based forum appears to be effective instrument to provide support to a cohort group of preservice science teachers during their student teaching semester.

## Introduction

Teaching has been characterized as a culture of isolation (Schlagel, Trathen, & Blanton,1996). A practicing teacher does not usually have access to ongoing development and support in their classroom setting which promotes idea sharing or support from peers. Electronic communities for teachers have the potential to break down these teacher isolation barriers and to provide a support network for teachers in the classroom (Bull, Harris, Lloyd & Short, 1989; Casey, 1997). New science reform platforms, such as the National Science Education Standards, recommend including educational technology, especially telecommunications, in our K-12 classrooms. Teachers now have the opportunities to join on-line discussion groups on the World Wide Web, post questions to electronic bulletin boards, and share thoughts and ideas using an e-mail listserv. Many studies describe how preservice teachers learn about telecommunications technology, the kind of support required to implement such tools effectively, and the obstacles that they must overcome in order to successfully incorporate telecommunications technology into their daily practice (Bos, Krajcik, & Patrick, 1995; Caggiano, Audet & Abegg, 1995; Casey, 1994; Casey & Vogt, 1994; Russett, 1994; Russett, 1995; Sunal & Sunal, 1992; Weir, 1992).

Classroom teachers use telecommunications for a variety of reasons. A study conducted by Honey and Henriquez (1993) reported the most frequent network activities were those used for collegial exchange, including sending e-mail to colleagues and posting questions or exchanging ideas on forums and bulletin boards. Benefits of network participation include exchanging ideas about projects, requesting and giving technical support, social exchanges and discussing general teaching approaches (Ruopp, Gal, Drayton & Pfister, 1993). Increased use of outside resources is a major benefit teachers perceive of implementing telecommunications resources into their professional development (SRI International, 1997). Davenport (1995) reported 33.8% of her survey respondents used the Internet for classroom activities and 60.6% indicated they use the Internet for professional development which included research for personal use, exchanging ideas with other educators, and information retrieval. Similar findings were reported in a study by Anderson and Harris (1997) of active network users with high levels of teaching tenure, schooling, and computer experience with convenient access to equipment needed to use the Internet.

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 and to the outside world and for 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.

## Background

Some studies have been conducted on the effects of preservice and beginning teachers interacting with an electronic telecommunications network. In each of these studies, the teachers were provided with computers and modems to access an electronic network. The Curry School of Education at the University of Virginia created the Teacher-LINK system in 1984 to study the process of establishing a network to support the student teaching process with 80 inservice teachers and 40 student teachers in two school districts (Bull, Harris, Lloyd & Short, 1989). This study reported that preservice teachers used Teacher-LINK as a communications link to their university instructors during their field experiences with electronic mail (e-mail) and an electronic conferencing system. Merseth (1991) investigated the nature and type of support delivered to 39 beginning teachers who participated on the Beginning Teacher Computer Network (BTCN) at Harvard University. This study showed that first year teachers used electronic telecommunications for personal, emotional, and technical support. Jean Casey, at California State University, Long Beach, created TeacherNet, a program designed to integrate technology use during the student teaching phase of teacher training. TeacherNet's pilot project involved the researcher, six student teachers, and six master teachers (Casey, 1994). Casey's (1994) study reported the following benefits of preservice teachers using a telecommunications network: increased time to reflect on what they were learning; increased feeling of rapport with and support from their university supervisor; decreased feeling of isolation, increased self-esteem due to mastering technology; and increased knowledge and use of information access and retrieval. The preservice teachers in Waugh and Rath's (1995) study perceived that networks can enhance teacher training and support their work in the schools by using it to access resources and communicate with others. Waugh's (1996) study on group interactions and students' questioning patterns in a university course using an electronic network showed that students posted questions predominantly concerned with technical aspects and network strategies more than personal questions. An exploratory investigation of eleven preservice English teachers using telecommunications during their methods instruction and student teaching (Thomas, Clift & Sugimoto, 1996) reported that electronic mail was an asset for meeting course requirements and maintaining contact between students and instructors. The results of a study by Schlagal, Trathen, and Blanton (1996) at Appalachian State University with 15 elementary preservice teachers and five professors point to the structure of e-mail use as being an important factor in eliciting spontaneous exchanges of ideas.

Each previous study of preservice teachers utilizing an electronic telecommunications network was conducted within the context of a restricted network environment. These studies involved preservice teachers using electronic e-mail, e-mail listservs, or bulletin board systems (BBS) as the community network space. Currently, there are no studies in the literature involving preservice education students using Web-based forums during their student teaching internships as the online community network space.

## Web-Based Forums

Today, 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 preservice teacher 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 cheap, fast, and broad opportunities for preservice teacher to have access to university supervisors and mentors. Using the Web, college instructors can apprentice preservice teacher learning by modeling expert-like answers, providing feedback on student misconceptions, and offering key instructional help and task structuring.

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. This new computer technology presents a more appropriate environment for online learning than e-mail listservs or bulletin board systems by providing users a more-user friendly interface to navigate within the online system and by providing users easier access to the system from remote locations. All that is needed is access to the World Wide Web. Web-based forum discussions occur asynchronously, permitting the user to read, browse, or add to multiple discussions at his or her convenience. One does not need access to networks or systems at a particular university 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 to 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.

## Questions/Methodology

The purpose of this pilot study was to investigate the 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.

More specifically, this study addresses the following questions:

1) Does use of a non-restrictive, public Web-based forum serve as an effective means of support for a cohort group of preservice science teachers?

2) What were our preservice science teachers' perception of their experience interacting within an electronic professional community?

3) What barriers preservice science teachers encounter when using a non-restrictive, public Web-based forum on the Internet?

To examine these questions, a survey was given to each of our 22 preservice science teachers at the end of their teaching semester. The survey consisted of open-ended questions, Likert-type questions, and multiple choice type questions. Furthermore, a sample of preservice teacher message postings from the Web-based forum from the Fall 1997 semester was analyzed to determine specific types of discourse appearing in the forum dialogue.

## The SciTeach Forum

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, we have constructed a Web-based forum called the SciTeach (Science Teaching) forum. The SciTeach forum is a place where science teachers can 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 is 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.

We chose to use the NetForum software to create the SciTeach forum for several reasons. Our university already had a site license to use the software. The software is easy to use. The software empowered us to structure the discussion topics on the forum in any order of our choosing. 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 is not a requirement to read forum messages or post messages on to the forum. Unlike many other previous studies involving preservice teachers using telecommunications during their student teaching semester, we did not have additional funding to equip our preservice science teachers with laptop computers and telephone modems. We assumed that at least one computer in the school where a student teacher was placed would have access to the World Wide Web.

We structured the SciTeach forum to contain discussion topics relating to teaching science content, incorporating instructional technology into the curriculum, and topics relating to teaching pedagogy in general. A special topic in the SciTeach forum called "Preservice Science Teachers" was created as a designated discussion area for preservice science teachers. Student teachers were encouraged to use this area to speak freely about their experiences.

The SciTeach forum is placed in the context of a larger web site on the World Wide Web called IMSEnet (online available at http://www.ncsu.edu/imse). IMSEnet is a "Network of Instructional Materials for Science Educators" which was created originally as a support network for the IMSE (Instructional Materials in Science Education) CD-ROM.

The participants in this study were composed of 22 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 the fall of 1997. The participants had completed the majority of their academic requirements for a Bachelor of Science degree in Science Education. Students were on campus daily for course instruction during the first five weeks of the semester. All students attended an Instructional Materials in Science course for two hours during these five weeks. This course was taught by three university instructors. Students were divided into different Methods of Teaching Science courses based on their science concentration area. The Methods of Teaching Science course was taught by different instructors than the Instructional Materials in Science course. 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. Student teachers were supervised by a university instructor from one of their "on campus" semester courses.

The preservice science teachers were introduced to the SciTeach forum during the second day of their Instructional Materials in Science Education course at North Carolina State University in the Fall, 1997 semester. Each student was instructed to use the forum in class and was required to post a message on to the forum which introduced themselves. As part of the course work for their Instructional Materials course, all students were expected to post three messages each week to the SciTeach forum.

## Student Discourse

Our preliminary analysis of the forum discourse reveals four emerging themes occurring. These are:

1. Socio-emotional - Messages pertaining to sharing classroom experiences; personal issues (e.g. managing time); student teacher needs; social acknowledgements.
2. Science pedagogy - Questions or comments relating specifically to teaching science content; e.g. - instructional laboratories, lessons, curriculum planning.
3. Nature of teaching - Message postings relating to classroom instruction, methods, or management in general; issues pertaining to students with special needs.
4. Course work related - Requests for information and questions specifically related to NCSU course assignments.

The analysis of the message threads reveals evidence of reflective discourse. Examples include: asking focused questions; seeking common meanings in teaching practice; and constructing ideas in collaboration with other preservice teachers and university instructors (scaffolding).

The following example comes from an exchange in the "Classroom Management Strategies" discussion topic section. Miranda is having discipline problems with a particular class. She posts a message to the forum which describes problems with students behaviors she is encountering, her attempts at resolving these problems, and a request for assistance.

> Original Message:
> Posted by: Miranda
> Date posted: Thu Nov 6 21:47:33 1997
> Subject: A tough class...
>
> Message: I am having a problem with controlling an academic biology class. There are about 6 or 7 really loud, disruptive students in the classroom. They aren't mean, or anything like that, they're just very, very loud....constantly. I'm having so much difficulty sticking to my discipline plan consistently simply because I can't be everywhere at once. While I'm calling down one student (or giving them a discipline slip) three more are acting up somewhere else. I've learned that the best way to get the class quiet is to have them writing lecture notes. Instead of trying to get then quiet at the beginning of class, I just get the lights off and start giving notes ASAP. They usually settle down within a minute or two. The problem with this is that I HATE doing lectures all the time! It bores the students and it bores me. I'm just not sure what to do here! Every time I try an activity the students go CRAZY! Any ideas?

Kirk has had a similar experience with a class during his student teaching semester and uses the forum to share some strategies he found useful in solving some of the student behavior problems he was encountering.

> Reply:
> Subject: Try an activity
> Reply Posted by: Kirk
> Date Posted: Fri Nov 717:17:54 1997
>
> Message: I have also found my academic class to be difficult at times. I think the kids at this level have shorter attention spans than advanced or AP kids. I have found the easiest way to manage academic is to keep them as busy as possible with a variety of instructional medias. Try using short "self quizzes" as an opener followed by a SHORT lecture and then an activity. I find academic does best with material if it is short, sweet and to the point.

Wanda also has had a similar experience and offers Miranda a suggestion based on her prior experience.

> Reply:
> Subject: Tough class
> Reply Posted by: Wanda
> Date Posted: Sun Nov 9 12:24:56 1997
>
> Message: Miranda, I know what you mean that you must resort to notes to keep you class quiet. I have a class in which there are students difficult to control. I have worksheets for them, which we do together. I find that the students stay on task better than being left to their own activities. When they are doing activities they are discovering things that I do not want them to discover!

Jack, has reflected on what has been said in the previous thread of messages and concludes that the problem lies with current pedagogical philosophies.

> Reply:
> Subject: Classroom discipline Reply
> Posted by: Jack Date
> Posted: Sun Nov 9 16:05:50 1997
>
> Message: To me the major fault lies in the fact that the schools tolerate too much to begin with. Back in the Precambrian era when I was in school, everybody knew from day 1 that there was a standard rule for every class: You come in, sit down, shut up, and don't touch anything until you're told to do so. Today we talk about developing each child's personality so that they are outgoing and sociable, which might work with 50% of them, but the other 50% are immature, undisciplined, unmotivated little gremlins who need to know the consequences of acting up. They can sit still - I've seen them do it in lunch detention, where they sit looking straight ahead without saying a word for 30 minutes. It seems a little hopeless to try and teach them when you have anything less than total control. Sorry - I've listened to what everybody has to say with an open mind, and now I'm more convinced than ever that the old system was better.

This exchange on the SciTeach forum between Miranda and her classmates enabled her to share an experience with her classmates. The content of Miranda's original message deals specifically with teaching pedagogy. She uses the SciTeach forum as a way to express tension she is experiencing during her student teaching. She uses the forum to request assistance for her problem. The replies to Miranda's original message show solidarity among the preservice science teachers. They are each experiencing a similar problem and use the forum as a mechanism to support each other. By using the forum, preservice science teachers are able to discuss problems and contribute ideas over extended periods of time. By engaging in this type of dialogue exchange, the SciTeach forum appears to serve as an effective means of socio-emotional support for a cohort group of preservice science teachers.

The SciTeach forum has been a useful tool to facilitate communication between our preservice science teachers and university instructors. The forum has been used by our preservice science teachers to express their concerns about course requirements. Many messages have been posted regarding specific course-related queries and housekeeping bulletins. Here is an example of a student requesting information about incorporating video into her portfolio:

> Posted by: Jean
> Organization:EMS 477
> Date posted: Tue Nov 11 18:30:43 1997
> Subject: Using video...how?
>
> Message: What is the proper procedure for using video as one of our artifacts in our portfolios? Also, how long should the video be and should it only contain one teaching event on it?

The SciTeach forum has also been used by the preservice teachers to critically reflect on the meaning of being a teacher:

> Posted by: Bob
> Organization:EMS 477
> Date posted: Tue Nov 25 23:02:44 1997
> Subject: Nice end before break
>
> Message: Just about everyday has been a trial in one of my classes. I am not joking when I say I have some students who are not fit to be in a regular classroom. What has truly frustrated me however, was my inability to make a change in these kids lives. But who am I to think I could do that. They need more than teachers. It really hurt to reach out to these particular kids only to get my hand bitten. I am hard-headed however, and it took me a while to just let go (actually I'm still working on it) and concentrate on the students I could help instead of constantly stressing over those I could not. These kids don't even recognize when somebody is trying to help them. What they need is full time counseling and I can't give them that. What they need is strong families, and I can't give them that either. So, instead of constantly worrying about how I can teach these kids, I'm letting them go and working on how to keep them from interfering with the education of my other students. This isn't easy, but at least I leave school with a sense that I'm accomplishing something. Teaching is a full time job and teachers need to care and help with the health and well being of their students. But being a mom, a dad, a social worker, a probation officer, or a shrink is also full time work. I've already chosen to teach others and be a dad to my kids; I just don't have the time and energy to cover the rest. I feel real good about some of my students and the way things have gone recently. I'm glad I'll be leaving the school on that positive note.

## Survey Results

Approximately half of our preservice science teachers in the Fall, 1997 semester stated they could access the World Wide Web (WWW) in their school placement during their student teaching experience (Figure 1). The school location where most students accessed the WWW was in their school's library (Table 1). Only one student had access to the WWW in their classroom. More than half of our students accessed the SciTeach forum from the North Carolina State University campus computer labs (Table 2). Only two students stated they accessed the SciTeach forum from their school placement. Five students stated that they had access to the WWW at home. Four of these five students accessed the SciTeach forum from their home (Table 2). More than half of the students accessed the SciTeach forum at least once each week (Table 3). 75% of our students stated that it was possible for them to access the SciTeach forum at least once a week (Table 4).

There was considerable variance in our students' responses to most of the attitudinal questions on our survey's Likert-type questions. Most student teachers felt that they had received adequate training to use the SciTeach forum (Figure 2). Most students felt that it was easy to access the SciTeach forum (Figure 3).

In general, most students felt that the SciTeach forum served as a good mechanism for facilitating communication. More than half of our preservice science teachers felt that the SciTeach forum facilitated communication with other students (Figure 4), helped them exchange teaching ideas, information, or advice (Figure 5), and enabled them to keep in touch with classmates (Figure 6). There was a mixed response from students that the SciTeach forum facilitated communication with their university instructors (Figure 7). This might be attributed to the low participation in forum discourse by some of the Methods of Teaching Science course instructors.

A majority of students felt that they gained support from others through their interactions with the SciTeach forum (Figure 8) and also felt they provided support for others through their use of the SciTeach forum (Figure 9). This type of support was socio-emotional in nature. Examples include sharing classroom experiences, personal issues, student teacher needs, and social acknowledgements. However, there was a very mixed response from our students with regard to receiving moral support through their interactions with the SciTeach forum (Figure 10). It is likely that some preservice teachers felt that the forum discourse did not assist them in dealing with the moral dilemmas they encountered during their student teaching experience. Examples include making special accommodations for students with disabilities, and management issues with extremely disruptive students.

Generally, our preservice science teachers had different attitudes regarding how their interactions with the SciTeach forum had promoted their professional growth and development in becoming a practicing teacher.
Much variance was reported in their responses to the attitudinal Likert scale questions regarding the SciTeach forum as a means to promote reflection on pedagogy learned in student teaching (Figure 11), and develop a broader perspective on teaching (Figure 12). A majority of preservice teachers felt that the their interactions with the SciTeach forum did not promote reflection on their teaching approaches and decision making (Figure 13).
Most students felt that the SciTeach forum did not help them improve their classroom management during their student teaching experience (Figure 14). Furthermore, a majority of students felt they could not use the SciTeach forum to get help with lessons and curriculum planning (Figure 15).

A majority of students stated that the SciTeach forum is an asset to NCSU's science teacher education program (Figure 16). Less than half of the students stated they would use the SciTeach forum as a resource during their first year of teaching (Figure 17).

Table 5 lists the barriers that students encountered when using the SciTeach Forum. These included: lack of personal time; inadequate access to a networked computer; and slow response of the web server which houses the SciTeach forum.

The most beneficial aspects of the SciTeach forum stated by the our preservice science teachers are listed in  Table 6. The most cited benefit by the students is that the SciTeach forum acts as a network of socio-emotional support for our preservice science teachers.  Other benefits reported by our students included that the SciTeach forum provided a means of communicating with other students and university instructors, and obtaining pedagogical resources.  Two students stated that there were no benefits of using the SciTeach forum during their student teaching.

The least beneficial aspect of using the SciTeach forum stated by our preservice science teachers are listed in Table 7. These included having to make time to access the forum, having to post messages as a course requirement, the use of topics by some students, and inconvenience to access computers.

## Discussion

The SciTeach forum appears to be effective in supporting a cohort group of preservice teachers.  The forum provides a means in which a cohort group can share and discuss common experiences over geographical distances. Our preliminary findings suggest that by using telecommunications with a "Web forum" structure,preservice science teachers can provide each other with socio-emotional support. Socio-emotional messages were those sent to one or more forum participants with content of a personal nature. Examples of socio-emotional discourse included personal issues of student teachers (e.g. time management), social acknowledgements, and student teacher needs. Preservice teachers are able to share experiences by engaging in the SciTeach forum dialogue. This sharing of experiences appears to reduce isolation barriers that preservice science teachers often encounter during their student teaching experiences. The forum provides a means for preservice teachers to receive help and support for the problems and tensions they experience during their student teaching experiences. The open structure of the SciTeach forum appears to be an important factor in the free exchange of ideas, questions, and other types of dialogue among preservice science teachers. Preservice science teachers use the SciTeach forum to post questions pertaining to pedagogical and course-work related issues. The forum is also used to exchange professional information such as teaching strategies and curricular material.

The forum can also serve to facilitate communication channels between the student teachers and their university instructors. Our results showed that many of our students felt that the SciTeach forum did not facilitate communications with their university supervisors. This might relate to the fact that most of our students' methods class instructors did not reply regularly to student messages posted on the forum. We believe that the active participation of all our university science methods instructors with the SciTeach forum could deliver a more desirable experience for our students.

Our preservice science teachers had a wide range of attitudes and perceptions with regard to their experiences engaging with the SciTeach forum. Many students felt it was very beneficial to interact with the forum during their student teaching semester. Other students had negative attitudes about using the SciTeach forum during their student teaching semester. This range of attitudes might be due to individual student's personality traits. Further study regarding personality factors and level of computer use may give a clue to the large variance in question response on the survey.

The barriers that preservice science teachers encounter when using a Web-based forum on the Internet appear to be a lack of adequate access to a networked computer and structuring time to engage in the Web forum dialogue. Even though we have seen a rapid increase in school connectivity to the Internet in recent years, our schools are not yet at the point where access to a networked computer is easily available and convenient to use. Based on our survey results, student teachers are not likely to use a school's networked computer to access a Web-based forum. Also, it appears that some of our student teachers could not locate a networked computer in their school placement. Some of our student teachers reported that there was no access to the Web in their student teaching placement when there actually was a networked computer with access to the Web located in their school. If preservice teacher preparation programs are expected to have students master telecommunications technology competency skills, then the students need to be provided with convenient access to the Internet in their school placements. The ideal solution to this problem would be to equip each preservice teacher with a laptop, a modem, and telecommunications software, and provide a "reflection time" period twice a week during the school day for preservice teachers to access and post messages to a Web-based forum. Given successful support to access a Web-based forum, novice teachers may well continue to bring their problems and support for one another to the Web.

## Conclusion

Although there are barriers to overcome, The SciTeach forum appears to be effective in providing support for a cohort group of preservice teachers. The forum provides a means in which a cohort group can share and discuss common experiences over geographical distances. Our preliminary findings are consistent with previous research (Bull, Harris, Lloyd & Short, 1989; Casey, 1997) which suggest that using telecommunications can provide preservice teachers with socio-emotional support during their student teaching experience.

Our preservice science teachers showed interest in what was happening in their classmates' classes during their student teaching experience. Our student teachers were able to share experiences by engaging in the SciTeach forum dialogue. This sharing of experiences appears to reduce isolation barriers that preservice science teachers often encounter during their student teaching experiences. The forum provides a means for preservice teachers to receive help and support for the problems and tensions they experience during their student teaching experiences. The open structure of the SciTeach forum appears to be an important factor in the free exchange of ideas, questions, and other types of dialogue among preservice science teachers. The SciTeach forum is an instrument that our preservice teachers have used to become critical and reflective about issues of pedagogical knowledge and practice.

Our preliminary findings illustrate that much variance exists with regard to our students teachers' attitudes and perceptions of their experiences with interacting with the SciTeach forum.  This variance might be attributed to learning styles, personality characteristics, students' comfort level and previous experience using telecommunications technology, or their attitudes towards using information technology.  Some students perceived posting to the Web forum merely as a response to an assigned task.  Student access to a networked computer might also have an effect towards students' attitudes towards participating in the Web forum.  Our results suggests that there is a need for further research studies to investigate possible factors that might be contributing to the variance of our students teachers' attitudes and perceptions of their experiences with interacting with the SciTeach forum.  Continued research in this area will involve addressing students' attitudes and perceptions of computers and telecommunications in education before and after their student teaching placement.

This study has spurred other research questions: Which topic areas promote the most reflective discourse?  What aspects of the Web-based forum do preservice science teachers feel foster their sense of an electronic community of educators?  Which topic areas promote the most exchanges of ideas among student teachers?  How does peer responsiveness affect the depth of the dialogue?  Does interacting with a Web-based forum promote reflection on what the students are learning, including teaching approaches and decision making? What types of mentoring do university supervisors provide on a Web-based forum? In a follow-up study, we hope to address these new questions with a more detailed analysis of the Web forum discourse and with preservice teacher interviews .

Given our results, we plan to continue to use 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 thinkers as part of their ongoing professional development. As a result of this research, we are beginning to understand how preservice science teachers can communicate with their peers and instructors from remote locations using the World Wide Web.

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**Table 1. School location where students could access the World Wide Web.**
Number of individual student responses in parentheses.

classroom (1)
computer lab (2)
library (4)
only one computer in library (3)
two computers in the library, 15 minute time limit (1)

**Table 2. Location of student access to the SciTeach Forum.**
Number of individual student responses in parentheses.

NCSU campus computer lab (12)
home (4)
school placement (1)
Friend's house (1)
Babysitting (1)
other university computer lab (1)
NCSU library and husband's work (1)
NCSU and at school (1)

**Table 3. Frequency of student access to the SciTeach Forum.**
Number of individual student responses in parentheses.

daily (2)
2-3 times/week (5)
once/week (12)
twice/month (3)
once/month (4)

**Table 4. Student responses to the question: How often was it possible for you to access the SciTeach forum?**
Number of individual student responses in parentheses.

daily (5)
2-3 times/week (5)
once/week (8)
twice/month (3)
once/month (3)

**Table 5. Student responses to the question: Which barriers or problems did you encounter when using the SciTeach forum?**
Number of individual student responses in parentheses.

Inadequate access to a networked computer. (13)
Lack of personal time.(18)
Insufficient time for learning how to use the forum. (0)
No source of ongoing assistance to use the SciTeach forum.(0)
Slow response of the web site.(8)
Other, Please list: (1)

I was not motivated because of the style of learning that comes from the web forum is not one I prefer or use really. Sort of busy work for me.

**Table 6. Student responses to the question: What was the most beneficial aspect of using the SciTeach forum during your student teaching experience?**
Number of individual student responses in parentheses.

Network of socioemotional support (11)
Communication with other students (6)
Obtaining pedagogical resources (3)
Communication with university instructors (2)
No benefits (2)

**Table 7: Student responses to the question: What is the least beneficial aspect of using the SciTeach forum during your student teaching experience?**
Number of individual student responses in parentheses.

Having to make time to access the forum (7)
Having to post messages as a course requirement (5)
The use of topics by some students (5)
Inconvenient to access computers (3)
Nothing (2)

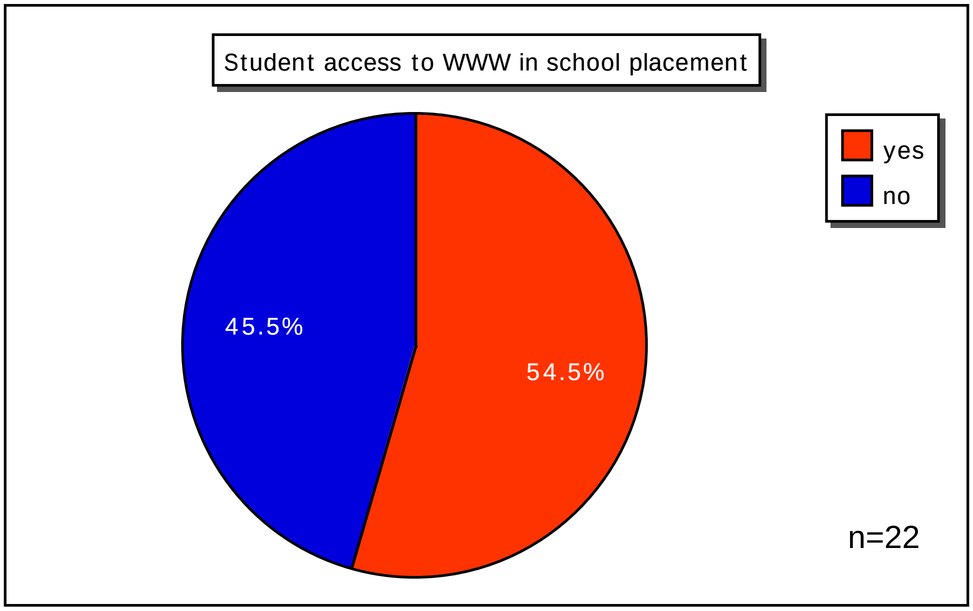


Figure 1. Access to the World Wide Web in student teaching placement.

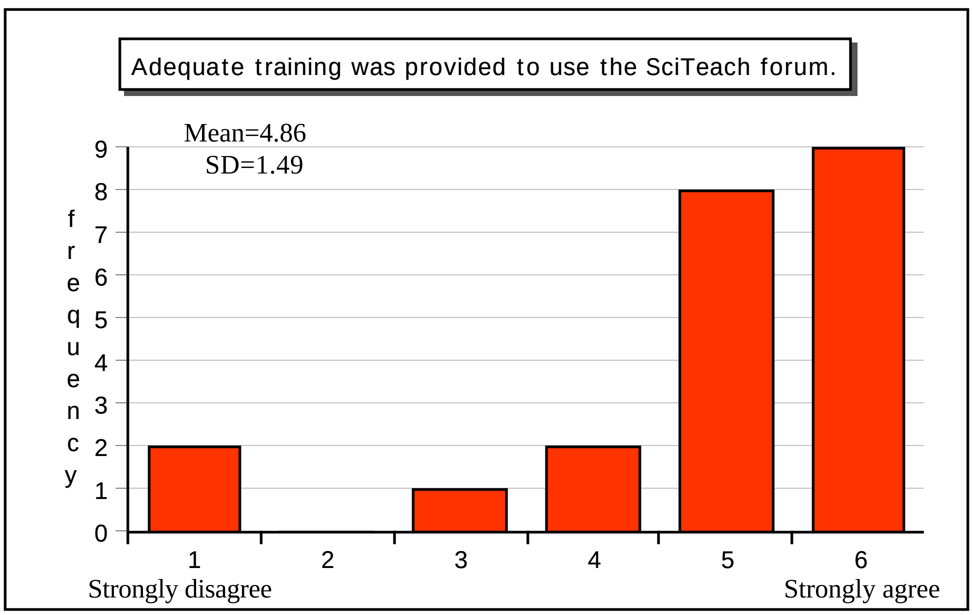


Figure 2. Students perception of their training to use the SciTeach forum.

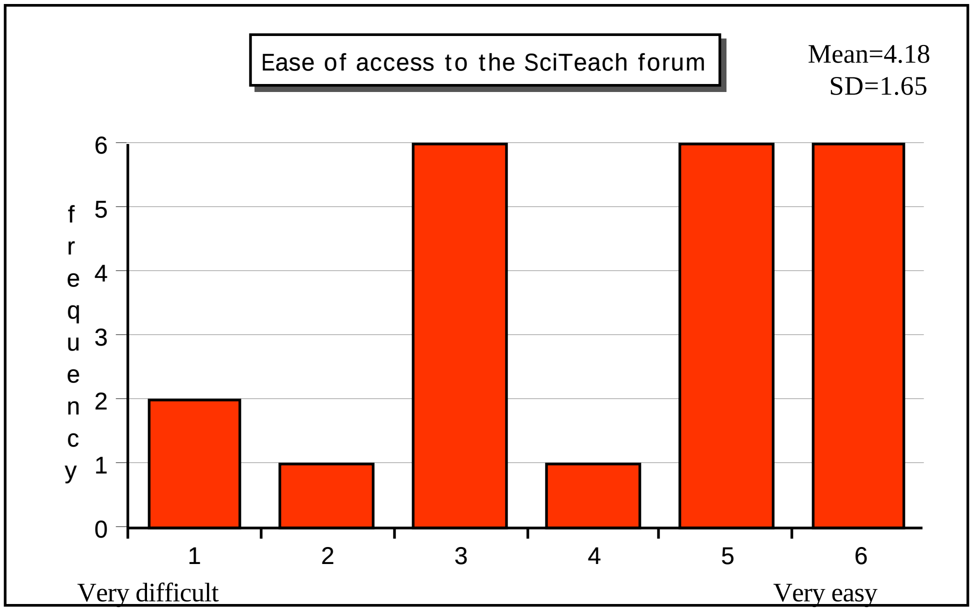


Figure 3. Students' perception of access to the SciTeach forum.

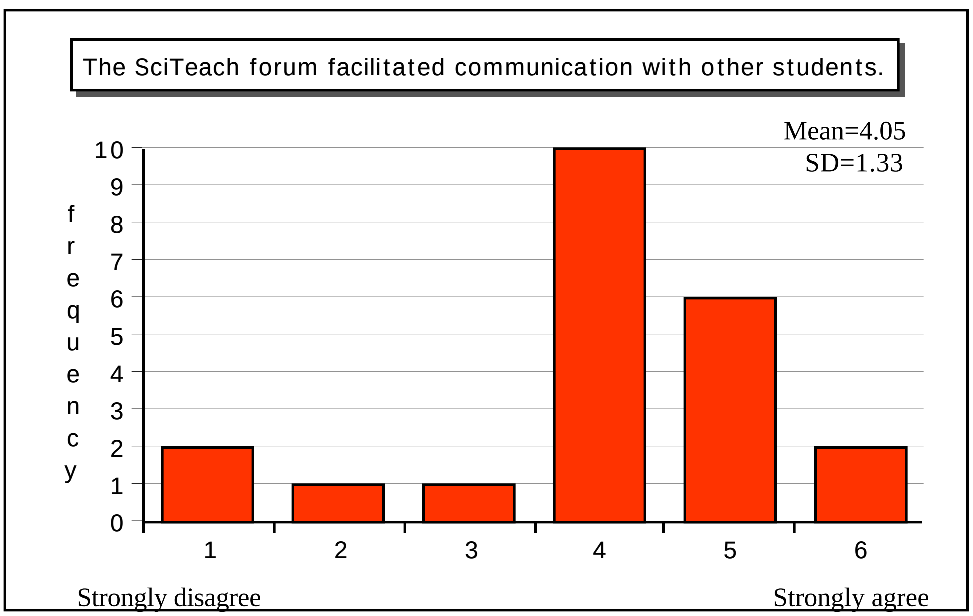


Figure 4. Students' perception of the SciTeach forum facilitating communication with other students.

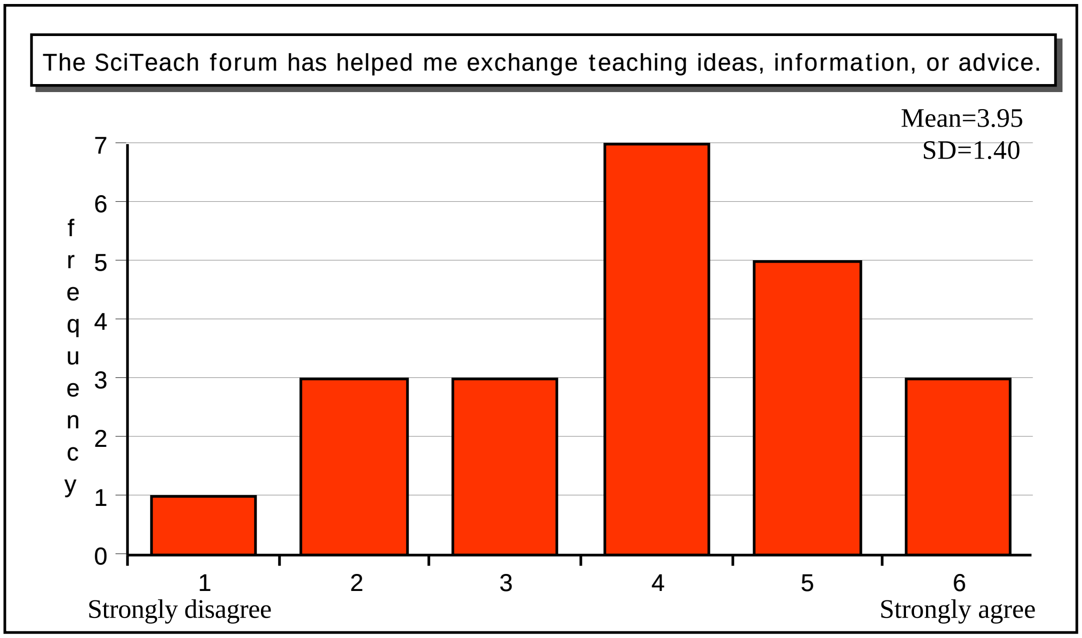


Figure 5. Students' perception of the SciTeach forum as a mechanism to exchange teaching ideas, information, or advice.

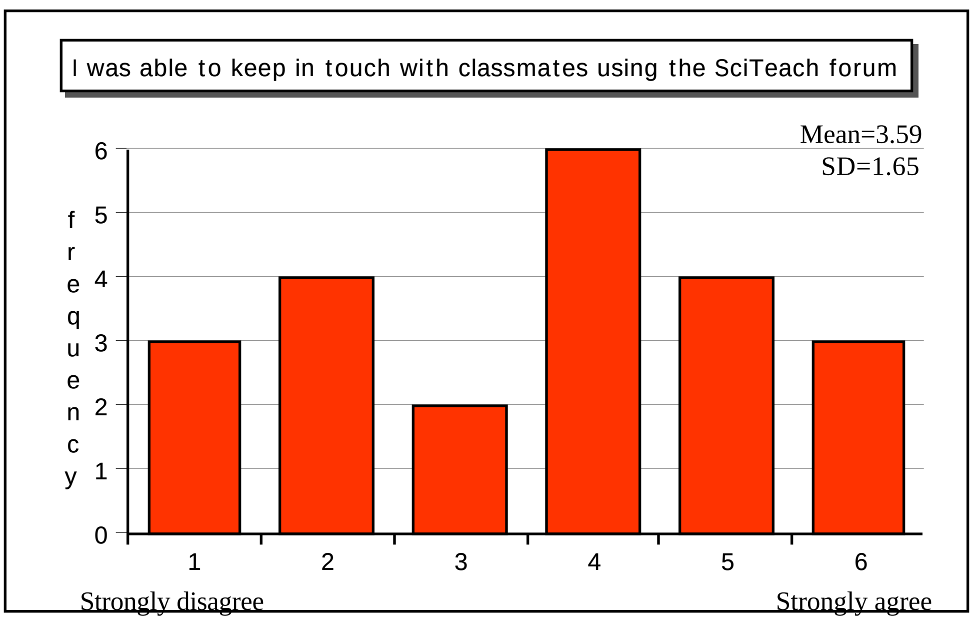


Figure 6. Students' perception of the using the SciTeach forum to communicate with classmates.

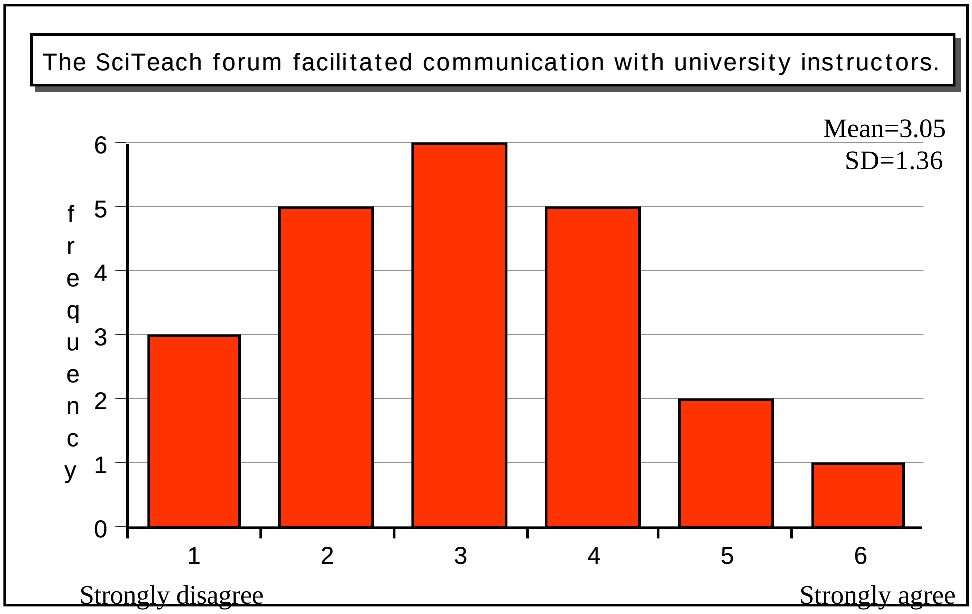


Figure 7. Students' attitude on the SciTeach forum facilitating communications with their university instructors.

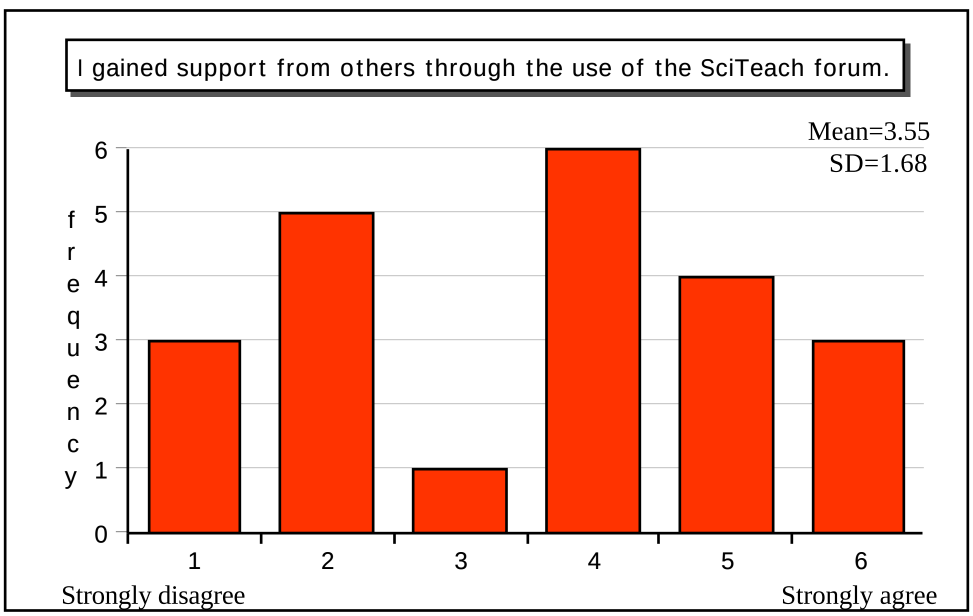


Figure 8. Students' perceptions on receiving support from others through use of the SciTeach forum.

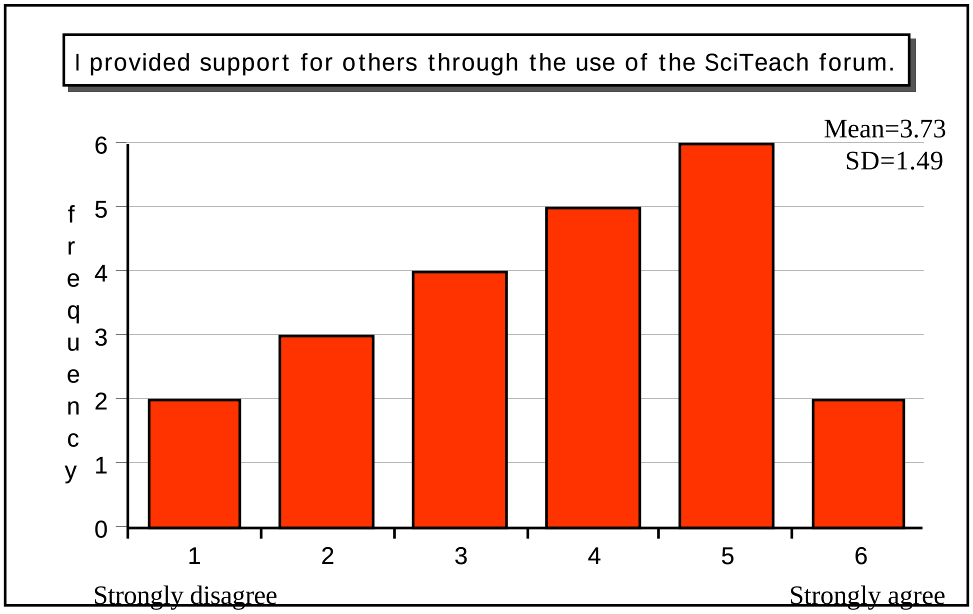


Figure 9. Students' perception that they provided support from others through use of the SciTeach forum.


Figure 10. Students' perceptions on receiving moral support through their interactions with the SciTeach forum.

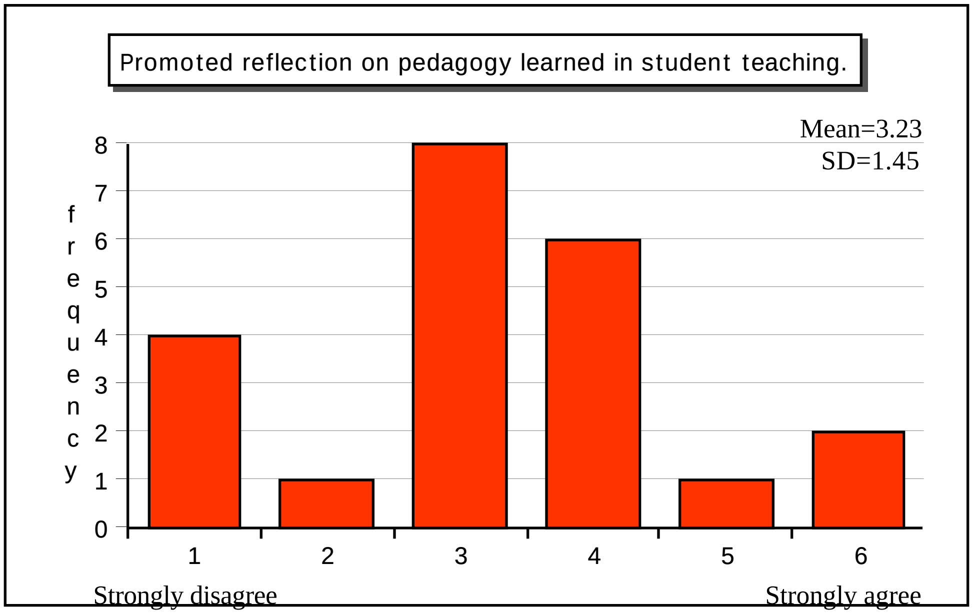


Figure 11. Students' perceptions that the SciTeach forum promoted reflection on pedagogy learned in their student teaching.

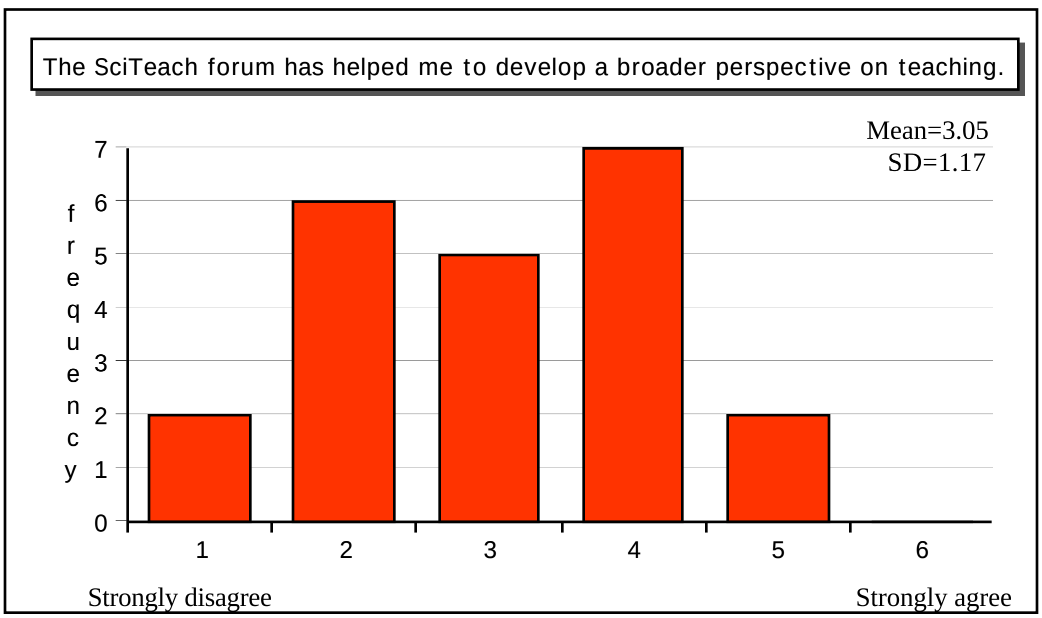


Figure 12. Students' perceptions that the SciTeach forum helped them to develop a broader perspective on teaching.

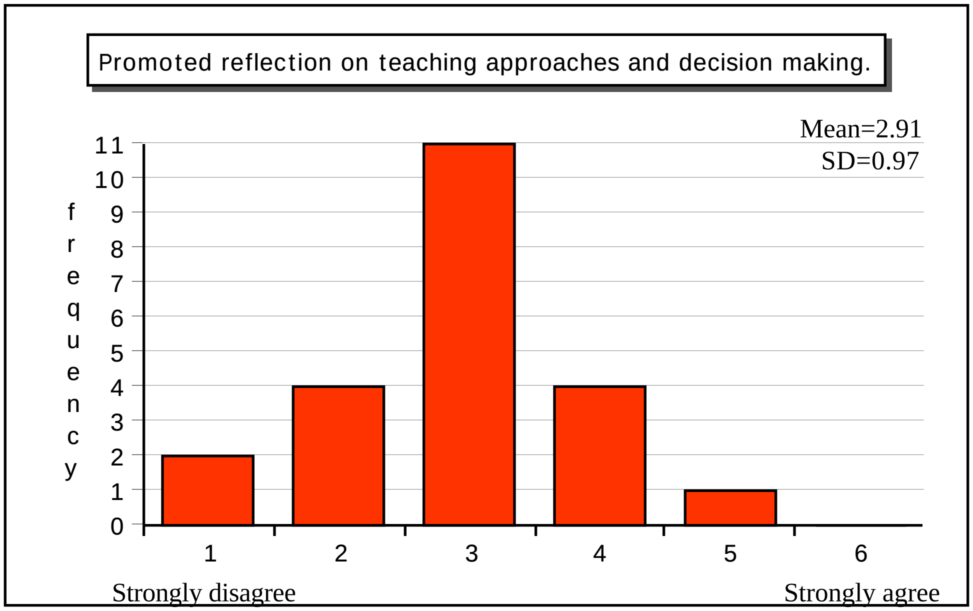


Figure 13. Students' perceptions that the SciTeach forum promoted reflection on teaching approaches and decision making.

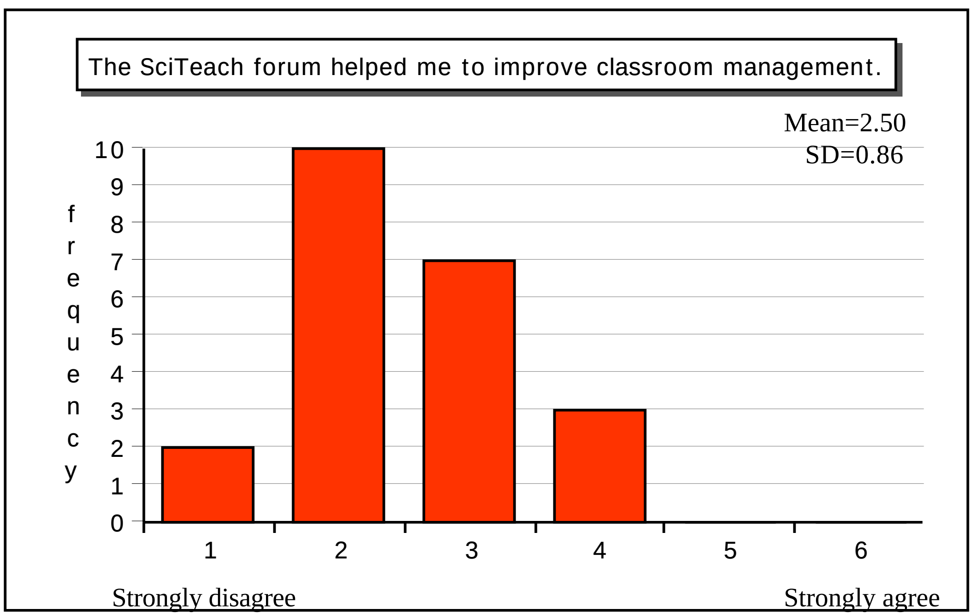


Figure 14. Students' perceptions of the SciTeach forum as a mechanism to use to improve their classroom management.

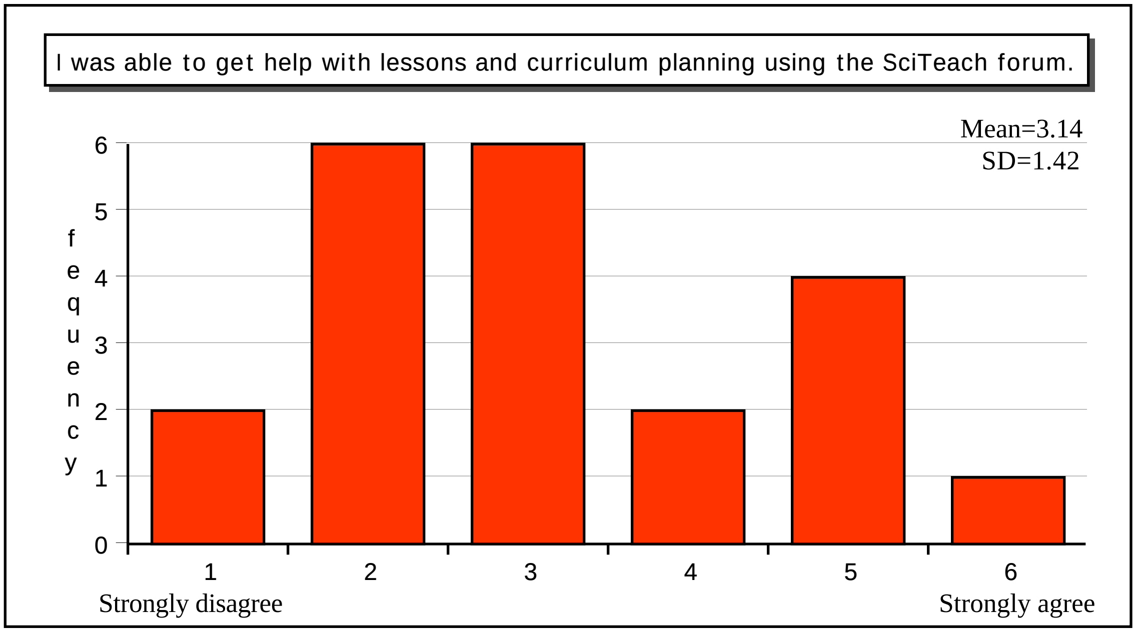


Figure 15. Students' perceptions on using the SciTeach forum to get help with lessons and curriculum planning.

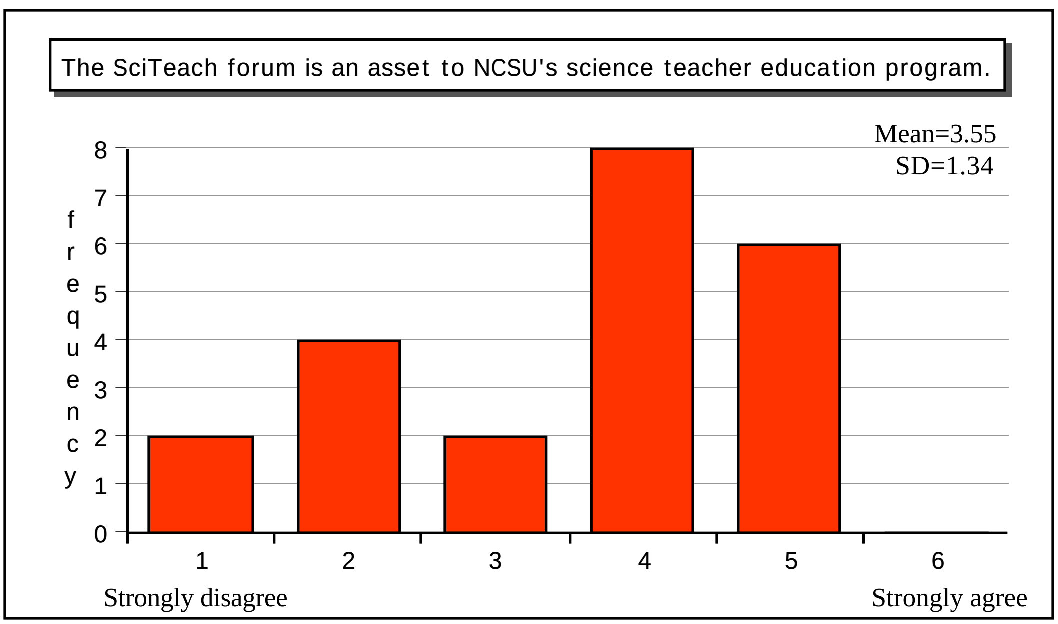


Figure 16. Students' opinions on the SciTeach forum as an asset to NCSU's science teacher education program.

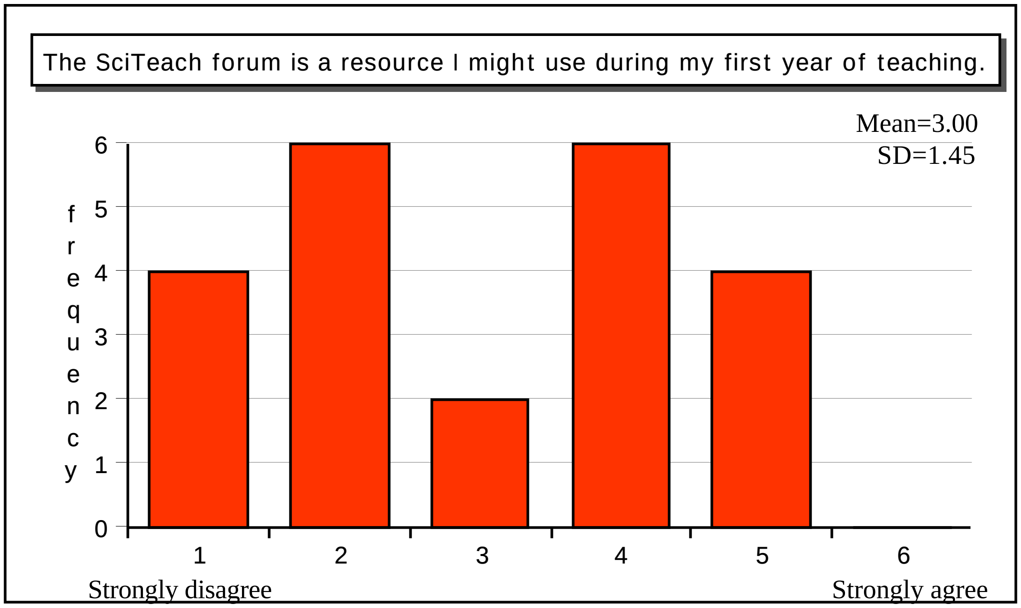


Figure 17. Students' opinion that the SciTeach forum is a resource that they might use during their first year of teaching.

## Critical Incidents in Science Teaching: Web-Based Reflective Discourse With Preservice Science Teachers

### Introduction

Teaching has been characterized as a culture of isolation (Schlagel, Trathen, & Blanton,1996). A practicing teacher does not usually have access to ongoing development and support in a classroom setting which promotes idea sharing or support from peers. Electronic communities for teachers have the potential to break down these teacher isolation barriers and provide a support network for teachers in the classroom (Bull, Harris, Lloyd & Short, 1989; Casey, 1997). New science reform platforms, such as the National Science Education Standards, recommend including educational technology, especially telecommunications, in our K-12 classrooms. Teachers now have the opportunities to join on-line discussion groups on the World Wide Web, post questions to electronic bulletin boards, and communicate thoughts and ideas using an e-mail listserv. Many studies describe how teachers learn about telecommunications technology, the kind of support required for teachers to implement such tools effectively, and the obstacles that teachers must overcome in order to successfully incorporate them into their daily practice (Bos, Krajcik, & Patrick, 1995; Caggiano, Audet & Abegg, 1995; Casey, 1994; Casey & Vogt, 1994; Russett, 1994; Russett, 1995; Sunal & Sunal, 1992; Weir, 1992).

In the last few years, an increasing number of schools and classrooms are accessing the Internet. This wave of increased connectivity has been in response to the National Information Infrastructure initiative which encourages all of the nation’s schools and classrooms to connect to the “Information Superhighway”. In 1994, 35% of U.S. public school had at least one computer connected to the Internet. This number rose to 65% in 1996 (Heaviside, Riggins, and Farris, 1997). However, only 14% of all public school instructional rooms (classrooms, computer or other labs, and library media centers) were connected to the Internet in 1996 (Heaviside, Riggins, and Farris, 1997).

## Background

Some studies have been conducted on the effects of preservice teachers interacting with an electronic telecommunications network. The Curry School of Education at the University of Virginia created the Teacher-LINK system in 1984 to study the process of establishing a network to support the student teaching process (Bull, Harris, Lloyd & Short, 1989). This study reported that preservice teachers used Teacher-LINK as a communications link to their university instructors during their field experiences using electronic mail (e-mail) and an electronic conferencing system. Merseth's (1991) study on first-year teachers participating in the Beginning Teacher Computer Network (BTCN) showed that first year teachers used electronic telecommunications for personal, emotional, and technical support. Casey's (1994) study on preservice teachers using TeacherNet at California State University reported the following benefits of preservice teachers using a telecommunications network: increased time to reflect on what they were learning; increased feeling of rapport with and support from their university supervisor; decreased feeling of isolation, increased self-esteem due to mastering technology; and increased knowledge and use of information access and retrieval. The preservice teachers in Waugh and Rath's (1995) study perceived that networks can enhance teacher training and support their work in the schools by using it to access resources and communicate with others. Waugh's (1996) study on group interactions and students' questioning patterns in a university course using an electronic network showed that students posted questions predominantly concerned with technical aspects and network strategies more than personal questions. An exploratory investigation of preservice English teachers using telecommunications during their methods instruction and student teaching (Thomas, Clift & Sugimoto, 1996) reported that electronic mail was an asset for meeting course requirements and maintaining contact between students and instructors. The results of a study by Schlagel, Trathen, and Blanton (1996) at Appalachian State University point to the structure of e-mail use as being an important factor in eliciting spontaneous exchanges of ideas.

The current educational reform movement calls for research to determine mechanisms for preservice teachers to use telecommunications for reflective conversations embedded with critical thinking. 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 towards the use of electronic community networks, as well as their feelings about 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.

There have been no studies conducted on the use of telecommunications in a science education methods/curriculum course involving use of an asynchronous Web-based forum for facilitating reflective discourse.  Very few research studies exist involving preservice teachers using telecommunications for purposeful discourse in any preservice education program.  Those that have been conducted were designed to evaluate the impact of the use of electronic mail and bulletin board systems on preservice teachers' attitudes dealing with the utility and use of the electronic medium during student teaching internships.  Each of these studies were conducted within the context of restricted networks of preservice teachers.  There have been no studies conducted involving preservice education students using asynchronous Web-based forums during their student teaching internships in which a public, non-restrictive Web-forum served as the online community network space.

Although there are increasing numbers of new teacher communications networks being 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.  Few studies have been conducted in which student teacher postings to electronic networks have been analyzed for types of discourse.  These studies have described only broad, general categories of discourse occurring on networks of preservice teachers.  None of the existing studies have analyzed whether the discourse is thoughtful and promotes a reflective practice in which a cohort group of preservice teachers engage in discourse that involves asking focused questions, seeking common meanings in teaching practice, or constructing ideas during collaboration with other preservice teachers.

The purpose of this study is to investigate the purposeful use of asynchronous (time-delayed) telecommunications in a science education methods/curriculum course involving the use of a non-restrictive, public Web-based forum for facilitating reflective discourse with preservice science teachers using critical incidents in science teaching. In a non-restrictive, public Web-based forum, any person with access to the Web can participate in the discourse. More specifically, the following questions are of interest in this research:

1. Does the discourse of critical incidents in science teaching with preservice science teachers on a non-restrictive, public Web-based forum reveal a reflective practice of teaching?

2. Does interacting using a Web-based forum allow reflection on what the preservice science teachers are learning, including teaching approaches and decision making?

3. What are the students' attitudes toward using a Web-based forum with critical incidents in science teaching during their methods course instruction?

## Methodology

### Participants

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 the fall of 1998. 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 telecommunication 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 a few 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. These courses were instructed by different science education faculty members than the Instructional Materials in Science course instructors. The 12 middle school students were instructed in a different Instructional Materials course and a different 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 the student teacher internship.

### The SciTeach (Science Teaching) Forum

As part of the required course work in the Instructional Materials in Science course and in the Middle School Methods course, each student was required to post two messages each week to the SciTeach (Science Teaching) Forum for the entire semester. The SciTeach Forum is placed in the context of a larger public Web site called Science Junction. 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 to post messages on the forum.

The SciTeach Forum has been structured to contain discussion topics relating to teaching science content, incorporating instructional technology into the curriculum, and teaching pedagogy in general. The online forum software 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.

## Critical Incidents in Science Teaching

Each week, the participants were required to place one forum posting to 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 posted to 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. The following is an example of a critical incident:

> Students are working with microscopes and you want them to observe and draw onion skin cells. They accurately set up the slides and microscopes, focus correctly, and begin observing and drawing. As you walk around the room you see some drawings that reflect the accepted image of onion cells, but approximately 1/3 to 1/2 the students are drawing sketches that look nothing like the accepted image of onion cells. What kinds of things would you say and do at this point?

## Role of the Researcher

The researcher in this study was involved with the Middle School Methods course on a daily basis and with the Instructional Materials in Science course during the first and last week of the on-campus instruction in the role as an instructor. He introduced the forum to all participants during their course and was responsible for maintaining the forum and answering any technical questions or problems the students might have during the semester. He was also responsible for posting a critical incident to the forum each week. The critical incidents were written prior to the beginning of the semester. To reduce any bias the researcher might introduce to the study, he did not post any additional responses and comments to the forum.

This study was conducted as a blind study. The preservice teachers did not know that they were participants in a research study. Using the Web-based forum was not a coercive thing. It was a normal course requirement for all students in the Materials and Middle School Methods course during the the semester. None of the students complained about having this particular assignment.

## Data Collection and Analysis

The critical incidents message threads were downloaded and entered into the QSR NUD*IST 4 software system for data analysis. The researcher reviewed the literature of computer-mediated communication use with preservice and inservice teachers in order to identify data categories of previous research to use initially to code the preservice teachers' message postings.

The constant comparative method was used to explore message types and patterns that facilitate collaborative student teacher reflective discourse in the "Critical Incidents in the Science Classroom" topic on the SciTeach Forum. According to Glasser (1978), the steps in the constant comparative method of developing theory are as follows:

1. Begin collecting data.
2. Look for key issues, recurrent events, or activities in the data that become categories of focus.
3. Collect data that provide many incidents of the categories of focus with an eye to seeing the diversity of the dimensions under the categories.
4. Write about the categories you are exploring, attempting to describe and account all the incidents you have in your data while continually searching for new incidents.
5. Work with the data and emerging model to discover basic social processes and relationships.
6. Engage in sampling, coding, and writing as the analysis focuses on the core categories.

Although one can talk about the constant comparative method as a series of steps, what has just been described proceeds non-linearly, and the analysis keeps doubling back to more data collection and coding (Bogdan & Bilken, 1992).

The data from the forum was coded and categorized by evaluating each message based upon the type of information or communication contained in the transcript. Emergent categories were assigned to identify the types of messages and interactions that were taking place. By using the constant comparative method, the initial coding scheme became modified rather quickly. Another science educator reviewed the coding categories as a measure of coding reliability. The emergent message type categories (or code words) identified in the critical incidents discourse were:

• Classroom experiences:  Statements referring to an event that occurs in the classroom.

• Science Pedagogy:   Statements pertaining to science-specific pedagogy and not general pedagogy.

• Nature of Teaching:  Statements relating to classroom instruction, methods, or classroom management issues; the role of the teacher; and specific teacher-student interactions.

• Support: Statements referring to support, including receiving or giving support, and supporting one’s ideas.

• Concern for students:  Statements pertaining to the welfare of classroom students.

• Requests for information:  Statements or specific questions which ask for information, advice or ideas.

• Resources:  Statements in which students share resources including teaching ideas, general information, or instructional strategies.

• Recognition:  Statements in which a student acknowledges an idea presented on the forum.

Each student message was also coded for evidence of reflective discourse.  The reflective discourse codes were:

• Perceptions:  Insight, intuition; knowledge gained by observing; becoming aware in one’s mind.

• Asking focused questions:  Asking focused questions to build on ideas previously presented in the message thread.

• Peer scaffolding: A statement that builds on a previous posting in the message thread.

Peer scaffolding was further subdivided into the following themes:

• Guidance and feedback: Messages that build on a previous response in the thread that offers some type of guidance and feedback on the issue discussed. Can include a response to a stated activity or provide movement of an issue into a new direction.

• General advice: Messages that offer general advice or personal views to further develop an idea in the message thread.

• Modeling pedagogical practices: Messages that augment an idea by illustrating a pedagogical practice.

***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 "critical incidents" on 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 conducted using audio tape. Appendix A lists the interview questions.

***Surveys*.** A survey 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 of their experience interacting with a Web-based forum.

## Findings

The findings of this study are presented within the context of emerging themes that resulted from the data analysis of the forum discourse, surveys, and interviews. Examples of forum discourse of participants and excerpts from the interview transcripts are provided in the discussion of these themes.

### Allowing a Reflective Practice of Teaching

> "Most of the time you maybe thinking it, but you can't necessarily get it out. So, sometimes people will spark something that you were thinking. I understand why they may have said that, so you get a new idea if you get to see someone else's reply to the same question."

Throughout the discourse of the critical incidents, there are many examples of preservice teachers engaging in reflective discourse. The critical incidents are 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. The incidents were authentic problems that the preservice teachers could "relate to". Reflective discourse was evident in the responses to the critical incidents in which students share their perceptions which ultimately result in the seeking of common meaning to resolve the critical incident. In many cases, peer scaffolding resulted in ideas of one preservice teacher as a foundation for others. This was illustrated in the participants' message postings as guidance and feedback, general advice, and modeling pedagogical practices.

### Guidance and Feedback

In many cases, the preservice teachers responded to messages that responded to a previous response or multiple responses in the thread and offered some type of guidance and feedback to the issue. Often, the participants responded to a stated activity or provided movement of an issue into a new direction. For example, much of the discourse in a microscope lab discussion tended to focus on showing their students a correct cellular organelle illustration when they notice that students were drawing incorrect pictures. In response to what has been said in the message thread, one student responded by saying:

> "Distributing the drawing is a good idea, but I would do it after students have made their own drawings. If 1/3 or so of the students have drawn a cell that looks nothing like an onion cell, then give them an actual drawing/picture and ask them to compare it to their drawing. After they have had time to do a visual comparison, ask the student to go back to the microscope. . . look closely. . . and redraw the onion cell again."

In this response, this preservice teacher has acknowledged that distributing a drawing is a good idea and then offers guidance to direct the students back to their microscope and reexamine the onion cell. This student has built her response based on the response of others. Not all students "respond along the same lines" in the message thread:

> “I don't think that showing them a "correct" drawing is the right answer in either case. It pretty much defeats the purpose of having them look into the microscope. If you wanted to do a similar activity with them later, students might be tempted to wait until you put up the "correct" drawing before attempting to do the work on their own.”

This response is very different from all the others in this message thread. This student shows a critical reasoning that no other students had previously shown in the discourse. Not only does this student disagree with the majority of her peers, she provides a good explanation to support her views. She believes that showing the students the “correct answer” might lead students to decrease their motivation to engage in a classroom activity.

### General Advice and Modeling Pedagogical Practices

> “If a teacher does pursue this discussion in class, do so in a discussion forum, or a round-circle discussion. This puts students at ease and each person has visual contact with the other students. This helps develop the listening, thinking, and communicating process.”

> “I think one way to curb the student from saying that the lab is dumb in the first place is by making a statement of objectives at the beginning of the lab.”

Throughout the discourse the preservice teachers offer each other general advice or personal views to develop an idea in the message thread. General advice is often offered after some discussion of a teacher-student interaction. In many cases, students have critically reflected on the situation and bring in discussions of science-specific or general pedagogical knowledge to address the critical incidents. As students experience critical incidents during their teaching internships, they bring these experiences into the forum dialogue.

For example, in response to a critical incident involving an inquiry lab, in which a student says to you: "This is dumb! You could just simply tell us the answer and how to do the lab. We'd learn the material more quickly and get to new things," one preservice teacher responds with her own personal experience:

> “This is a tough thing to handle sometimes. This very comment has been said to me in my classroom. I told the student that science is about figuring out how the world works, like an investigation into nature, and that he could not truly learn about science without participating in this investigation. I reminded him that I could tell him anything but only if he saw it for himself, would he actually know for sure.”

In her response, she stresses to the student a basic constructivist view, the importance of creating meaning for himself through his own experiences. This discussion of constructivism is developed further in the message thread in which students reflected on various reasons why inquiry labs are more engaging and interesting to students than being lectured to. Modeling specific science pedagogical theory such as the learning cycle is also presented in the discourse as an example of making science content meaningful and relevant to their students. By offering advice and sharing pedagogical practices, common meaning becomes evident in the discourse: “If you just give the answer to the student, they are less likely to retain the information and use it correctly”.

### Seeking Common Meaning

In this study, the Web-based discourse promoted reflection and understanding on common meanings these preservice science teachers seek to understand. They seek to clarify and extend their understanding of their role as a teacher and also seek to understand their students. In many cases, they perceive their role as a teacher to extend beyond facilitating student knowledge of scientific processes and concepts:

> “Why have females been lagging behind in the field of science? Have our educators not been sparking their interest? Have they been drawing the females attention away from math and science and gearing it more towards liberal arts areas? Have our teachers been turning to the males for correct responses and been setting higher expectations for the males? Have educators been accepting that females are just ‘not as good in science’ or what? These are a few questions that researchers have been confronted with for years. So how, as a new science teacher, will I deal with the prejudice of a male dominated field?”

By asking focused questions, this participant seeks to understand how gender bias originated and how to come to terms with this issue in her new role as a classroom teacher. Her peers respond with discussion of gender roles in historical and societal contexts, ideas on why women were not given credit in the past for their ideas, and how gender roles are presented by textbooks and perceived by people. The role of the science teacher becomes more than just being a facilitator of knowledge:

> “ It is the job of science teachers today to reach out to females and create confident scientists.”

The participants seek out their limitations in their role as a teacher. In a discussion of teaching AIDS and sex education, a preservice teacher states:

> "I agree with Tamika. It is unfortunate how little can be discussed on this matter. Teachers just are not in a position where they can freely give their opinions about sex. We seem to have little choice but to cut the conversation short. It would be an interesting and informative discussion for students and the teacher but it just cannot happen in today's classroom."

As the student teachers spend more time in the classroom and become exposed to school district policies and the daily nature of teaching, they begin to move away from “idealistic” thoughts of teaching and become more aware of the “realistic” world of teaching.

Throughout the discourse, preservice teachers seek to understand meaning from the perspective of their own students:

> “I agree with David and Leslie. A student should know before they begin a lab why they are doing it. That is the whole point of having objectives with a lesson. Joseph and Dalia also make a key point, that if the kid still says its dumb, ask him/her why. We are supposed to be challenging students to think, but we must also think before we pose an activity to a student: Is it on their level? Does it challenge them? Can they relate to it? Just giving a kid an activity is not teaching. It must have real meaning and benefit to the topic and the student. Just because I as the teacher think it is awesome, doesn't mean a kid will. Listen to this type of statement when it comes from a kid, ask them why they feel this way, and if it is a legitimate reason rethink the activity. Adapting plans is part of being a good teacher!!!”

In this case, a preservice teacher seeks to understand how a student would view the activity. She critically reflects on the issue by asking focused questions in an attempt to place herself in the students’ shoes. In doing so, she seeks to understand the differences in how teachers and their students perceive an activity.

## Teaching Approaches and Decision Making

The structure of the critical incidents requires the preservice teachers to think about their teaching approaches and decision making in the classroom. A recurring concern which emerges in the discourse is how to create learning environments in which students take ownership for their own learning.

> “I’ve also noticed that I had a tendency if I’m doing some hands-on stuff in a class like a lab, that I’m trying to do the work for them. With responding with people [on the forum], I’ve learned to stand back and let them [the students] do it. I have a tendency to help them to do it quicker. I know

> they can't learn like that from me. They have to think through the process. I think its [the forum] just influenced me in making me not react so quickly, thinking about it a little more."

In this statement from the interview, a participant has used the discourse on the forum to reflect on her teaching approaches and realized she was not giving her students the opportunity to think for themselves. By having the opportunity to read the pedagogical ideas of her peers in similar situations, she has been able to reflect on her own teaching and realizes how she needs to change her pedagogical style in the classroom.

In sharing peer perceptions, the participants are able to engage in scaffolding pedagogical ideas with each other.

> "And I think its really good if you can see how different people deal with a certain situation. So you can integrate everybody's little pieces together, and then you can decide, okay, this is how I'm going to do it and then you can sit back and reflect did that work or not, and do something different next time if need be."

The preservice teachers were able to integrate bits and pieces of different teaching ideas that were presented in the message threads. They integrate the pieces together and decide how they can improve their own teaching from what has been previously said by others. This type of peer scaffolding appears to promote reflection on topics the participants are learning in their university course work. In some instances, participants have stated openly on the forum that they had a preconceived notion about handling a certain situation and that notion changed after reading the responses of others on the forum.

### Being Prepared

The discourse also promotes reflection on the day-to-day activities a teacher deals with in the school environment.

> "It made me realize that, even though you're not consciously thinking about it when you are making your lesson plans, you have to start thinking about what am I going to do if this child asks a question and I don't completely understand, and you have to be prepared for stuff like that. 'Cause kids will ask you something out of the blue and you're like, well what would make them think like that. Or, if you're in a lab and it just does not want to work, you have to figure out how am I going to control, or what can I do to move along. And you have to be ready for it if something does happen. You have to be ready with something else. So, it just makes you be more aware that you have to be prepared and you always have to have a back-up plan. As I have experienced, so far, I have to have back-up plans because last minute assembly, during one of my classes tomorrow. So it makes you think about all this extra curricular stuff the school puts in. So you have to be prepared for that kind of stuff."

This participant has realized that the average school day is full of unexpected surprises that the classroom teacher must think about. Interacting with the critical incidents discourse has helped this preservice teacher to contemplate these issues.

### Preservice Teacher Interactions

Sharing peer experiences of interactions with their students opens doors to ideas of different teaching approaches. As one participant notes:

> "There's a lot of different views. Especially with the middle and high school teachers. And how they would handle it. You know, like different preparation they have, and classes, and how to work with their students. How they handle interactions with their students."

Much of the discourse in the beginning of the participants' professional semester tended to focus on the types of teacher-student interactions they perceive having with their students. These interactions appear to be a concern of the participants at this point in time in their professional semester. By reading the forum discourse of the participants, one gets a sense that they are very concerned with how they will interact with their students when they are classroom teachers and how this will influence student learning in their classroom.

**Broad Views**

In responding to critical incidents, some participants extrapolate the discourse to a larger contextual picture.

> "I think what you would do has a lot to do with the students in your class. Is this a class where a lot of the students tend to do well on most tasks, but are having difficulty with this one in particular? If so, your method would be much different than it would be in a class which has a lot of students who tend to be off task quite often."

In this participant's response, the preservice teacher focuses on the nature of the students in the classroom instead of the particular situation. In many critical incident responses, some students expand on the discourse as an opportunity to discuss the nature of science in a more general perspective.

> "Understanding science means understanding the world around you. It can also be important to learn about the things we do not understand about our world and the way it works. In our science class, you learn how to ask good questions about why things happen. You also learn how search for the answers to those questions. In short, you learn problem solving skills. You are also becoming scientifically literate, and that can be very important in American society."

This participant has built on the discourse by placing a large emphasis on science process skills and becoming a scientifically literate citizen. This participant continues her dialogue by providing detailed examples to how these skills will impact an individual to make life-improving decisions.

## Student Attitudes

### Preparing to Teach Science

All participants who were interviewed stated that the critical incidents were helpful in preparing them to teach and to think about situations that they might encounter during their student-teaching placements. These statements were correlated with responses from open-ended survey questions.

> "I feel like it prepares you more."
> "They were problems I could relate to a lot more."

The critical incidents were perceived by these participants as being relevant and meaningful to them not only for their internship but also for their future job placements.

> "Its important for us as students to touch on all the fields since we will be generally certified in science. And it may not be important right now, but at least it gives me an idea on how I might handle these issues if say I was to teach in a biology classroom. It might help. A topic like evolution will probably not come up in a chemistry class, but it would in a biology class. At the same time, there are some chemistry examples which may not be used in a biology class. The critical incidents gives us the opportunity to react to different situations. It presents a situation where they may not know how to handle it."

This participant acknowledged the fact that it is important to think about all kinds of science topics even though he had a concentration in only one area. The critical incidents compel the participants to think about and respond to certain science teaching problems that they might not otherwise have the opportunity to be exposed to.

### Touchy Issues

> "Evolution is a very touchy issue that can spark serious conflicts among people."

> "I feel like the ones that are real touchy issues are real important to think about a lot before you get into the classroom."

Throughout the forum discourse and in the participants' interviews, the critical incidents were often referred to as "touchy" or controversial issues. Discussing controversial issues was perceived by these participants as getting them "fired up" and very interested in hearing how their peers thought or how they would react to the situation. Some also stated in the interviews that they extended the discussion of these "touchy issues" outside of the forum with other teachers at their school placements.

## Conclusions

In traditional student teaching internships, preservice teachers are often disconnected from their peers in other classrooms. Separated by geographical barriers, preservice teachers interact sporadically with university faculty and rely almost exclusively on cooperating teachers for guidance, information, and support. The SciTeach Forum provides a place for preservice teacher reflection and one in which they can communicate with one another across geographical distances. Interacting with the critical incidents topic of the forum provided preservice science teachers the means and opportunity to develop as reflective practioners. Preservice teachers become 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 appears in the discourse. The discourse in the critical incidents topic of the SciTeach Forum is thoughtful and promotes a reflective practice in which a group of preservice teachers engage in a dialogue that involves the asking focused questions, seeking common meanings in teaching practice and constructing ideas in collaboration with other preservice teachers.

Although the preservice teachers are interested in discussing controversial topics on the forum, it appears that most them respond by "playing it safe". In general, most preservice responses are conservative in nature. Very few take the approach to present risk-taking ideas in the classroom. A reason for this might be due to the open nature of the forum being in a non-restrictive environment. Participants are cognizant that anyone with access to the Internet can view their postings and they might take this into consideration before they place a posting on to the forum.

Non-facial communication issues are intrinsic to this situation. Communication exchange is not guaranteed among all participants since participants can chose selectively 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 disregarding messages or skimming others. One participant stated that he usually skims through messages and usually reads only those posted by his peers from his methods class. Furthermore, the comfort level with the Web-based medium itself might be a factor 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.

The discourse in the critical incidents section provides university instructors with a unique insight into the thoughts and concerns of their preservice teachers. Issues of power, status, and authority between preservice teachers and cooperating teachers appear throughout the dialogue. Often, the participants discuss how they would handle a situation when they would be given their own classroom and discuss the limitations they perceive as having when they are in their cooperating teacher's classroom. The discourse also offers a lurker (those who only read and do not respond) insight into the participants' views of the nature of teaching. This includes how preservice teachers talk about student-teacher interactions and the types of science-specific pedagogy they would implement or actually do implement in their classrooms.

The participants' notion of how they define their cohort varied in this study. Most participants viewed their cohort as being only the students from their methods course. However, some participants did view all participants on the forum as part of one big cohort group. This differing view might be due to the nature of the methods course and how the student interacted within that cohort.

Having 32 respondents to a critical incident appears to cause a saturation effect in the discourse. In many of the message threads, after approximately half of the students have responded, the responses begin to "sound along the same lines". Some students read the postings of others and are saying basically the same thing with a new twist to the dialogue. In some cases, the students responded to the critical incident without reading the responses of others. Some participants stated in interviews that having been educated in a similar fashion might also be a factor that causes the preservice teachers to respond in similar ways. However, this was not the case for all participant postings in the latter stages of the discourse. There were students who often posted toward the end of the message thread with a reflective posting that built on the ideas of others. In order to reduce this saturation effect, one might want to consider reducing the number of participants responding to a critical incident, or have a group of students adopt a "devil's advocate" role in their response to the discourse generated in a critical incident thread.

## Relevance to the Field

Web-based forums are computer-conferencing tools which can be used to promote reflective thinking of critical issues in science teaching to preservice teachers in remote student teaching placements. As an educational tool, implementing discussion on critical incidents in science teaching through computer conferencing provides an effective and efficient means of sharing ideas, generating new meanings in educational practices, and communicating among peers from remote geographical placements. Since asynchronous communication allows for the rules of communication to be changed, Web-based forums can be structured to create an environment to promote critical reflection on teaching. This study is relevant to anyone who works with preservice teachers and is interested in structuring Web-based forums as a virtual discussion area to promote critical reflection in science teaching.

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## Appendix A

The following is a list of research questions used in the interviews.

What specific experiences of this electronic activity was most valuable?

What specific experiences of this electronic activity was least valuable?

How did the “critical incidents” help to prepare you for your student teaching internship?

How has interacting with the “critical incidents” topic influenced your teaching approaches and decision making?

How do you read the conversation threads in the Web-based forum?

How is the Web-based forum like a community network?

What seems to affect the depth of the dialogue in the Web-based forum?

What are the differences between Web-based communication and face-to-face communication?

How does the Web-based medium promote discussion?

How does the Web-based medium inhibit discussion?

# Non-Restricted Asynchronous Web-Based Forums: A Study of Preservice Science Teachers' Attitudes


## 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 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 ease of 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., 1996). 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

### Participants

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 chunck 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 practioners. 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.

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**Table 1. TAT Pre and Post Survey Results**

| Item | X (Pre) | SD | X(Post) | SD | t-stat | P-value |
|---|---|---|---|---|---|---|
| Kay Semantic | 4.92 | .92 | 5.21 | 1.23 | 1.92 | .03* |
| E-mail D'Souza | 3.19 | .81 | 3.23 | .79 | .30 | .38 |
| E-mail | 5.47 | .96 | 5.5 | 1.26 | .20 | .42 |
| World Wide Web | 6.22 | .92 | 6.16 | .96 | -.35 | .36 |
| Multimedia | 5.92 | .91 | 6.44 | .67 | 3.29 | .001* |
| Productivity | 6.23 | .69 | 6.39 | .69 | 1.60 | .06 |

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**

| Item | X (AA) | X(IA) | t-stat | P-value |
|---|---|---|---|---|
| Kay Semantic | 5.36 | 4.9 | .96 | .17 |
| E-mail D'Souza | 3.24 | 3.21 | .06 | .47 |
| E-mail | 5.48 | 5.49 | -.02 | .49 |
| World Wide Web | 6.18 | 6.08 | .27 | .39 |
| Web-Based Forum | 5.06 | 4.71 | .83 | .20 |
| Multimedia | 6.42 | 6.46 | -.18 | .43 |
| Productivity | 6.41 | 6.36 | .16 | .43 |

Note. Adequate access (AA): n=20
Inadequate access (IA): n=11

**Table 3. Telecommunications tools confidence levels before and after the student teaching semester**

| Item | X (Pre) | SD | X(Post) | SD | t-stat | P-value |
|---|---|---|---|---|---|---|
| computer use | 4.50 | 1.01 | 5.20 | .85 | 4.58 | <.001* |
| e-mail use | 4.97 | 1.00 | 5.33 | .99 | 2.36 | .01* |
| World Wide Web use | 4.47 | 1.25 | 5.30 | .99 | 3.61 | <.001* |
| Web-based forum use | 1.90 | 1.35 | 5.20 | .85 | 12.97 | <.001* |

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

I was able to get help with lessons and curriculum planning using the SciTeach Forum. (Q22)
Mean = 3.03 SD = 1.49

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)
Mean = 3.78 SD = 1.74

This Web-based conferencing activity fostered my generation of ideas and creativity. (Q25)
Mean = 3.84 SD = 1.25

This Web-based conferencing activity fostered my evaluation of ideas and critical thinking. (Q26)
Mean = 3.97 SD = 1.25

I was able to keep in touch with classmates using the SciTeach Forum. (Q20)
Mean = 4.09 SD = 1.57

The SciTeach Forum has helped me to develop a broader perspective on teaching. (Q19)
Mean = 4.10 SD = 1.40

Interacting with the SciTeach Forum has promoted my reflection on teaching approaches and decision making. (Q13)
Mean = 4.20 SD = 1.00

The SciTeach Forum is an asset to the science teacher education program at NCSU. (Q15)
Mean = 4.30 SD = 1.30

Interacting with the SciTeach Forum has promoted reflection on what I learned during my student teaching semester. (Q12)
Mean = 4.41 SD = 1.01

The SciTeach Forum helped me improve classroom management. (Q21)
Mean = 4.59 SD = 1.34

I provided support for others through the use of this forum. (Q23)
Mean = 4.66 SD = 0.75

This Web-based conferencing activity fostered a sense of a collaborative learning community. (Q27)
Mean = 4.70 SD= 1.10

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

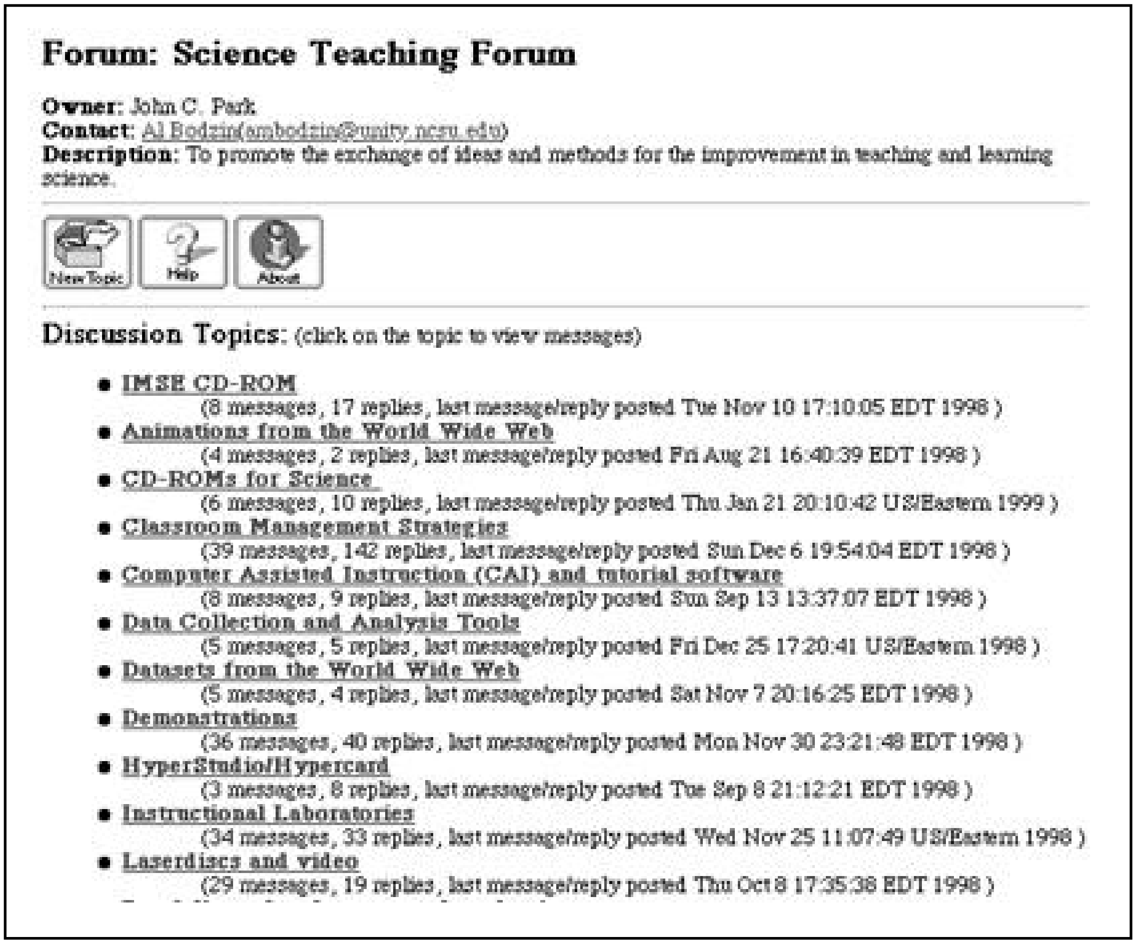
I feel that the SciTeach Forum facilitated communication with other student teachers. (Q14)
Mean = 4.80 SD = 1.30

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**

| Item | X (AA) | X(IA) | t-stat | P-value |
|---|---|---|---|---|
| Q12 | 4.33 | 4.55 | -0.68 | .25 |
| Q13 | 4.19 | 4.09 | 0.12 | .45 |
| Q14 | 4.71 | 5.00 | -0.64 | .27 |
| Q15 | 4.23 | 4.36 | -0.35 | .36 |
| Q17 | 4.76 | 4.73 | -0.06 | .48 |
| Q18 | 4.71 | 5.09 | -1.18 | .12 |
| Q19 | 4.00 | 4.36 | -0.83 | .21 |
| Q20 | 4.24 | 3.82 | 0.60 | .28 |
| Q21 | 4.52 | 4.73 | -0.48 | .32 |
| Q22 | 2.81 | 3.45 | -1.20 | .12 |
| Q23 | 4.67 | 4.64 | -0.08 | .46 |
| Q24 | 3.86 | 3.64 | 0.26 | .40 |
| Q25 | 3.71 | 4.09 | -0.90 | .19 |
| Q26 | 3.86 | 4.18 | -0.80 | .22 |
| Q27 | 4.61 | 4.82 | -0.60 | .28 |

Note. Adequate access (AA): n=20
Inadequate access (IA): n=11



# Forum: Science Teaching Forum

**Owner:** John C. Park
**Contact:** Al Bodzin(ambodzin@unity.ncsu.edu)
**Description:** To promote the exchange of ideas and methods for the improvement in teaching and learning science.

New Topic | Help | About

**Discussion Topics:** (click on the topic to view messages)

- IMSE CD-ROM
  (8 messages, 17 replies, last message/reply posted Tue Nov 10 17:10:05 EDT 1998 )
- Animations from the World Wide Web
  (4 messages, 2 replies, last message/reply posted Fri Aug 21 16:40:39 EDT 1998 )
- CD-ROMs for Science
  (6 messages, 10 replies, last message/reply posted Thu Jan 21 20:10:42 US/Eastern 1999 )
- Classroom Management Strategies
  (39 messages, 142 replies, last message/reply posted Sun Dec 6 19:54:04 EDT 1998 )
- Computer Assisted Instruction (CAI) and tutorial software
  (8 messages, 9 replies, last message/reply posted Sun Sep 13 13:37:07 EDT 1998 )
- Data Collection and Analysis Tools
  (5 messages, 5 replies, last message/reply posted Fri Dec 25 17:20:41 US/Eastern 1998 )
- Datasets from the World Wide Web
  (5 messages, 4 replies, last message/reply posted Sat Nov 7 20:16:25 EDT 1998 )
- Demonstrations
  (36 messages, 40 replies, last message/reply posted Mon Nov 30 23:21:48 EDT 1998 )
- HyperStudio/Hypercard
  (3 messages, 8 replies, last message/reply posted Tue Sep 8 21:12:21 EDT 1998 )
- Instructional Laboratories
  (34 messages, 33 replies, last message/reply posted Wed Nov 25 11:07:49 US/Eastern 1998 )
- Laserdiscs and video
  (29 messages, 19 replies, last message/reply posted Thu Oct 8 17:35:38 EDT 1998 )

Figure 1. The SciTeach Forum.

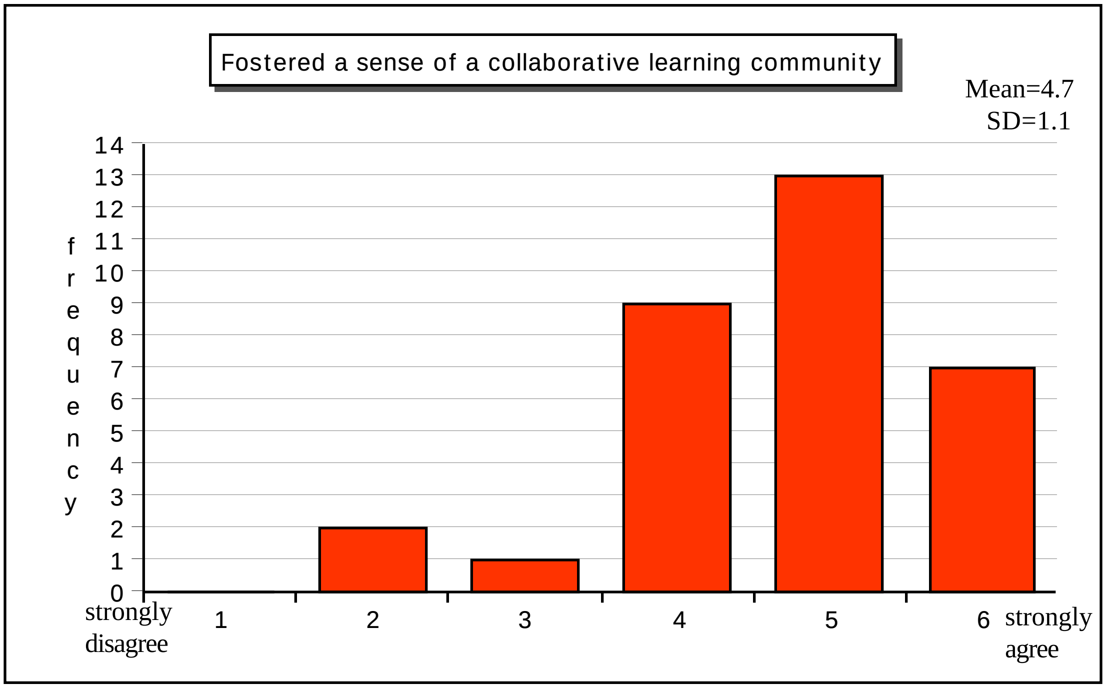



Figure 2. Participant response to survey question: This Web-based conferencing activity fostered a sense of a collaborative learning community.
Likert Scale: 1= Strongly Disagree, 6 = Strongly Agree

## 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?

# <u>SciTeach Forum Survey (part 2)</u>

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.
strongly disagree- __ __ __ __ __ __ -strongly agree

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

# Dialogue Patterns of Preservice Science Teachers Using Asynchronous Computer-Mediated Communications on the World Wide Web

**Abstract**

This study analyzed patterns of computer-mediated communication of 32 preservice science teachers on a public Web-based forum. The participants were able to engage in scaffolding pedagogical ideas with each other as a result of sharing peer perceptions. The findings revealed that a large amount of structure is needed for students to discuss science-specific pedagogical issues on a Web-based forum. A saturation effect in the discourse may occur with large groups of preservice teachers responding to one particular forum posting. Dialogue prompts and scaffolding were aspects of the Web-based forum that facilitated new learning in both science-specific and general pedagogical areas.

The American educational system is currently undergoing a major reform initiative as a result of new telecommunications technology. A massive connectivity movement is occurring throughout American schools in response to a new national mission for students to enter the work force technologically literate in the 21st Century. 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 and 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 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 American 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 for 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 using telecommunications technology, they deserve early and continuous exposure to it at all levels of the preservice curriculum.

## Computer-Mediated Communications (CMC)

Computer-mediated communications (CMC) is often used interchangeably with other terms such as electronic seminars, computer conferencing, and online class discussion.  CMC refers to the use of a network of microcomputers linked to a central host computer by a variety of means including local networks, telephone lines, and special data networks (Cifuentes, Murphy, Segur, & Kodali, 1997).  It involves delayed-time, text-based messages with a variety of possible facilities ranging from electronic mail to accessing remote databases.

CMC is essentially a many-to-many communication tool that structures information exchange and group interactions.  Computer conferencing software, which automatically files notes into topical discussions and updates users on any new comments in a topic, presents an appropriate environment for online learning (Harasim, 1990).  According to Harasim, computer conferencing was designed to support "collective intelligence" and meetings of minds through the topical structure of the system.  This structure provides the shared space essential to group interaction: All members of an online group can read the same messages about a particular topic in the same order.  Each participant in a conference has access to each message posting to read and make responses.  The shared electronic area enables a dialogue to take place.  The conferencing software also generates a record of the interactions that take place.  This record becomes a common resource for later reference, manipulation, and further discussion (Eastmond, 1992).   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. According to Davie and Wells (1991), this permanent record challenges all participants to be accountable for their work, and to 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.

Computer conferences can be conducted using electronic mail (e-mail) listservs. Participants use a computer to compose, send, and receive e-mail messages as part of an ongoing discussion, which may or may not be moderated. Messages arrive back to the listserv participant in a sequential order and are not organized by topics or "threads". The organization of the messages is the responsibility of the receiver. This can be a confusing task for a new user (Morrison, 1993; Romiszowski & deHaas, 1989). Archives of listserv postings can be created, and these compilations of the listserv's e-mail postings can be sent to the participant.

In distance education conducted through asynchronous CMC, students and instructors use personal computers and phone lines to communicate with a central host mainframe computer running a computer-conferencing program (Davie & Wells, 1991; Eastmond, 1992). The choice of when to contribute to the discussion is the sole discretion of the participants. Online course activities can be structured to require student initiative, discussion, and reflection. The environment of the physical interface can vary from user to user and affect accessibility, interaction, motivation, and therefore, the learning process (Murphy, Drabier, and Epps, 1998).

New technology has made computer conferencing possible today on the World Wide Web. Web-based conferencing allows users to read, browse, and add to multiple discussions by using a Web browser anywhere in the world with an online connection. One does not need access to networks or systems at a particular university to participate in a Web-based discussion since all that is needed is access to the World Wide Web. Web-based discussions occur asynchronously, permitting the user to read, browse, or add to the discussion at his or her convenience. Web-based computer conferencing software has the following characteristics:

- some manner for identifying participants and e-mail addresses on the system;
- topical conference areas for group discussion with a permanent record of interactions;
- a writing work space for users to draft thoughts and ideas;
- 24 hour accessibility;
- no dependence on the user’s location; and
- a fast mode of communication.

### Telecommunications Use With Inservice Teachers

There are studies in the literature that have analyzed teachers’ perceptions of educational networks, with much emphasis placed on perceived benefits and barriers of the networks (Anderson & Harris, 1997; Danin, 1993; Davenport, 1995; Murfin, 1995; Ruopp, Gal, Drayton & Pfister, 1993; SRI International, 1997; Starr & Milheim, 1996). Some studies reported that teachers have used networks to change their pedagogical approaches in the classroom (Hakarem, Dobrynina, Hurwitz, Shann, & Shore,1993; Muscella & DiMauro, 1995; SRI International, 1997; Topp, Grandgenett, & Mortenson,1995;

Weir, 1992). These studies found that network exchanges presented an opportunity for collaboration among teachers. In principle, teachers join a community of learners, where the network becomes the framework for cooperative learning and the scaffolding for teacher learning (Merseth, 1991). The network serves as a forum to share expertise, try out new ideas, reflect on practices, and develop new curricular ideas. Making a classroom experience public on a network enables participating teachers to share a teaching and learning experience (Roberts, Blakeslee, Brown, & Lenk, 1990).

### Instructional Uses of Electronic Mail in Preservice Teacher Education

A review of the literature reveals a number of studies in which university teacher preparation programs have integrated e-mail telecommunications with preservice teachers. Some studies described the the use of electronic e-mail journals with teacher education students to facilitate self-reflection (Kovalchick, Milman, and Elizabeth, 1998; Russett, 1994; Russett, 1995). E-mail listservs have been used to analyze case-based scenarios to promote critical thinking (Bronack & Kilbane, 1998; Campbell and Zhao, 1996). E-mail has been used for mentoring preservice teachers in teacher preparation programs with one-to-one communication between a university supervisor and preservice teacher (Casey, 1994; 1997; 1998; Thompson and Hamilton,1991), one-to-one communication between a preservice teacher and an inservice teacher (Johnson, 1997), and one-to-many communication between a group of preservice teachers and university supervisors (Loiselle, Dupuy-Walker, Gingras, and Gagnon, 1996; White, 1997; Zimmerman and Greene, 1998 ).

Some studies have examined the types of interactions possible among correspondents on an e-mail listserv, the validity of using the medium for meaningful instructional interactions, factors that enable university-based instructors and novice teachers to integrate electronic mail into teacher education, and attitudes of preservice teachers towards this telecommunication technology (Dow and Geer, 1996; Piburn and Middleton,1998; Sunal and Sunal,1992; Zimmerman and Greene,1998). Researchers contend that the use of listservs guided by faculty provides opportunities for student teachers to engage in reflections and dialogue, providing ongoing opportunities for pedagogical concepts to be discussed and examined (Dow and Geer, 1996; Zimmerman and Greene,1998). Alternatively, Piburn and Middleton (1998) reported that their unstructured listserv existed as a true conversation in which students were able to question, reflect, plan, and respond to topics of mutual interest.

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 offer preservice science teachers a vehicle to engage in reflective discourse with university supervisors and faculty from their remote student teaching locations. Some studies have been conducted using e-mail listservs and bulletin board systems with a cohort group of preservice teachers during their student teaching internships (Bull, Harris, Lloyd, and Short, 1989; Merseth, 1991; Schlagal, Trathen, and Blanton,1996;

Thomas, Clift, and Sugimoto, 1996; Waugh, 1996). Of these studies, three have analyzed e-mail postings type of discourse categories generated on listservs used in preservice teacher education instructional courses (Schlagal et al., 1996; Thomas et al., 1996; Waugh, 1996).

Electronic community networks of preservice teachers can provide socioemotional support to a cohort group (Bull et al., 1989; Casey, 1997; Merseth, 1991; Schlagal et al., 1996; Thomas et al., 1996). Preservice teachers use networks to share and discuss common experiences. Interactions often include sharing student teaching experiences and discussing 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, Audet, and Abegg, 1995; Harasim, Hiltz, Teles, and Turoff, 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 et al., 1995).

## Rationale for this Study

Today, the World Wide Web is more easily accessible to preservice teachers at home, at the university, and in their student teaching placements.

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 for preservice science teachers (Koschmann, Myers, Feltovitch, & Barrows, 1994). Each of the previous telecommunications studies with preservice teachers were conducted within the context of restricted networks. As far as we know, there have been no studies conducted involving preservice education students using asynchronous Web-based forums during their student teaching internships in which a public, non-restrictive Web-forum served as the online community network space.

## Research Questions

To determine patterns of computer-mediated communication of preservice teachers on a public Web-based forum, we asked the following questions:

1. What types of discourse emerges when preservice science teachers use a non-restrictive, public Web-based forum during their student teaching internship?
2. Does the discourse of preservice science teachers on a non-restrictive, public Web-based forum promote a reflective practice of teaching?

## Methodology

### Participants

The participants in this study included 32 prospective secondary school science teachers enrolled in the Professional Student Teaching Semester at

North Carolina State University during Fall 1998. This semester included Methods of Teaching Science, Instructional Materials in Science, Seminar in Science Education, and Student Teaching. 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 telecommunication 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 a few 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 each day during these five weeks. These students were divided into different Methods of Teaching Science courses based on their science concentration area. These courses were instructed by science education faculty members who were different than those teaching the Instructional Materials in Science course. The 12 middle school students were instructed in separate Instructional Materials and methods courses than 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.

### The SciTeach (Science Teaching) Forum

As part of the required course work in the Instructional Materials in Science course and in the Middle School Methods course, each student was required to post two messages each week to the SciTeach (Science Teaching) Forum (see Figure 1) for the entire semester. The SciTeach Forum is placed in the context of a larger public Web site called Science Junction, so 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.

The SciTeach Forum has been structured to contain discussion topics relating to teaching science content, incorporating instructional technology into the curriculum, and teaching pedagogy in general (see Appendix A). The online forum software 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. Replies to messages are organized temporally with the newest reply at the bottom of the message thread. This reflects the natural flow of a face-to-face conversation and mirrors the organization of a bulletin board system. The software also enables the user to read an entire thread of successive replies to the original message.

### Critical Incidents in Science Teaching

Each week, the participants were required to place one forum posting to 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 posted to 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. The following is an example of a critical incident:

> Students are working with microscopes and you want them to observe and draw onion skin cells. They accurately set up the slides and microscopes, focus correctly, and begin observing and drawing. As you walk around the room you see some drawings that reflect the accepted image of onion cells, but approximately 1/3 to 1/2 the students are drawing sketches that look nothing like the accepted image of onion cells. What kinds of things would you say and do at this point?

**Data Collection and Analysis**

The critical incidents message threads were downloaded and entered into the QSR NUD*IST 4 software system for data analysis. The literature of computer-mediated communication use with preservice and inservice teachers was reviewed in order to identify data categories of previous research to use initially to code the preservice teachers' message postings.

The constant comparative method was be used to explore message types and patterns that facilitate collaborative student teacher reflective discourse on the SciTeach Forum. According to Glasser (1978), the steps in the constant comparative method of developing theory are as follows:

1. Begin collecting data.
2. Look for key issues, recurrent events, or activities in the data that become categories of focus.
3. Collect data that provide many incidents of the categories of focus with an eye to seeing the diversity of the dimensions under the categories.
4. Write about the categories you are exploring, attempting to describe and account all the incidents you have in your data while continually searching for new incidents.
5. Work with the data and emerging model to discover basic social processes and relationships.
6. Engage in sampling, coding, and writing as the analysis focuses on the core categories.

Although one can talk about the constant comparative method as a series of steps, what has just been described is non-linear, and the analysis keeps doubling back to more data collection and coding (Bogdan & Bilken, 1992).

We coded and categorized the data from the forum by evaluating each message based upon the type of information or communication contained in the transcript. Emergent categories were assigned to identify the types of messages and interactions that we thought were taking place. By using the constant comparative method, we discovered that our initial coding scheme became modified rather quickly. Another science educator reviewed the coding categories as a measure of coding reliability.

The emergent message type categories identified in the student discourse were:

- Experiences: Statements referring to an event that occurs in the classroom.
- Science: Statements pertaining to science-specific pedagogy and not general pedagogy.
- Teaching: Statements relating to the nature of teaching including classroom instruction, methods, or classroom management issues; the role of the teacher; and specific teacher-student interactions.
- Support: Statements referring to support, including receiving or giving support, and supporting one's ideas.
- Concern: Statements pertaining to the welfare of classroom students.
- Resources: Statements in which students share resources including teaching ideas, general information, or instructional strategies.
- Recognition: Statements in which a student acknowledges an idea presented on the forum.

It should be noted that some message postings contained discourse that could be coded into more than one category.

Each student message was also coded for evidence of reflective discourse.  The reflective discourse codes were:

• Perceptions:  Insight, intuition; knowledge gained by observing; becoming aware in one's mind.

• Asking focused questions:  Asking focused questions to build on ideas previously presented in the message thread.

• Peer scaffolding:  A statement that builds on a previous posting in the message thread intended to spur new idea linkages.

Peer scaffolding was further subdivided into the following themes:

• Guidance and feedback:  Messages that build on a previous response in the thread that offers some type of guidance and feedback on the issue discussed.  This can include a response to a stated activity or provide movement of an issue into a new direction.

• General advice:  Messages that offer general advice or personal views to further develop an idea in the message thread.

• Modeling pedagogical practices:  Messages that augment an idea by illustrating a pedagogical practice.

Appendix B lists student posting examples for each type of message category.

The emergent message type categories for instructors were:

• Resources:  Statements in which instructor provide instructional resources including materials, equipment, software, and Web sites.

• General advice:  A message which offers general advice.  It can be the first topic in a message thread and in which no scaffolding occurs in the posting.

• Response to Questions:  Statements that are responses to specific questions.

• Instructional pedagogy:  Statements of general teaching methods or instruction.

• Questions:  Questions asked regarding a student posting.

• Support:  Statements referring to supporting the preservice teachers in their student teaching placements.

The emergent instructor scaffolding categories were:

• Guidance and feedback:  Messages that build on a previous response in the thread that offers some type of guidance and feedback on the issue discussed.  Can include a response to a stated activity or provide movement of an issue into a new direction.

• General advice:  Messages that offer general advice to further develop an idea in the message thread.

• Modeling pedagogical practices:  Messages that augment an idea by illustrating a pedagogical practice.

***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.

***Surveys.*** A survey 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 of their experience interacting with a Web-based forum.

## Findings and Discussion

For each discussion thread we determined the number of message postings in the thread, the length (in days), the number of peer responses, and the number of instructor responses. The average length of dialogue thread on the forum was 6 messages per thread over 11 days. There was a wide range of variability since the length of the threads varied from 1-60 days. More specifically, 49 messages threads lasted 14 days or longer, 50 message threads lasted between 2-14 days and 54 message threads lasted only 1 day.

To investigate the patterns of computer-mediated communication in the asynchronous Web-based forum, we first identified the type of discussion that took place among the participants and then counted the number of instances in each topic area that occurred for each coded category. Empirical data for each discussion topic including the number of threads, total messages, and the number of threads without replies is listed on Table 1. A summary of the types of participant discourse within each topic is provided in Table 2. A summary of conference topics that promoted various types of reflective discourse is provided in Tables 3a-3f.

Table 1 shows much variability in the use of topics by the participants. Some topics were used more than others. Further, there was much variability with respect to the number of messages in each thread. Many topics had threads with only one message while some topic threads such as “Critical Incidents” contained up to 34 messages. In general, topics pertaining to general pedagogy tended to promote the most exchanges of ideas (see Table 4), while topics pertaining to instructional technology and science-specific pedagogy did not tend to promote responses among the participants (see Table 5). The Critical Incidents topic was the exception to this tendency because the students were required to post to this topic each week as a course requirement. Also, the initial message of each thread was structured in such a way that it required the preservice teachers to think and reflect on an authentic science-specific teaching situation and prompted a response to a given situation. The Critical Incidents topic promoted the most reflective discourse of all forum topics in the areas of perceptions, asking focused questions, and peer scaffolding (see Tables 3a-3f).

Excluding the Critical Incidents topic, most students preferred to post to forum topics pertaining to general pedagogy (see Figure 2). These conference topics provided a place for participants to discuss personal classroom experiences. Many of the participants were experiencing similar situations in their student teaching placements and they used the forum to share and discuss their experiences. Student-experienced critical incidents in their own classrooms also became topics of interest to most participants. The participants were also interested in discussing controversial topics and “touchy issues” on the forum. In addition, the critical incidents and general pedagogy topics provided an area for collaboration to take place.

As one participant stated:

> “It promoted discussions by reading the [critical] incident or reading what happened to somebody, and then we discussed how to solve a problem. Like with classroom management or how to get aid with special students. It was kind of more an aid of help to figure out how to solve problems such as class management.”

The Web-based medium allowed for multiple participation in the forum in which participants shared their perspectives on issues. This sharing of perceptions resulted in seeking common meaning for a given situation. Furthermore, the Web-based medium assisted students in seeing different aspects of an issue or problem.

In general, postings to the science pedagogy and instructional technology forum topics by the participants were primarily written to share information. As one participant stated:

> “I did not receive much feedback to my postings, but none of them really warranted any. My postings were primarily FYI or response/ feedback for someone.”

In these conference topics, most participants shared science-specific teaching lessons and instructional technology resources. In most messages, there were no prompts in the dialogue to illicit a response. Even when an instructor posted messages to instructional technology topics using a focused question, a response from the preservice teachers did not occur. We believe this took place because the preservice teachers were not well-knowledged in these areas. As one student stated:

> "I never used the HyperCard section. I didn't even know what it was, but I went on and read a little bit about it, but I didn't post to it."

This was also corroborated by other participants who were interviewed.

Our study results reveal that a large amount of structure is needed for students to discuss science-specific pedagogical issues. Most participants did not post to the topic areas pertaining to science-specific pedagogy. One participant shared her insight into this phenomena:

> "Whereas a concept in science might be less talked about just because we either know a lot about this concept or we don't. So, maybe if it was a lab, for instance the cheek lab. Not too many people talked about how to do something other than the cheek lab. That's just standard biology concept. But we had no idea how to go about doing something different. So I think that the content areas, either we're weak in or strong in. And the strongness, we kind of leave out because we already know about it or we think we know about it. Whereas, the weaknesses, we can't answer the person, so we don't respond. We're not going to respond to something that other people should know, too. That's just a misconception. Our prof pointed out to us all through the methods course that there are a lot of misconceptions that we hold as science teachers that we have to overcome. And we assume so much from each other that we already know it, but we really don't and we don't question each other. I guess its just a miscommunication between the student teachers on what we do know and what we don't know."

We concur with this participant's view that many preservice science teachers have preconceived notions that they are well-knowledged with respect to their science content. If one assumes that all participants have a shared collective knowledge on a topic, they might be less likely to discuss a certain content-specific item out of fear of being perceived by the online group as being inferior in their knowledge base.

## Promoting a Reflective Practice of Teaching

The structure of the critical incidents required the preservice teachers to think about their teaching approaches and decision making in the classroom. A recurring concern that emerged in the forum discourse was how to create learning environments in which students take ownership for their own learning.

> "I've also noticed that I had a tendency if I'm doing some hands-on stuff in a class like a lab, that I'm trying to do the work for them. With responding with people [on the forum], I've learned to stand back and let them [the students] do it. I have a tendency to help them to do it quicker. I know they can't learn like that from me. They have to think through the process. I think its [the forum] just influenced me in making me not react so quickly, thinking about it a little more."

In this interview statement, a participant used the discourse on the forum to reflect on her teaching approaches and realized she was not giving her students the opportunity to think for themselves. By having the opportunity to read the pedagogical ideas of her peers in similar situations, she was able to reflect on her own teaching and realize how she needed to change her pedagogical style in the classroom.

In sharing peer perceptions, the participants are able to engage in scaffolding pedagogical ideas with each other.

> "And I think its really good if you can see how different people deal with a certain situation. So you can integrate everybody's little pieces together, and then you can decide, okay, this is how I'm going to do it and then you can sit back and reflect did that work or not, and do something different next time if need be."

The preservice teachers were able to integrate bits and pieces of different teaching ideas that were presented in the message threads. They integrated the pieces together and decided how to improve their own teaching from what had been previously said by others. This type of peer scaffolding appeared to promote reflection on topics the participants were learning in their university course work. In some instances, participants stated openly on the forum that they had a preconceived notion about handling a certain situation and that notion changed after reading the responses of others on the forum. The discourse also promoted reflection on the day-to-day activities a teacher deals with in the school environment.

> The critical incidents is probably the most helpful to me. And I talked to some other students about what they thought about this forum. And a lot of us talked about how the critical incidents helped us think about how the classroom situations was going to be. And even a fellow student suggested, well, some of that might not have happened in our room. But when I went to a job interview, a critical incident was posed to me and that helped me reflect on how I would answer it. So, that actually helped in job decisions. This helped us to prepare for future interviews. There could be some questions that principals might ask you, given this incident in your classroom, what would you do? I think it was helpful to already have that skill of reflecting on a problem and coming back with an answer.

The discourse in the critical incidents topic of the SciTeach forum was thoughtful and promoted a reflective practice in which a group of preservice teachers engaged in a dialogue that involved the asking focused questions, seeking common meanings in teaching practice, and constructing ideas in collaboration with other preservice teachers. Most participants felt that interacting with the SciTeach Forum promoted their reflection on teaching approaches and decision making (see Figure 3).

On the other hand, having 32 participants respond to one critical incident appeared to cause a saturation effect in the discourse. In many of the message threads, after half of the students responded, the responses began to “sound along the same lines”. Some students read the postings of others and then contributed to the dialogue by restating previous ideas with “a new twist” added to the discourse. In some cases, the participants responded to the critical incident without reading the responses of others. Some participants stated in interviews that having been educated in a similar fashion might also be a factor that causes the preservice teachers to respond in similar ways. However, this was not the case for all participant postings in the latter stages of the discourse. There were students who often posted toward the end of the message thread with a reflective posting that built on the ideas of others. In order to reduce this saturation effect, one might want to consider reducing the number of participants responding to a critical incident, or have a group of students adopt different thinking-related roles in their response to the discourse generated in a critical incident thread. These roles could include a “devil’s advocate”, speculator, brainstormer, optimist, pessimist, or judge.

### Sociocultural Perspective

Previous research by Vygotsky (1978), although not referring to online environments, offers insight into how writing can contribute to knowing. According to Vygotsky, individuals find meaning, not only through individual experiences, but also through social interactions. Learners actively construct knowledge by formulating ideas into words; and these ideas/concepts are built upon through reactions and responses of others to the formulations. According to Vygotsky (1978), knowledge is socially constructed. Individuals find meaning not only through individual experiences but also through social interactions.

The phenomena we have observed with our participants can be viewed in terms of Vygotsky's sociocultural ideas on learning within a social context. According to sociocultural theory, each individual functions within a zone of proximal development (ZPD). The ZPD is the range or distance between what an individual may accomplish in an activity or task independently and what one may accomplish through problem solving under adult guidance or in collaboration with more capable peers (Vygotsky, 1978). Web-based conferencing can be viewed as a tool to facilitate moving students toward the more skillful and capable side of their ZPD. Dialogue prompts and scaffolding were aspects of the SciTeach Forum that facilitated new learning in both science-specific and general pedagogical areas. This scaffolding included guidance, assistance, recommendations, advice, and suggestions. We believe that our participants' learning experience was further enhanced by being exposed to ideas of their instructors and peers.

The discussion of real life experiences was instrumental in promoting the discourse on the Web-based forum. Learning occurred when our participants had the opportunity to discuss authentic pedagogical situations in a community of practice. Participants in the Web-based forum were provided the opportunity to obtain different perspectives on issues and offer their own insight to a presented problem or situation. Reading and responding to peers' and instructors' forum postings forced the participants to think and form ideas. This resulted in participants seeking common meanings as they engaged in critical thinking that focused on issue analysis and problem solving of authentic classroom experiences.

The Web-based environment facilitated idea generation and knowledge building within this online community of preservice teachers. A key factor enabling this was that our participants shared a collective understanding and experience as they embarked in an intensive indoctrination into the science teaching profession in cohort groups. For most participants, this intensive experience within a cohort group provided a common framework which enabled them to easily exchange ideas, participate in in-depth discussion, and seek new knowledge as part of an online community. The Web-based medium provided a space for the participants to continue to be activity involved in discussing the practical and ethical dimensions of science teaching from their remote student teaching placements.

## Implications for Further Research

The findings presented in this study are only the beginning to understanding how preservice science teachers engage in a public, non-restrictive, Web-based forum in a delayed conferencing environment. Issues for further research that can be drawn from this study include design of the interface, restricting network participation, using asynchronous or synchronous communication with preservice teachers in remote internship placements, and non-facial communication.

As more Web-based conferencing tools continue to emerge, researchers should be concerned with how the interface of the electronic medium facilitates scaffolding learning. The Web-based forum in our study was linear. Messages and replies were entered in a temporal sequence. The software did not allow the user to attach one reply directly to another reply. A forum system with a more hierarchical tree-like branching structure that enables participants to post to any part of the dialogue might result in different types of discourse from participants. Furthermore, one must take in consideration the amount of time needed to learn a new conferencing software system. A complex conferencing system might not be appropriate for a public, non-restrictive online community in which the goal is to encourage global participation in the online community since providing users with adequate training to use the system would not be feasible.

Conferencing in delayed-time versus real-time with preservice teachers in remote geographical internships remains an issue to be further explored. A disadvantage that some participants perceived with using asynchronous communication was they did not receive immediate feedback to problems they were experiencing in their classrooms. Using synchronous communication with preservice teachers could provide for more immediate feedback to problems and concerns they experience in their classrooms. Furthermore, a synchronous environment would enable participants to participate in a dialogue which more resembles a face-to-face interaction. However, communicating asynchronously, may encourage the more timid and reflective learners in a group to participate more than they might in a synchronous or face-to-face conversation. We believe that the logistics of coordinating synchronous communication with our participants would be extremely difficult given the resources in their school placements. Unless provisions can be made to ensure each participant has access to a networked computer, engaging preservice teachers in synchronous communication would not be feasible.

The results of our study show the many benefits of having preservice teachers participate in a non-restricted network of learners. Participants were exposed to ideas and perceptions of other science educators that would not have been possible with a restrictive network. As one participant stated, “if the network was restricted, you would have a limited supply of resources and it would make it difficult to have a large variety of responses.” By restricting the network to the participants of only one university, the knowledge base becomes more limited. Additional participation outside of one university can provide additional insight and perspectives to an issue. Dialoguing with a global audience encouraged our participants to be reflective in their postings.

The rules of communication change when one participates 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 chose selectively 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 to accompany the dialogue.

Web-based forums can be used as a tool to facilitate task-oriented and socially oriented exchanges without the limitations of time and geographic location. Learning experiences embedded within a real-world context that is shared with a global audience for reflection and synthesizing meaning are facilitated in this medium. However, further research needs to be conducted to investigate how to optimize the structure of Web-based communications to maximize participant reflection and avoid saturation in the discourse.

In traditional student teaching internships, preservice teachers are often disconnected from their peers in other classrooms. By using a Web-based forum, preservice science teachers have the opportunity to question their peers' assertions, open different aspects of a problem, or apply reflective thinking on an issue presented. A Web-based forum provides opportunities for preservice teachers to engage in dialogue and reflections where ongoing opportunities for content-specific and general pedagogical concepts are discussed and examined. Interacting with a variety of different topics on the forum provides preservice science teachers the means and opportunity to develop as reflective practioners. Preservice teachers become engaged in thoughtful discourse about science teaching practices, classroom management strategies, teacher-student interactions, and other issues pertaining to the nature of teaching. Given the telecommunication resources that exist in schools and universities today, 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.

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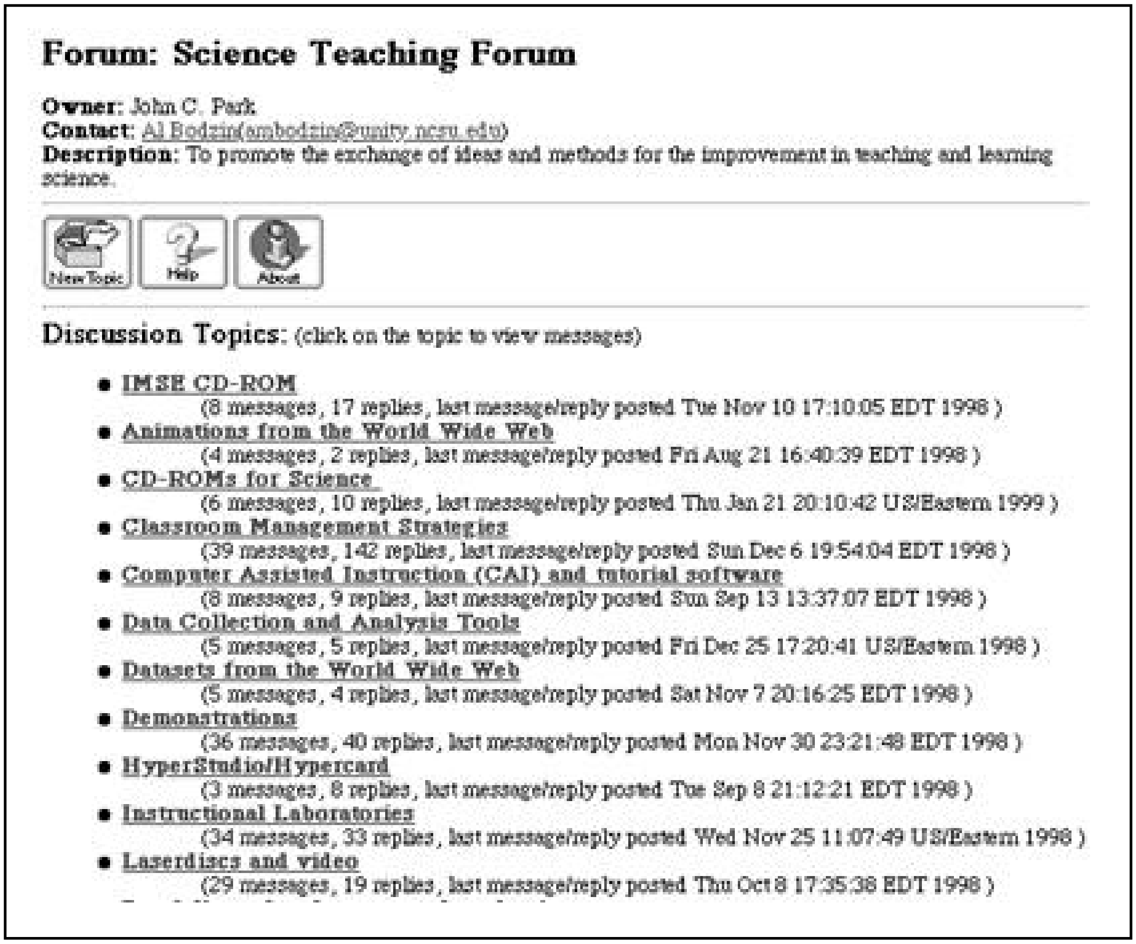


Figure 1. The SciTeach Forum.

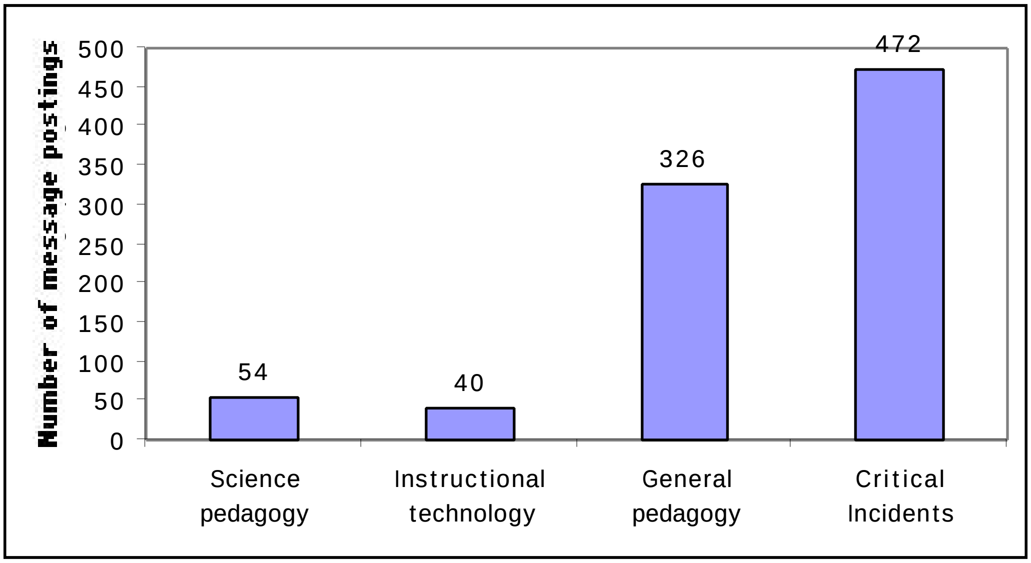


Figure 2. Participant message postings by content. Critical Incidents listed separate from other Science pedagogy topics.

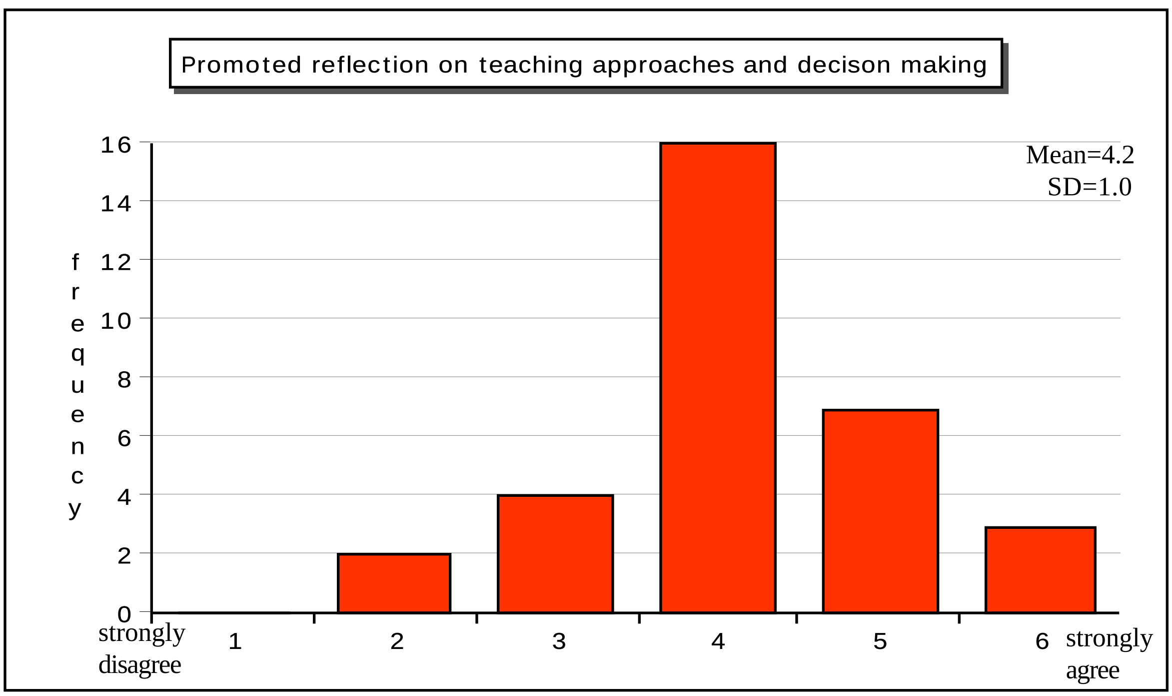


Figure 3. Participant response to survey question: Interacting with the SciTeach Forum has promoted my reflection on teaching approaches and decision making.
Likert Scale: 1= Strongly Disagree, 6 = Strongly Agree

**Table 1. Total message postings to forum topics.**

| Topic | # of threads | total messages | threads w/o replies |
|---|---|---|---|
| Brain Teasers | 1 | 3 | 0 |
| Critical Incidents | 21 | 472 | 0 |
| Demonstrations | 13 | 19 | 8 |
| Labs | 7 | 19 | 3 |
| Quick Help | 3 | 4 | 2 |
| Research | 1 | 1 | 1 |
| Science Fair | 0 | 0 | 0 |
| Science House | 4 | 8 | 0 |
| Sounds | 0 | 0 | 0 |
| Staff Development | 0 | 0 | 0 |
| Animations | 1 | 1 | 1 |
| Apparatus | 1 | 5 | 0 |
| CAI | 2 | 3 | 1 |
| CD-ROMs | 1 | 1 | 1 |
| CU SEE-ME | 0 | 0 | 0 |
| Data Collection | 1 | 3 | 0 |
| Datasets | 3 | 7 | 1 |
| HyperStudio | 2 | 3 | 1 |
| IMSE CD-ROM | 1 | 2 | 0 |
| Laserdiscs | 4 | 8 | 2 |
| Search engines | 1 | 1 | 1 |
| Simulations | 2 | 3 | 1 |
| Telecommunications | 0 | 0 | 0 |
| Web site reviews | 3 | 3 | 3 |
| Assessment | 5 | 21 | 3 |
| Class Management | 15 | 86 | 1 |
| First Year | 1 | 2 | 0 |
| Humor | 13 | 27 | 7 |
| Locating materials | 9 | 15 | 6 |
| Portfolios | 7 | 21 | 2 |
| Pre-Service | 17 | 104 | 3 |
| Special Students | 5 | 14 | 2 |
| Student kindness | 2 | 10 | 0 |
| Teachable Moments | 7 | 26 | 1 |
| Teaching Models | 0 | 0 | 0 |
| Total | 153 | 892 | 51 |

**Table 2. Breakdown of preservice teachers' discourse by topic**

| Topic | Experiences | Recognition | Science | Teaching | Resources | Support | Concern |
|---|---|---|---|---|---|---|---|
| Apparatus | 0 | 0 | 2 | 0 | 0 | 0 | 0 |
| Assessment | 8 | 7 | 1 | 3 | 15 | 0 | 0 |
| Brain teasers | 0 | 0 | 0 | 0 | 2 | 0 | 0 |
| CAI | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CD-ROMs | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| Critical Incidents | 35 | 89 | 146 | 226 | 32 | 16 | 12 |
| Classroom Management | 38 | 27 | 0 | 31 | 45 | 2 | 5 |
| Data | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| Datasets | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| Demos | 6 | 3 | 9 | 0 | 6 | 0 | 1 |
| First Year | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Humor | 22 | 8 | 5 | 13 | 0 | 0 | 0 |
| HyperStudio | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| IMSE CD-ROM | 0 | 1 | 0 | 0 | 1 | 0 | 0 |
| Kindness | 9 | 4 | 0 | 2 | 0 | 0 | 0 |
| Labs | 3 | 3 | 9 | 1 | 6 | 0 | 0 |
| Laserdiscs | 1 | 1 | 4 | 0 | 3 | 0 | 0 |
| Materials | 0 | 3 | 4 | 0 | 9 | 0 | 0 |
| Portfolios | 0 | 11 | 0 | 0 | 10 | 3 | 0 |
| Preservice | 29 | 38 | 6 | 16 | 29 | 30 | 8 |
| Quick Help | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Science House | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Simulations | 0 | 0 | 0 | 0 | 3 | 0 | 0 |
| Special Students | 4 | 6 | 0 | 8 | 3 | 1 | 5 |
| Teachable Moments | 10 | 10 | 6 | 9 | 2 | 4 | 4 |
| Web Sites | 0 | 0 | 0 | 0 | 3 | 0 | 0 |
| **Total** | 166 | 211 | 192 | 309 | 172 | 56 | 35 |

**Table 3a**
**Conference topics promoting reflective discourse**
**Perceptions**

| Topic | # Postings | # Threads |
|---|---|---|
| Critical Incidents | 151 | 20 |
| Preservice Teachers | 28 | 9 |
| Classroom Management | 20 | 8 |
| Teachable Moments | 19 | 5 |
| Assessment | 4 | 3 |
| Humor | 2 | 2 |
| Laserdiscs | 2 | 2 |
| Labs | 4 | 1 |
| Demonstrations | 1 | 1 |
| Special Students | 2 | 1 |

**Table 3b**
**Conference topics promoting reflective discourse**
**Asking Focused Questions**

| Topic | # Postings | # Threads |
|---|---|---|
| Critical Incidents | 12 | 7 |
| Classroom Management | 3 | 3 |
| Preservice Teachers | 1 | 1 |

**Table 3c**
**Conference topics promoting reflective discourse**
**Peer Scaffolding/ General**

| Topic | # Postings | # Threads |
|---|---|---|
| Critical Incidents | 8 | 4 |
| Teachable moments | 3 | 2 |
| Preservice teachers | 3 | 1 |
| Classroom Management | 1 | 1 |
| Labs | 1 | 1 |

**Table 3d**
**Conference topics promoting reflective discourse**
**Peer Scaffolding/ Guidance and feedback**

| Topic | # Postings | # Threads |
|---|---|---|
| Critical Incidents | 23 | 9 |
| Preservice Teachers | 6 | 4 |
| Classroom Management | 5 | 4 |
| Special students | 4 | 2 |
| Teachable moments | 2 | 2 |
| Assessment | 1 | 1 |
| Laserdiscs | 1 | 1 |

**Table 3e**
**Conference topics promoting reflective discourse**
**Peer Scaffolding/ General Advice**

| Topic | # Postings | # Threads |
|---|---|---|
| Critical Incidents | 32 | 12 |
| Classroom Management | 3 | 2 |
| Preservice | 3 | 2 |
| Labs | 1 | 1 |
| Portfolio | 1 | 1 |

**Table 3f**
**Conference topics promoting reflective discourse**
**Peer Scaffolding/ Modeling pedagogical practices**

| Topic | # Postings | # Threads |
|---|---|---|
| Critical Incidents | 36 | 12 |
| Classroom Management | 4 | 3 |
| Labs | 2 | 2 |
| Preservice | 3 | 1 |
| Special students | 1 | 1 |

**Table 4. Conference topics that promoted the most exchanges of ideas (Threads with 4 or more messages)**

| Topic | # of threads |
|---|---|
| Critical Incidents | 18 |
| Preservice | 12 |
| Classroom Management | 10 |
| Assessment | 2 |
| Humor | 2 |
| Portfolio | 2 |
| Teachable moments | 2 |
| Apparatus | 1 |
| Datasets | 1 |
| Kindness | 1 |
| Laserdiscs | 1 |
| Materials | 1 |
| Special students | 1 |

**Table 5. Topics which did not promote responses**
% of threads without responses

| Topic | % without responses |
|---|---|
| Animations | 100% |
| CD-ROMs | 100% |
| Research | 100% |
| Search engines | 100% |
| Web Sites | 100% |
| Materials | 66% |
| Quick Help | 66% |
| Demonstrations | 62% |
| Assessment | 60% |
| Humor | 54% |
| CAI | 50% |
| HyperStudio | 50% |
| Laserdiscs | 50% |
| Simulations | 50% |
| Labs | 43% |
| Special students | 40% |
| Datasets | 33% |

# Appendix A. SciTeach Forum Discussion Topics

Science-specific Pedagogy
Demonstrations
Instructional Laboratories
Research in Science Education
Science Fair project ideas
Sounds of Science
Science House
Quick Help
Staff Development Opportunities
Critical Incidents in the Science Classroom
Science Brain Teasers

Instructional Technology
IMSE CD-ROM
Animations from the World Wide Web
CD-ROMs for Science
Computer Assisted Instruction (CAI) and tutorial software
Data Collection and Analysis Tools
Datasets from the World Wide Web
HyperStudio/Hypercard
Laserdiscs and video
Science Software Simulations
Search engines on the World Wide Web
Telecommunications in the classroom
Video conferencing/CU SEE-ME in the science classroom
Web site reviews and evaluations
Apparatus and Equipment Folder

General Pedagogy
Classroom Management Strategies
Portfolios - development and evaluation
Pre-Service Science Teachers
Working with Special Students
Learning and Teaching Models
Assessment Strategies
First Year Science Teachers
Teachable Moments
Locating good (and cheap) materials
Humor in the Classroom
Student kindness

## Appendix B. Forum Coding Categories Examples of Student Discourse

**Emergent message type categories (preservice teachers)**:

1. Classroom experiences: Statements referring to an event that occurs in the classroom.

Example: This very comment has been said to me in my classroom. I told the student that science is about figuring out how the world works, like an investigation into nature, and that he could not truly learn about science without participating in this investigation. I reminded him that I could tell him anything but only if he saw it for himself, would he actually know for sure.

2. Science Pedagogy: Statements pertaining to science-specific pedagogy and not general pedagogy.

Example: I would have the students post their data so that they could have a discussion about the different numbers. I would want them to try to think about what factors may have been different between the groups. After they talked about that, I would let them do another verification lab and compare their results. Hopefully, these results would be a little closer to the norm and this would help demonstrate the concept a little more clearly.

3. Nature of Teaching: Statements relating to classroom instruction, methods, or classroom management issues; the role of the teacher; and specific teacher-student interactions.

Example: Again, I say that science is truly relevant and that a teacher presented with this question should be able to explain it's (science's) relevance. If it's not important then why are we teaching it? It must be relevant in our eyes.

4. Support: Statements referring to support, including receiving or giving support, and supporting one's ideas.

Example: Do not be discouraged. I want you to know that frustration can sometimes develop a voice and speak. Ignore frustration. There are many of us who are having a ball student teaching. I love it as well, however, I too have been frustrated. I am wise though. I silence my frustration. Don't hold the comments against those teachers. It is probably that they gave there frustration an opportunity to speak and you just were there to overhear it. I admire anyone who has taught for 20+ years. Those teachers are to be admired. Just realize that they are human and humans can and do get frustrated.

5. Concern for students: Statements pertaining to the welfare of classroom students.

Example: I wouldn't want to offend the students who are not artistic. To them they may have drawn an onion cell. It just might not look like the onion cell you want to see. I'd ask the student to explain his or her drawing to me.

6. Requests for information: Statements or specific questions which ask for information, advice or ideas.

Example: If issues about life arise, should we take the time to educate according to our own individual personal beliefs or should we leave that up to scout masters, clergy, and parents?

7.Resources: Statements in which students share resources including teaching ideas, general information, or instructional strategies.

Example: I have one book that's really neat. It's THE FLYING CIRCUS OF PHYSICS by Jearl Walker. It is copyright 1975 and the ISBN number is 0-471-91808-3. It is a compilation of hundreds of fun real-world physics questions/teasers. E-mail me back if you want to see it.

8.Social Acknowledgments: Statements in which a student acknowledges an idea presented on the forum.

Example: I too have students who seem to be absent often and it is hard to keep them up with the rest of the class. This is especially hard when they are missing labs and I don't have access to the materials but just those days I reserved them. What I have done is always give the students 3 days to make up missed work. I have told them that they can set up a time with me before or after school and I will go over what they missed with them. I know this is kind of punishing me in a way, but I don't see any other option. I can't just stop class so this one student can catch up. They have to take on the responsibility that comes with being absent and make up that work.

**Emergent reflective discourse categories**:

1. Perceptions: Insight, intuition; knowledge gained by observing; becoming aware in one’s mind.

Example: Science is not cut and dry. A major component of science is curiosity. A good thing to do at this point is to open class discussion and dialogue as to what could have happened. Also the groups could engage in trouble shooting their experiment to see if they followed directions properly or if something unexpected happened. The precision of scientific inquiry could also be discussed.

2. Asking focused questions: Asking focused questions to build on ideas previously presented in the message thread.

Example: Why have females been lagging behind in the field of science? Have our educators not been sparking their interest? Have they been drawing the females attention away from math and science and gearing it more towards liberal arts areas? Have our teachers been turning to the males for correct responses and been setting higher expectations for the males? Have educators been accepting that females are just "not as good in science" or what? These are a few questions that researchers have been confronted with for years. So how, as a new science teacher, will I deal with the prejudice of a male dominated field?

3. Peer scaffolding: A statement that builds on a previous posting in the message thread intended to spur new idea linkages.

Example: First of all, I would recognize the student's comment. To ignore a direct comment in class like this one would lead to more problems. The other students would try to force you to acknowledge the dilemma if they see that you are avoiding it. I would point out that science is based on facts and data collected from experimentation and research. Religion is an entirely different entity, a foundation of beliefs based on moral judgments, faith, and ancient scriptures. The 6 day creation is a widely accepted belief by many people. Likewise, evolution is a widely accepted scientific theory. Then I would stress the point that this is a science class, therefore, we are focusing on science.

I must admit personally that this would be a difficult issue to handle. I would prefer to avoid an in-depth discussion about the matter because some parents can become very concerned about the welfare of their students if they hear that science class challenged their religious beliefs. As a public school teacher, it would not be appropriate for me to pass on my personal opinions about evolution and creationism in my class. While students, such as the one in the critical incident, should be allowed to express their opinions in class, they should also be restrained from going any further. Science class should not be allowed to become a pulpit for students to get out of hand and interject their religious views during class. However, it is always important to acknowledge that people are entitled to their own individual opinions and beliefs.

**Peer scaffolding themes**:

1. Guidance and feedback: Messages that build on a previous response in the thread that offers some type of guidance and feedback on the issue discussed. Can include a response to a stated activity or provide movement of an issue into a new direction.

Example: I believe that by doing this (and not TELLING them what the answer should have been) the students will WANT to redo the experiment using the error reduction techniques that they have thought of. This will solidify the need to be very careful when doing science experiments.

2. General advice: Messages that offer general advice or personal views to further develop an idea in the message thread.
Example: If a teacher does pursue this discussion in class, do so in a discussion forum, or a round-circle discussion. This puts students at ease and each person has visual contact with the other students. This helps develop the listening, thinking, and communicating process.

3. Modeling pedagogical practices: Messages that augment an idea by illustrating a pedagogical practice.

Example:
I agree with Joey.  I think that the issue should not be one that just "pops up" in class.  I think that when you start developing this type of lesson you need to take this into account. You could start the lesson with an example which helps them "see" adaptations that occur in a short period of time -i.e. the white moths in pre-Industrial Revolution Europe that became black moths within a few decades due to the pollution of their habitat. By doing this you could help them see that evolution does exist.

# Factors That Influence Asynchronous Discourse With Preservice Teachers on a Public, Web-Based Forum


## Abstract

This study analyzed patterns of computer-mediated communication of 32 preservice science teachers on a public Web-based forum. The participants were able to engage in scaffolding pedagogical ideas with each other as a result of sharing peer perceptions. The findings revealed that a large amount of structure is needed for students to discuss science-specific pedagogical issues on a Web-based forum. A saturation effect in the discourse may occur with large groups of preservice teachers responding to one particular forum posting. Dialogue prompts and scaffolding were aspects of the Web-based forum that facilitated new learning in both science-specific and general pedagogical areas.


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 training 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).

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). Since the World Wide Web is 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 preservice teachers' use of Web-based forums, as well as their perceptions of dialoguing with the aid of this new technology tool.

## Background

A major area of research regarding computer-mediated communication (CMC) concerns non-facial aspects of communication. Characteristic of CMC is an absence of social, contextual, and nonverbal cues that normally regulate and influence social interactions (Berge, 1997; Harasim, 1990). Information about individuals' job titles or positions, social status, race, age, and physical appearance are all lacking with CMC. Facial expressions, voice dynamics, and body language are also absent from the computer medium. The lack of social context cues on a computer network can permit individuals to experiment with different roles and identities.

According to Berge (1997), since computer conferencing provides a text-based environment with low levels of social context cues compared to face-to-face interactions, it can have both negative and positive consequences in an instructional setting.  Low levels of social context cues can lead to more uninhibited behavior on the part of the computer conferencing users than would occur with face-to-face interactions.  This has the possibility of leading to misunderstandings and intense arguments, but it can facilitate more interpersonal interaction in a virtual class setting and involve persons who are normally shy or wary in a face-to-face classroom (Bellman, 1992, as cited in Berge, 1997).

There are cognitive benefits to text-based interaction.  Non-facial communication allows participants time to reflect and consider their response (Berge, 1997; Harasim, 1990).  The time lag associated with delayed-time computer conferencing is well suited to shy, thoughtful, or hesitant conversationalists due to the fact that answers and responses are considered and carefully framed before presentation.  Written communication is perceived by learners as contributing to more reflective interaction than talking in a face-to-face class or telephone conference.   A textual mode of communication provides opportunities for students to pace their processing of information, review and skip ahead, and easily refer to discussion comments later (Eastmond, 1992).  Student discourse with asynchronous communication provides a learner the opportunity either to respond immediately or first to reflect, compose, and edit one's response.  Furthermore, Vygotsky (1962) asserts that the process of articulating thoughts into written speech involves deliberate analytical action.

According to Harasim (1990), asynchronous group learning can also reduce competition for air-time among participants.  There is no concern that time restrictions or turn taking will limit expression or opportunities to speak.

Participants who require additional time to present their ideas are not interrupted by more assertive individuals.

Text-based communication has no social or physical cues to distract one from the cognitive content of a message (Harasim, 1990). The focus of the message is on the content and not the presenter. A text-based medium lacks mechanisms for displaying or enforcing social differentiation by such factors as social status cues, or physical cues such as race, gender, or physical handicap, that in other communication contexts interfere with group interaction. Online learners report that text-based interactions diminish the stereotyping associated with high external social status or physical appearance, thereby removing a significant barrier to equal participation (Davie & Wells, 1991; Harasim, 1986).

Asynchronous collaboration also has its drawbacks. Communication anxiety (the feeling of speaking into a vacuum) can occur when a participant receives no immediate response to ideas and comments (Feenberg 1987). Physical cues such as facial expressions, voice intonations, and gestures are eliminated. Participants may also feel inhibited within online discussions because their words will be preserved in a database (Davie & Wells, 1991; Harasim, 1990).

Text-based communication preserves 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 to 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.

## Purpose

The purpose of this study was to investigate asynchronous communication factors that influence the discourse of preservice science teachers on a non-restrictive, public Web-based forum. The following two research questions were investigated:

1. What differences do preservice teachers perceive between Web-based asynchronous communication and face-to-face-communication?
2. How does the asynchronous Web-based medium promote or inhibit online discussion?

## Methodology

### Participants

The participants in this study were composed of 32 prospective secondary school science teachers enrolled in the Professional Semester at North Carolina State University during Fall 1998. This consisted of Methods of Teaching Science, Instructional Materials in Science, Seminar in Science Education, and Student Teaching. 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 telecommunication 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. These courses were instructed by science education faculty members other than those who taught the Instructional Materials in Science course. The 12 middle school preservice teachers were instructed in separate instructional materials and methods courses than 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.

### Context

In order to examine the potential benefits of preservice science teachers engaging in an electronic professional community of science teachers on the

World Wide Web, a public Web-based forum called the SciTeach Forum 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.

The NetForum software was selected to create the SciTeach Forum because it was 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. Message threads are displayed in a temporal sequence with the most recent message 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 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 (Bull, Harris, Lloyd, and Short, 1989; Casey, 1994; Loiselle, Dupuy-Walker, Gingras, and Gagnon, 1996; Merseth, 1991; Schlagal, Trathen, and Blanton, 1996; Thomas et al., 1996; Thompson and Hamilton,1991; Waugh, 1996; White, 1997; Zimmerman and Greene, 1998). We assumed that at least one computer in the school where a student teacher would be placed during the 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 to the SciTeach Forum for the entire semester each week. 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.

### Survey Instrument

A survey was administered to each subject at the end of their student teaching semester. The survey consisted 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.

## Findings and Discussion

### Comfort Level with Web-Based Communication:

> "I guess it's more informal, Web-based. When you are face-to-face with someone, you would be on your best behavior. You don't have to worry about your manners when you are sitting there typing. I don't feel like that's a formal way of communication. It's zapping information to somebody and zapping it back and there's no person-to-person contact."

This participant perceived Web-based communication as not being a formal way of communicating. The rules for communication are different in a Web-based medium. Many participants reported they can ask questions and make comments in the Web-based forum that they felt uncomfortable doing in a face-to-face setting. The Web-based medium enabled participants to feel less inhibited to "say what they truly feel" and discuss how they genuinely think regarding a topic or issue. The participants did not experience feelings of nervous tension communicating on the forum. Furthermore, some participants felt it was easier to give a more honest opinion when they were not directly speaking face-to-face with an individual.

The absence of a physical presence and low social context cues on the Web-based forum enabled participants to feel comfortable communicating in the medium. As one participant stated:

> "I would say I'm an extrovert and I enjoy face-to-face communication. But there are more times when I would feel more comfortable with the Web, perhaps speaking with a professor that I felt a little uncomfortable with. It's a lot easier to communicate using Web-based communication because there are a lot of cases where you feel uncomfortable asking questions in front of a class or asking questions to a teacher because you feel like they might think of you as being stupid."

This participant stated that she felt uncomfortable talking in front of a class due to fear of being perceived as less-knowledgeable than other students. Harasim (1990) contends that text-based interactions diminish stereotyping associated with external social status. In this respect, the Web-based medium facilitates discourse by removing visual cues that promote assumptions pertaining to established social hierarchies and dominant personalities.

Not all participants felt comfortable engaging with the Web-based forum. One participant stated:

> "I'm more comfortable with the face-to-face [communication] than I am with the Web-based [communication]. I'm not really proficient on computers. And posting those things on the forum, I was

> always paranoid they weren't going to go through. I just don't rely on that kind of thing. I would never put everything solely on a computer. Like my life on a computer for fear of a crash or something."

This participant was more comfortable with face-to-face interactions because of her previous computer technology experience. Although this participant had positive experiences participating in the forum discourse, she continued to have anxiety about using computers for telecommunication purposes. Even with successful forum involvement, a fear of the unknown with implementing computer telecommunications technology can endure.

### Feedback

Receiving feedback in delayed-time was perceived as being a non-advantageous aspect to communicating on the forum. Because the majority of participants accessed the forum only once a week (n=22), feedback to immediate classroom concerns (discipline problems and other management issues) "came too late to be of any use". Many participants perceived having immediate feedback to difficult situations they encountered during their student-teaching internships as imperative. As one participant stated, "With knowledge and information, the sooner you have it, the more easier it is for you to use it." Infrequent access to the forum did not facilitate an immediate response to participants' urgent concerns and situations. In some cases, participants did not receive any feedback to their postings.

The participants perceived dialoguing on a public Web-forum of science educators as being advantageous to their particular situation. A variety of people who the participants could otherwise not have been able to communicate with provided feedback. Feedback from disparate people allowed the participants to see different aspects of an issue or problem. Our participants were exposed to ideas and notions of science educators who would not have been a part of a restrictive network. If the network was restricted "you would have a limited supply of resources and it would make it difficult to have a large variety of responses." By restricting a network, the knowledge base becomes more limited thereby reducing the amount of feedback one receives. Network participation from science educators who were not involved with the participants' methods course instruction provided additional insight and perspectives to issues that our participants were dealing with in their classrooms.

**Reflective Thinking**

The asynchronous nature of the forum provided the participants with the opportunity to think and reflect on their teaching. A main difference asynchronous, Web-based communication has over face-to-face communication is that "you can say what you need to say and/or change it before you actually send it." Many participants stated that their forum communications were "well thought out". Since the forum discourse is preserved as a permanent record, the participants are conscientious about what they post to the forum. Similar to previous studies (Berge, 1997; Harasim, 1990), our participants felt that the asynchronous medium allowed them more time to think and reflect before responding to postings. Reading and responding to forum postings forced the participants to reflect, form ideas, and reexamine their own understandings and interpretations. However, this may not be the case for all individuals:

> "In Web-based you may not think about it, but then you could. Several times I've half-way typed something and be like that sounds stupid. So I'd erase it and start over again. So, maybe its more well-thought out when its Web-based. Or not. It could go one way or the other. You could just do it and not really think about it."

An impetuous individual might react to a posting on impulse without really thinking or reflecting. A few participants stated they were sometimes quick to post responses to the forum without careful reflection. Several participants asserted that a lack of personal time, due to the amount of work that was required of them during their student teaching internship, was the reason for this.

### Impersonal Nature

> "In face-to-face communication, you can see someone's emotion and how they express themselves. A lot of times, you can tell something about a person by their posture, whether they have a closed type of posture or an open posture, if they're happy about the way things are going or they're not so happy. You know that a person understands what you want to say. In Web-based, it's all what they write or what they type on the screen."

The participants perceived the Web-based forum as being more impersonal than face-to-face interactions. Participants could not see the emotion behind one's responses. Since there was lack of visual cues on the forum, it was sometimes difficult for participants to comprehend the exact meaning of what a person was trying to communicate. Face-to-face communication involves physical cues and interactions including hand gestures, facial expressions, voice intonations and body posture. These physical cues help to provide meaning and aid in understanding the context of a spoken discourse. The absence of social context cues in Web-based discourse changes one's conventional rules of communication. One can not rely on physical cues to facilitate understanding in the Web-based medium. This can be advantageous because it focuses the communication exchange more on the content of the message and not on the characteristics of the speaker.

### Promoting Discussion

An assortment of factors appeared to promote discourse among the participants. The level of interest in a topic appears to be an essential factor in promoting discussion. The immediate relevancy of a topic to a participant at a particular time is also an influential element to the depth of the dialogue. Furthermore, interpersonal factors among participants were salient elements in promoting discourse. The participants were a group of preservice teachers experiencing similar situations during their student teaching internships. As the participants encountered similar classroom management and discipline problems, they used the forum to share and discuss their related situations.

Discussion of controversial topics also increased the depth of the forum dialogue. As one participant stated,

> "When you get fired up about something and you're really interested and passionate in an idea, I think you are going to talk about it more than if you just feel so-so about it. If you're not real sure how you feel then you are not going to respond as much. But if you know what you're thinking, then you're going to talk a lot more. You're going to have a lot more to say."

On the forum, participants expressed their personal opinions and views in discussions involving ethical issues. Throughout the discourse and in the participants' interviews, several critical incidents were referred to as "touchy" or controversial issues. Discussing controversial issues was perceived by these participants as getting them “fired up”. Furthermore, they were interested in hearing what their peers thought or how they would react to a given situation. In the discourse, participants explained and defended their moral positions and beliefs. Some participants also said they were more willing to contribute to the discussion of sensitive issues than to other topics.

The forum promoted discussion by allowing one access to others’ perspectives. It allowed for different opinions to be analyzed and agreed with or argued against. For students who were isolated in their student teaching placements, the forum promoted discussion just by being there. The forum provided a place where isolated student teachers could share and discuss their teaching experiences.

### Inhibiting Discussion

The interface of the Web-based forum appeared to be a factor that limited the depth of discussion on the forum. Replies to posted messages are organized temporally with the newest reply at the bottom of the message thread. This mirrors the organization of a bulletin board system. Users could also read an entire thread of successive replies to an initial message. In this manner, an entire thread resembled a face-to-face conversation. However, the nature of communicating asynchronously in a temporal, linear manner was sometimes perceived as restricting the discourse.

> “It’s not an immediate dialogue. Its put a question up there or a problem up there and somebody replies back and you read it whenever you get to a computer. It’s not a constant dialogue. It’s not back and forth, back and forth, back and forth. It’s a posting, then a reply. That’s it. Because it’s not immediate, you can’t really

> challenge it or ask more questions or ask to go into further detail. Not the way it was set up. I guess you could e-mail that person and ask them. But as far as the forum went, it wasn't set up that way."

The nature of asynchronous communication does not promote an immediate back-and-forth dialogue that is often required by a person to get the specific type of feedback one is looking for. When one engages in face-to-face conversation, the nature of the communication is often a continuous process. The forum interface does promote a reply, but not a "back and forth, back and forth" discussion. A natural flow of conversation is not easily achieved when participants access the forum on a weekly basis. Participants viewed the forum's linear structure as impeding the flexibility of the communication because they could not place their replies directly to specific messages in a thread.

A large number of participants responding to the same critical incident appeared to cause a saturation effect in the discourse. In many of the message threads, after half of the students responded, the responses began to "sound along the same lines". One participant shared her insight to this phenomena:

> "I think people will wait to see other people respond to it. And then pull their responses up on the screen and be like okay, this look good. I'll type that down as well. Versus sitting down and really thinking about the incident and being like, well, this is the way that I would handle it, let me see someone else's view, but this is the way I'm going to handle it. Versus comparing and contrasting, they'll just take the easy route out and write just what someone else has or type out what someone else has."

Some participants read the postings of others and then contributed to the dialogue by restating previous ideas by adding "a new twist" to the discourse. In some cases, the participants responded to a critical incident without reading the responses of others. However, this was not the case for all participant postings in the latter stages of the thread. There were students who often posted toward the end of a message thread with a reflective posting that built on the ideas of others. In order to reduce this saturation effect, one might want to consider reducing the number of participants responding to a critical incident, or have a group of students adopt different thinking-related roles in their response to the discourse generated in a critical incident thread. These roles could include a “devil’s advocate”, speculator, brainstormer, optimist, pessimist, or judge. Even though we structured critical incidents with dialogue prompts to intentionally promote discussion of science-specific pedagogy, it appears that more structure is required in order to facilitate large group discussions on the Web.

### Discourse Beyond the Web

More than two-thirds of the participants reported that they extended the forum discourse outside the online environment. Participants continued to discuss classroom management issues, critical incidents, and ethical issues raised on the forum with their peers, cooperating teachers, and other teachers at their school placements. Not only did certain topics promote discussion on the Web, but this discourse extended outside the medium to others. In some cases, the online discourse continued with peers over the telephone and during face-to-face discussions in school placements with more than one student teaching participant.

## Conclusions

The findings in this study illustrate a variety of factors that influenced the discourse of preservice science teachers using an asynchronous, non-restrictive public Web-based forum. The asynchronous nature of the Web-based forum allows preservice teachers to communicate in a reflective online community at their convenience. Many of the message threads that occurred on the forum were topics that were not part of the preservice teachers' in-class instruction. The forum offered new opportunities for participants to discuss and reflect on classroom issues that were directly relevant to their student teaching experiences. Our findings also revealed there are some constraints and limitations with using asynchronous communication with preservice teachers. These include receiving feedback too late to be of use and issues pertaining to the absence of visual cues during discourse exchanges. Moreover, if we expect preservice teachers to use telecommunications tools to engage in reflective communities of practice, then it is important that time be provided in their daily routine to use these tools to reflect on their practice.

The conventional rules of communication change in the online medium. Non-facial communication issues are intrinsic to this situation. Communication exchange is not guaranteed among all participants since participants can chose selectively 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. One participant stated that he usually skimmed through messages and read only those posted by peers from his methods class. Furthermore, the comfort level with the Web-based medium itself might be a factor 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.

With more than sixty different asynchronous conferencing software packages available to use (see Woolley, 1998), more research needs to be conducted to determine the most appropriate design structure to use with a public, non-restrictive asynchronous Web-based forum. Ease of use with respect to the design structure is an important factor to consider. Most asynchronous conferencing software packages use either a linear or hierarchical tree structure. Linear structures add a reply in a temporal manner to the end of a linear chain of messages. A hierarchical tree structures allows a user to attach a response directly to any message. This allows a discussion to potentially branch out infinitely. The linear structure is simpler to navigate and more closely resembles a face-to-face conversation. However, some of our participants felt frustrated with the lack of flexibility in the linear structure and wished the forum provided a hierarchical tree structure. Although we view the linear structure as easier to navigate, some participants still experienced difficulty locating older messages threads on the SciTeach Forum.

Conferencing in delayed-time versus real-time with preservice teachers placed in remote geographical internships remains an issue to be further explored. A disadvantage some participants perceived with using asynchronous communication was that they did not receive immediate feedback to problems they were experiencing in their classrooms. Using synchronous communication with preservice teachers could provide for immediate feedback to problems and concerns they experience in their classrooms. Furthermore, a synchronous environment would enable participants to participate in a dialogue which more resembles a face-to-face interaction. We believe that the logistics of coordinating synchronous communication with our participants would have been extremely difficult given the resources in their school placements and their schedules. Unless provisions could be made to ensure each participant has access to a networked computer and busy schedules could be coordinated, engaging preservice teachers in synchronous communication would not be feasible.

We have just embarked on a journey to understand how preservice teachers use asynchronous communications in a public, non-restrictive Web-based forum. We are learning how the structure of a Web-based medium promotes learning in a social context. As higher education continues to integrate Web-based tools into teaching pedagogy, it is important that we continue to analyze and research the mechanisms that facilitate learning online.

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# CONCLUSIONS

## Attitudes Towards Electronic Communications and Computers

This study revealed significant differences in the participants' attitudes towards computer use before and after their student teaching internship as measured by the Kay Semantic and multimedia subscales on the Teachers Attitudes Toward Information Technology Questionnaire (TAT). The participants began and ended their professional semester with positive attitudes towards implementing electronic communication tools and using information technology to improve teacher productivity. Furthermore, no significant differences in participants' 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. This study also found that the participants' confidence levels in using computers and telecommunications tools significantly increased after the student teaching semester.

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.

The findings in this study are consistent with Bandura's theory of self-efficacy being affected by temporal patterns of successes and failures. Experiences with computer networking increased the participants' feelings of control and confidence. These encounters also encouraged individuals to learn more about the technology, thus reducing and eventually eliminating the fear of the unknown factor. As the fear and the anxiety with computer telecommunications technology diminished and positive experiences added up, self-efficacy and the willingness to cope with mastering the task increased.

### Attitudes Toward Using a Web-Based Forum During the Student Teaching Field Internship

The findings of this study revealed that most participants had positive attitudes towards interacting with the Web-based forum. Furthermore, there were no significant differences in attitude between participants who had access to a networked computer and those who didn't. This result was surprising. Some studies have found that easy and convenient access to equipment and networks is an important consideration for network use (Anderson & Harris, 1997; Honey & Henriquez, 1993). According to Schrum (1995), telecommunications is not likely to be used by an educator unless time is built into the school day, or educators have access to telecommunications equipment at home. 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).

The findings of this study tell a different story. These barriers were most likely overcome because the network was more accessible on a Web-based forum rather than an 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 on the university campus (n=8). For many participants, accessing the Web-based forum was easier than accessing their campus e-mail. 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.

The survey and interviews revealed a preference among the participants for using a Web-based forum for this activity rather than an e-mail listserv. Many participants perceived the Web-based forum to be more accessible and user-friendly than e-mail for this type of activity.

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. Many participants expressed a sense of empowerment with using the forum since they were able to pick and choose topics of interest to them. Furthermore, many participants stated that reading messages on the forum was preferable to being overwhelmed by a large number of e-mail messages in their e-mail box.

It appears that participation in the Web-based forum has overcome many technical and logistical issues that shape network adoption and use. These issues include the user friendliness of the system, system reliability, and technological infrastructure. The participants in this study did not experience frustrations accessing the telecommunications network or becoming lost in the online system.

The Critical Incidents in Science Teaching topic was helpful in preparing the participants to teach and to think about situations they might encounter during their student-teaching placements. The critical incidents were perceived by the participants as being relevant and meaningful to them not only for their internship but also for their future job placements. Having to reflect and respond to certain science teaching problems that they might not otherwise have the opportunity to be exposed to was perceived as being a beneficial aspect of using the Web-based forum during their internships.

### Isolation in the Field

The Web-based forum provided a convenient network space for the participants to have conversations pertaining to moral support over geographical distances. This support appeared to decrease the feeling of isolation among the participants who were placed in schools without other interns. The sharing of peer experiences on the Web-based forum seems 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 problems and tensions they experienced during their student teaching internships. This finding was 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 forum appears to be an important factor in the free exchange of ideas, questions, and other types of dialogue among preservice science teachers, helping to reduce feelings of loneliness.

**Fostering a Sense of an Electronic Community of Educators**

Most participants felt that the Web-based conferencing activity fostered a sense of a collaborative learning community. The forum allowed 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." A sense of community was fostered because the group of forum participants experienced similar situations. Even in similar situations, members of this Web-based community did not have the same opinion.

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. By interacting with others in the online network space, participants did not feel threatened by engaging 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. In addition, much reflection occurred on science-specific pedagogy within this Web-based community. This study's findings were consistent with previous research that found 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).

The participants experienced a sense of belonging together. The online community space promoted the feeling of a supportive group of individuals working together to seek common meaning in teaching, and provided an opportunity to learn how to value the contributions of others. As an online community of practice, preservice teachers became united by a common purpose since they were 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 shared teaching experiences, problems, ideas and pedagogical resources. The Web-based medium itself promoted a reflective practice as a place where preservice teachers could share their perceptions and seek common meanings in their teaching practices.

### Support for a Cohort Group of Preservice Science Teachers

The SciTeach forum provided support for a cohort group of preservice science teachers. Many forum postings of the participants were written in a supportive fashion. Such statements provided words of encouragement to peers in difficult situations and support for one's ideas. Most participants felt they received support through their interactions with the SciTeach forum, including sharing classroom experiences and discussing student teaching issues. Furthermore, most participants stated they provided support to others through the use of the forum.

The Web-based forum was used by some participants as a tool to support each other throughout their student teaching internship. Participants received moral support from their peers during stressful periods of their professional semester. The forum served as a place where participants could receive support and assistance from their peers with classroom management decisions and other pressing concerns they experienced in their classrooms.

An analysis of the discourse revealed a general trend of many participants responding to forum postings of peers from their specific methods course. Although the participants' notion of how they defined their cohort varied in this study, most participants viewed their cohort as being comprised of the students from their methods course. Some participants did regard all participants on the forum as part of one big cohort group. This differing view might be due to the nature of the methods course and how individual students interacted within that cohort.

### Conference Topics that Promote the Most Exchanges of Ideas

In general, topics pertaining to general pedagogy tended to promote the most exchanges of ideas, while topics pertaining to instructional technology and science-specific pedagogy generally did not promote responses among the participants. The conference topics that promoted the most exchanges were Critical Incidents, Preservice Science Teachers, and Classroom Management. There was quite a bit of variability in the use of topics by the participants as well as the number of messages in each thread. Many topics had threads with only one message while some topic threads, such as “Critical Incidents”, contained up to 34 messages.

Excluding the critical incidents topic, most participants preferred to post to forum topics pertaining to general pedagogy. These conference topics provided a place for participants to discuss personal classroom experiences. Many of the participants were experiencing similar situations in their student teaching placements and they used the forum to share and discuss these experiences. The participants were also interested in discussing controversial topics and “touchy issues” on the forum as well as critical incidents they personally experienced in their own classrooms.

The Web-based medium allowed participants to share particular perspectives on pedagogical issues. This sharing of perspectives resulted in participants seeking common meaning for a given situation. Furthermore, the Web-based medium assisted students in seeing different sides of an issue or problem.

In general, postings to the science pedagogy and instructional technology forum topics were primarily written to share information. In these conference topics, most participants shared science-specific teaching lessons and instructional technology resources. In most messages, there were no prompts in the dialogue to illicit a response. Even when an instructor posted messages to instructional technology topics using a focused question, a response from the participants was not received. This phenomena most likely occurred because the preservice teachers were not well-knowledged in these areas.

The results of this study indicate that a large amount of structure is needed for preservice teachers to discuss science-specific pedagogical issues on a Web-based forum. Most participants did not post to topic areas pertaining to science-specific pedagogy. Many preservice science teachers have preconceived notions that they are well-knowledged with respect to their science content. If one assumes that all participants have a shared collective knowledge on a topic, they might be less likely to discuss a certain content-specific item out of fear of being perceived by the online group as being inferior in their knowledge base.

**Conference Topics that Promote the Most Reflective Discourse**

The participants' reflective discourse on the forum included perceptions, the asking of focused questions, and peer scaffolding. The conference topic that promoted the most reflective discourse was the critical incidents topic. The initial message of each critical incident thread was structured in such a way that it required the preservice teachers to think and reflect on an authentic science-specific teaching situation and respond to a given situation. Discourse in the critical incidents topic of the SciTeach forum was generally thoughtful and promoted a reflective practice in which a group of preservice teachers engaged in a dialogue that involved the asking of focused questions, seeking common meanings in teaching practice, and constructing ideas in collaboration with other preservice teachers. Other topics that promoted reflective discourse involved general pedagogical topics that served to provide participants with the opportunity to read the pedagogical ideas of peers in similar situations. By reading peer postings, participants were able to reflect on their own teaching and realize how they needed to alter their own pedagogical styles in their classrooms.

By sharing peer perceptions, the participants were able to scaffold pedagogical ideas with each other. The participants were able to integrate bits and pieces of different teaching ideas that were presented in the message threads. They integrated the pieces together and decided how to improve their own teaching from what had been previously said by others. This type of peer scaffolding appeared to promote reflection on topics the participants were learning in their university course work. In some instances, participants stated openly on the forum that they had a preconceived notion about handling a certain situation and that notion changed after reading the responses of others on the forum. The discourse also promoted reflection on the day-to-day activities a teacher deals with in the school environment. Most participants felt that interacting with the SciTeach forum promoted their reflection on teaching approaches and decision making.

### Average Length of Dialogue Thread in the Web-Based Forum

The average length of a dialogue thread on the forum was 6 messages over 11 days. There was a wide range of variability since the length of the threads varied from 1-60 days. More specifically, 49 message threads lasted 14 days or longer, 50 message threads lasted between 2-14 days and 54 message threads lasted only 1 day. Topics that were used to share instructional technology resources contained many message postings without responses. Forum topics that contained postings participants perceived as being directly consequential to their immediate classroom situation had the most participant discourse.

### Peer Responsiveness Affecting the Depth of the Dialogue

Peer response does affect the depth of the forum dialogue. By using a Web-based forum, preservice science teachers can take advantage of the opportunity to question their peers' assertions, open different aspects of a problem, or apply reflective thinking on an issue presented. However, depth of response is not guaranteed since participants can chose selectively to which postings they read and respond. 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. One participant stated that he usually skimmed through messages and read only those posted by peers from his methods class.

The text-based medium of the forum might be a factor in whether students add responses to the forum. 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 reflect on what has been said, think critically, and then respond. In addition, the forum contains no visual cues that might intimidate some participants.

**Extending the Forum Discourse Beyond the Computer Medium**

More than two-thirds of the participants reported that they extended the forum discourse outside the online environment. Participants continued to discuss classroom management issues, critical incidents, and ethical issues raised on the forum with their peers, cooperating teachers, and other teachers at their school placements. Not only did certain topics promote discussion on the Web, but this discourse extended outside the network to others. In some cases, the online discourse continued with peers over the telephone and during face-to-face discussions in school placements with more than one student teaching participant.

**Promoting a Reflective Practice of Teaching**

On the Web-based forum, preservice teachers became engaged in thoughtful discourse about science teaching practices. The structure of the critical incidents themselves seemed 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.

In this study, the Web-based discourse promoted reflection and understanding on pedagogical issues. Participants endeavored to clarify and extend their understanding of their role as a teacher and also to understand their students. In many cases, they perceived their role as a teacher to extend beyond facilitating student knowledge of scientific processes and concepts. In responding to specific critical incidents, some participants extrapolated the discourse to a larger contextual picture pertaining to the nature of teaching.

In traditional student teaching internships, preservice teachers are often disconnected from their peers in other classrooms. Separated by geographical barriers, preservice teachers interact sporadically with university faculty and rely almost exclusively on cooperating teachers for guidance, information, and support. The SciTeach forum provided a place for preservice teacher reflection; one in which they could communicate with one another across geographical distances. Interacting with the critical incidents topic of the forum provided preservice science teachers the means and opportunity to develop as reflective practioners while becoming engaged in thoughtful discourse about science teaching practices.

### Promoting Reflection on What Students Are Learning, Including Teaching Approaches and Decision-Making

Previous research by Vygotsky (1978), although not referring to online environments, offers insight into how writing can contribute to knowing. According to Vygotsky, individuals find meaning, not only through individual experiences, but also through social interactions. Learners actively construct knowledge by formulating ideas into words; and these ideas/concepts are built upon through reactions and responses of others to the formulations.

The phenomena observed with this study's participants can be viewed in terms of Vygotsky's sociocultural ideas on learning within a social context. According to sociocultural theory, each individual functions within a zone of proximal development (ZPD). The ZPD is the range or distance between what an individual may accomplish in an activity or task independently and what one may accomplish through problem solving under adult guidance or in collaboration with more capable peers (Vygotsky, 1978). Web-based conferencing can be viewed as a tool to facilitate moving students toward the more skillful and capable side of their ZPD. Dialogue prompts and scaffolding were aspects of the SciTeach forum that facilitated new learning in both science-specific and general pedagogical areas. This scaffolding included guidance, assistance, recommendations, advice, and suggestions. The participants' learning experience was further enhanced by being exposed to ideas of their instructors and peers.

The discussion of real life experiences was instrumental in promoting the discourse on the Web-based forum. Learning occurred when the participants had the opportunity to discuss authentic pedagogical situations. On the forum, participants were exposed to different perspectives on issues and able to offer their own insight to a presented problem or situation. Reading and responding to peers' and instructors' forum postings forced the participants to think and form ideas. This resulted in participants seeking common meanings as they engaged in critical thinking that focused on issue analysis and problem solving of authentic classroom experiences.

The Web-based environment facilitated idea generation and knowledge building within this online community of preservice teachers. A key factor enabling this was that the participants shared a collective understanding and experience as they embarked in an intensive indoctrination into the science teaching profession in cohort groups. For most participants, this intensive experience within a cohort group provided a common framework that enabled them to easily exchange ideas, participate in in-depth discussion, and seek new knowledge as part of an online community. The Web-based medium provided a space for the participants to continue to be actively involved in discussing the practical and ethical dimensions of science teaching from their remote student teaching placements.

## Mentor Scaffolding of University Instructors

University instructors provided different types of mentor scaffolding on the forum. Types of learning assistance included asking questions, providing guidance and feedback, and supplying structure to a task. Instructors offered feedback to the participants on pedagogical instruction, guiding them to improve or continue performance on their next attempt. Some instructors modeled science-specific pedagogical practices that served to provide clarity or other information to the participants. Cognitive task structuring was also provided on the forum through the use of descriptive scenarios and focused questions in message postings to the critical incidents topic. Instructors provided assistance and support on the forum that included prompts, comments, explanations, questions, and suggestions. In the discourse, participants were provided with additional ways to solve problems they were experiencing during their student teaching internship.  The Web-based forum appears to be a tool that university instructors can use to support preservice teachers in remote student teaching placements in learning tasks that may be beyond their current capabilities.

### Benefits and Barriers Preservice Science Teachers Encounter Using a Web-Based Forum

The participants described 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 felt they received 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.

Using a Web-based forum, preservice science teachers had the opportunity to question their peers' assertions, discuss different aspects of a problem, or apply reflective thinking on an issue presented.  Because the interface of the Web-based forum permits responsive feedback, it contributed very effectively to the shaping of reflective thinking.  The forum provided opportunities for preservice teachers to engage in dialogue and reflections, enabling 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 in a variety of different topics on the forum provided preservice science teachers the means and opportunity to develop as reflective practioners. 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.

The results of this study demonstrate that there are many benefits to having preservice teachers participate in a non-restricted network of learners. Participants were exposed to ideas and perceptions of other science educators that would not have been possible using a restrictive network. If the network was restricted, “you would have a limited supply of resources and it would make it difficult to have a large variety of responses.” By restricting the network to the participants of only one university, the knowledge base becomes more limited. Participation outside of one university could provide additional insight and perspectives to an issue. Dialoguing with a global audience encouraged our participants to be reflective in their postings.

Many participants reported that they could ask questions and make comments in the Web-based forum that they wouldn’t have felt comfortable doing in a face-to-face setting. The Web-based medium enabled participants to feel less inhibited and “say what they truly feel” as far as how they genuinely think regarding a topic or issue. The participants did not experience feelings of nervous tension communicating on the forum. Furthermore, some participants felt it was easier to give a more honest opinion when they were not speaking face-to-face with an individual or group. The absence of a physical presence and low social context cues on the Web-based forum enabled participants to feel comfortable communicating on the network.

Receiving feedback in delayed-time was perceived as a disadvantage to communicating on the forum. Because the majority of participants accessed the forum only once a week (n=22), feedback to immediate classroom concerns including discipline problems and other management issues “came too late to be of any use”. Many participants perceived having immediate feedback to difficult situations they encountered during their student-teaching internships as imperative. As one participant stated, “With knowledge and information, the sooner you have it, the more easier it is for you to use it.” Infrequent access to the forum did not facilitate an immediate response to participants’ urgent concerns and situations. In some cases, participants did not receive any feedback to their postings.

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 with using the Web-based forum. A large amount of time is involved when one must sit, think, reflect critically, and then write a response to a message posting on a Web-based forum.

Some participants were not comfortable interacting with a computer network. Some participants were more comfortable with face-to-face interactions. A few participants with little previous computer technology experience had anxiety with using computers for telecommunication purposes. Even with successful forum involvement, a fear of the unknown with implementing computer telecommunications technology endured for these participants.

### How the Web-based Medium Influences a Discussion

There appear to be many factors of the Web-based medium that influence the discourse. The Web-based medium facilitates discourse by removing visual cues that promote assumptions pertaining to established social hierarchies and dominant personalities. The asynchronous nature of the forum provided the participants with the opportunity to think and reflect on their teaching. A main advantage that asynchronous, Web-based communication has over face-to-face communication is that “you can say what you need to say and/or change it before you actually send it.” Many participants stated that their forum communications were “well thought out”. Since the forum discourse is preserved as a permanent record, the participants are conscientious about what they post to the forum. Similar to previous studies (Berge, 1997; Harasim, 1990), our participants felt that the asynchronous medium allowed them more time to think and reflect before responding to postings. Reading and responding to forum postings forced the participants to reflect, form ideas, and reexamine their own understandings and interpretations. However, this may not be the case for all individuals. An impetuous individual might react to a posting on impulse without really thinking or reflecting. A few participants stated they were sometimes quick to post responses to the forum without careful reflection. Several participants asserted that a lack of personal time, due to the amount of work that was required of them during their student teaching internship, was the reason for this.

There are other factors that influenced the participants’ discourse. The asynchronous nature of the Web-based forum allowed for preservice teachers to communicate in a reflective online community at their convenience. Many of the message threads that occurred on the forum were topics that were not part of the preservice teachers' in-class instruction. The forum offered new opportunities for participants to discuss and reflect on classroom issues that were directly relevant to their student teaching experiences. The findings of this study also revealed that there are some constraints and limitations to using asynchronous communication with preservice teachers. These include receiving feedback too late to be of use and issues pertaining to the absence of visual cues during discourse exchanges. Moreover, if we expect preservice teachers to use telecommunications tools to engage in reflective communities of practice, then it is important that time be provided in their daily routine to use these tools to reflect on their practice.

The participants perceived the Web-based forum as being more impersonal than face-to-face interactions. Participants could not see the emotion behind others' responses. Since there was a lack of visual cues on the forum, it was sometimes difficult for participants to comprehend the exact meaning of what a person was trying to communicate. Face-to-face communication involves physical cues and interactions including hand gestures, facial expressions, voice intonations and body posture. These physical cues help to provide meaning and aid in understanding the context of a spoken discourse. The absence of social context cues in Web-based discourse changes the conventional rules of communication. One can not rely on physical cues to facilitate understanding in the Web-based medium. This can be advantageous because it focuses the communication exchange more on the content of the message and not on the characteristics of the speaker.

### Promoting Online Discussion

An assortment of factors appeared to promote discourse among the participants. The level of interest in a topic was an essential factor in promoting discussion. The immediate relevancy of a topic to a participant at a particular time was also an influential element to the depth of the dialogue. Furthermore, interpersonal factors among participants were salient elements in promoting discourse. The participants were a group of preservice teachers experiencing similar situations during their student teaching internships. As the participants encountered similar classroom management and discipline problems, they used the forum to share and discuss their related situations.

Discussion of controversial topics also increased the depth of the forum dialogue. On the forum, participants expressed their personal opinions and views in discussions involving ethical issues. Throughout the discourse and in the participants' interviews, several critical incidents were referred to as "touchy" or controversial issues. Discussing controversial issues was perceived by these participants as a way to get them "fired up". Furthermore, they were interested in hearing what their peers thought or how they would react to a given situation. In the discourse, participants explained and defended their moral positions and beliefs. Some participants also said they were more willing to contribute to the discussion of sensitive issues than to other topics.

The forum promoted discussion by allowing access to others' perspectives. It allowed for different opinions to be analyzed and agreed with or argued against. For students who were isolated in their student teaching placements, the forum promoted discussion just by being there. The forum provided a place where isolated student teachers could share and discuss their teaching experiences.

### Inhibiting Online Discussion

The interface of the Web-based forum appeared to be a factor that limited the depth of discussion on the forum. Replies to posted messages are organized temporally with the newest reply at the bottom of the message thread. This mirrors the organization of a bulletin board system. Users could also read an entire thread of successive replies to an initial message. In this manner, an entire thread resembled a face-to-face conversation. However, the nature of communicating asynchronously in a temporal, linear manner was sometimes perceived as restricting the discourse. The nature of asynchronous communication does not promote an immediate back-and-forth dialogue that is often required by a person to get the specific type of feedback one needs. When a person engages in face-to-face conversation, the nature of the communication is often a continuous process. A natural flow of conversation is not easily achieved when participants access the forum on a weekly basis. The forum interface does promote a reply, but not a “back and forth, back and forth” discussion. Participants viewed the forum’s linear structure as impeding the flexibility of the communication because they could not place their replies directly to specific messages in a thread.

A large number of participants responding to the same critical incident appeared to cause a saturation effect in the discourse. In many of the message threads, after half of the students responded, the responses began to “sound along the same lines”. Some participants read the postings of others and then contributed to the dialogue by restating previous ideas by adding "a new twist" to the discourse. In some cases, the participants responded to a critical incident without reading the responses of others. However, this was not the case for all participant postings in the latter stages of the thread. There were students who often posted toward the end of a message thread with a reflective posting that built on the ideas of others. In order to reduce this saturation effect, one might want to consider reducing the number of participants responding to a critical incident, or have a group of students adopt different thinking-related roles in their response to the discourse generated in a critical incident thread. These roles could include a "devil's advocate", speculator, brainstormer, optimist, pessimist, or judge. Even though we structured critical incidents with dialogue prompts to intentionally promote discussion of science-specific pedagogy, it appears that more structure is required in order to facilitate large group discussions on the Web.

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## Appendix A

### Teacher's Attitudes Toward Information Technology Survey

Name:______________________________ Date:___________

### Teacher's Attitudes Toward Information Technology

To the Educator:

This questionnaire is designed to assess your perceptions of the use of information technology for your own productivity as well as for the benefit of your students. It should require about 10 minutes of your time. Usually it is best to respond with your first impressions, without giving a question much thought. Your answers will remain confidential.

Thank you for your cooperation!

Alec M. Bodzin, The SERVIT Group, North Carolina State University

Background questions:

Courses anticipate student teaching:_______________________________________

Science concentration area: _______________________________

How much experience do you have using the World Wide Web?

How much experiences do you have using a Bulletin Board System (BBS), Chat, Web-based forums, or other electronic conferencing systems?

How often do you use a computer in a week other than when connected to the SciTeach forum?
1-2 times 3-4 times 5-6 times daily

How confident do you feel using....

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| a. a computer | not confident- | __ | __ | __ | __ | __ | __ | -very confident |
| b. e-mail | not confident- | __ | __ | __ | __ | __ | __ | -very confident |
| c. the World Wide Web | not confident- | __ | __ | __ | __ | __ | __ | -very confident |
| d. a Web-based forum | not confident- | __ | __ | __ | __ | __ | __ | -very confident |

# Electronic mail

**Instructions: Place an 'x' between each adjective pair to indicate how you feel about the object.**

To **me**, **using electronic mail** is:

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1. important | _____ | _____ | _____ | _____ | _____ | _____ | _____ | unimportant |
| 2. boring | _____ | _____ | _____ | _____ | _____ | _____ | _____ | interesting |
| 3. relevant | _____ | _____ | _____ | _____ | _____ | _____ | _____ | irrelevant |
| 4. exciting | _____ | _____ | _____ | _____ | _____ | _____ | _____ | unexciting |
| 5. means nothing | _____ | _____ | _____ | _____ | _____ | _____ | _____ | means a lot |
| 6. appealing | _____ | _____ | _____ | _____ | _____ | _____ | _____ | unappealing |
| 7. fascinating | _____ | _____ | _____ | _____ | _____ | _____ | _____ | mundane |
| 8. worthless | _____ | _____ | _____ | _____ | _____ | _____ | _____ | valuable |
| 9. involving | _____ | _____ | _____ | _____ | _____ | _____ | _____ | uninvolving |
| 10. not needed | _____ | _____ | _____ | _____ | _____ | _____ | _____ | needed |

For **my students**, **using electronic mail** is::

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1. important | _____ | _____ | _____ | _____ | _____ | _____ | _____ | unimportant |
| 2. boring | _____ | _____ | _____ | _____ | _____ | _____ | _____ | interesting |
| 3. relevant | _____ | _____ | _____ | _____ | _____ | _____ | _____ | irrelevant |
| 4. exciting | _____ | _____ | _____ | _____ | _____ | _____ | _____ | unexciting |
| 5. means nothing | _____ | _____ | _____ | _____ | _____ | _____ | _____ | means a lot |
| 6. appealing | _____ | _____ | _____ | _____ | _____ | _____ | _____ | unappealing |
| 7. fascinating | _____ | _____ | _____ | _____ | _____ | _____ | _____ | mundane |
| 8. worthless | _____ | _____ | _____ | _____ | _____ | _____ | _____ | valuable |
| 9. involving | _____ | _____ | _____ | _____ | _____ | _____ | _____ | uninvolving |
| 10. not needed | _____ | _____ | _____ | _____ | _____ | _____ | _____ | needed |

# World Wide Web

**Instructions: Place an 'x' between each adjective pair to indicate how you feel about the object.**

To **me**, **using the World Wide Web** is:

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1. important | _____ | _____ | _____ | _____ | _____ | _____ | _____ | unimportant |
| 2. boring | _____ | _____ | _____ | _____ | _____ | _____ | _____ | interesting |
| 3. relevant | _____ | _____ | _____ | _____ | _____ | _____ | _____ | irrelevant |
| 4. exciting | _____ | _____ | _____ | _____ | _____ | _____ | _____ | unexciting |
| 5. means nothing | _____ | _____ | _____ | _____ | _____ | _____ | _____ | means a lot |
| 6. appealing | _____ | _____ | _____ | _____ | _____ | _____ | _____ | unappealing |
| 7. fascinating | _____ | _____ | _____ | _____ | _____ | _____ | _____ | mundane |
| 8. worthless | _____ | _____ | _____ | _____ | _____ | _____ | _____ | valuable |
| 9. involving | _____ | _____ | _____ | _____ | _____ | _____ | _____ | uninvolving |
| 10. not needed | _____ | _____ | _____ | _____ | _____ | _____ | _____ | needed |

For **my students**, **using the World Wide Web** is:

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1. important | _____ | _____ | _____ | _____ | _____ | _____ | _____ | unimportant |
| 2. boring | _____ | _____ | _____ | _____ | _____ | _____ | _____ | interesting |
| 3. relevant | _____ | _____ | _____ | _____ | _____ | _____ | _____ | irrelevant |
| 4. exciting | _____ | _____ | _____ | _____ | _____ | _____ | _____ | unexciting |
| 5. means nothing | _____ | _____ | _____ | _____ | _____ | _____ | _____ | means a lot |
| 6. appealing | _____ | _____ | _____ | _____ | _____ | _____ | _____ | unappealing |
| 7. fascinating | _____ | _____ | _____ | _____ | _____ | _____ | _____ | mundane |
| 8. worthless | _____ | _____ | _____ | _____ | _____ | _____ | _____ | valuable |
| 9. involving | _____ | _____ | _____ | _____ | _____ | _____ | _____ | uninvolving |
| 10. not needed | _____ | _____ | _____ | _____ | _____ | _____ | _____ | needed |

## Web-based Forums

**Instructions: Place an 'x' between each adjective pair to indicate how you feel about the object.**

To **me**, **using Web-based forums** are:

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1. important | _____ | _____ | _____ | _____ | _____ | _____ | _____ | unimportant |
| 2. boring | _____ | _____ | _____ | _____ | _____ | _____ | _____ | interesting |
| 3. relevant | _____ | _____ | _____ | _____ | _____ | _____ | _____ | irrelevant |
| 4. exciting | _____ | _____ | _____ | _____ | _____ | _____ | _____ | unexciting |
| 5. means nothing | _____ | _____ | _____ | _____ | _____ | _____ | _____ | means a lot |
| 6. appealing | _____ | _____ | _____ | _____ | _____ | _____ | _____ | unappealing |
| 7. fascinating | _____ | _____ | _____ | _____ | _____ | _____ | _____ | mundane |
| 8. worthless | _____ | _____ | _____ | _____ | _____ | _____ | _____ | valuable |
| 9. involving | _____ | _____ | _____ | _____ | _____ | _____ | _____ | uninvolving |
| 10. not needed | _____ | _____ | _____ | _____ | _____ | _____ | _____ | needed |

For **my students**, **using Web-based forums** are:

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1. important | _____ | _____ | _____ | _____ | _____ | _____ | _____ | unimportant |
| 2. boring | _____ | _____ | _____ | _____ | _____ | _____ | _____ | interesting |
| 3. relevant | _____ | _____ | _____ | _____ | _____ | _____ | _____ | irrelevant |
| 4. exciting | _____ | _____ | _____ | _____ | _____ | _____ | _____ | unexciting |
| 5. means nothing | _____ | _____ | _____ | _____ | _____ | _____ | _____ | means a lot |
| 6. appealing | _____ | _____ | _____ | _____ | _____ | _____ | _____ | unappealing |
| 7. fascinating | _____ | _____ | _____ | _____ | _____ | _____ | _____ | mundane |
| 8. worthless | _____ | _____ | _____ | _____ | _____ | _____ | _____ | valuable |
| 9. involving | _____ | _____ | _____ | _____ | _____ | _____ | _____ | uninvolving |
| 10. not needed | _____ | _____ | _____ | _____ | _____ | _____ | _____ | needed |

# <u>Multimedia</u>

**Instructions: Place an 'x' between each adjective pair to indicate how you feel about the object.**

To **me**, **multimedia** is:

| | | |
|---|---|---|
| 1. important | _____ _____ _____ _____ _____ _____ _____ | unimportant |
| 2. boring | _____ _____ _____ _____ _____ _____ _____ | interesting |
| 3. relevant | _____ _____ _____ _____ _____ _____ _____ | irrelevant |
| 4. exciting | _____ _____ _____ _____ _____ _____ _____ | unexciting |
| 5. means nothing | _____ _____ _____ _____ _____ _____ _____ | means a lot |
| 6. appealing | _____ _____ _____ _____ _____ _____ _____ | unappealing |
| 7. fascinating | _____ _____ _____ _____ _____ _____ _____ | mundane |
| 8. worthless | _____ _____ _____ _____ _____ _____ _____ | valuable |
| 9. involving | _____ _____ _____ _____ _____ _____ _____ | uninvolving |
| 10. not needed | _____ _____ _____ _____ _____ _____ _____ | needed |

For **my students**, **multimedia** is:

| | | |
|---|---|---|
| 1. important | _____ _____ _____ _____ _____ _____ _____ | unimportant |
| 2. boring | _____ _____ _____ _____ _____ _____ _____ | interesting |
| 3. relevant | _____ _____ _____ _____ _____ _____ _____ | irrelevant |
| 4. exciting | _____ _____ _____ _____ _____ _____ _____ | unexciting |
| 5. means nothing | _____ _____ _____ _____ _____ _____ _____ | means a lot |
| 6. appealing | _____ _____ _____ _____ _____ _____ _____ | unappealing |
| 7. fascinating | _____ _____ _____ _____ _____ _____ _____ | mundane |
| 8. worthless | _____ _____ _____ _____ _____ _____ _____ | valuable |
| 9. involving | _____ _____ _____ _____ _____ _____ _____ | uninvolving |
| 10. not needed | _____ _____ _____ _____ _____ _____ _____ | needed |

# <u>Professional Productivity</u>

**Instructions: Place an 'x' between each adjective pair to indicate how you feel about the object.**

To **me**, **using computers for my professional productivity** is:

| | | |
|---|---|---|
| 1. important | _____ _____ _____ _____ _____ _____ _____ | unimportant |
| 2. boring | _____ _____ _____ _____ _____ _____ _____ | interesting |
| 3. relevant | _____ _____ _____ _____ _____ _____ _____ | irrelevant |
| 4. exciting | _____ _____ _____ _____ _____ _____ _____ | unexciting |
| 5. means nothing | _____ _____ _____ _____ _____ _____ _____ | means a lot |
| 6. appealing | _____ _____ _____ _____ _____ _____ _____ | unappealing |
| 7. fascinating | _____ _____ _____ _____ _____ _____ _____ | mundane |
| 8. worthless | _____ _____ _____ _____ _____ _____ _____ | valuable |
| 9. involving | _____ _____ _____ _____ _____ _____ _____ | uninvolving |
| 10. not needed | _____ _____ _____ _____ _____ _____ _____ | needed |

For **my students**, **using computers in the classroom** is:

| | | |
|---|---|---|
| 1. important | _____ _____ _____ _____ _____ _____ _____ | unimportant |
| 2. boring | _____ _____ _____ _____ _____ _____ _____ | interesting |
| 3. relevant | _____ _____ _____ _____ _____ _____ _____ | irrelevant |
| 4. exciting | _____ _____ _____ _____ _____ _____ _____ | unexciting |
| 5. means nothing | _____ _____ _____ _____ _____ _____ _____ | means a lot |
| 6. appealing | _____ _____ _____ _____ _____ _____ _____ | unappealing |
| 7. fascinating | _____ _____ _____ _____ _____ _____ _____ | mundane |
| 8. worthless | _____ _____ _____ _____ _____ _____ _____ | valuable |
| 9. involving | _____ _____ _____ _____ _____ _____ _____ | uninvolving |
| 10. not needed | _____ _____ _____ _____ _____ _____ _____ | needed |

# Appendix B

## SciTeach Forum Survey

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

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.
strongly disagree- __ __ __ __ __ __ -strongly agree

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

# Appendix C

## SciTeach Forum Discussion Topics

<u>Science-specific Pedagogy (n=10)</u>
Demonstrations
Instructional Laboratories
Research in Science Education
Science Fair project ideas
Sounds of Science
Science House
Quick Help
Staff Development Opportunities
Critical Incidents in the Science Classroom
Science Brain Teasers

<u>Instructional Technology (n=14)</u>
IMSE CD-ROM
Animations from the World Wide Web
CD-ROMs for Science
Computer Assisted Instruction (CAI) and tutorial software
Data Collection and Analysis Tools
Datasets from the World Wide Web
HyperStudio/Hypercard
Laserdiscs and video
Science Software Simulations
Search engines on the World Wide Web
Telecommunications in the classroom
Video conferencing/CU SEE-ME in the science classroom
Web site reviews and evaluations
Apparatus and Equipment Folder

<u>General Pedagogy (11)</u>
Classroom Management Strategies
Portfolios - development and evaluation
Pre-Service Science Teachers
Working with Special Students
Learning and Teaching Models
Assessment Strategies
First Year Science Teachers
Teachable Moments
Locating good (and cheap) materials
Humor in the Classroom
Student kindness

# Appendix D

## Forum Coding Categories Examples

**Emergent Message Type Categories (Preservice Teachers)**:

1. Classroom experiences: Statements referring to an event that occurs in the classroom.

Example:
This very comment has been said to me in my classroom. I told the student that science is about figuring out how the world works, like an investigation into nature, and that he could not truly learn about science without participating in this investigation. I reminded him that I could tell him anything but only if he saw it for himself, would he actually know for sure.

2. Science Pedagogy: Statements pertaining to science-specific pedagogy and not general pedagogy.

Example:
I would have the students post their data so that they could have a discussion about the different numbers. I would want them to try to think about what factors may have been different between the groups. After they talked about that, I would let them do another verification lab and compare their results. Hopefully, these results would be a little closer to the norm and this would help demonstrate the concept a little more clearly.

3. Nature of Teaching: Statements relating to classroom instruction, methods, or classroom management issues; the role of the teacher; and specific teacher-student interactions.

Example:
Again, I say that science is truly relevant and that a teacher presented with this question should be able to explain it's (science's) relevance. If it's not important then why are we teaching it? It must be relevant in our eyes.

4. Support: Statements referring to support, including receiving or giving support, and supporting one's ideas.

Example:
Do not be discouraged. I want you to know that frustration can sometimes develop a voice and speak. Ignore frustration. There are many of us who are having a ball student teaching. I love it as well, however, I too have been frustrated. I am wise though. I silence my frustration. Don't hold the comments against those teachers. It is probably that they gave there frustration an opportunity to speak and you just were there to overhear it. I admire anyone who has taught for 20+ years. Those teachers are to be admired. Just realize that they are human and humans can and do get frustrated.

5. Concern for students: Statements pertaining to the welfare of classroom students.

Example:
I wouldn't want to offend the students who are not artistic. To them they may have drawn an onion cell. It just might not look like the onion cell you want to see. I'd ask the student to explain his or her drawing to me.

6. Requests for information: Statements or specific questions which ask for information, advice or ideas.

Example:
If issues about life arise, should we take the time to educate according to our own individual personal beliefs or should we leave that up to scout masters, clergy, and parents?

7.Resources: Statements in which students share resources including teaching ideas, general information, or instructional strategies.

I have one book that's really neat. It's THE FLYING CIRCUS OF PHYSICS by Jearl Walker. It is copyright 1975 and the ISBN number is 0-471-91808-3. It is a compilation of hundreds of fun real-world physics questions/teasers. E-mail me back if you want to see it.

8.Social Acknowledgments: Statements in which a student acknowledges an idea presented on the forum.

Example:
I too have students who seem to be absent often and it is hard to keep them up with the rest of the class. This is especially hard when they are missing labs and I don't have access to the materials but just those days I reserved them. What I have done is always give the students 3 days to make up missed work. I have told them that they can set up a time with me before or after school and I will go over what they missed with them. I know this is kind of punishing me in a way, but I don't see any other option. I can't just stop class so this one student can catch up. They have to take on the responsibility that comes with being absent and make up that work.

**Emergent Reflective Discourse Categories**:

1. Perceptions: Insight, intuition; knowledge gained by observing; becoming aware in one’s mind.

Example:
Science is not cut and dry. A major component of science is curiosity. A good thing to do at this point is to open class discussion and dialogue as to what could have happened. Also the groups could engage in trouble shooting their experiment to see if they followed directions properly or if something unexpected happened. The precision of scientific inquiry could also be discussed.

2. Asking focused questions: Asking focused questions to build on ideas previously presented in the message thread.
Example:

Why have females been lagging behind in the field of science? Have our educators not been sparking their interest? Have they been drawing the females attention away from math and science and gearing it more towards liberal arts areas? Have our teachers been turning to the males for correct responses and been setting higher expectations for the males? Have educators been accepting that females are just "not as good in science" or what? These are a few questions that researchers have been confronted with for years. So how, as a new science teacher, will I deal with the prejudice of a male dominated field?

3. Peer scaffolding: A statement that builds on a previous posting in the message thread.

Example:
First of all, I would recognize the student's comment. To ignore a direct comment in class like this one would lead to more problems. The other students would try to force you to acknowledge the dilemma if they see that you are avoiding it. I would point out that science is based on facts and data collected from experimentation and research. Religion is an entirely different entity, a foundation of beliefs based on moral judgments, faith, and ancient scriptures. The 6 day creation is a widely accepted belief by many people. Likewise, evolution is a widely accepted scientific theory. Then I would stress the point that this is a science class, therefore, we are focusing on science.

I must admit personally that this would be a difficult issue to handle. I would prefer to avoid an in-depth discussion about the matter because some parents can become very concerned about the welfare of their students if they hear that science class challenged their religious beliefs. As a public school teacher, it would not be appropriate for me to pass on my personal opinions about evolution and creationism in my class. While students, such as the one in the critical incident, should be allowed to express their opinions in class, they should also be restrained from going any further. Science class should not be allowed to become a pulpit for students to get out of hand and interject their religious views during class. However, it is always important to acknowledge that people are entitled to their own individual opinions and beliefs.

**Peer Scaffolding Was Further Subdivided into the Following Themes**:

1. Guidance and feedback: Messages that build on a previous response in the thread that offers some type of guidance and feedback on the issue discussed. Can include a response to a stated activity or provide movement of an issue into a new direction.

Example:
I believe that by doing this (and not TELLING them what the answer should have been) the students will WANT to redo the experiment using the error
reduction techniques that they have thought of. This will solidify the need to be very careful when doing science experiments.

2. General advice: Messages that offer general advice or personal views to further develop an idea in the message thread.

Example:
If a teacher does pursue this discussion in class, do so in a discussion forum, or a round-circle discussion. This puts students at ease and each person has visual contact with the

other students. This helps develop the listening, thinking, and communicating process.

3. Modeling pedagogical practices: Messages that augment an idea by illustrating a pedagogical practice.

Example:
I agree with Joey. I think that the issue should not be one that just "pops up" in class. I think that when you start developing this type of lesson you need to take this into account. You could start the lesson with an example which helps them "see" adaptations that occur in a short period of time -i.e. the white moths in pre-Industrial Revolution Europe that became black moths within a few decades due to the pollution of their habitat. By doing this you could help them see that evolution does exist.

**The Emergent Message Type Categories for Instructors**:

1. Resources: Statements in which instructor provide instructional resources including materials, equipment, software, and Web sites.

Example:
TERC's testbed for collaboration, online at http://teaparty.terc.edu has available online a step-by-step hand-out that allows you to download online data directly into a spreadsheet program. The copy I currently have tells you how to configure Netscape 2.0 and 3.0.

TERC's CLEO (Collaborative Learning Environments On-line), has an online area where teachers and students design and publish data-rich inquiry projects in science and mathematics. You can browse through their library, join collaborations, and author your own projects. Registration is open to all interested educators and students. They use a software package called Alice Data Tools software to facilitate analyzing spreadsheet data.

2.General advice: A message which offers general advice. It can be the first topic in a message thread and in which no scaffolding occurs in the posting.

Example:
Computer-aided instruction can come in handy for certain topic areas and for certain students. If you can get hold of just one computer for your classroom, it could be used as a station. Students could use it during "down time" in class, during lunch, or after school. n my experience, students respond very positively to software (chemistry) that helps teach how to balance chemical equations and (physics) teach ray diagrams for mirrors and lenses and the particles of modern physics. CAI helps students at both ends of the scale. It's good for remediation and it's good as an extension.

3.Response to Questions: Statements that are responses to specific questions.

Example:
As far as I know, teachers are allowed to buy software out of their own pocket and bring it

into their classroom to use with their students as long as they are following the software license statement included with the software. For example, if the license states that only one copy of the software can be loaded on only one computer, then the teacher could legally only load it on one classroom computer and no where else. Sometimes, licenses will permit you to load one copy of the software at work and one copy at home.

4. Instructional pedagogy: Statements of general teaching methods or instruction.

Example:
Many demonstrations usually classified as a demonstration for Newton's Laws are actually demonstrations of impulse. Take for instance the card and coin demo. Why do you have to move the card fast for the demo to work? Does the coin have more inertia when the card is moved fast as compared to moving it slow? In order to move the coin as fast as the card, the frictional force must be large enough to produce the required change in momentum of the coin (m times change in v). An impulse, a force over a period of time (F times the change in time) is required to produce a change in momentum. If the frictional force is not great enough to produce the required change in momentum, the coin will not "keep up" with the card and it will fall. Most inertia demos are actually impulse demos.

5. Purposeful questions: Purposeful questions asked regarding a student posting.

Example:
When the students have been working in groups or talking, how do you like to call them back to order? Have you seen some techniques that work well? I've seen blinking the light switch, holding a hand up with 5 fingers and silently counting down, and saying "if you can hear my voice, raise your hand" and keep saying it until they all have their hands up. What feels natural?

6. Support: Statements referring to supporting the preservice teachers in their student teaching placements.

Example:
As a student teacher/intern you have less control over "your" classroom than you will as a teacher. Usually the cooperating teacher (CT) is willing for the intern to try a variety of strategies in their teaching, so I would encourage you to approach your CT with lesson plans that reflect the philosophy you support. If you feel some resistance from the CT, talk with your wonderful, supportive University Supervisor (US) and let him work with the CT. Your intern placement is in a situation that really should support creative teaching and inquiry lesson. I have no doubt that you will be able to carry this off.

**The Emergent Instructor Scaffolding Categories**:

1. Guidance and feedback: Messages that build on a previous response in the thread that offers some type of guidance and feedback on the issue discussed. Can include a response to a stated activity or provide movement of an issue into a new direction.

Example:
Yep. I think it is a mistake to use a good educational method (laboratory) as a behavior modifier. Don't give the control of your class over to your students by saying "If you don't do X, then I will do Y." Set the rule and enforce it without eliminating good teaching practice.

2. General advice: Messages that offer general advice to further develop an idea in the message thread.

Example:
Teaching with someone who has a different style and philosophy than you may be more challenging, but you can still learn a great deal from your CT. When I student taught my CT was very traditional and we were on opposite ends of the spectrum in regards to teaching style. However, she was an amazing organizer and task master with great classroom management strategies. She helped me improve in those areas. She also encouraged me to teach in the manner and philosophy that suited me. In short, if you seem willing to learn, your CT will be supportive and helpful when you begin to excerpt your style in the classroom. Good luck!

3. Modeling pedagogical practices: Messages that augment an idea by illustrating a pedagogical practice.

Example:
I think Tanya has a good idea here. On the first day of class I like to send the paperwork home and do demos. In physics, most students don't really know what they will be studying so I would choose my flashiest demo from mechanics, thermo, optics, electricity, and modern physics and do them all saying, "By the end of the year you will be able to explain how these work."

# Appendix E

## Interview Questions

The following is a list of questions used in the interviews. Interviews were semi-structured.

What specific experiences of this electronic activity was most valuable?

What specific experiences of this electronic activity was least valuable?

How did the "critical incidents" help to prepare you for your student teaching internship?

How has interacting with the "critical incidents" topic influenced your teaching approaches and decision making?

How do you read the conversation threads in the Web-based forum?

How is the Web-based forum like a community network?

What seems to affect the depth of the dialogue in the Web-based forum?

What are the differences between Web-based communication and face-to-face communication?

How does the Web-based medium promote discussion?

How does the Web-based medium inhibit discussion?

# Appendix F

## Message Posting Times of Preservice Teachers

| | Week 1 | Week 2 | Week 3 | Week 4 | Week 5 | Week 6 | Week 7 | Week 8 |
|---|---|---|---|---|---|---|---|---|
| school hours | 69 | 33 | 24 | 23 | 39 | 16 | 14 | 17 |
| M-Th evenings | 0 | 27 | 32 | 29 | 18 | 18 | 31 | 21 |
| weekends | 0 | 6 | 9 | 9 | 5 | 20 | 14 | 14 |
| Total | 69 | 66 | 65 | 61 | 62 | 54 | 59 | 52 |
| % school hours | 100% | 50% | 37% | 38% | 63% | 30% | 24% | 33% |
| % M-Th evenings | 0% | 41% | 49% | 48% | 29% | 33% | 53% | 40% |
| % weekends | 0% | 9% | 14% | 15% | 8% | 37% | 24% | 27% |

| | Week 9 | Week 10 | Week 11 | Week 12 | Week 13 | Week 14 | Week 15 | Week 16 |
|---|---|---|---|---|---|---|---|---|
| school hours | 6 | 25 | 15 | 17 | 20 | 14 | 10 | 17 |
| M-Th evenings | 10 | 18 | 23 | 16 | 23 | 25 | 11 | 14 |
| weekends | 17 | 29 | 14 | 31 | 11 | 8 | 3 | 22 |
| Total | 33 | 72 | 52 | 64 | 54 | 47 | 24 | 53 |
| % school hours | 18% | 35% | 29% | 27% | 37% | 30% | 42% | 32% |
| % M-Th evenings | 30% | 25% | 44% | 25% | 43% | 53% | 46% | 26% |
| % weekends | 52% | 40% | 27% | 48% | 20% | 17% | 13% | 42% |

| | **Total postings** |
|---|---|
| school hours | 359 |
| M-Th evenings | 316 |
| weekends | 212 |
| Total | 887 |
| % school hours | 40% |
| % M-Th evenings | 36% |
| % weekends | 24% |

## Appendix G

## Forum Topic Use of Preservice Science Teachers

| Topic | Content | Topic Use | # of threads | total messages | threads w/o replies | % w/o replies |
|---|---|---|---|---|---|---|
| Brain Teasers | 1 | 1 | 1 | 3 | 0 | 0% |
| Critical Incidents | 1 | 1 | 21 | 472 | 0 | 0% |
| Demonstrations | 1 | 0 | 13 | 19 | 8 | 62% |
| Labs | 1 | 0 | 7 | 19 | 3 | 43% |
| Quick Help | 1 | 2 | 3 | 4 | 2 | 67% |
| Research | 1 | 2 | 1 | 1 | 1 | 100% |
| Science Fair | 1 | 0 | 0 | 0 | 0 | NA |
| Science House | 1 | 1 | 4 | 8 | 0 | 0% |
| Sounds | 1 | 1 | 0 | 0 | 0 | NA |
| Staff Development | 1 | 1 | 0 | 0 | 0 | NA |
| Animations | 2 | 0 | 1 | 1 | 1 | 100% |
| Apparatus | 2 | 1 | 1 | 5 | 0 | 0% |
| CAI | 2 | 1 | 2 | 3 | 1 | 50% |
| CD-ROMs | 2 | 1 | 1 | 1 | 1 | 100% |
| CU SEE-ME | 2 | 3 | 0 | 0 | 0 | NA |
| Data Collection | 2 | 2 | 1 | 3 | 0 | NA |
| Datasets | 2 | 2 | 3 | 7 | 1 | 33% |
| HyperStudio | 2 | 0 | 2 | 3 | 1 | 50% |
| IMSE CD-ROM | 2 | 1 | 1 | 2 | 0 | 0% |
| Laserdiscs | 2 | 0 | 4 | 8 | 2 | 50% |
| Search engines | 2 | 2 | 1 | 1 | 1 | 100% |
| Simulations | 2 | 0 | 2 | 3 | 1 | 50% |
| Telecommunications | 2 | 3 | 0 | 0 | 0 | NA |
| Web site reviews | 2 | 1 | 3 | 3 | 3 | 100% |
| Assessment | 3 | 3 | 5 | 21 | 3 | 60% |
| Class Management | 3 | 3 | 15 | 86 | 1 | 7% |
| First Year | 3 | 0 | 1 | 2 | 0 | 0% |
| Humor | 3 | 1 | 13 | 27 | 7 | 54% |
| Locating materials | 3 | 0 | 9 | 15 | 6 | 67% |
| Portfolios | 3 | 1 | 7 | 21 | 2 | 29% |
| Pre-Service | 3 | 3 | 17 | 104 | 3 | 18% |
| Special Students | 3 | 3 | 5 | 14 | 2 | 40% |
| Student kindness | 3 | 3 | 2 | 10 | 0 | 0% |
| Teachable Moments | 3 | 3 | 7 | 26 | 1 | 14% |
| Teaching Models | 3 | 1 | 0 | 0 | 0 | NA |

| | # of threads | total messages | threads w/o replies |
|---|---|---|---|
| Total - Grand | 153 | 892 | 51 |
| Total Content 1 | 50 | 526 | 14 |
| Total Content 2 | 22 | 40 | 12 |
| Total Content 3 | 81 | 326 | 25 |
| Total Content 1 (excluding Critical Incidents) | 29 | 54 | 14 |

Note: Content 1 = Science specific pedagogy
Content 2 = Instructional technology
Content 3 = General pedagogy

Topic Use 0 = Topics not used by participants
Topic Use 1 = Topics rarely used by participants (1-3 threads and contains messages with 0-1 responses)
Topic Use 2 = Topics sometimes used by participants (4-6 threads)
Topic Use 3 = Topics often used by participants (7 or more threads)

## Appendix H

## Message Thread Data

| Thread | # of Thread | length (days) | peer response | # instructor response | # outside response | student originated |
|---|---|---|---|---|---|---|
| Animations 1 | 1 | 1 | 0 | 0 | 0 | no |
| Apparatus 1 | 5 | 9 | 1 | 3 | 0 | yes |
| Assessment 1 | 12 | 60 | 10 | 1 | 0 | yes |
| Assessment 2 | 1 | 1 | 0 | 0 | 0 | yes |
| Assessment 3 | 6 | 33 | 4 | 1 | 0 | yes |
| Assessment 5 | 1 | 1 | 0 | 0 | 0 | yes |
| Assessment 4 | 1 | 1 | 0 | 0 | 0 | yes |
| Brain teasers 1 | 3 | 2 | 2 | 0 | 0 | yes |
| CAI 1 | 1 | 1 | 0 | 0 | 0 | no |
| CAI 2 | 2 | 1 | 0 | 1 | 0 | yes |
| CD-ROMs 1 | 1 | 1 | 0 | 0 | 0 | no |
| CI1 | 29 | 4 | 28 | 0 | 0 | no |
| CI2 | 32 | 8 | 31 | 0 | 0 | no |
| CI3 | 29 | 34 | 27 | 0 | 1 | no |
| CI4 | 34 | 21 | 32 | 0 | 1 | no |
| CI5 | 34 | 8 | 33 | 0 | 0 | no |
| CI6 | 30 | 35 | 29 | 0 | 0 | no |
| CI7 | 30 | 28 | 29 | 0 | 0 | no |
| CI8 | 28 | 21 | 27 | 0 | 0 | no |
| CI9 | 29 | 15 | 28 | 0 | 0 | no |
| CI10 | 29 | 10 | 28 | 0 | 0 | no |
| CI11 | 24 | 22 | 23 | 0 | 0 | no |
| CI12 | 2 | 2 | 1 | 0 | 0 | yes |
| CI13 | 7 | 6 | 6 | 0 | 0 | yes |
| CI14 | 4 | 10 | 3 | 0 | 0 | yes |
| CI15 | 24 | 36 | 23 | 0 | 0 | no |
| CI16 | 10 | 31 | 9 | 0 | 0 | yes |
| CI17 | 29 | 28 | 28 | 0 | 0 | no |
| CI18 | 25 | 21 | 24 | 0 | 0 | no |
| CI19 | 17 | 14 | 13 | 0 | 0 | no |
| CI20 | 24 | 10 | 23 | 0 | 0 | no |
| CI21 | 2 | 4 | 1 | 0 | 0 | yes |
| CM1 | 9 | 38 | 7 | 1 | 0 | no |
| CM2 | 7 | 12 | 6 | 0 | 0 | yes |
| CM3 | 8 | 27 | 7 | 0 | 0 | yes |
| CM4 | 2 | 2 | 1 | 0 | 0 | yes |
| CM5 | 2 | 3 | 1 | 0 | 0 | yes |
| CM6 | 15 | 12 | 14 | 0 | 0 | yes |
| CM7 | 5 | 14 | 4 | 0 | 0 | yes |
| CM8 | 10 | 24 | 8 | 0 | 1 | yes |
| CM9 | 3 | 6 | 1 | 1 | 0 | yes |
| CM10 | 4 | 16 | 3 | 0 | 0 | yes |
| CM11 | 6 | 11 | 5 | 0 | 0 | yes |
| CM12 | 8 | 7 | 6 | 0 | 0 | yes |
| CM13 | 4 | 7 | 3 | 0 | 0 | yes |
| CM14 | 2 | 19 | 1 | 0 | 0 | yes |
| CM15 | 1 | 1 | 0 | 0 | 0 | yes |

| Thread | # of Thread | length (days) | peer response | # instructor response | # outside response | student originated |
|---|---|---|---|---|---|---|
| Data 1 | 3 | 23 | 2 | 0 | 0 | no |
| Datasets 1 | 2 | 3 | 0 | 1 | 0 | no |
| Datasets 2 | 1 | 1 | 0 | 0 | 0 | yes |
| Datasets 3 | 4 | 39 | 0 | 2 | 1 | no |
| Demo 1 | 2 | 4 | 0 | 1 | 0 | yes |
| Demo 2 | 1 | 1 | 0 | 0 | 0 | yes |
| Demo 3 | 1 | 1 | 0 | 0 | 0 | no |
| Demo 4 | 3 | 9 | 2 | 0 | 0 | yes |
| Demo 5 | 1 | 1 | 0 | 0 | 0 | yes |
| Demo 6 | 2 | 5 | 0 | 1 | 0 | yes |
| Demo 7 | 2 | 11 | 1 | 0 | 0 | yes |
| Demo 8 | 1 | 1 | 0 | 0 | 0 | yes |
| Demo 9 | 1 | 1 | 0 | 0 | 0 | yes |
| Demo 10 | 1 | 1 | 0 | 0 | 0 | yes |
| Demo 11 | 2 | 8 | 0 | 1 | 0 | yes |
| Demo 12 | 1 | 1 | 0 | 0 | 0 | yes |
| Demo 13 | 1 | 1 | 0 | 0 | 0 | yes |
| First year 1 | 2 | 2 | 0 | 1 | 0 | yes |
| Humor 1 | 2 | 8 | 1 | 0 | 0 | yes |
| Humor 2 | 3 | 11 | 2 | 0 | 0 | no |
| Humor 3 | 1 | 1 | 0 | 0 | 0 | yes |
| Humor 4 | 5 | 25 | 4 | 0 | 0 | yes |
| Humor 5 | 3 | 30 | 1 | 0 | 1 | yes |
| Humor 6 | 5 | 5 | 4 | 0 | 0 | yes |
| Humor 7 | 1 | 1 | 0 | 0 | 0 | yes |
| Humor 8 | 1 | 1 | 0 | 0 | 0 | yes |
| Humor 9 | 1 | 1 | 0 | 0 | 0 | yes |
| Humor 10 | 1 | 1 | 0 | 0 | 0 | yes |
| Humor 11 | 1 | 1 | 0 | 0 | 0 | yes |
| Humor 12 | 1 | 1 | 0 | 0 | 0 | yes |
| Humor 13 | 2 | 7 | 1 | 0 | 0 | yes |
| Hyperstudio 1 | 1 | 1 | 0 | 0 | 0 | no |
| Hyperstudio 2 | 2 | 5 | 0 | 1 | 0 | yes |
| IMSE 1 | 2 | 1 | 0 | 1 | 0 | yes |
| kindness 1 | 7 | 20 | 6 | 0 | 0 | yes |
| kindness 2 | 3 | 5 | 2 | 0 | 0 | yes |
| labs 1 | 5 | 15 | 4 | 0 | 0 | yes |
| labs 2 | 2 | 2 | 1 | 0 | 1 | no |
| labs 3 | 7 | 32 | 6 | 1 | 0 | no |
| labs 4 | 2 | 9 | 0 | 1 | 0 | yes |
| labs 5 | 1 | 1 | 0 | 0 | 0 | yes |
| labs 6 | 1 | 1 | 0 | 0 | 0 | yes |
| labs 7 | 1 | 1 | 0 | 0 | 0 | yes |
| laserdiscs 1 | 4 | 19 | 2 | 1 | 0 | no |
| laserdiscs 2 | 2 | 4 | 0 | 1 | 0 | yes |
| laserdiscs 3 | 1 | 1 | 0 | 0 | 0 | yes |
| laserdiscs 4 | 1 | 1 | 0 | 0 | 0 | yes |
| materials 1 | 2 | 2 | 0 | 1 | 0 | yes |
| materials 2 | 1 | 1 | 0 | 0 | 0 | yes |
| materials 3 | 2 | 14 | 1 | 0 | 0 | yes |
| materials 4 | 1 | 1 | 0 | 0 | 0 | no |
| materials 5 | 5 | 49 | 2 | 2 | 0 | yes |

| Thread | # of Thread | length (days) | peer response | # instructor response | # outside response | student originated |
|---|---|---|---|---|---|---|
| materials 6 | 1 | 1 | 0 | 0 | 0 | yes |
| materials 7 | 1 | 1 | 0 | 0 | 0 | yes |
| materials 8 | 1 | 1 | 0 | 0 | 0 | yes |
| materials 9 | 1 | 1 | 0 | 0 | 0 | yes |
| portfolio 1 | 1 | 1 | 0 | 0 | 0 | no |
| portfolio 2 | 3 | 2 | 0 | 2 | 0 | yes |
| portfolio 3 | 1 | 1 | 0 | 1 | 0 | no |
| portfolio 4 | 6 | 48 | 5 | 0 | 0 | yes |
| portfolio 5 | 2 | 28 | 1 | 0 | 0 | no |
| portfolio 6 | 6 | 29 | 5 | 0 | 0 | yes |
| portfolio 7 | 2 | 3 | 1 | 0 | 0 | yes |
| preservice 1 | 9 | 54 | 8 | 0 | 0 | yes |
| preservice 2 | 8 | 26 | 6 | 1 | 0 | yes |
| preservice 3 | 1 | 1 | 0 | 0 | 0 | yes |
| preservice 4 | 5 | 13 | 4 | 0 | 0 | yes |
| preservice 5 | 8 | 24 | 7 | 0 | 0 | yes |
| preservice 6 | 6 | 12 | 3 | 2 | 0 | yes |
| preservice 7 | 1 | 1 | 0 | 0 | 0 | yes |
| preservice 8 | 9 | 28 | 8 | 0 | 0 | yes |
| preservice 9 | 1 | 1 | 0 | 0 | 0 | yes |
| preservice 10 | 12 | 21 | 9 | 1 | 1 | yes |
| preservice 11 | 7 | 21 | 6 | 0 | 0 | yes |
| preservice 12 | 7 | 11 | 6 | 0 | 0 | yes |
| preservice 13 | 12 | 8 | 11 | 0 | 0 | yes |
| preservice 14 | 2 | 2 | 1 | 0 | 0 | yes |
| preservice 15 | 7 | 22 | 6 | 0 | 0 | yes |
| preservice 16 | 7 | 7 | 6 | 0 | 0 | yes |
| preservice 17 | 2 | 6 | 1 | 0 | 0 | yes |
| quick help 1 | 1 | 1 | 0 | 0 | 0 | yes |
| quick help 2 | 1 | 1 | 0 | 0 | 0 | yes |
| quick help 3 | 2 | 2 | 0 | 0 | 1 | yes |
| research 1 | 1 | 1 | 0 | 0 | 0 | no |
| scihouse 1 | 2 | 1 | 0 | 1 | 0 | yes |
| scihouse 2 | 2 | 2 | 0 | 1 | 0 | yes |
| scihouse 3 | 2 | 14 | 0 | 1 | 0 | yes |
| scihouse 4 | 2 | 2 | 0 | 1 | 0 | yes |
| search 1 | 1 | 1 | 0 | 0 | 0 | no |
| simulations 1 | 1 | 1 | 0 | 0 | 0 | yes |
| simulations 2 | 2 | 30 | 1 | 0 | 0 | yes |
| special students 1 | 2 | 4 | 1 | 0 | 0 | yes |
| special students 2 | 1 | 1 | 0 | 0 | 0 | yes |
| special students 3 | 7 | 31 | 6 | 0 | 0 | yes |
| special students 4 | 3 | 14 | 2 | 0 | 0 | yes |
| special students 5 | 1 | 1 | 0 | 0 | 0 | yes |
| teachable mom 1 | 2 | 6 | 1 | 0 | 0 | yes |
| teachable mom 2 | 3 | 19 | 2 | 0 | 0 | yes |
| teachable mom 3 | 2 | 23 | 1 | 0 | 0 | yes |
| teachable mom 4 | 1 | 1 | 0 | 0 | 0 | yes |
| teachable mom 5 | 6 | 43 | 5 | 0 | 0 | yes |
| teachable mom 6 | 10 | 36 | 9 | 0 | 0 | yes |
| teachable mom 7 | 2 | 27 | 1 | 0 | 0 | yes |
| web sites 1 | 1 | 1 | 0 | 0 | 0 | yes |

| Thread | # of Thread | length (days) | peer response | # instructor response | # outside response | student originated |
|---|---|---|---|---|---|---|
| web sites 2 | 1 | 1 | 0 | 0 | 0 | yes |
| web sites 3 | 1 | 1 | 0 | 0 | 0 | yes |
| | | | | | | |
| **Total** | 892 | | 695 | 35 | 8 | |
| **Average/thread** | 6.11 | | | | | |

# Appendix I

## SciTeach Forum Survey Results

1. Did your school have access to the World Wide Web?
yes (24)
no (8)

If yes, where in your school could you access the SciTeach forum?
library - 16
computer lab - 10
career center - 1
classroom - 1

2. Were you able to access the SciTeach forum from your home?
yes (15)
no (17)

3. From where did you access the SciTeach forum? (list all)
home only (5)
home and NCSU (6)
home, NCSU & school (2)
home and school (3)
school only (6)
NCSU and school (2)
NCSU only (8)

4. How often did you access the SciTeach forum?
daily (0)
2-3 times/week (4)
once/week (22)
twice/month (4)
once/month (2)

5. How often was it possible for you to access the SciTeach forum?
daily (14)
2-3 times/week (6)
once/week (11)
twice/month (2)
once/month (0)

6. How did you read the messages on the SciTeach forum? Check all that apply.
    <u>16</u> checked to see who sent messages
    <u>28</u> scanned the content for issues of interest disregarding messages or skimming others
    <u>20</u> checked to see when the latest messages were posted in a topic area
    <u>24</u> always went to the "Critical Incidents" area first

3 always went to the "Preservice Science Teachers" area first
0 other; Please describe:

7. How often did you go back to a topic area to check for responses to your message postings?
always (6)
sometimes (17)
rarely (8)
not at all (1)

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.

11 Inadequate access to a networked computer.
27 Lack of personal time.
0 Insufficient time for learning how to use the forum
1 No source of ongoing assistance to use the SciTeach forum.
5 Slow response of the web site.
3 Other, Please list:
Lack of recent postings.
Forgot how to post my own listing.
Not connecting to the Web site.

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
Mean = 5.1 SD = 1.5

10. Getting to a computer to access the SciTeach forum was....
very difficult- __ __ __ __ __ __ -very easy
Mean = 4.25 SD = 2.02

11. Finding the forum on the World Wide Web was....
very difficult- __ __ __ __ __ __ -very easy
Mean = 5.6 SD = 0.75

12. Interacting with the SciTeach forum has promoted reflection on what I learned during my student teaching semester.
strongly disagree- __ __ __ __ __ __ -strongly agree
Mean = 4.41 SD = 1.01

13. Interacting with the SciTeach forum has promoted my reflection on teaching approaches and decision making.
strongly disagree- __ __ __ __ __ __ -strongly agree
Mean = 4.2 SD = 1.0

14. I feel that the SciTeach forum facilitated communication with other student teachers.
strongly disagree- __ __ __ __ __ __ -strongly agree
Mean = 4.8 SD = 1.3

15. The SciTeach forum is not an asset to the science teacher education program at NCSU.
strongly disagree- __ __ __ __ __ __ -strongly agree
Mean = 4.3 SD = 1.3

16. The SciTeach forum is a resource I might use during my first year of teaching.
strongly disagree- __ __ __ __ __ __ -strongly agree
Mean = 3.69 SD = 1.4

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
Mean = 4.75 SD = 0.92

18. The SciTeach forum did not help me exchange teaching ideas, information, or advice.
strongly disagree- __ __ __ __ __ __ -strongly agree
Mean = 4.84 SD = 1.17

19. The SciTeach forum has helped me to develop a broader perspective on teaching.
strongly disagree- __ __ __ __ __ __ -strongly agree
Mean = 4.1 SD = 1.4

20. I was able to keep in touch with classmates using the SciTeach Forum.
strongly disagree- __ __ __ __ __ __ -strongly agree
Mean = 4.09 SD = 1.57

21. The SciTeach forum did not help me improve classroom management.
strongly disagree- __ __ __ __ __ __ -strongly agree
Mean = 4.59 SD = 1.34

22. I was able to get help with lessons and curriculum planning using the SciTeach forum.
strongly disagree- __ __ __ __ __ __ -strongly agree
Mean = 3.03 SD = 1.49

23. I provided support for others through the use of this forum.
strongly disagree- __ __ __ __ __ __ -strongly agree
Mean = 4.66 SD = 0.75

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
Mean = 3.78 SD = 1.74

25. This Web-based conferencing activity fostered my generation of ideas and creativity.
strongly disagree- __ __ __ __ __ __ -strongly agree
Mean = 3.84 SD = 1.25

26. This Web-based conferencing activity fostered my evaluation of ideas and critical thinking.
strongly disagree- __ __ __ __ __ __ -strongly agree
Mean = 3.97 SD = 1.25

27. This Web-based conferencing activity fostered a sense of a collaborative learning community.
strongly disagree- __ __ __ __ __ __ -strongly agree
Mean = 4.7 SD= 1.1

## **Open-ended Questions**

Response quotes are selected from the pool.

1. What was the most beneficial aspect of using the SciTeach forum during your student teaching experience?
To hear the opinions, ideas and suggestions of other student teachers. (17)
Sharing peer experiences. (6)
Discussing critical incidents in science teaching. (5)
Reduced feelings of isolation (3)
Support from peers (2)

“I used the Classroom Management topic the most. I used and implemented a lot of the ideas that my peers suggested. I even took the opportunity to post a question, and the answers I received were very beneficial.”

“Finding out that we all (as student teachers) have similar experiences including both the bad and good!”

“Critically thinking about real life, science classroom situations.”

“It made me feel less isolated. I liked being able to interact with my peers.”

“There were no other student teachers at my school, so I did not feel so “alone”/isolated from my peers during the semester.”

“Some of the problems presented in Critical Incidents actually occurred in a similar manner, so I had different options to chose to solve the situation at hand.”

"Giving and receiving advice and suggestions from the other student teachers. It helped keep communication lines open after we all left campus for our schools."

"It gave me the opportunity to receive supportive words of encouragement from my peers."

"Reading different people's responses to comments and getting ideas of how to handle difficult situations."

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

Making time to post to the forum on a weekly basis/Posting was time consuming. (12)
Responding to critical incident postings were not relevant to me. (9) *Note- 5 MSM*
Having to remember to post twice a week. (3)
Inconvenient to access the forum. (3)
Having to post as a course requirement. (2)
Finding something else to post other than a reply to critical incidents. (3)
The interface of the forum software. (1)
Posting a new topic and very few if any people responding. (1)
Nothing (2)

"I really didn't like the Critical Incidents that we were required to do. I got more helpful advice from the other topics.

"Sometimes you didn't have anything to discuss so you had to search through all the topics to find something."

"Although many of the critical incidents were thought provoking, sometimes I found myself just making up something to say since it was required when there were other topics which were more relevant/beneficial to me."
"I really did not understand some of the topics introduced in the critical incidents topic."

"Often I was too busy to get both entries in or just did not find something to comment on."

"Trying to look at a number of responses, because there are so many in some sections, and getting back and forth can be a real pain."

"Like everything during student teaching, it demands another small chunk of your time each week."

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

Classroom management and other problems. (19)
Help with activities/lesson planning/instructional resources. (11)
Sharing my experiences and frustrations. (11)

Improving teaching practice (3)
Critical think skills (2)
Portfolio development (4)

“We also got to vent some of the frustrations of student teaching in an effective way.”

“Mostly on how to deal with situations or just to think through on issue and see how others responded.”

“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.”

“Answering the critical incidents postings let me know I could handle the situations with confidence.”

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?

Yes (23)

“Yes! Every question I asked was answered. Most questions were about classroom management issues. My peers suggested strategies to use in the classroom that they were already using.”
“I felt I got a lot of feedback on many issues. This helped me because I valued their opinions and it was easier to make decisions after hearing what they thought.”
“It helped me gauge what others thought.”
“Peer input help see things in a different light and also game me ideas I otherwise would not have thought of.”
“It was helpful to read their ideas on certain things, so that I could try them in my classroom.”
“I got some feedback involving suggestions on how to improve my instruction with my ESL students for I posted a message requesting advice. Several fellow student teachers provided useful tips on techniques they found to be successful.”
“I had one particular posting in which I was very discouraged with student teaching and I received many supportive words from many different sources.”
“Questions were responded to quickly.”

No (10)

“None of my peers did, but professors did, ideas about labs and sources to go to for ideas. I don’t think anything could really be done--there’s just so many topics to choose from--not everyone has the same interests.”
“Not really. I think it’s difficult to always get feedback, because there are so many topics that yours might not be read by too many people at all.”
“I would like to see a category just for open discussion.”
“Reflecting daily was hard enough to accomplish w/the stress of student teaching.”
“Not really. There was some. It was so hard to look through all that was up there, so I’m

not sure my peers didn't have enough time to go through all of it.  I know I didn't."
"Requiring each student to post a topic would be a good idea."
"I did not receive any feedback to my postings, but none of them really warranted any.  My postings were primarily FYI or a response /feedback for someone."

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

Classroom Management/Discipline issues (15)
Critical Incidents (7)
Controversial issues/Touchy content (6)
Activities and demonstration (4)
Difficult teaching experiences (4)
Humor in the classroom (2)

"Controversial issues such as the inhumanity of dissection and evolution seemed to lead to more thoughtful questions."

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

Classroom management and discipline (7)
Demonstrations and lab activities (7)
Others:
"How to deal with an activity that fails to demonstrate what was supposed to happen (ex on forum: measuring oxygen from plant; ex from my class: a lab on ocean currents where the currents didn't circle in the right direction).
"Waiting for students to quiet down instead of yelling."
"How to take up papers without losing class time."
"Instructional techniques such as how to get students to better understand your reasoning, making a connection with the students."
"Use of Internet in classroom discussion."
"How to tactfully but honestly approach an issue."
"Learned how to over plan to make period is filled."
"How to keep on task;  Avoid "touchy" issues, but respect everyone's beliefs."
"Humor in class."
"Using the method of contacting parents to help curb and stop undesirable behavior."
"For management I learned to hold kids after the bell as long as it took them to quiet down during the class.  It worked great.  I also got help with how to balance journal readings for my part."

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

Yes (25)
No (7)

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

No (11)

Yes (21)
Whom:
other student teachers (13)
friends (2)
loved ones (2)
cooperating teacher (6)
other teachers (2)
university instructor (1)

Topics:
Religion in the classroom (4)
Critical incidents (5)
Classroom Management (4)
General topics (5)
Controversial issues (1)
Demonstrations (1)

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.

"Web-based conferencing tools contribute by providing a mechanism for dialogue amongst busy educators."

"I think it helps to hear that other people are experiencing similar problems."

"Offering suggestions, opinions, demos, activities, and lesson plans."

"It allowed us to communicate with each other whenever we wanted. We didn't have to physically meet each other, so the forum was very convenient. Web-based conferencing can contribute to preservice and licensed teachers because it was easily accessible and it allowed us to voice our opinions and concerns in an open atmosphere."

"As a new teacher you can learn many things (ideas, techniques, tricks, etc.) from a "seasoned" teacher who has seen almost every "trick in the book" and has had many experiences that you may be facing with students."

"Gives teachers ideas that improve practice, discussion opportunities with other teachers."

"May find solutions to problems you are experiencing in the classroom, learn about good material, workshops, etc."

"I think it provided an avenue for teachers to share opinions and ideas, which will help teachers improve professionally."

"It would help to get more people involved in issues."

"Can  aid in lesson planning and classroom management ideas."

It's a great resource for information and collaboration with more experienced teachers if you have time to use it.

"They too could post questions and get feedback.  It is a nice option when you have a question."

"Gives teachers new perspectives and ideas on how some activities might be done. Broadens their horizons with unlimited ideas from other teachers."

"An idea bank can be a great tool, especially for new teachers."

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

"You must be more concise.  People have a chance to think about and read what they say on the Web, whereas face-to-face people will usually just go with their train of thought."

"You have time to think and reflect on an answer."

"Feedback is not immediate.  Many times in education you need immediate feedback."

"One major difference is you don't get feedback immediately.  Another difference is you don't have to schedule and appointment to meet with someone.  You could communicate at your own leisure and convenience on the Web-based forum."

"There is no interaction or emotion.  I gain a lot from sharing face to face."

"You can ask questions and make comments you may have otherwise felt uncomfortable doing."

"You cannot carry on about a specific idea that is intriguing as well.  If you were talking it would be a more continuous process between you and that individual."

"There is no nervousness that comes into play, so you can really articulate what you want to say."

"We don't get to see everyone face-to-face on a daily basis, but through the forum we get to communicate with a wider range of colleagues."

"Impersonal, not an immediate response."

"You can say what you need to say and/or change it before you actually send it."

"You can feel more comfortable telling what you really think."

“Web communication is less interactive. Also in face-to-face communication people use the interaction skills they have been working on their entire lives. Forum communication is sometimes more well thought out and other times people don’t consider the consequences of their postings.”

“You cannot see the person and provide immediate feedback on the Web-based forum. This can be good to protect identity at times, but often feedback comes too late to be of any use.”

“It was great to get to read 20 or so thoughts or ideas at one sitting which is hard to acquire face to face but communication on the web doesn’t allow in-depth discussion or immediate feedback.”

“The responses are not as fast or complete like a conversation would.”

“Communication on the forum loses some emotion and is not as personable as face-to-face communication.”

“Emotions are hard to read. People might not “say” as much if they have to type it in.”

“It offers clear, concise and occasionally the “blunt” responses needed.”

“You can say what you feel, sometimes face to face it is hard to say what you feel.”

“Not so personalized, more difficult to get feedback that I’m really looking for in a lot of circumstances.”

“I don’t think you get to see the emotion and that is important. I also felt rushed, but when I’m talking to someone I don’t. Also, talking to someone you can go see their sources and have a chance to see what happened in their classroom.”

“Everything written is concise and to the point. Face-to-face will always be a better way.”

“Communication is less personal. People maybe more willing to give criticism.”

“Web-based is less personal, hard to get the meaning of what a person was trying to communicate.
Face to face creates a warmer, more personal transfer of ideas. This is also a good social/networking way to gain new ideas and meet more people.”

“It is sometimes easier to give a more honest opinion when you are not directly speaking with an individual. Also, you can receive feed-back from people you may not necessarily associate with.”

“You may feel less inhibited to say what you truly feel.”

“There is no prejudice or prejudgments, just helpful information.”.

“Each person involved can communicate when he or she has the time.”

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

Promotes discussion:

“I am careful about what I post because anyone can read it.”

“It promotes because you can participate whenever you were ready and you had choice of what you wanted to discuss.”

“With categories it helps you find exactly what you want. If you have problems, answers are easy to find.”

“It asks for responses from readers on real life questions other teachers may be familiar with in the classroom.”

“Promotes discussions by giving opportunity for questions to be asked.”

“It promotes it by providing interesting topics for teachers to discuss.”

“It allows people from different states to communicate ideas on teaching.”

“It promotes discussion because it gets people talking about teaching-related things.”

“I think the forum lends itself to more honest and open discussion.”

“It promotes it just by being there.”

“It gives you a place to do it. I don’t know of any other places I would go to discuss educational topics.”

“I feel it promotes online discussion because it is easy to access and use. It also contains interesting topics and allows for new topics to be created.”

“It promotes on-line discussion because it initiates thinking and opens dialogue.”

“I think it promotes discussion because you have so much freedom--read postings, respond, or create a new posting, or even an entirely new category.”

Inhibits discussion:

“It can be time consuming.”

“It inhibits because you don’t get feedback right away.”

“I feel like you have to stop your thoughts and pick them up at another time. It is hard to find time to really think and commit to when there is not a person there to make you. It is easy to put it off or forget.”

“Not immediate, waste valuable time waiting for response.”

"If a person is not a computer buff (like myself) it's intimidating (especially if it's part of your grade and you can't afford to screw it up)."

"It makes it more difficult to discuss back and forth about the topic though."

"It inhibits discussion because the feedback is not immediate."

"People use it at different times and you cannot tell when someone is online to contact them or comment to them."

"Hard to write or "type" in depth answers to questions."

"If I did not feel like responding on the forum I would personally e-mail a response to a peer or send a thank you for their support."

"It could inhibit what you say because you may not want everyone to hear what you are saying."

"You don't know when or if someone will respond to what you've written, so if there is any discussion, there is a definite time lapse in there."

"I did not have all the extra responsibilities and I was constantly busy, so I know full time teachers do not have the freedom to go and chat online at their leisure."

"It's hard to have a discussion or rebut/respond to someone's answer what I mean is you ask a question and then wait for their response before you can respond again. In a conversation, you could respond right away. But on the forum you have to wait for them to answer."

"It is a posting not an interactive discussion. The thoughts are cold and takes time to clarify exact meanings. A chat room style forum would be more spontaneous and produce better dialogue."

"I feel it may inhibit online discussion because the list of topics can get very long and you sometimes have to read each topic description to know what it was about. In other words, you could not always tell from the title what the topic was about.

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?

"Web-based forum is a better way to communicate because you can read other people's issues and go back and reference other topics and reflect on your own thoughts."

"Web is more accessible. I couldn't get telnet working from home. Also it's easier to see what others are saying about a question or topic."

"It would take too long.  The Web-forum is better because you can also respond directly to their e-mail if desired."

"The forum is in a format that is more accessible and user-friendly than e-mail is to this type of activity."

"E-mail is one-to-one and the forum was a whole community of people.  The forum was definitely better than e-mail since I got to hear from many people, and pick topics of interest to me."

"Not as good.  With the forum you get to choose what you read.  E-mail lists are obnoxious and are not organized by topic.  The forum allows the user to have more control."

"Not everyone has an off-campus e-mail account and getting to campus to check it is difficult during student teaching.  Accessing the Internet off-campus is much easier."

"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 topic 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."

"It would be a hassle; the Web-based forum is much easier to access and allows for cross-science curriculum interaction."

"Everything would be sent to you, time-consuming to go through it all.  Forum allows one to pick and choose topics, can still e-mail if you want."

"The forum allows the students to communicate on a more individual basis."

"Not e-mail.  #1--I rarely came to campus, so I didn't check my e-mail.
The Internet is a lot more accessible than e-mail from any location. The Internet is definitely better."

"I prefer the Web-based forum because all the responses are listed and it is easy to access."

"Using an e-mail list would only get information from those on the list.  Web gives access to anyone that finds the page.  I would say a mixture, sometimes you need the support of your peers and sometimes one needs help from the outside."

"E-mail lists are annoying.  Web forum allows you to read only what you want and doesn't fill up your e-mail box."

"You get feedback from only those in your field (not soliciting).Web-based forum would be best it narrows down the number of responses you will receive."

"The forum is designed to be used by people that I know personally.  I can call or e-mail these people after reading their posting.  That's why I think the forum is a better means."

“I like the Web-based forum, it allows you to look on list to decide the topics you need help with or would like to view.”

“Since I was not able to check my e-mail often during student teaching and the Forum was available on the Internet, the forum would be better. Also that way when you reply everyone on the listserv does not have to read my reply.”

“The postings would be sent to all, forcing them to read each topic. The mail list would be better, but it would create a hassle to check e-mail.”

“I think a Web-based forum is a better form of communication than an e-mail list because you have less wording to scroll through. Also, you can receive feedback from others outside of your own circle.”

“Forum--more people and you never know who might be able to respond to you. You can pick and choose what you want to read or respond to.”

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?

“You would have a limited supply of resources and it would make it difficult to have a large variety of responses.”

“Because we basically have the same college courses and experiences, I do not thing the forum would be very diverse and enriching if it was restricted to our limited knowledge.”

“We couldn’t benefit from the masses. You’d get a lot of NCSU opinions and responses. Restrictions wouldn’t cap effectiveness.”

“We would probably discuss issues about cooperating teachers and particular student/administration problems more openly.”

“Limited to experiences of student teacher and university faculty.”

“It probably would not have a wide range of ideas and opinions because we probably think alike in a lot of ways.”

“More private and have an “In house” feeling. We could discuss more school related topics.”

“You may limit the knowledge base. There could be students at Duke w/great ideas that no one at NCSU (student or faculty) had tried.”

“It may not be that much different because a majority of the “discussion” occurs among NCSU preservice teachers and faculty anyway.”

“I don’t think it would change, because I didn’t notice a lot of responses being from anyone besides preservice teachers and faculty. I think it should be open to anyone. Now that I know how to use it, I may want to use it next year.”

“Not very different because I didn’t see many people outside of our university posting messages.”

14. What improvements would you suggest for the SciTeach forum?

“Instead of having the “navigation buttons at the top and bottom only, have them fixed on the screen, so it is not necessary to scroll and find them.” (Picture is drawn which shows a “frames” screen orientation).

“Maybe a “What’s Hot Section” that comes up daily on what is the coolest thing to go to. Also more clear definitions as to what is in each topic would help. I think some of the topics are out-of-date and should be deleted if they are not visited after ~ 6 months.”

“Possibly removing some of the messages after a certain time. Or removing topics that have been inactive over a certain period of time.”

“If from my account I could see my personal postings highlighted so I could go directly to them and see the responses I received. I suggest a quicker way to get directly to my postings.”

“Maybe adding a search engine of some sort. This would help people find things that they needed.”

“List topics alphabetically. Allow users to reply to a reply, and indicate it by indenting the entry.”

“The SciTeach forum is fine. However, it was difficult keeping up with 2 different aspects of the forum. I feel that I was rushed to do reflects for Methods and really was not able to reflect like I should on the forum. I would suggest just having the critical incidents.”

“It is good for teachers but maybe it shouldn’t be forced onto people. It think a lot of people would use it, even if it wasn’t required. It is definitely something I would suggest someone to go to if they need help or needed to talk about anything during student teaching.”

“I’m not sure. I know I had a hard time remembering when I got really busy. I was at school until 7 or 8 usually which made me think about getting home instead of getting on the Web. It was/is a good idea but sometimes hard to keep up with. Maybe if we were required to do “x” amount in a month instead of 2 every week.”

“Allowing any two postings (not requiring one to be a critical incident).”

“Allow flexibility. I know it was my own problem that I had to work while I student taught, but I had to support myself, so my time was extremely limited, I had limited access to a computer and it rarely worked (for me). So to me I began to forget about these postings in the middle of a crazy week. I even had an index card in the front of my notebook w/the weekly date on it to check off when I completed the postings and I still messed up. I thought I could make it up by posting extras, but I have now learned I can't. This is extremely frustrating to me because I work very hard and I still don't feel like I did a good enough job. Maybe the postings should be biweekly or optional in the middle of student teaching."

"Publicize it more so more people in the US or the world would use it."