

LEARNING EXPERIENCES OF SCIENCE TEACHERS IN A  
COMPUTER-MEDIATED COMMUNICATION CONTEXT

by

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of the requirements for the Doctor of  
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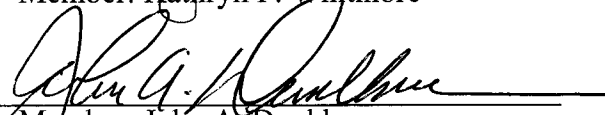
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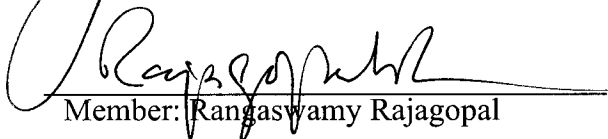
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Dedicated to my amazing parents Chung, Ping-Tung and Tseng, Ching-Hsiang who offered me unconditional love and support throughout the course of this thesis and loving memory of my grandparents. Also, to my dear grandma, Li, Tzu-Mei, who passed in 1991 and lives in my heart forever. Thank you, grandma, for loving and encouraging me so much throughout my life. May this Ph.D. dissertation be a lasting testimony to God's love and the love of a wonderful family that enabled me to reach the pinnacle of my academic career.

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## ABSTRACT

The use of computer-mediated-communication (CMC) has been applied increasingly in staff development efforts for teachers. Many teacher education programs are looking to CMC, particularly computer conferencing systems, as an effective and low-cost medium for the delivery of teacher educational programs anytime, anywhere.

Based on constructivist learning theories, this study focused on examining the use of an online discussion board in a graduate course as a place where forty-six inservice teachers shared experiences and ideas. Data collection focused on online discussion transcripts of all the messages from three separate weeks, and supplemented by interviews and teacher self-evaluation reports. The nature and development of the discussions were studied over one semester by analyzing teacher online discussions in two domains: critical reflections and social-interpersonal rapport. In effect, this study provided insights into how to employ computer conferencing technology in facilitating inservice teachers' teaching practices and their professional development.

Major findings include:

1. Participation: The level of participation varied during the semester but was higher at the beginning of the semester and lower at the end of the semester.
2. Critical Reflection: Teachers' critical reflection developed over time as a result of the online discussion board according to mean critical thinking scores during the three selected weeks. Cognitive presence was found mostly in focused discussion forums and social presence mainly existed in the unfocused discussion forums.
3. Social-Interpersonal Rapport: The number of social cues in the messages increased initially but declined significantly over time. When teachers focused more on on-task discussions or critical reflection, there was less social conversation.

4. Teaching Practices and Professional Development: The researcher, the instructor, and teachers identified some advantages for using computer conferencing for improving teaching practices and for professional development.

The results of this study suggest that applying computer-mediated communication in teacher education would impact positively on teachers' growth in critical reflection and social-interpersonal rapport. Furthermore, this study may encourage other researchers to use cognitive and social learning theories as the theoretical backgrounds for developing teacher educational models by applying computer conferencing.

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## CHAPTER I

### INTRODUCTION

The important goals of recent educational reform are to achieve high standards in student performance and to cultivate improved skills in problem solving and critical thinking. In addition, teachers are expected to assume new classroom roles for themselves and their students, and to teach in student-centered ways. However, many reform efforts have not resulted in these kinds of learning outcomes. Darling-Hammond (1998) indicated that successful school reform movements are “likely to be dependent on dramatically increased support for teachers and learning” (p. 6) and the failures of past reform efforts have been caused by “the lack of sustained, serious, systemic investments in the knowledge base of individual educators” (p. 11). In the recent standards-based efforts to improve student learning and achievement, professional development is viewed as central to educational reform (Elmore, 1996; National Commission on Teaching and America’s Future [NCTAF], 1996; National Education Goals Panel, 1995). The NCTAF statistical report provides further evidence:

- More than half (56%) of high school students taking physical science courses, 21% in English, and 27% in mathematics courses are taught by teachers who do not have backgrounds in these fields.
- “In high poverty schools and in lower track classes, the proportion of teachers inadequately prepared is even higher” (pp. 15-16).
- Annually, over 50,000 untrained people enter teaching on either emergency or substandard licenses.

The increased importance placed on high-quality ongoing and intensive professional development is an integral part of the teachers’ teaching career (U.S. Department of Education, 1996). As the calls for systemic school change continue,

teacher professional development is viewed with increasing interest. However, an examination of K-12 teachers' typical practices provides little evidence that changes are occurring (Cuban, 1993; Simmons, et al., 1998).

### Lack of a Culture for Encouraging Sharing

Most professional development for teachers involves the pursuit of advanced degrees, school and district-wide meetings at conferences and workshops, and personal study on selected topics using library resources (Hawk, 1999; Rallis, Rossman, Phelgar, and Abeille, 1995). Traditionally, most educators are used to one-time or short-term professional development workshops and seminars that provide limited information. In these kinds of short-duration, fixed-schedule, and activity-based professional development workshops or seminars, teachers can only share their brief experiences and discuss their questions within a limited time.

After such meetings, conferences or workshops, teachers are still isolated in their own classrooms and do not reflect upon their teaching or questions with other teachers, especially teachers in other school districts. The time teachers actually start to learn new pedagogical principles is when they practice and implement those principles in their own classrooms. They often find it difficult to apply what they have learned once they return to their classrooms. They lack collegial and material support, which is required to use new curricula. In addition, classroom interactions are still dominated by whole-class non-interactive activities and individual seatwork, where "instruction remains primarily didactic, dominated by lecture, demonstration, textbook readings memorization" (Stofflett and Stoddart, 1994, p. 32). The primary reason is the lack of a culture of sharing among teachers (Chism, 1985). Miles (1995) put it directly:

Let's frame the issue in extreme terms. A good deal of what passes for "professional development" in schools is a joke – one we'd laugh at if we weren't trying to keep from crying. It's everything that a learning environment shouldn't be: radically under resourced, brief, not sustained,

designed for “one size fits all,” imposed rather than owned, lacking any intellectual coherence, treated as a special add-on event rather than as part of a natural process, and trapped in the constraints of bureaucratic system we have come to call “school.” In short, it’s pedagogically naive, a demeaning exercise that often leaves its participants more cynical and no more knowledgeable, skilled, or committed than before (Miles, 1995, p. vii).

Ongoing support with other teachers and educational professionals or follow-up activities from well-designed professional development programs are highly effective in helping teachers apply new ideas. Helping teachers shift both what they learn and how they teach increases the complexity of the learning challenge. Thus, opportunities for analysis and reflection are central to learning to teach (Loucks-Horsley and Matsumoto, 1999). Wang (2002) has argued that an opportunity for reflection on teaching influences how teachers develop their pedagogical content knowledge. If teachers feel and get used to the culture of sharing in professional development environments, they will build a sense of community where each member enjoys the benefits of sharing while also having the responsibility to contribute or to reflect.

#### Lack of a Mechanism for Sharing

Most professional developmental models simply impose the knowledge on the teacher; rather, the models must create environments that provide teachers with ongoing support for change that are situated in and which address their everyday pedagogical needs (Smylie and Conyers, 1991). Professional development needs to be built on an effective mechanism for facilitating sustained information sharing and access to the distributed expertise, such as other teachers, university faculty, and curriculum developers (Loucks-Horsley and Matsumoto, 1999). In other words, the culture of teacher sharing is not well established in the existing professional development models.

There are some good examples of professional development models. For example, the Inquiry Learning Forum (ILF) is a Web-based professional development tool designed to support a community of inservice and preservice mathematics and science

teachers creating, sharing, and improving inquiry-based pedagogical practices. The ILF has been designed based on the idea of a “visiting-the-classroom” metaphor. A website (<http://www.indiana.edu/ilf>) has been developed where teachers all around the United States can be involved in professional development activities and interact with other teachers. There is an online discussion board for teachers to share and reflect, an online virtual classroom utilizing many video clips of actual classroom teaching and professional presentations, and many online educational resources.

Due to a lack of a mechanism for sharing, Ingvarson (1998) concludes that the teaching profession has lacked rich opportunities for meaningful growth experiences that are so critical for continued development of the profession. Moreover, the teaching profession has also lacked the responsibility for teachers to engage in professional discourse with one another to evaluate and reflect on their practices (Ingvarson, 1998). Teachers need to be full participants in, and owners of, their virtual space for meaningful and active interactions to occur (Barab, 2001).

### Effective Professional Development

When designing professional development activities, it is important to understand how teachers learn. A recent report on the science of learning from the National Research Council summarized some of the important themes that relate to how teachers learn, including the following (NRC, 1999):

- To gain meaning and deep understanding, learners must build coherent structures of information organized around core concepts or big ideas of a discipline, rather than collecting facts and principles through memorization.
- In order to transfer learning, learners need to understand major concepts and generalized principles, plus when and how to apply what they have learned.

- Learners are aided by self-monitoring and analysis of what they are learning now.
- Learning is influenced by participation in a community, by its norms, its constraints and resources, and its limits and possibilities.

Therefore, creating a learning community, where teachers can engage actively, learn over time, have opportunities to reflect and share and resolve the dissonance through discussion, and essentially, crystallize, externalize, develop criticisms, and revise their thinking becomes significantly important.

### Reflection

One of the most powerful tools for professional development is reflection. It is the outcome that is not examined or is missed in many professional development programs. In the professional development activities, teachers will learn new standards, strategies, and other ideas. They will act as the learners at that time and will go through the same learning processes as the students. However, in many professional development programs, especially short-term programs, it is very hard to examine teachers' reflective outcomes.

“Reflection refers to active, intellectual thinking for monitoring one’s own learning activity and process, and a continuous internal activity of exploring oneself for new learning” (Kim and Lee, 2002, p. 375). According to Silver (1998), only reflective learners can use their own reflective thinking during practice and thereby effectively revise their learning strategies in practice. Reflection can be considered not only an individual process (thinking independently) but also a social process (providing conflict or gaining help from the group). Reflective thinking can help the learner make persistent changes in the learning environment and move closer to upper proficiency levels.

Dewey (1933) was the one of the earliest scholars to examine critical thinking. He used the term reflective thinking to refer to “active, persistent, and careful consideration of any belief or supposed form of knowledge in the light of the grounds that support it and the further conclusions to which it tends” (p.9). The initial concept of reflection means the active, careful consideration of any belief or supposed form of knowledge, and meaningful learning occurs in the balanced integration of experience and reflection (Dewey, 1933). In many professional development programs, it is hard to find the balanced integration that Dewey mentions in teachers’ own learning. Teachers always have a chance to experience new ideas but do not have enough time to reflect. Dewey also proposes a five-phase model for reflective thought:

1. Suggestions, in which the mind leaps forward to a possible solution;
2. An intellectualization of the difficulty or perplexity that has been felt (directly experienced) into a problem to be solved, a question for which the answer must be sought;
3. The use of one suggestion after another as a leading idea, or hypothesis, to initiate and guide observation and the other operations in collection of factual material;
4. The mental elaboration of the idea or supposition (reasoning, in the sense in which reasoning is a part, not the whole, of inference); and
5. Testing the hypothesis by overt or imaginative action (p. 107).

Dewey’s reflective learning model is consisted with his emphasis on the scientific method as a way of knowing and it is clearly situated in a deductive, problem-solving perspective. Many scholars have built on the work of Dewey to develop different learning models and to differentiate the levels of reflective outcomes.

### Critical Thinking and Critical Reflection

Most of the research on critical reflection focuses on formal educational issues, particularly in the context of the kindergarten to grade twelve educational levels.

Brookfield (1987) is one of a few scholars who have applied the concept of critical thinking to adult education. He claims his conceptualization of critical thinking moves from mechanical, cognitive-skill-oriented view to “the context of adults’ lives – in their relationships, at their workplace, in their political involvements, and in their reactions to mass media of communication” (p.12).

McPeck (1981) defines critical thinking as “the propensity and skill to engage in an activity with reflective skepticism” (p.8). He focuses on the “analysis of arguments” view of critical thinking which is the evaluative and not the productive dimension of critical thinking. He concludes by suggesting that simply having the disposition to think critically in all areas is not sufficient for being a critical thinker. The person is not “a critical thinker unless he has an understanding of the area or field in which he is being critical. This is because critical thinking is tied more closely to specific knowledge and understanding than to any specific set of allegedly transferable skills” (p.156). Similarly, Paul (1993) offers the distinction between what he calls strong sense and weak sense critical thinking. The weak sense critical thinkers know all the component cognitive skills of critical thinking but they are unable to “critique their own most fundamental categories of thought and analysis” (p. 206). Consequently, strong sense critical thinking is: a) an ability to question deeply one’s own framework of thought, b) an ability to reconstruct sympathetically and imaginatively the strongest versions of points of view and frameworks of thought opposed to one’s own, and c) an ability to reason dialectically (multilogically) to determine when one’s own point of view is weakest and when an opposing point of view is strongest” (p.206).

Correspondingly, Mezirow's (1990) definition of critical reflection is similar to Paul's (1993) notion of strong sense critical thinking. According to Mezirow, reflection is a procedural consideration dealing with the assessment of assumptions about how to solve problems. Merirow's notion of critical reflection is to "addresses the question of the justification for the very premises on which problems are posed or defined in the first place" (p.12). Critical reflection "involves challenging our established and habitual patterns of expectation, the meaning perspectives with which we have made sense out of our encounters with the world, others and ourselves. To question the validity of a long-taken-for-granted meaning perspective predicated on a presupposition about oneself can involve the negation of values that have been very close to the center of one's self-concept" (p.12).

Garrison (1991) builds on the work of Dewey (1933) and Brookfield (1987) in developing critical thinking model in adult education in which critical thinking is "viewed as an over-arching concept encompassing problem solving and creative thinking" (p.290). The four phases of the critical thinking process are triggering, exploration, integration, and resolution. Critical thinking is essential in cognitive presence, which is defined as "the extent to which learners are able to construct and confirm meaning through sustained discourse in a critical community of inquiry" (Garrison et al., 2001). In other words, cognitive presence reflects higher-order knowledge construction and application, or critical reflection. Consequently, cognitive presence (also called critical reflection) is most associated with the literature and research in human learning, including adult learning and teacher education.



### Social-Cultural Learning Theory

Piaget (1973) was a cognitive constructivist and who believed that learning in social contexts is largely a matter of cognitive development. He also argues that social interaction leads to confrontative and contradictive conversation and cognitive changes.

Vygotsky (Rogoff, 1990, Tharp and Gallimore, 1988) develops the socio-constructive approach to mental functioning. He concluded that higher forms of mental activity are derived from social and cultural contexts and are shared by members of those contexts because these mental processes are adaptive. The socio-constructive approach leads to knowledge and skills that are essential for successful learning within a particular social-cultural context. Social-cultural theory places strong emphasis on the development of cognitive capacities among human beings from young learners to adult learners (Berk and Winsler, 1995).

A social learning community with a larger number of learners can be particularly beneficial for developing higher-level cognitive skills because they provide more variety of levels and help for the learners. Thus it is widely believed that effective professional development should provide teachers with shared social-cultural world to reflect on their teaching practices and to interact with other teachers.

### A New Model for Teacher Professional Development

Many researchers believe that new models providing for more collaboration and higher quality of learning experiences for professional development are needed. An effective professional development model should provide ongoing support (i.e., knowledge networks) and motivate the culture for sharing among the teachers.

Technology is increasingly applied in professional learning, such as computer technology (Internet, software) and interactive television. These could be effective tools if designed with principles of effective professional development. As Tretin (2000, p.5)

notes, “Information and communication technology (ICT) may play a crucial role, offering learners new opportunities to participate actively in the learning processes via network-based activities.” The potential applications of ICT are varied, including inservice training for school teachers, distance education and training, open and distance learning, and integrated (online/onsite) education (Tretin, 2000). The task of delivering personalized professional development to teachers becomes possible, feasible, and practical with ICT. For example, teachers can browse web resources and email, post or chat about their concerns regarding science education with trusted colleagues from distant school districts that otherwise would be impossible. The Wisconsin Technology Task Force stated:

Rapid change of staggering proportions with the field of technology necessitates a commitment to ongoing and sustained professional development opportunities. All professional development should model and include the use of current and emerging technology resources. Without such a commitment on the part of the educational community, no amount of planning will yield success (Center for Educational Leadership and Technology, 1995)

### Computer Technology Applications in Teacher

#### Professional Development

As interest in network-based communication technologies grows, so does its use in America’s public schools (Hawkes, 2001). A study conducted by the National Center for Education Statistics (1998) reported that 785 of the nation’s public schools provided teachers with access to the World Wide Web, email, and resource location services in 1997. The percentage of teachers having school-based access to distributed network resources was up from 65% during the 1995-1996 school year to 75% in the 1997-1998 school year. A computer conferencing network, which is also called “computer conferencing”, is thought to be an especially effective tool for linking teachers together in experiences that may be both professionally and personally rewarding (Honey, 1995) and

making teacher professional development more collegial, collaborative, and discourse oriented (Harrington-Lueker, 1996; Kruse, 1999; Lieberman, 1995).

Within the education community, there are three types of uses for educational networks: information-based networks, activity-based networks, and conversation-based networks (DiMauro and Gal, 1994). Information-based networks mainly display and distribute information and resources to the recipients, e.g., bulletin boards. Activity-based networks connect teachers, students, and classes and provide a forum for collaborative activities. Conversation-based networks offer teachers a place to discuss and share their teaching experiences and pedagogical strategies. Even though educational networks have been used for several years, it is difficult to tell from recent research how teachers use them to build their skills and to improve their teaching practice (Mehlinger, 1995).

### Use of Computer Conferencing in Teacher Professional

#### Development

A computer conferencing network is a generic term that describes a variety of systems that enable people to communicate with others using computers and networks (Romiszowski and Mason, 1996). For the past ten years, computer-mediated communication (CMC) tools have been seen as revolutionary tools to support instruction (Kang, 1998; Rice, 1989). There are two types of computer conferencing tools: synchronous (real time) and asynchronous (not real time). Examples of synchronous formats include computer conferencing and chat rooms. Asynchronous communication formats assume some lapse of time between delivery of the message and its receipt by an intended audience (Hawkes, 2001), such as online forums and email. Asynchronous computer conferencing network is the main system applied in this study. Several features of computer conferencing network, such as speed, time-and-place independence,

participation capacity, storage capacity, and text orientation, have potential for reflective and collaborative discourse by way of the medium (Hawkes, 2001).

The asynchronous computer conferencing tools increase “wait-time” and general opportunities for reflective learning and processing information. Berliner (1987) and Newman (1992) advocate this kind of tool to give students ample time to reflect and cultivate critical thinking skills. The features of computer conferencing should encourage learners to consider their own perspectives (Harasim, 1993), express their ideas, and learn from the content of interaction itself (Henri, 1992). Additionally, computer logging devices and dialogue transcript records provide useful tools for tracking learners’ development over extended periods of time. Asynchronous computer conferencing also provides a permanent record of one’s thoughts for later reflection and debate (Hara, Bonk, and Angeli, 1998). The Online collaborative community has been viewed as one of the most important learning concepts in technology-based instruction (Tu and Corry, 2002).

From a social learning perspective, a learning community is defined as a common place where people learn through a group activity to define problems affecting them, to decide upon a solution, and to act to achieve the solution. As they progress, they gain new knowledge and skills (MacNeil, 1997). Sharing information has never been a problem in human learning. However, how humans apply appropriate information to knowledge construction is more important than simply obtaining it. Knowledge construction in an online learning community and the level that a community learns are the essential outcomes to examine, rather than just a community set up for information sharing and learning together.

The design of a collaborative community is relevant to sociability issues, which refer to the social policies and technical structures which support the community’s shared purpose and social interactions among group members (Preece, 2000). A desirable

feature of an online learning community is that there exist varying demands, information, and abilities. The process of scaffolding enables the transfer of knowledge within the community and creates better conditions for learning (Wenger, 1998).

With the increasing use of computers in education, teachers tend to communicate with other teachers and do some professional development activities via the Internet more than before. Thus, the Internet may have the potential for building a collaborative community for teacher professional development. The learning experiences via the Internet include email, online chat rooms, and online discussion boards. An online discussion board is a kind of computer conferencing network that provides more flexibility of time and participation compared to online chat rooms. It also has the ability to save whole discussions posted by different people during a period of time unlike email. Based on the features of a computer conferencing network, there are more reasons to believe that the value of a computer conferencing network in professional development lies in matching teachers' real-life concerns, being available at anytime and any place, building on the paths that other educators have forged, aligning with teachers' varying skills levels, and being ongoing (Hawkes, 1999). In short, computer technology applications open new ways for thinking, learning, and teaching together.

The use of a computer conferencing network in collaborative communities is not just a technological entity. Instead, it is an organized environment to support human-computer interactions and human-human interactions mediated through technology. As mentioned earlier, reflection is the process, which is not emphasized in most teacher professional development programs, and it constitutes both an individual process and a collaborative process. The collaborative process includes the social aspect of human-human interaction and social behaviors such as communication and decision-making. The social factors in designing an online collaborative community are categorized as: structured dialogue, linking actions with reflection, forming reflective practices with

inquiry and participatory motivation (DiMauro and Gal, 1994). The goal of socio-technological interaction networks is to enhance sociability by facilitating more participation and providing a sense of ownership of the professional development.

Despite the ability of computer-mediated technology to help teachers break down the walls of isolation and share each other's teaching experiences, little is known about the ability of technology to facilitate a collaborative reflective process for teachers and how to build an effective online collaborative community for teacher professional development. This study explores the nature of teachers' use of an online discussion board in a graduate-level course. Moreover, it also addresses teachers' views about the use of computer conferencing in teaching practices and professional development.

#### Purpose of the Study

Science Cooperative: Effecting Local Systemic Change in Rural Missouri and Iowa (Science Co-op) connects eight regional clusters of elementary schools formed from 38 school districts spread over 40, 000 square miles and includes more than 1,400 teachers and 20,000 elementary school students. The collaborative units in the Science Co-op Project involve significant distance and time dislocations that require combining face-to-face and technological deliveries to address ideas, to share resources, to solve common instructional concerns, and to meet the needs of elementary teachers. There are three central ideas behind the Science Co-op project. The first idea is to help elementary teachers in rural districts construct content-pedagogical knowledge and implement specific science modules that stress reform standards and principles. The second central idea is the intention to build a supportive community of teaching practices for the long-term. The third idea is the mission to promote the effective use of new technologies in science teaching and learning. The Science Co-Op Project offers the opportunities of

distance education for the participating teachers to take every semester over a few year periods.

“Curriculum Construction in Elementary and Secondary Schools” is a graduate-level course offered by the Science Co-Op Project. It was taught by one university professor through interactive technologies in the Fall of 2003. The course focused on the discussion of the applied curriculum (FOSS, STC, INSIGHT) and its implementation, resulting in action research. The emphasis of the course was placed upon aligning curricula with the National Science Education Standards (NSES). A science lesson was analyzed in this course to determine its alignment with the NSES and then enhanced to be in complete alignment. This model lesson became the focal point for the action research to be undertaken.

However, the main focus of this study is to examine the impact of applying the computer conferencing network to stimulate teachers’ reflective discourse and to build sociability. In addition, teachers’ perceptions of the role of computer conferencing in their thinking of teaching practices and professional development, is also explored. The design of the study includes three elements: a) content analysis of teachers’ postings on a computer conferencing network; b) qualitative analysis of teachers’ self-evaluations; and c) qualitative analysis of interview data.

#### Statement of the Problem

The major problem is that many professional developmental activities fail to provide teachers with opportunities to reflect on their teaching practices and to converse with other teachers and education professionals in an ongoing way. An effective professional development model should help teachers break down the walls of isolation and get them to reflect critically on their own and each other’s teaching. Unfortunately,

there are relatively few professional development opportunities that provide ongoing support for changes in teachers' professional lives (Schank, and Schlager 1997).

A computer conferencing network is proposed as an effective tool in facilitating professional development. Computer conferencing has the potential to allow teachers to share their teaching experiences, review their practices, and to create more reflective discourse to improve their teaching. In addition, more and more school districts are interested in computer technologies for teachers to use in their instruction and professional development. However, many teachers are not willing or do not know how to use technology for their own professional development. In a national survey of 24 schools and 72 teachers in 1997 (Teaching, Learning and Computing, Center for Research on Information Technology and Organizations, 2001), the results indicate that far fewer teachers use the Internet to engage in professional communications (publishing on the World Wide Web and email with teachers from other schools) than use the Internet as an information-gathering tool to obtain resources for lesson preparation (Center for Research on Information Technology and Organizations, 2001). A majority of teachers (68%) use the Internet in their efforts to find information resources for use with their lessons, but only 16% of the teachers communicate by email with teachers from other schools and only 18% of the teachers post information, suggestions, opinions, or student work on the World Wide Web. Furthermore, few conceptual frameworks have been developed regarding designing technologically and socially effective online collaborative communities for teacher professional development.

Therefore, this study was to couple a computer conferencing network in this inservice teacher education course with the existing two-way interactive video (ITV). The goal of the computer conferencing network applied in this course was to create an online collaborative community based on the need for more communication and interaction among a growing number of teachers. It was important to determine if a computer



conferencing network could produce critically reflective discourse and sociability among the teachers, and if there was any difference in teachers' teaching practices and professional development before and after participating in the computer conferencing network-based discussion.

### Research Questions

The following research questions guided this study:

1. How frequently and how much did participating teachers contribute to the computer conferencing in this course?
2. What patterns characterize the content of the teachers' postings to the computer conferencing? (i.e., in terms of levels of critical reflection and their efforts to attain social-interpersonal rapport)
3. What were the participating teachers' perceptions of the factors that affected participation and learning interactions in computer conferencing?
4. What were the participating teachers' perceptions of the role of computer conferencing in their thinking about their teaching practices and in their overall professional development?

### Significance of the Study

An effective model of professional development is needed if science education is to be successful with current reform efforts. Preliminary studies suggest professional development via a computer network may be a way to improve science teaching. Since this study is designed to determine if an asynchronous computer network will facilitate elementary teachers' thinking and actions during a professional development effort and improve the quality of such professional development programs, the findings can be used for several purposes:

1. They may identify factors to consider in designing online professional development programs;
2. They may identify factors for gaining more reflective thinking and social interactions among the teachers when involving in professional development;
3. They may expand our understanding of the ability of the asynchronous computer networks to mediating learning and reflection about teachers' practice;
4. They may determine what social and cognitive processes are embedded in an asynchronous computer network for teacher professional development;
5. The relationship between reflective thinking and social outcomes and the results of interactive outcomes may be helpful in facilitating science teachers engaging in professional development;
6. Results of this study may give some indication of the importance given to professional development in science education and its impact on teachers' reflective thinking and teaching practices.

## CHAPTER II

### LITERATURE REVIEW

Many studies have been completed to evaluate the impact of using computer conferencing networks in teacher professional development. The following section includes a discussion of the research on computer conferencing networks in teacher professional development. It is discussed based on four themes: reducing isolation and promoting support sharing, fostering reflection, influencing teacher practice, and establishing collaborative communities.

#### Computer Conferencing Networks Foster Reflection

Recent professional development efforts started to emphasize critical reflection on teaching practices through collaboration and collegial discussion. A computer conferencing network can allow learners to discuss and reflect while as having an archival record that can be revisited and used as a springboard for future knowledge construction. The flexible time control that a computer conferencing network allows for users to engage in discourse at anytime and to give themselves enough time to construct and refine ideas.

Levin (1999) conducted a study with thirty-five prospective elementary teachers enrolled in an undergraduate teacher education program which created and used a network-based environment. There were four types of message exchanges in this network: a) student-to-peer: email journal entries exchanged between self-selected pairs, b) student-to-keypal: email exchanges with a teacher candidate in another state, c) student-to-instructor: messages exchanges between students and their university instructor/supervisor, and d) student-to-group: messages exchanged as part of asynchronous, Web-based, threaded discussions. From the constant comparative analysis of web-based discussion forums and email exchanges, she found the primary use of the

computer-mediated discussion forum was for reflection, but the major use of email was for personal reflection, sharing teaching activities and offering support. Levin concluded there were three reasons that web-based discussion supported reflection, including: a) an appreciation of the chance to learn from others, b) a sense of validation because their feelings and experiences were similar to others, and c) enjoying feedback on their ideas from more than one person.

In another study, 28 elementary and secondary middle school teachers in ten suburban Chicago schools were involved in a two-year technology supported program. Hawkes (2001) used Simmons et al. (1989) reflective thinking taxonomy to analyze online and face-to-face discourse among the 28 teachers and to determine whether an exchange from online or face-to-face discourse was reflective. He found that neither face-to-face nor online communication had high overall reflective discourse; yet in comparison, the networked-based discussions resulted in higher reflective discourse than did the face-to-face discussions. However, Hawkes also found 66% of the teachers posted reflective messages when they were outside of the schools or at home. In addition, focused topics, that are immediately applicable to the classrooms, subjects, and grade levels, were found to promote more reflective discussions in his study than other unfocused topics found in general discussion forums.

Dimauro and Gal (1994) examined how a group of teacher leaders (TLCs) used network exchanges to reflect upon their involvement with peer leadership and teacher-teacher support in The LabNet project. They identified three dominant modes of discourse: informative, responsive, and reflective. From the analysis of online dialogue, reflective messages, which were normally the longest, and rarely were found in network-based discussions.

In a recent study, Schlagel, Trathen, and Blaton (1996) examined the online conversations between sixteen preservice teachers and five professors in a preservice

teacher education course. They found that reflective conversations would occur if the preservice teachers had open, thematic prompts, focused messages, and time to reflect. However, how to promote teachers' reflection concerning their practices on computer-mediated forums is still a very great challenge. Research to date does not develop a good model that would make teachers become more reflective when participating in a computer conferencing network.

### Computer Conferencing Networks Reduce Isolation and Support Sharing

A computer conferencing network can reduce teacher isolation and support sharing. Many teachers spend most of the time in their own classrooms teaching, grading to assignments, preparing lessons, and other routine activities. They may not have time or a chance to talk and share their teaching experiences and problems with their colleagues at the same school, and especially with teachers in different schools or districts. In one of the earliest studies on the use of electronic communication by teachers, Kimmel, Kerr, and O'Shea (1988) conducted a study that provided inservice teachers access to a computer networking conferencing tool that had both an asynchronous network and instant messaging capabilities. The researchers reviewed the conference transcripts in order to see if computer conferencing supported increased communication and sharing. The results showed that there were increased sharing of classroom materials and ideas, and increased collaboration among teachers in developing activities for professional development workshops. Likewise, Thorensen (1997) evaluated how rural inservice and preservice teachers could share and discuss teaching strategies and concerns in the Montana Educational Telecommunication Network (MET-NET). Before using the electronic network, mentor teachers and mentee teachers met in face-to-face sessions to get to know each other. Through her formative evaluation surveys, she found both mentor

and mentee teachers considered the electronic network valuable for sharing information and discussing teaching practices. Specifically, the teachers also reported that initial face-to-face meetings were useful in helping them feel more comfortable before using the network.

Emotional support provided by a computer conferencing network makes the teachers feel less isolated in their schools. It is valuable, especially for teachers in rural school districts, with fewer educational resources and fewer opportunities of professional development. Merseth (1991) conducted a year-long study with 39 first-year teachers participating in the Beginning Teacher Computer Network at Harvard University and used surveys, post interviews, and the data concerning computer use to find out the nature and type of support the beginning teachers could receive over an electronic network. In his study, he found that the computer networking provided moral support and allayed feelings of helplessness and embarrassment for beginning teachers. Similarly, Tannehill, Berkowitz and LeMaster (1995) linked physical education teachers with nine physical education doctoral students by establishing a working relationship via email and using a newsgroup. Using information from questionnaire data and analyses of teachers' journals, doctoral student summary reports, and online postings, they explored perceptions of teachers about technology as an important factor in their feelings regarding isolation and providing them valuable access to expertise.

Powers and Dutt-Doner (1997) used a frequency analysis of over 856 listserv postings in a preservice teacher education course to evaluate changes in student communication. He and his colleague found that nearly 18% of all messages were focused on peer support and 35% were focused on sharing information and reflecting on their field experiences. Along similar lines, Roddy (1999) focused on using an email list serve to help maintain contact among student teachers and the university. After analyzing

the email exchanges, he found that the email list could help student teachers so that they feel less isolated and to enhance their understanding of teaching.

In another example of using an electronic network to build mentoring relationships among inservice and preservice teachers, Norton and Sprague (1997) were interested in teacher beliefs about telecommunication and how they changed as a result of collaboration with other groups of inservice and preservice teachers and whether the interaction with others would impact the quality of lesson plans. There were forty inservice teachers enrolled in a technology integration course at the University of New Mexico. Fifteen teachers were randomly paired with another fifteen inservice teacher taking an instructional technology course at George Mason University and the remaining twenty-five were paired with twenty-five preservice teachers taking an introductory educational technology course at George Mason University. Using two Likert-type surveys to assess teachers' beliefs about the use of electronic networks, they found that the preservice teachers' perceptions and attitudes toward the use of an electronic network for teaching improved and all participants in the study considered the experience valuable. However, from the analysis of lesson plans by using the rubric created by Norton and Sprague, there was no significant difference between the quality of the lessons created by inservice teams and inservice/preservice teams.

Recently, Dutt-Donner and Powers (2000) conducted a study about assessing the capability of electronic networks in supporting sharing and discussion in the preservice teacher course they taught. Initially, the students in their course were required to post to the newsgroup ten times (five posts and five replies to their peers' posts) and were required to do evaluation surveys. From the analysis of newsgroup postings and the result from the summative evaluation survey, the students began to rely upon one another for support, teaching skills, and ideas, as they were more experienced with self-directed discussions and participation.

However, a big challenge when developing an online professional development model is to utilize participant structures that represent and facilitate the sharing of tacit knowledge that is central to effective sharing of expertise (Brown and Duguid, 1998). Thus, when designing a computer conferencing network for professional development of the teachers, the model has to make teachers believe the discussion has immediate relevancy to their teaching and student learning while encouraging both newcomers and experienced users to not only engage in, but also sustain longitudinal discussions.

#### Computer Conferencing Networks Enhance Sociability and Support Forming a Collaborative Community

In the past twenty years, the concept of a community of practice which is defined as “set of relations among persons, activity, and world” (Lave and Wenger, 1991, p.98) has become a major theme of professional development. Recent research has begun to explore whether using a computer conferencing network in teacher professional development in communities of practice can enhance teacher professionalism (Guzdial and Weingarten, 1996). Over time, the researchers concluded that a sense of collegiality, a sense of a shared history, and a trust for the system are the beginning components for community development (Barab and Duffy, 2000).

In Levin and Waugh’s study in 1998, a community linking beginning teachers in the preservice classrooms and their off-campus colleagues was built, and the effects of teleapprenticeships in collaboration and communication among the beginning teachers were examined. From the case comparisons and analysis of online discourse, Levin and Waugh found that the beginning teachers could answer their students’ questions more accurately and completely after participating in an electronic community. The results also showed that the community provided the beginning teachers the opportunities to request help, discussing their own teaching and reflecting on the processes.



In an on-going project, TAPPED IN (a web-supported professional development site for teachers), the role of technology in transforming and sustaining an on-line teacher professional development site grounded in the concept of a “community of practice” was examined by the researchers (Schlager, Fusco and Schank, 1997, in press). The purpose of this project is to assess whether TAPPED IN member teachers would conduct their activities using this online system. The data source was online discourse in the TAPPED IN community. Schlager and his colleagues found that teachers in the online collaborative community appeared to be more engaged in thoughtful, focused, and reflective discussions surrounding their everyday experiences, and that they would develop their own activities in this online system.

Similarly, The LabNet was another online project with the focus of building a “community of practice” among 150 physics teachers through engaging physics teachers in developing ways to teach project-enhanced science learning. Central to this effort was the nationwide telecommunications that provide the opportunities for professional development. Ruopp, et. al., (1993) found a similar result, that teachers are in a better position to keep up to date concerning school change and more willing to experiment with innovative teaching practices when involved with a “community of practice”.

Selwyn (2000) examined a shared sense of community emerging among the teachers in SENco (Special Needs Coordinators forum). After reviewing 18 months of online discourse (n=3,654 messages and 734 total threads), Selwyn found that there was little evidence to show that the online messages constituted a shared sense of community in the online forum. Instead, the online forum was mainly used for information and resource exchanges. However, it is hard to draw conclusions about the impact of an online collaborative communities on professional development, because the results were collected over a short period of time (i.e., a few weeks or a semester course). In fact, teachers need enough time to get used to and familiar with the technological design and

the social design within an online collaborative community, and then move even further, starting to enjoy being a member of the community.

### How Computer Conferencing Network Influences Teacher

#### Practices

The desire for teacher professional development is to produce changes in actual teacher practices. Understanding the use of telecommunications in teacher practices was found in Sunal and Sunal's (1992) study. They grouped 58 preservice teachers into a control group (in the schools without an administrative-supportive local network) and an experimental group (in schools with an administrative-supportive local network). After reviewing the analysis of online discourse and teachers' lesson plans, they found the preservice teachers in the administrative supportive schools developed a more favorable attitude toward use of technology in schools, communicated more frequently with their peers, and were more willing to try innovative practices in their classrooms.

Bliss and Mazur (1996) examined the interactions between six experienced history teachers and six student teachers as they used computer videoconferencing to discuss how to teach history in actual classrooms. They analyzed the data sources from interviews and online discourse. Bliss and his colleague found that the participants valued conversation via computer conferencing connected with their immediate classroom situation, and that the mentors (inservice teachers) liked having opportunities to discuss history teaching with student teachers and to think more deeply about their practices and how they could improve their teaching. Moreover, they also found that teachers engaged in rich online dialogue around actual class issues.

In an ongoing project, Barab (2001) and colleagues (in press) have developed a web-based professional development system called the Inquiry Learning Forum (ILF), which is designed to support a community of inservice and preservice science and

mathematics teachers sharing and observing other teachers' classrooms through online video vignettes. Barab and her colleagues specifically investigated the impact of participating in online discussions on teacher practices. Teachers in this project believed that the participation was helpful in thinking more about their practices even though the results did not yet shown the impact on how teachers actually teach.

McGinnis (1996) used an action research approach in a graduate level elementary science methods course and had his students use email to communicate among members in the class (n=13). Then, he analyzed the comments and found that most students in the course believed that the computer conferencing network had enhanced their teaching practice and caused them to increase their teaching professionalism. Moreover, he also found that students believed that using email communication had fostered a sense of community.

However, to date, little research has been conducted concerning how computer conferencing networks can support teachers by examining and reforming their practices. Simmons, et al., (1999) discovered that there are still many teachers reporting they are student-centered when in fact their actual practices are still teacher-centered. According to the results from many studies, there is evidence to show that teachers "believe" and appreciate the advantages of a computer conferencing network. However, without a well-established online learning environment, pedagogical philosophies and teaching strategies will not be changed by surface discussion or chatting.

#### Factors Affecting Participating in Computer Conferencing

The research in the field of computer conferencing in education has shown that the level and nature of participation in computer conferencing can vary considerably in different situations. Understanding the factors that affect participation provides important theoretical and practical implications. Hiltz (1986), Harasim (1987a), Fenberg (1987),

Mason (1989) and Burge (1988) indicate the following factors that may affect participation in their studies of computer conferencing:

**Absence of Nonverbal Cues:** Some students report difficulties in adjusting to a new and different form of communication and relate this to the absence of the accustomed nonverbal cues of face-to-face interaction.

**Information Overload:** The number of messages can be overwhelming for some students in particularly active conferences or large classes. It normally takes a lot of time for students to read the messages and post their feedback.

**Asynchronicity:** This feature is often presented as an advantage of computer conferencing because it allows the students to post and read messages at anytime and any place. However, the delay in receiving feedback is seen as a problem for some students. Feenberg (1987) suggests it can result in communication anxiety which he says “may silence individuals who would speak if only they had the minimum feedback necessary to feel welcome and at home in the conversation” (p. 179).

**Access:** Learning online from home or school is also usually seen as benefit of computer conferencing, but for some student it presents a barrier. Some students do not have adequate study areas at home or computers at home to log onto the learning system.

**Keeping Track of Multiple Discussions:** In Harasim’s (1987a) study, students reported difficulty in keeping track of several ongoing discussions and deciding when to respond.

**Cognitive Maturity:** Hiltz (1988) states that students who are cognitively immature are not as likely to be active participants. Garland (1993) describes as “the lack of congruence between the student’s cognitive and affective characteristics and perceptions of knowledge, and the knowledge presented in the subject matter” (p. 192).

**The Technology:** McConnell (1990) reports that some students felt the computer conferencing technology hindered their participation. This perception varies considerably

depending on the different technology configurations. The newer applications are more user-friendly and are easier to use.

Lack of Time: Mason (1989) found that this was a common complaint from the students in her study. Students commented that it took quite a lot of time to read or post the messages especially when they had little free time available.

### Conclusions

Barnett, Harwood, Keating, and Saam (2002) reviewed sound studies and concluded that there are eight capabilities for a computer conferencing network-based teacher professional development program. These are:

1. The ability to connect the mentors and mentees in preservice teacher education programs;
2. The ability to produce more collaborative groups working on a particular task;
3. The ability to share resources and information;
4. The ability to support and encourage focused and sustained discussions;
5. The ability to encourage more reflective outcomes surrounding classroom teaching;
6. The ability to support diverse groups (inservice teacher – inservice teacher, inservice teacher – preservice teacher);
7. The ability to support a shared sense of community;
8. The ability to encourage more participation in professional development with the support from skilled facilitators and moderators.

The shift from using computer networks for exchanges of information to engaging teachers in developing their reflective and social processes is part of current national educational reforms. From the previous research results concerning slow changes in the classrooms and teachers' actual needs in their professional development lives and

developing effective professional developmental models that fit teachers' needs are both very important as new networks and their evaluation are contemplated. Too often, professional development activities only provide the "extra events" for teachers but not an ongoing and supportive mechanism in teachers' professional development. The features of a computer conferencing network can be applied in building this kind of mechanism or community in order to move towards educational reforms and making changes in the classrooms.

## CHAPTER III

### RESEARCH METHODOLOGY

The first purpose of this study was to explore the nature of teachers' actual use of the computer conferencing, in terms of participation, growth in critical reflection and social-interpersonal rapport. The second purpose was to discover teachers' perceptions of the role of computer conferencing in their thinking of teaching practices and professional development. Both qualitative and quantitative methodologies were used in this study.

#### The Science Co-Op Project

Science Co-op (2000-2005) is a five-year program of professional development designed to help 38 rural school districts in Missouri and Iowa improve their K-6 science programs through multifaceted professional development and materials-acquisition activities. In many instances rural districts may lack the critical mass of teachers, the financial resources, and the specialized expertise to launch systemic reform on their own. The goal of this project was to support local initiatives for major, systemic change in the elementary science programs.

The basic plan of the project was to form five cooperatives within clusters of school districts, all of which have recently implemented or have agreed to implement instructional units from one or more of three innovative K-6 curriculum projects (FOSS, STC, and Insights) funded by the National Science Foundation. FOSS provides a hands-on approach to science instruction and assessment for students in kindergarten through grade six. Its modular design provides versatility for use in many different classroom settings. Science and Technology for Children (STC) is a complete science program for children in grades 1-6. It is filled with innovative hands-on activities designed to motivate young students. Insights is an elementary hands-on inquiry science program designed to

develop children's understanding of key concepts and to improve students' abilities to think creatively and critically.

The current project utilizes an incremental participation model that is focused on ways to adapt innovative materials to local school district needs. Inservice activities focus on issues of content and pedagogy, including science standards, student preconceptions, balanced assessment activities, integrating the curriculum, teaching for understanding, and working with parents.

University-based Science Co-op Project teams of science educators and scientists work with local (district) facilitators to deliver summer and school-year teacher enhancement activities to an increasingly larger teacher cohort in the cooperatives across the five project years. An initial group of one teacher (advocate) per K-6 building in the participating districts and one middle school or high school science teacher (partner) per district participated in the first cycle of summer and school year professional development activities.

#### Settings and Subjects

The study was conducted in a thirteen-week graduate level course sponsored by the Science Co-Op Project. This course "Curriculum Construction in Elementary and Secondary Schools" was taught by one university professor using ITV technologies in the Fall of 2003. The course focused on the discussion of the selected curricula (FOSS, STC, INSIGHT) and their implementation, resulting in action research. The emphasis of the course was placed upon aligning curricula with the National Science Education Standards (NSES). A science lesson was analyzed in the course to determine its alignment with NSES and then enhanced to be in complete alignment. This model lesson also became the focal point of the action research to be undertaken.



There were forty-eight students in this course who were inservice teachers in the Science Coop Project who registered for taking graduate-level courses as part of the fulfillment to get a Master's degree. They met two hours every Thursday during the Fall semester. Students at nine different district sites were connected via ITV technologies (with video, audio, and computer with Internet access), so that they could see both each other and their instructor through ITV. Each class period was usually devoted to a variety of activities such as class discussions of issues regarding science education (scientific misconceptions, constructivism, National Science Education Standards, inquiry-based science lessons), the instructor's summaries of the weekly online discussions and readings, and instructor or students demonstrating scientific experiments and team projects. Each student could voice his/her opinions, understandings, and questions about science education issues or team projects during the two-hour session. However, a thorough discussion of course topics and multiple perspectives of course topics could not be achieved during the allocated class time (two-hour sessions). Since there were nine ITV sites for the class, it normally took much time to get the students' responses from the students from all nine ITV sites. Basically, the instructor invited students at each site to present a group idea summary. Thus, most of the discussion about course topics and sharing of individual understanding and experiences took place in the form of computer-mediated communication (CMC). In this case, it was the use of Blackboard™'s CourseInfo 6.0, which integrated a variety of communication tools for collaborative work, including an asynchronous conferencing called discussion board and Internal e-mail.

The instructor in this course spent about thirty minutes at the first class session introducing the use of the online discussion board and the purpose for adding this new communicative tool in this course. Therefore, teachers were very clear about the expectation of online discussion participation at the beginning. At the rest of class

sessions, the instructor also spent at least ten to twenty minutes doing the following activities based on the content of online discussions:

1. Summarizing the overall participation in the online discussion board; for example, “The highest number of messages posted by the teacher was 25 last week.”
2. Summarizing the content of the online discussions; for example, “It seems like most teachers are more interested in scientific misconceptions.”
3. Providing some highlights or examples from teachers’ online discussions and discussing them in the class; for example, “ Mary contributed a very good website called ‘ZOOM’.”
4. Assigning homework needed to be posted on the discussion board; for example “Please post your interview results in the forum called ‘Data Report’ on the discussion board.”
5. Reminding or restating the purpose and the responsibility of online discussion participation; for example, “Please spend some time reading and responding to the messages on the discussion board.”
6. Providing support or feedback; for example, “Any question or comment about the online discussion board?”

The technical assistance was also efficient and available for teachers in this course. First of all, most teachers never used an online discussion board before. Secondly, increasing the level of comfort for using this new tool and reducing the level of technical difficulty were efforts used to facilitate the participation. Therefore, a technical assistant was assigned in this course to provide any technical support for the teachers in class or by email or phone.

### Design of an Online Discussion Board

Blackboard™'s CourseInfo 6.0 was the software used to develop the online discussion board in this study. BlackBoard™ was developed by Washington D.C.-based BlackBoard Inc., a company for e-Education. It was a web-based application used to make and host course web sites. BlackBoard included bulletin boards and chat rooms, online quizzes and surveys, a grade book, a calendar and other tools that are difficult to implement on a regular (free-form) web site. The use of tool “bulletin board” in BlackBoard™ was the main focus for this study.

The design of the online discussion board was mainly reflection-based, response-based, and information-based. Each teacher had his/her own user ID and password to access the online discussion board supported by BlackBoard™ 6.0. The teachers were able to access this online discussion board at anytime and any place with an Internet-connected computer.

The discussion board maintained an archive of its hierarchical thread, including the author, date sent, and the number of times the message was read. It also made it easier for the teachers to follow a specific discussion through many diverse messages. Areas, or “forums”, could be set up by course designers for different functions, such as whole group discussion, small group discussion, socializing, and technical help. The instructor set up four types of forums (see Figure 1): content forums, teacher’s lounge forum (whole-group forums) as well as district forums and grade forums (small-group forums). There were five whole-group discussion forums: “Teaching for Understanding”, “Scientific Misconceptions”, “Constructivism”, “Inquiry-based Lesson”, “Professional Development Model.” These “content” forums each corresponded to one of the main course topics. These forums set up a number of public spaces for a variety of functions to help organize the discussions. The teachers could discuss the issues of the five main topics for the class as a whole in these forums. In addition, there was a whole-group

forum called “Teacher’s Lounge”, especially for “free talk” that did not necessarily relate to course topics. Similarly, the forum titled “Technical Support” was to be used for any question or comment about using the discussion board or for downloading course readings.

The small-group forums could separate for “within-” and “among-” district discussions. All teachers were free to read messages in any small group forums and only posted messages to their respective groups. There were nine district forums which were basically set up for the students in that district to work on their collaborative work, such as: sharing ideas, interview data, reporting, and summary synthesizing. If the teachers wanted to share or discuss outside of their own district, they could go to grade level forums. There were three grade level forums: Grade K-2, Grade 3-6 and Grade 7-9. In conclusion, the small-group forums allowed teachers to create their own spaces in the system enhancing management of messages and supporting interactive, collaborative projects.

#### Implementation of the Plan

The first training was held in the summer workshop in June 2003. The training was a face-to-face meeting and the teachers received the tutorial focusing on the use of the discussion board at that time. The second training was held through ITV in the first class in the Fall of 2003. It was basically a review session. Both training sessions involved the following:

1. Describe the design and the purposes of the online discussion board;
2. Introduce the functions and the tools in the online discussion board;
3. Read, respond, and post messages
4. Add attachments to the messages
5. Insert hyperlink in the messages

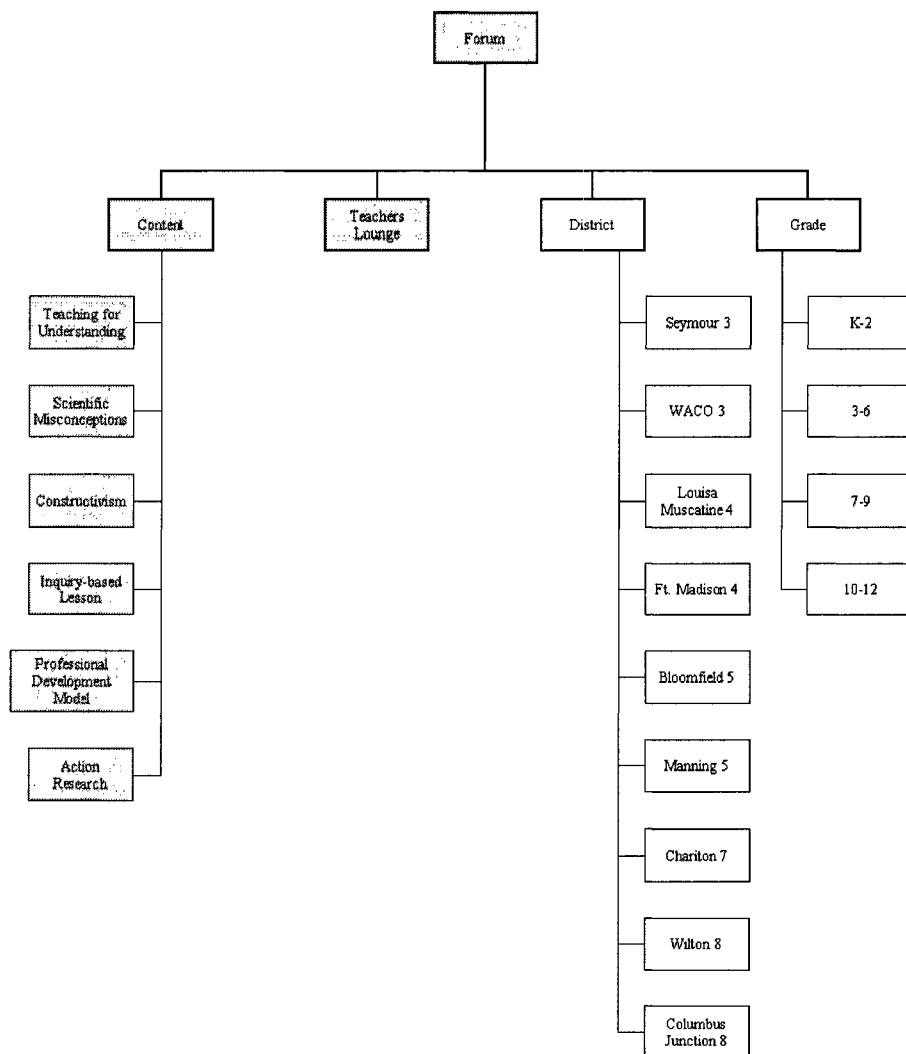
6. Save and compose the messages
7. Give each teacher his/her user ID and password to log on the online discussion board;
8. Read and post exercises: each teacher will learn how to read and post the messages in the online discussion board.

The study period was one semester (Fall 2003). During this period, an email list serve was used by the researcher to contact participating teachers and to send the following information:

1. Reminder for each teacher of his/her user ID and password;
2. Provision for technical support;
3. Announcing hot topics and new topics for the online discussion board;
4. Announcing new added resources for the online discussion board;
5. Forwarding letters to encourage more participation and to stimulate more discussion.

In order to encourage the teachers to use the online discussion board, I frequently contacted the teachers and kept them posted about the latest discussion. Moreover, I provided some useful information such as websites, documents, video clips, and pictures for the discussion board for teachers to download.

Figure 1. Types of Discussion Forums Organized for This Study.



Note: Large-Group Discussion Forums are Content Forum and Teacher's Lounge Forum; Small-Group Discussion Forums are District Forum and Grade Forums.

### Research Design

This study involved both qualitative and quantitative criteria to analyze the content of online discourse and the patterns of online discourse. As for the qualitative content analysis, this study was specifically focused on teachers' critical thinking and

social processes exhibited in the online discourse. Content analysis is a generic term for a variety of textual analyses that typically involve categorizing, comparing, and contrasting a set of data to produce both numeric and interpretive data (Schwandt, 1997). Many research studies use quantitative methodology for online content analyses (e.g., Walther and Tidwell, 1995) for determining the results, including participation rate, the number of postings and average hits per day. However, there is a growing emphasis on qualitative tools to analyze online content or discourse (Iseke-Barnes, 1996; Riel, 1990; Romiszowski and Mason, 1996). The qualitative content analyses were used to explore different levels and types of discussions and the interactions among the users.

Online discourse can be analyzed from many different perspectives. Reflective or critical thinking skills are the most frequently analyzed outcomes in many network-based studies. For instances, Hawkes (2001) used Simmons et al.'s (1989) seven level taxonomy of reflective discourse to assess 28 teachers' online discourse in a suburban Chicago elementary school district in his study. Henri (1992) also developed a model, which has helped the researchers to identify the level of reflective outcomes, such as questioning, sharing, and others.

In addition, many studies have focused on exploring the social effects of online conferencing since social issues are important for this form of analysis (Henri, 1992; Kuehn 1994; Rice and Love, 1987; Walther, 1996). Therefore, social outcomes became another focus in the qualitative data analysis.

The quantitative analysis of the content for this study focuses on the changes in the quality of the discussion content and the participation rate by counting the number of the total posting messages and the reflective outcomes and the social cues observed during three selected weeks.

### Data Sources

By using both qualitative and quantitative analyses, the researcher hoped to obtain a more comprehensive picture of applying computer conferencing in a teacher professional development program. Therefore, qualitative and quantitative data were collected for this study (see Figure 2).

### Qualitative Data

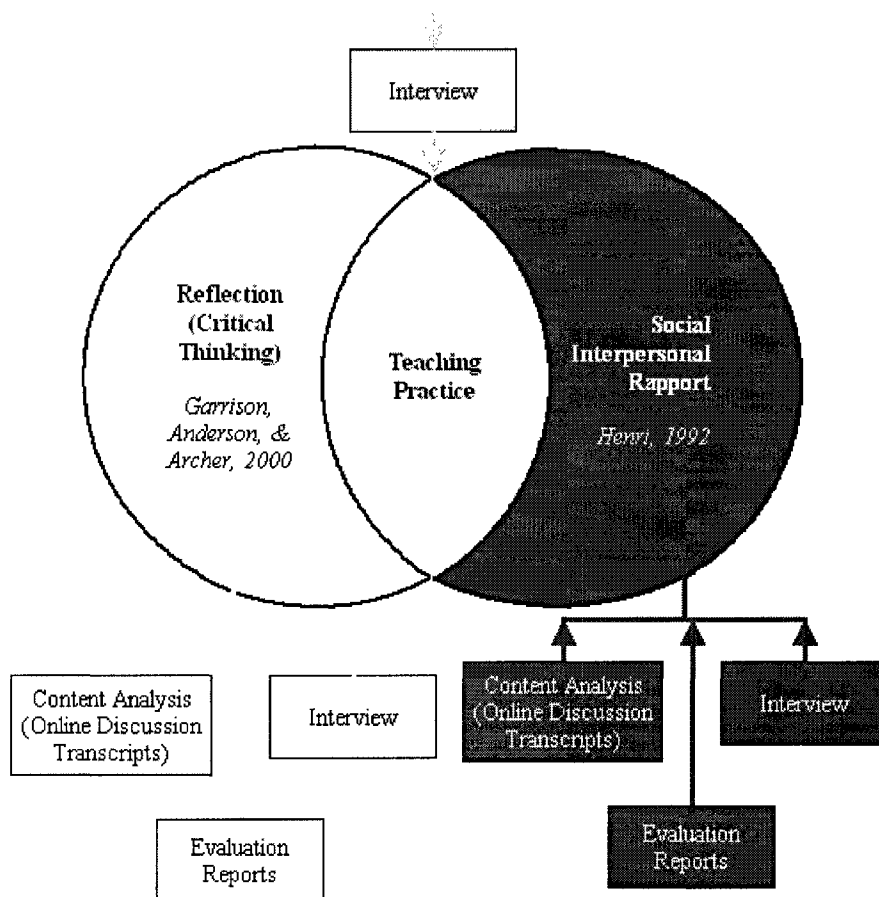
As indicated already, the purpose of this study was to examine two main aspects (critical reflection and social-interpersonal rapport) of interactions in online discourse among the teachers. The qualitative data were collected from BlackBoard™ discussion transcripts, interviews, and self-evaluations. Quantitative analysis were performed on all data collected; however, due to the vast amount of data, a qualitative, descriptive, and detailed analysis was completed only on the discussions for three selected weeks (Week 3, Week 7 and Week 10), as well as for the results from interview data and self-evaluations.

### Online Discussion Transcripts

Data for the qualitative analyses consisted of the online discussion transcripts (see Appendix B) from the communication in course for three selected weeks. Four types of forums, (Content, Teacher's Lounge, District, and Grade level) were included in the course for teachers to share and discuss thoughts and feelings about science teaching and learning at a distance through computer conferencing.



Figure 2. Data Sources for Responding to Research Outline.



Note: Online Discussion Transcripts (Explore Critical Reflection and Social-Interpersonal Rapport); Interviews (Explore Critical Reflection, Social-Interpersonal Rapport and Teaching Practices); Self-Evaluation Reports (Explore Critical Reflection and Social-Interpersonal Rapport).

### Interview

The main purpose of the interview was to gather a special kind of information that included elements from the cognitive and social domains. In this study, the semi-structured interviews based on carefully worded questions as involving with five interview participants in an online chat room at the end of the course. Each participant

arranged to meet at an online chat room and at a convenient time. The online meeting was secured and easy to use. Each participant had his/her own login ID and password to access the online chat room. A letter including an interview invitation was sent to each teacher of this course by email after the researcher gained IRB approval in November, 2003 (Appendix D). Five teachers expressed their interest in participating in the interview. The five interview participants were fully informed of the purpose for the interviews prior to beginning interviews. The interview transcripts were recorded by the computer system called BlackBoard™. The following were the questions that the participants were asked:

1. Please share something you did on the online discussion board that really helped you learn (science, action research or others).
2. Could you please share any example?
3. As being a learner on the discussion board, do you think it is an example of inquiry (or a constructivist) learning environment?
4. Please share something you did on the online discussion board that really helped you teach (science or other subjects)?
5. Have you ever tried anything that was suggested by other teachers' online discussions in your classroom? How did it work?
6. As being an educator on the discussion board, have you ever felt a sense of community of practice was formed?
7. What are the professional outcomes you have experienced from online discussions?
8. Are the professional outcomes different from what you got from other professional development activities in which you have participated (in Science CoOp or others)? In what ways?

9. Please describe your feelings (or changes) of your own or of the others' posting messages on the discussion from the beginning of this semester till present.

### Self-Evaluations

All participating teachers (forty-six) were asked to submit their feedback about using the online discussion board for this course to gain further understanding of what participating teachers did as they learned in a computer-mediated communications context in the distance learning environment. The data gathered from self-evaluations might confirm, contradict, further explicated, or add to data collected through personal interviews. Study participants contributed their feedback based on the following four questions (see Appendix A):

1. Please share what helped or hindered your learning growth through the online discussions.
2. What is your thinking about the group interactions, which occurred with the online discussion board?
3. Please share your feelings about the online discussion component of the course at this time.

The data from self-evaluations were analyzed by using the coding categories in Table 1.

Table 1. Self-Evaluation Categories Used to Collect Data from Teacher Participants

<p>Overall Impression</p> <p>Positive</p> <ul style="list-style-type: none"> <li>• Interesting</li> <li>• So much to read</li> <li>• New and exciting</li> <li>• Cost less time than reading a textbook</li> <li>• More personal</li> <li>• Useful</li> <li>• Insightful</li> <li>• Fun</li> <li>• Enlightening</li> <li>• Beneficial</li> <li>• Easier</li> </ul> <p>Negative</p> <ul style="list-style-type: none"> <li>• Exhausted</li> <li>• Waste time</li> </ul> <p>Things which Helped the Growth</p> <ul style="list-style-type: none"> <li>• Opportunities to compare similarities and differences</li> <li>• Be able to synthesize and relate their thoughts</li> <li>• Have a good understanding of the learning</li> <li>• Feeling that other teachers have the same concerns</li> </ul>	<p>Social</p> <p>Positive</p> <ul style="list-style-type: none"> <li>• Enjoy social conversation</li> <li>• Enjoy have more discussions with the teachers among the sites</li> <li>• Enjoy have more discussions with the teachers within their site</li> <li>• Be able to know the others better</li> <li>• Connect the names with the faces</li> <li>• Feel more confident with each other</li> <li>• Make group more accountable</li> <li>• Everyone in the group is so involved</li> <li>• Enjoy being able to chat with colleagues on a daily basis</li> <li>• Creates a sense of community</li> </ul> <p>Negative</p> <ul style="list-style-type: none"> <li>• Easier to contact people at the same site by person</li> <li>• Hard for the site with less number of the teachers</li> <li>• Feeling of competition</li> </ul> <p>Applications</p> <ul style="list-style-type: none"> <li>• Would like to use with their students</li> <li>• Help to apply what they have learned</li> </ul>
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Table 1. Continued.

<ul style="list-style-type: none"> <li>• Have the same problems</li> <li>• Have the same misconceptions</li> <li>• Feel secure in sharing the ideas</li> <li>• Feel freer to express opinions</li> <li>• Convenience</li> <li>• Have a place to discuss learning</li> <li>• Contact people at any time and any place</li> <li>• Make it easier to learn</li> <li>• Not be limited by distance</li> <li>• Discussions organized in different forums</li> <li>• Pick and choose who to communicate with</li> <li>• Increased content knowledge</li> <li>• Gain enrichment from varied background</li> <li>• Resources <ul style="list-style-type: none"> <li>Ideas</li> <li>Advices</li> <li>Websites</li> <li>Questions</li> <li>School issues</li> <li>Class issues</li> </ul> </li> <li>• Respect and encouragement</li> <li>• Other teachers' perspectives <ul style="list-style-type: none"> <li>From the same grade level</li> <li>From different grade levels</li> <li>From the same school district</li> <li>From different school districts</li> </ul> </li> <li>• Support from other teachers</li> <li>•</li> </ul>	<p>Course Design</p> <p>Positive</p> <ul style="list-style-type: none"> <li>• Help the instructor to know students' thinking better</li> <li>• Contact with the instructor and peers on a regular basis</li> <li>• Better than reading a textbook</li> <li>• Better than writing papers</li> <li>• Spend more time on the discussion board than work on previous assignments</li> <li>• Using it as a requirement is not a hindrance</li> <li>• Interesting addition to the class</li> <li>• Follow up on the class discussions</li> </ul> <p>Negative</p> <ul style="list-style-type: none"> <li>• Quantity requirement</li> <li>• Pressure <ul style="list-style-type: none"> <li>To receive better grade</li> <li>To read the postings everyday</li> <li>To perform</li> </ul> </li> <li>• Don't have anything new to add</li> <li>• No guidelines for Quantity and quality</li> <li>• Low-quality postings <ul style="list-style-type: none"> <li>Redundant postings</li> <li>Only chat without value</li> <li>Forced conversation</li> <li>People don't communicate as clearly through a written format</li> </ul> </li> <li>• Just put time in</li> </ul>
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Table 1. Continued.

<p>Things Which Hindered the Growth</p> <ul style="list-style-type: none"> <li>• Never use discussion board before</li> <li>• Limited knowledge of discussion board</li> <li>• Time consuming <ul style="list-style-type: none"> <li>Time to login</li> <li>Time to read postings</li> <li>Time to reply postings</li> </ul> </li> <li>• Busy on school works</li> <li>• Being a teacher, a mom and a student</li> <li>• Limited time</li> <li>• Try to read everything</li> <li>• Hard to prepare the presentations with other districts</li> <li>• Writing skills</li> <li>• Could not speak smoothly through writing</li> <li>• Have difficulty putting the thoughts in words</li> <li>• Feel burdened to try to come up with something to post</li> <li>• Feel uncomfortable to post things that everyone can scrutinize</li> <li>• Delayed feedback</li> </ul> <p>Changes</p> <ul style="list-style-type: none"> <li>• Change his/her whole view</li> <li>• Like it more than s/he expected</li> <li>• Easier than s/he thought</li> <li>• Become more comfortable to use it</li> <li>• Force him/her to explore</li> <li>• Being reluctant to share the problems at the begining but being more comfortable to ask questions later on</li> </ul>	<p>Lots of repetition</p> <p>Too many positive comments</p> <ul style="list-style-type: none"> <li>• Need directions for the postings</li> <li>• Announce the things to post too late</li> <li>• Hard to read all postings in one week</li> <li>• Hard to view and reply the postings under too many forums</li> <li>• Categorize the forums by weeks of the class</li> </ul> <p>Technical Issues</p> <p>Positive</p> <ul style="list-style-type: none"> <li>• Learn more computers</li> <li>• Better than using email to contact</li> <li>• Effective in keeping track of a discussion among a group</li> <li>• Easy to address a specific message</li> <li>• Email someone who made a comment from the discussion board</li> <li>• More confidence to use computer technology</li> </ul> <p>Negative</p> <ul style="list-style-type: none"> <li>• Computer facilities</li> <li>• No computers at home</li> <li>• No internet at home</li> <li>• Low speed computers (at home or school)</li> <li>• Low speed Internet (at home or school)</li> <li>• Not being able to delete read postings</li> <li>• Frustration from technical problems</li> <li>• Need spell check</li> </ul>
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Table 1. Continued

<ul style="list-style-type: none"> <li>• More improved than the previous classes</li> <li>• Get more immediate feedback than previous classes</li> <li>• More interactions than previous classes</li> <li>• Talk directly to people from other districts</li> <li>• Not only in-house group conversation but also out-house groups' conversation</li> <li>• Things could not happen on ICN</li> <li>• Have more impersonal discussions that could not happen through ICN format</li> <li>• Feel freer to share the ideas than feel on spot on ICN</li> <li>• Add new dimension to the program</li> </ul>	<ul style="list-style-type: none"> <li>• Hard to read through the messages</li> <li>• Hard to login</li> </ul>
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#### Quantitative Data

Quantitative data were obtained from online discussion transcripts. The total number of messages from the thirteen weeks was analyzed. The data revealed the frequency of teacher participation as well as the total number of messages of the three weeks. In addition, the online discussion transcripts collected from three selected weeks were analyzed for the indicators of critical thinking skills and social cues. The data revealed the frequency of four levels of critical thinking skills used in the three weeks' online postings, as well as the frequency of social cues shown in postings of the three weeks.

#### Data Collection

The purpose of the study was to describe and improve understanding of teachers' experiences as they learn in a CMC context within a distance education environment.

Data were gathered in three ways, with any one method providing support for the veracity of the data collected by the others. The bulk of data was collected through three-week's computer conferencing transcripts, the transcript-recorded interviews with fifteen participating teachers, and the self-evaluations from forty-six participating teachers who were enrolled in this course.

The transcripts of the computer conferencing discussions in this course were collected from the first class session (September, 11, 2003) to the last class session (December 11, 2003). However, only the transcripts of three selected weeks were analyzed.

Generally, the fifteen interviews were conducted via the online chat room, which was synchronous and could record the transcript. Further evidence was gathered through self-evaluations.

#### Data Analysis

The data sources in this study included: a) the transcripts of computer conferencing discussions, b) interviews, and c) self-evaluations. The researcher used content analyses to examine the data (the transcripts) for two perspectives: reflection and social interaction. The online discussion transcripts of the three weeks were collected and printed out for coding by the researcher. The examples of reflective or social outcomes were also included in the result part.

The computer transcripts called online discussion transcripts from Week 3, Week 6, and Week 10 were analyzed for both quantity and quality of the reflective outcomes. The Weeks of 3, 6, and 10 represented the beginning, middle and the end of the semester. The reason that Week 10 was selected instead of Week 9 was because there was a technical problem encountered in Week 9 and most teachers could not log on to the discussion board for that week.



Any message could conceivably contain several ideas; therefore, when two continuous paragraphs dealt with the same idea, they were counted as a one-idea unit. When one paragraph contained two ideas, it was counted as two idea units. All posted messages from the teachers were coded and analyzed. There were two code sheets, which were used for analyzing critical thinking skills and social outcomes.

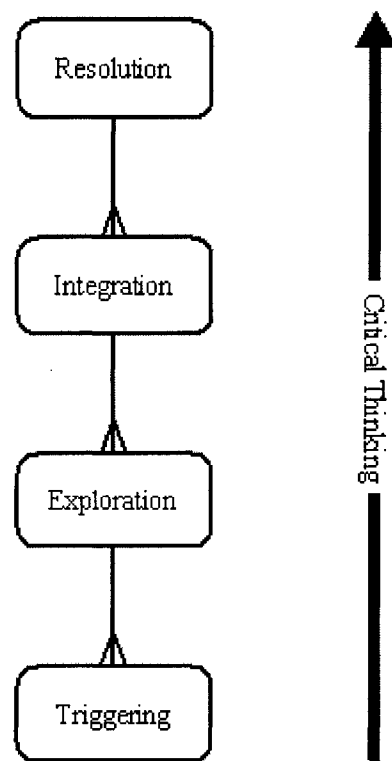
Content analysis was used to assess the degree to which teacher message units appeared to reflect the use of critical thinking. All critical thinking messages were scored on a four-point rubric using Garrison's critical thinking model (see Figure 3 and Table 2) in order to determine if the quality of reflective messages changed over time.

Two criteria were applied to analyze the online discourse with constructivism serving as the theoretical background for the two coding criteria. The qualitative data source was discourse content analysis resulting from use of Garrison's (1991) "Practical Inquiry Model" to examine the first aspect namely, critical thinking. In Garrison's et al., model of a community of inquiry, the three elements of this community of inquiry are cognitive presence, social presence, and teaching presence. Cognitive presence is defined as the vital element in critical thinking, a practical inquiry process and outcome that is frequently presented as the main goal of all higher education as well as collaborative discourse (Garrison, Anderson and Archer, 2001). The participants with the cognitive presence are able to construct and confirm the meaning through situated communication in a community of inquiry (Garrison, Anderson and Archer, 2001). Similarly, Silver (1998) argues that the relationship between a learning experience and a learner's cognitive skills indicates that only reflective learners can use their own reflective thinking during practice and thereby effectively revise their learning strategies in practice.

Garrison's (1991) model of critical thinking is grounded very much in experiences but also includes imagination and reflection, which lead back to experiences and practice (Dewey, 1933). The model of critical thinking defines four categories to

outline and understand cognitive presence in an educational context. The four categories of critical thinking model suggested by Garrison include: triggering event, exploration, integration, and resolution.

Figure 3. Garrison's Critical Thinking Model.



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Note: There are four phases of critical thinking process from lower-level to higher-level: Triggerring, Exploration, Integration and Resolution (Garrison, 1991).

Table 2. Four Phases in Critical Thinking Process

Skill	Indicators	Socio-cognitive processes
<u>Triggering Events</u> Example: It has been argued that the only way to deliver effective science instruction is through inquiry approach. However, this approach is rarely used. Why do you think that is?		
Evocative	Recognizing the problem  Sense the puzzlement	Presenting background information that culminates in a question. Asking questions. Messages that take discussion in new direction.
<u>Exploration</u> Example: One reason I think it is seldom used is that it costs too much time to let students ask questions and discuss. Another may be that teachers feel difficult to manage the instruction.		
Tentative	Divergence - within the online community Divergence - within a single message Information exchange  Suggestions for consideration  Brainstorming  Leaps to conclusions	Unsubstantiated contradiction of previous ideas. Many different ideas/themes presented in one message. Personal narratives/descriptions/facts Another explicitly characterizes message as exploration Adds to established points but does not systematically defend/justify/develop addition. Offers unsupported opinions.
<u>Integration</u> Example: I think all this work with misconceptions, prior knowledge and concept mapping really hits home that you can't assume anything. I use everyday vocabulary and assume the kids know what I'm talking about. It only takes a student to ask what a hospital or a garage is to make me realize I probably assume too much.		
Provisional	Convergence – among group members  Convergence – within a single message  Connecting ideas, synthesis  Creating solutions	Reference to previous message followed by substantiated agreement. Building on, adding to other's ideas. Justified, developed, defensible, yet tentative hypotheses. Integrating information from various sources. Explicit characterization of message as a solution by participant.
<u>Resolution</u> Example: how we solved this problem was...???		
Committed	Various applications to real world Testing solutions Defending solutions	

Source: Garrison, D.R., Anderson, T. Archer W. (2001). Critical thinking, cognitive presence, and computer conferencing in distance education. *American Journal of Distance Education*, 15(1), 7-23.

Henri's (1992) model for content analysis of computer-mediated communication was applied for assessing the social aspects. Many studies have attempted to analyze the social aspect of online discussion since social cues are considered important in this form of analysis (Henri, 1992; Kuehn 1994; Rice and Love, 1987; Walther, 1996). Social cues were defined by Henri (1992, p. 126, see Table 3) as a "statement or part of a statement not related to formal content of subject matter." They may include a self-introduction (e.g., "My name is Mike and I teach first grade..."), expression of feeling (e.g., "I am feeling frustrated...."), greeting (e.g., "Congratulations!!!"), closure (e.g., "That's it for now"), jokes, the use of symbolic icons (e.g., "☺"), and compliments to others. Using Henri's model, the social presence in computer conferencing (social cues, for example "This is my birthday, what a great day!") was examined for analysis of online discussion.

Table 3. Social Cues in Online Discussion Transcripts

Types of Social Cues	Examples
Self-introduction	e.g., "Hi! My name is Smith Wilson and I teach in..."
Expression of feeling	e.g., "I am feeling frustrated."
Greeting	e.g., "Congratulations!!!"
Closure	e.g., "That's it for now"
Jokes	e.g., "tell you a very funny story..."
The use of symbolic icons	e.g., "☺"
Compliments for others	e.g., "I totally agree with your idea.."

Source: Henri, F. (1992). Computer conferencing and content analysis. In Collaborative learning through computer conferencing. (pp. 117-136). Berlin: Springer Verlag.

### Coding of Transcripts

Since the focus of this study is on teachers' growth in critical thinking and social-interpersonal rapport as well as teachers' perceived views of using computer

conferencing, the majority of the data were obtained from the online discussions, interviews, and self-evaluation reports.

Content analysis was used to assess the degree to which teacher message units appeared to reflect the use of critical thinking and social cues. Figure 4 indicates the coding procedures used for analyzing online discussion transcripts.

Since the interviews were conducted via the online chat room, the transcripts were automatically recorded in the online chat room system as the interviews were completed. In addition, the self-evaluation reports were emailed to the researcher; the transcripts of the self-evaluation data were also in the digital format. Only the researcher had the access to the transcripts from two sets of the data. Once the transcripts were printed out, the researcher used qualitative methods to code the transcripts, first reading and then rereading the postings to determine major topics and discerning underlying themes.

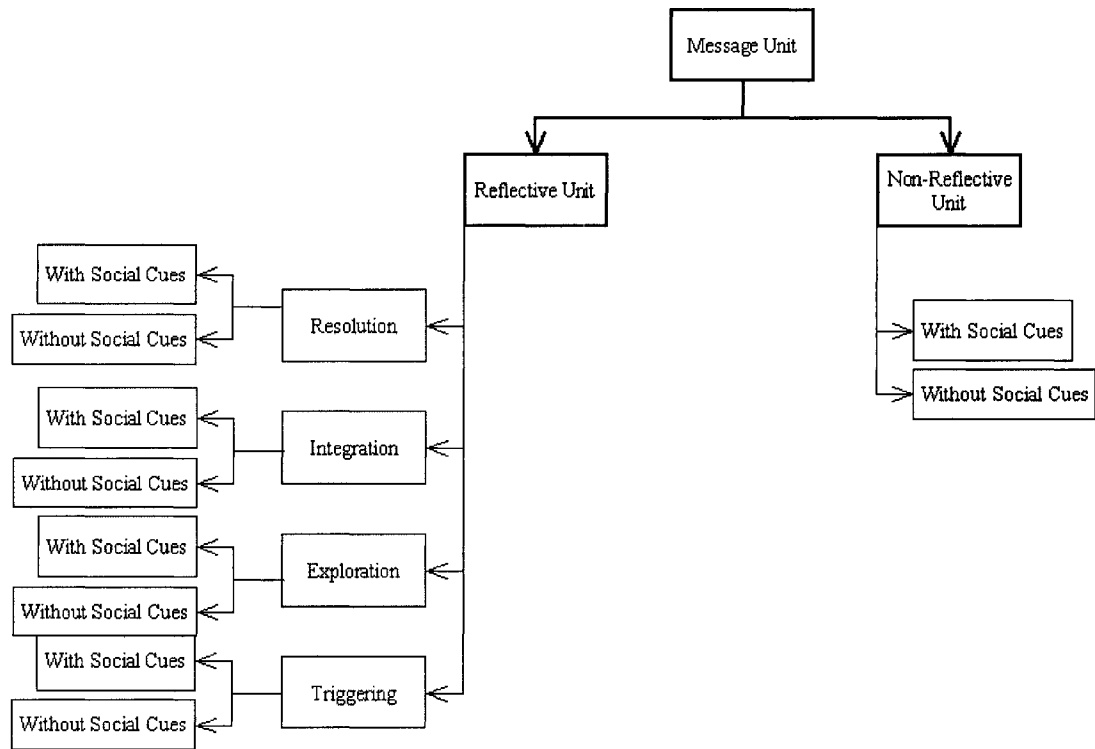
#### Units of Measure

Transcripts collected from the online discussion board, interviews, and self-evaluation reports were too large to be codified. In an attempt to establish criteria for breaking down messages, Henri and Rigault (1996) borrowed from pragmatic linguistics to define the following possible units of measure:

1. Exchange: the smallest unit of interaction involving more than one participant;
2. Message: the greatest unit controlled by a speaker at one time;
3. Speech segment: the smallest unit of delivery, linked to a single theme, directed at the same interlocutor (singular, plural or indefinite), identified by a single type, and having a single function (Henri and Rigault, 1996).

The basic unit of measure selected for this study was the speech segment.

Figure 4. Coding Procedure for Classifying Indicators of Critical Thinking and Social Cues from the Online Discussion Transcripts.



### Development of a Coding Scheme

However, “messages do not have a single meaning and need to be ‘unwrapped’ . Data can always be looked at from numerous perspectives, especially when they are symbolic in nature” (Krippendorff, 1980). Therefore, the length of a speech segment is determined by the term “identified by a single type”, depending on the number and the fitness of the characteristics under study (McDonald, 1998). After reviewing the objectives and research questions for the study and rereading the transcripts from online discussions, interviews and self-evaluations, the following variables for coding were selected:

1. Participation of Computer Conferencing: what factors did the speech segment indicate? Encouraging the participation or discouraging the participation in using the computer conferencing;
2. Critical Thinking: what factors did the speech segment indicate that helped with critical thinking/learning or that hindered critical thinking/learning?
3. Social-Interpersonal Rapport: what factors did the speech segment indicate about social-interpersonal rapport?
4. Teaching Practice: what perceptions did the speech segment indicate about teaching practice?
5. Professional Development: what perceptions did the speech segment indicate about professional development?

Two models were applied for examining variable 2 and variable 3. One was Garrison’s (1991) critical thinking model and another one was Henri’s (1992) model of social cues. These two models have been applied widely in much educational research.

For the data from interviews and self-evaluations, the researcher developed two coding categories for examining variables 1, variable 4, and variable 5. The aspects of

critical thinking and social domains were also gathered and analyzed from interview and self-evaluation data sources.

Table 4 summarizes the data that was analyzed using the four research questions elaborated in Chapter I.

#### Researcher Status

The researcher has been involved with Science Co-op Project for three years (June 2000 – present). She has worked as a research assistant helping teachers to use software programs and Internet resources in science teaching. She also participated in most of the professional development activities with the teachers and project staff, including summer workshops, April workshops, staff meetings, and conferences. In this study, she was a teaching assistant and course website designer. She conducted the training sessions for teachers to learn about this tool. Moreover, she kept in contact with all participating teachers by email and by telephone to solve any problem with using this tool.

#### Permissions and Clearances

The proposal for this study was approved by the University of Iowa Human Subject Committee. In addition, written approval was granted by the University of Iowa, Interview consent forms were signed giving the researcher permission to use the interview data.



Table 4. Research Questions and Data Analyses Used in This Study

Research Question/Topic	Data Analysis	Data Sources and Instruments
<b>Research Question 1</b> How frequently and how much did participating teachers contribute to the computer conferencing in this course? <b>Operational Questions:</b>		
1-1 Over the duration of the course, how often did participating teachers contribute to the computer conferencing?	<ul style="list-style-type: none"> <li>• Overall participation in computer conferencing (per teacher, per week, nice school districts).</li> <li>• Number of messages posted over thirteen weeks indicating the participation in four discussion forums.</li> <li>• Factors that affected teachers' participation in computer conferencing.</li> </ul>	Online Discussion Transcripts  Self-evaluation Survey
<b>Research Question 2</b> What patterns characterize the content of the teachers' postings to the computer conferencing? (e.g., in terms of levels of critical reflection and their efforts to social-interpersonal rapport) <b>Operational Questions:</b>		
2-1 What critical thinking outcomes were observed when participating teachers used the computer conferencing in this course?	<ul style="list-style-type: none"> <li>• Examples of critical thinking messages.</li> </ul>	Online Discussion Transcripts
2-2 How did the quantitative and qualitative characteristics of critical thinking outcomes change over the duration of the course?	<ul style="list-style-type: none"> <li>• Total number of critical thinking messages during Weeks of 3, 6, and 10.</li> <li>• Total number of each category of critical thinking messages during Weeks of 3, 6, and 10.</li> <li>• Mean critical reflection scores during Weeks of 3, 6, and 10.</li> </ul>	Online Discussion Transcripts
2-3 What social-interpersonal rapport was observed when participating teachers used the computer conferencing in this course?	<ul style="list-style-type: none"> <li>• Examples of social messages.</li> </ul>	Online Discussion Transcripts
2-4 How did the quantitative and qualitative characteristics of social outcomes change over the duration of the course?	<ul style="list-style-type: none"> <li>• Total number of social messages during Weeks of 3, 6, and 10.</li> <li>• Total number of each category of social messages during Weeks of 3, 6, and 10.</li> </ul>	Online Discussion Transcripts

Table 4. Continued

<p><b>Research Question 3</b>            What were the participating teachers' perceptions of the factors that affected participation and learning interactions in computer conferencing?  <b>Operational Questions:</b></p>			
3-1	What did the participating teachers' perceive to be the factors that affected their participation in the computer conferencing discussions?	<ul style="list-style-type: none"> <li>List and examples of factors that have positive impact on participants' participation.</li> <li>List and examples of factors that have negative impact on participants' participation.</li> </ul>	Interview Self-evaluations
3-2	What did the participating teachers' perceive to be the factors that affected their critical thinking/learning in computer conferencing discussions?	<ul style="list-style-type: none"> <li>List and examples of factors that have positive impact on participants' critical thinking.</li> <li>List and examples of factors that have negative impact on participants' critical thinking.</li> </ul>	Interview Self-evaluations
3-3	What did the participating teachers' perceive to be the factors that affected their social-interpersonal rapport in computer conferencing discussions?	<ul style="list-style-type: none"> <li>List and examples of factors that have positive impact on participants' social-interpersonal rapport.</li> <li>List and examples of factors that have negative impact on participants' social-interpersonal rapport.</li> </ul>	Interview Self-evaluations
<p><b>Research Question 4</b>            What were the participating teachers' perceptions of the role of computer conferencing in their thinking about their teaching practices and in their overall professional development?  <b>Operational Questions:</b></p>			
4-1	What were the participating teachers' perceptions of the role of computer conferencing in their thinking about their teaching practices?	<ul style="list-style-type: none"> <li>List and examples of teachers' perceptions of the role of computer conferencing in their thinking about their teaching practices.</li> </ul>	Interview
4-2	What were the participating teachers' perceptions of the role of computer conferencing in their thinking in their overall professional development?	<ul style="list-style-type: none"> <li>List and examples of teachers' perceptions of the role of computer conferencing in their thinking in their overall professional development.</li> </ul>	Interview

### Pilot Study

A pilot study was conducted to examine the effectiveness of using the ICT (information computer technologies) in distance delivery of professional development and to specify possible improvements in these ICT applications. The design of this pilot study consisted of the analysis of the project website log (Year 2002) and summer workshop (Year 2001) evaluations. A research and development (R&D) approach was used for designing an innovation, testing the innovation in an authentic context, and identifying problems and specific refinements needed for future study. The study is a report of exploration of the participants' use of the project website and their views expressed on the ICT applications for improving science teaching. This study assumed that ICT applications created effective distance delivery of professional development, encouraged more teachers' involvement, and improved the quality of professional development.

The analysis of the project website was constructed with six foci: average hits per day, average visiting users per day, average visiting user stay length, most popular hour, most popular day of the week, and most requested pages. The results revealed that most teachers used the project website during the school day. One possible reason for this pattern of usage is that the availability of the Internet access and computer equipment is higher at schools than at homes for the teachers in rural school districts. These data were evidence to evaluate the project's effort to improve the technical equipment and the Internet access in the rural school districts in order to deliver professional development more effectively.

The project web pages were categorized according to six kinds of information: project information, summer workshops, ITV information and ITV survey log in, contact information, educational resources, and FAQ. Comparing the hit number of resource

pages (optional) and ITV pages (partially required), the hit number of resource pages was much lower than ITV pages. This comparative statistic reveals that the teachers mainly used the project website as a tool to complete the required tasks (ITV surveys) instead of using it as a much more global professional developmental tool, such as finding educational resources or science inquiry resources in the resource pages. These results appeared to indicate that it is necessary to provide new, exciting and useful information in the project website for teachers and to maintain the usage pattern of active visitors.

The summer workshop evaluation (2001) was based on a survey of four main open-ended questions:

- What is the main idea of the workshop?
- What is the most valuable idea of the workshop?
- What is the least valuable part of the workshop?
- Other comments?

In response to question 2, What is the most valuable idea arising from the workshop, the most frequent answer was “having a chance to interact with teachers from other districts and learn a lot from other teachers,” which indicates that most teachers enjoyed interacting with and learning from teachers from other school districts during the workshop. The results also indicated that teachers learn most and best from other teachers that they can discuss and share together not only during the summer workshops but also whenever teachers want to ask questions or to share teaching experiences.

According to the results from the study, teachers learn most and best from other teachers and value it as the most significant parts of their professional development. However, the project website does not play an effective role in increasing more interactions and communications among the teachers and making the teachers more willing to use it more. Therefore, in the current study, I added an online discussion board to the project website and created an online learning community for teachers.

## CHAPTER IV

### RESULTS

This chapter is a summary of the results of the study, looking for patterns in overall participation, reflection, and social-interpersonal rapport as well as teachers' perceptions of the role of computer conferencing in their thinking about teaching practices. Content analysis was used to address the specific research objectives using computer transcripts to identify patterns of participation, reflection, and social-interpersonal rapport inherent in the teachers' professional growth. The self-evaluation reports and interviews provided additional information regarding factors affecting participation, learning and social-interpersonal rapport, and the role of computer conferencing in teaching practices.

#### Participation

In this study, there were forty-six elementary teachers from nine different Iowa school districts and one instructor from The University of Iowa in a graduate level course called "Curriculum Construction in Elementary and Secondary Schools." It was the course sponsored by the Science Co-Op Project and was conducted with the use of two-way audio and video conferencing technologies. In addition, an online discussion board was applied for out-class participation during the semester.

Participation in computer conferencing counted for 15% of the teachers' final grades. Both quality and quantity of the postings were graded by the instructor and the teachers themselves during the first half of the semester. After the mid-term, the course requirement for computer conferencing participation was changed so that only quality of the postings for was used for grading purposes. In-class participation was used for 20% of the grade, while paper and project assignments were worth 65%. The instructor tried several approaches to promote and encourage online discussion by highlighting some

conversations from the online discussions in class and emphasizing the importance of interactive responses in computer conferencing. Teacher perceptions of factors affecting their participation were also addressed.

#### Quantitative Data

In total, 48 teachers posted 1,573 messages during 13 weeks of online activity for an average of 32.7 messages per teacher (see Table 5). The range was from a low of 2 to a high of 70. The amount of teacher participation varied over the 13 weeks of the course (see Table 6 and Figure 5). In Week 7, the instructor announced that the quantity of the postings would no longer be graded and only quality would be graded. After Week 7, it was encouraging to see that the number of messages still increased until Week 9.

Table 5. Overall Participation in Computer Conferencing

Mean	Median	Mode	Standard Deviation	Range	Confidence Level
32.16	31	23	15.88	68 Largest (1) 70 Smallest (1) 2	(95.0%) 4.5127

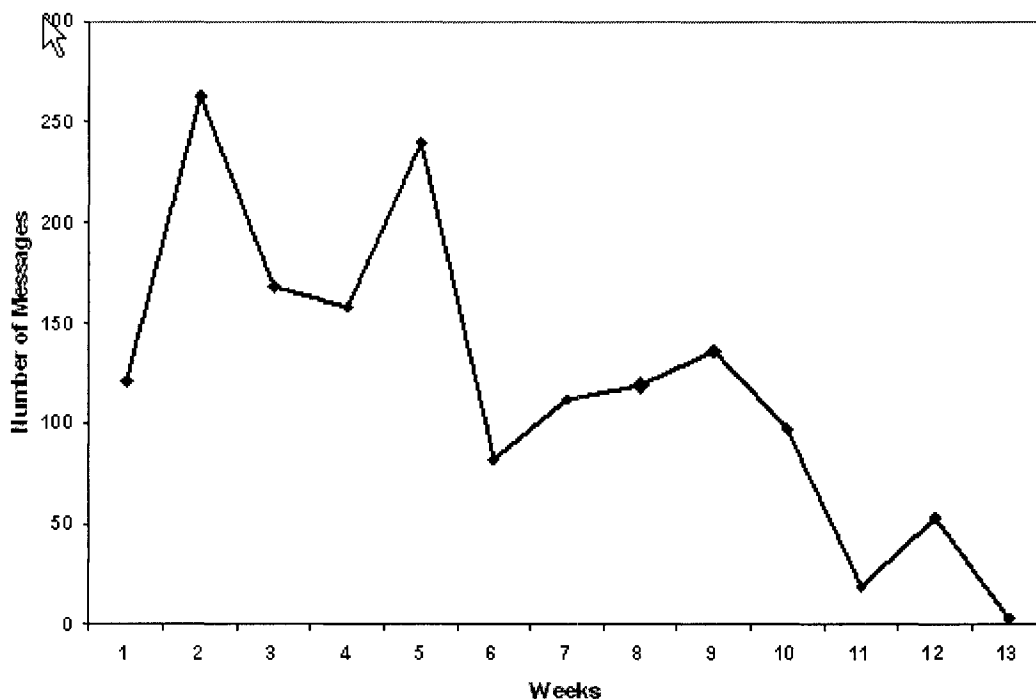
Note: The numbers are the numbers of messages per teacher over the thirteen weeks in the Fall of 2003.

Table 6. Overall Participation in Computer Conferencing

	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7
Total Number of Messages	121	263	168	158	240	82	112
	Week 8	Week 9	Week 10	Week 11	Week 12	Week 13	
Total Number of Messages	119	136	97	19	53	3	

Note: The numbers are the total numbers of messages each week over the thirteen weeks in the Fall of 2003.

Figure 5. Weekly Teacher Use with Computer Conferencing Over the Thirteen Weeks.

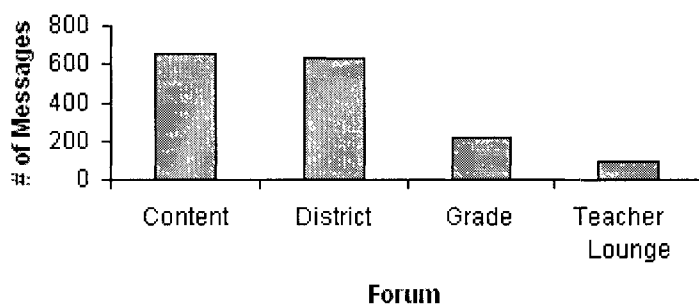


There were four types of discussion forums created for this course: content, district, grade level and teacher's lounge. The level of participation varied among the four discussion forums. Content forums resulted in the highest number of messages (N=659). This was followed with district forums which resulted in very similar number of messages (N=638). Compared to content and district forums, grade level forums resulted in a lower level of participation (N=222); the teacher's lounge forum resulted in the lowest number of messages (N=98) (see Table 7 and Figure 6).

Table 7. Number of Messages Posted over Thirteen Weeks indicating the Participation in Four Discussion Forums

Forums	Content	District	Grade level	Teacher's Lounge
Number of Messages	659	638	222	98

Figure 6. Number of Messages Posted over Thirteen Weeks indicating the Participation in Four Discussion Forums.



The teachers in the course were from nine different school districts; each district had a different number of teachers from a low of 3 and a high of 8 (see Table 8). The total number of the postings in each forum also varied across different district forums. Even though the participation rate tended to be higher in the district with a higher number of people, there was no obvious trends observed with respect to the results.



Table 8. Teacher Participation in the Nine School Districts

District	School District 1	School District 2	School District 3	School District 4	School District 5
Number of People	3	4	4	4	5
Number of Messages	33	56	36	32	87
Average Number of Message per Teacher	11	14	9	8	17
District	School District 6	School District 7	School District 8	School District 9	
Number of Teachers	5	7	8	8	
Number of Messages	50	145	80	119	
Average Number of Message per Teacher	10	21	10	15	

### Qualitative Data

During the mid-term, the teachers completed the survey called “self-evaluation report.” In it, they identified the factors that affected their participation in computer conferencing. Most teachers’ impressions of participating in computer conferencing were positive. They described their impressions as interesting, new and exciting, beneficial, insightful, enlightening (see Table 9 and 10).

Fewer teachers had negative impressions of participating in computer conferencing. Of these, teachers pointed out two main complaints: computer conferencing was too time consuming and they were too exhausted after a full day of teaching. One teacher summarized with this comment:

Time is the biggest problem for me!! We are so busy with all of the demands of our job here at school, and then all of the demands of being a mother, and being a student. It's not easy to find the time to get everything done. [SE15]

However, other teachers had different comments about the time issue in using computer conferencing in this course: “Though I do realize it takes no more time than if I was reading chapters out of a textbook that would not have much meaning for me. At least the online is more personal, useful, and insightful.”

Participating in computer conferencing was a new experience for most teachers in this course. Overall, the teachers were willing to use it for learning, communicating, and other purposes. However, the electronic discussion board was used frequently in this course with a great number of postings. It became too stressful for many teachers to read through the postings and then to provide their own ideas and feedback. Time was a big complaint for many teachers because they did not have great amounts of time for professional development in addition to routine business required in their homes and schools.

Table 9. Positive Factors Identified by Teachers which Affected Their Participation

Overall Impression (Positive)	Overall Impression (Negative)
Interesting New and exciting Cost less time than reading a textbook More personal Useful Insightful Fun Enlightening Beneficial Easier	Exhausting Waste of time

Table 10. Examples of Positive Factors Expressed by Teachers Which Affected Their Participation

"I think that this discussion board is a much better way of learning than writing papers and submitting them--never to see or hear about them again." (SE14)  
 "It's very interesting, professionally, to read other people's perspectives. I appreciate the ideas, websites, and general support of other teachers." (SE1)  
 "It has been a new and exciting experience to be part of." (SE2)

*\*SE: Self-Evaluation Respondent*

### Critical Reflection

The pattern and quality of the teacher critical reflections in computer conferencing over three selected weeks were the primary outcomes evaluated in this study. The critical thinking model developed by Garrison (1991) was used to analyze teachers' critical reflections in computer conferencing. In addition, teachers' perceptions of factors affecting their learning as well as their personal reflections are addressed in this section.

### Quantitative Data

The total number of critical thinking messages in three selected weeks is shown in Table 11 and Figure 7. In total, 48 teachers posted 552 messages using critical thinking skills during the weeks of 3, 6, and 10 of online activity, for an average of 11.5 messages where critical thinking skills were used. Ninety percent of the total messages in the three weeks were categorized as critical reflection messages.

The number of critical reflection messages varied over the three selected weeks of the course. As can be seen in Figure 7, it peaked at Week 3 (214 messages) but began to decline after Week 3 and until Week 10.

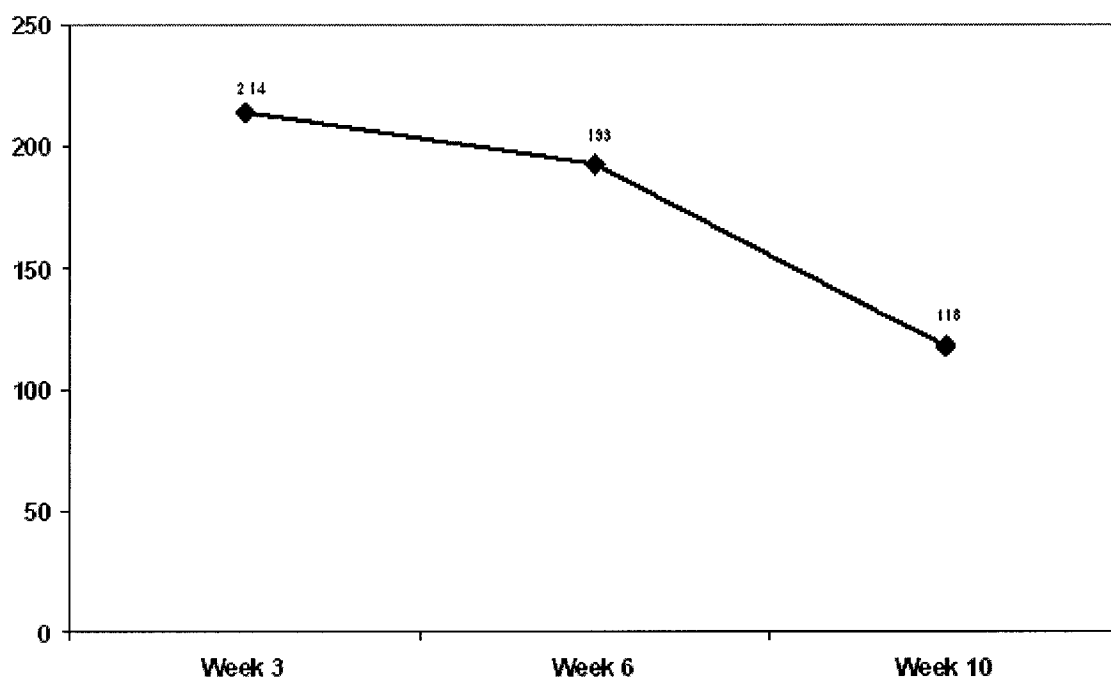
As discussed in Chapter III, the content analysis was conducted in two phases. First, the online discussion transcripts were analyzed for indicators of the critical thinking skills identified in the framework (Garrison's critical thinking model), which was described in Chapter III. Then, in the second phase, the messages with the indicators of the critical thinking skills were scored (see Table 12), ranging from a low of one (triggering) to a high of four (resolution), based on the criteria described in Chapter III.

The content analysis revealed that the means of scores concerning critical thinking during the three weeks increased considerably from Week 3 (2.02) to Week 10 (2.19) (see Figure 8).

Table 11. Number of Critical Reflective Messages Posted during Weeks of 3, 6, and 10

	Week 3	Week 6	Week 10
Content Forum	32	123	56
District Forum	124	55	25
Grade level Forum	46	9	20
Lounge Forum	12	6	17
Total	214	193	118

Figure 7. Number of Critical Reflective Messages Posted during Weeks of 3, 6, and 10.



Most teachers used the second level of critical thinking skills (Exploration) when posting critical thinking messages during the weeks of 3, 6, and 10. In addition, the teachers rarely applied the higher-level critical thinking skills in their critical thinking messages. For example, in Week 3, only 2.8% of the critical thinking messages indicated

the use of the skill of resolution. Even though the percentage of the use of the skill of resolution in three weeks was low, the percentage increased continuously from the Week 3 with the percentage of 2.8, to Week 10 with the percentage of 10.2 (see Table 13 and Figure 9).

Table 12. Rubric for Scoring Messages in Various Levels of Critical Reflection

Level of Critical Reflection	Triggering (Level 1)	Exploration (Level 2)	Integration (Level 3)	Resolution (Level 4)
Score	1	2	3	4

Table 13. Percentage of Messages during Weeks of 3, 6 and 10 regarding the Four Levels of Critical Reflection

	Week 3	Week 6	Week 10
Triggering	8.9%	8.3%	10.2%
Exploration	82.7%	73.6%	71.2%
Integration	5.6%	14.0%	8.5%
Resolution	2.8%	4.1%	10.2%

Figure 8. Mean Critical Reflection Scores during Weeks of 3, 6, and 10.

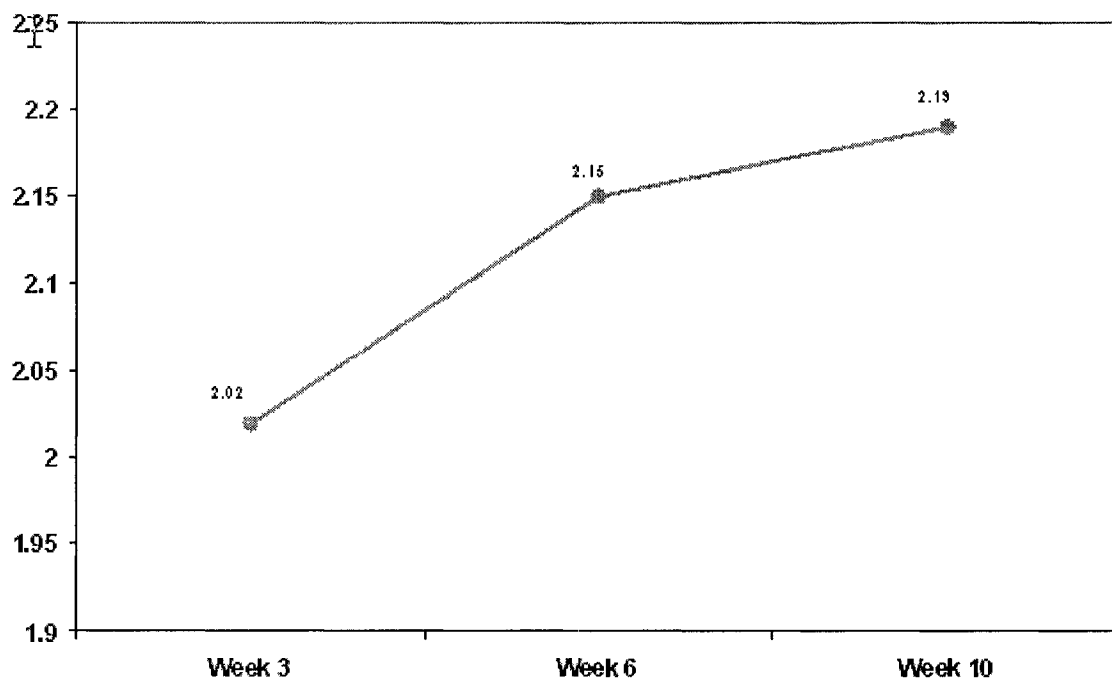
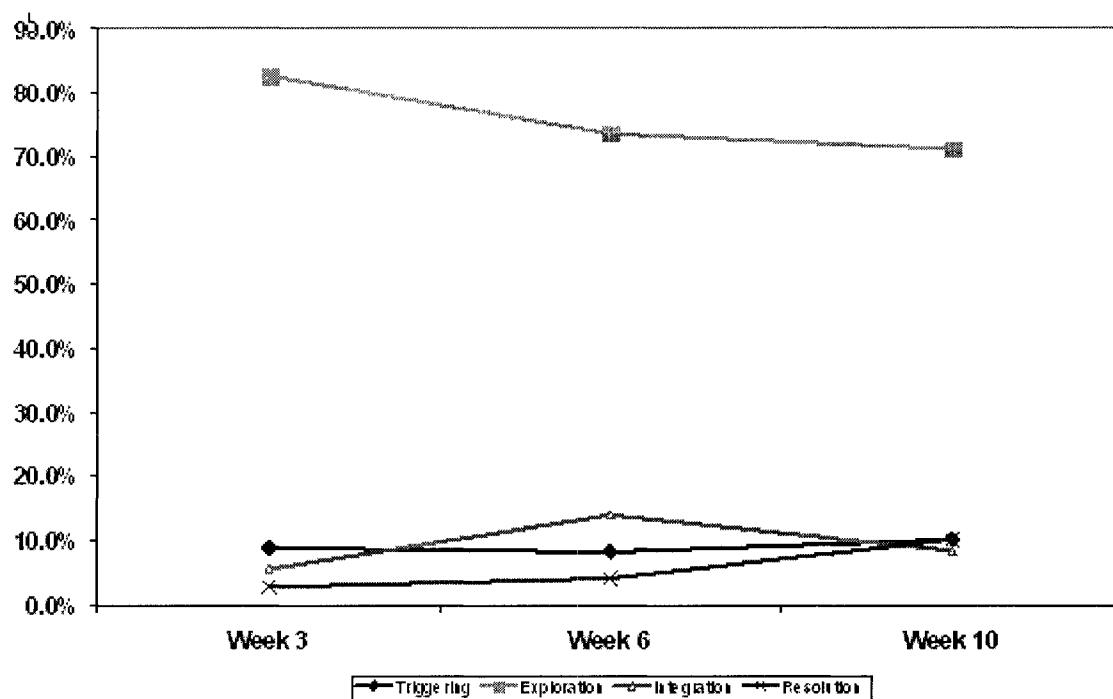


Figure 9. Summary of Percentage of Messages during Weeks of 3, 6 and 10 regarding Four Levels of Critical Reflection.



A chi-square test for trend analysis regarding the four types of critical thinking messages (Triggering, Exploration, Integration and Resolution) was performed to find if the type of critical thinking message which resulted in statistically significant linear trends. Table 14 presents a summary of the calculations and shows that two levels of critical thinking skills (exploration and resolution) where there were significant trends. The critical thinking messages at the level of exploration resulted in a significant downward trend. Consequently, the critical thinking messages at the highest level (i.e., resolution) provided a significant upward trend (see Table 14).

The proportion of critical thinking messages varied in the four types of discussion forums (content, district, grade level, and teacher's lounge). Figure 10 indicates that teachers tended to post the most critical thinking messages in district (40.5%) and content



(39.3%) forums. The grade level forums only resulted in 13.8% of the messages being classified as critical reflection.

However, the mean value of critical thinking scores in grade level forum (2.32) was highest when compared to the district forum (1.98) and the content forum (2.15). The results imply that teachers tend to use higher order critical thinking skills when interacting in the grade level forums (see Figure 11).

Table 14. Trend Analysis of the Messages during Weeks of 3, 6 and 10 in Four Levels of Critical Reflection

	Week 3	Week 6	Week 10	Trend		
					P	
Triggering	19	16	12	0.0992	0.7528	
Exploration	177	142	84	6.6467	0.009934*	↓
Integration	12	27	10	1.8205	0.1773	
Resolution	6	8	12	7.8138	0.005185*	↑
Total	214	193	118			

Note:  $p < .01$ .

Figure 10. Critical Reflection Postings Occurring in the Four Discussion Forums.

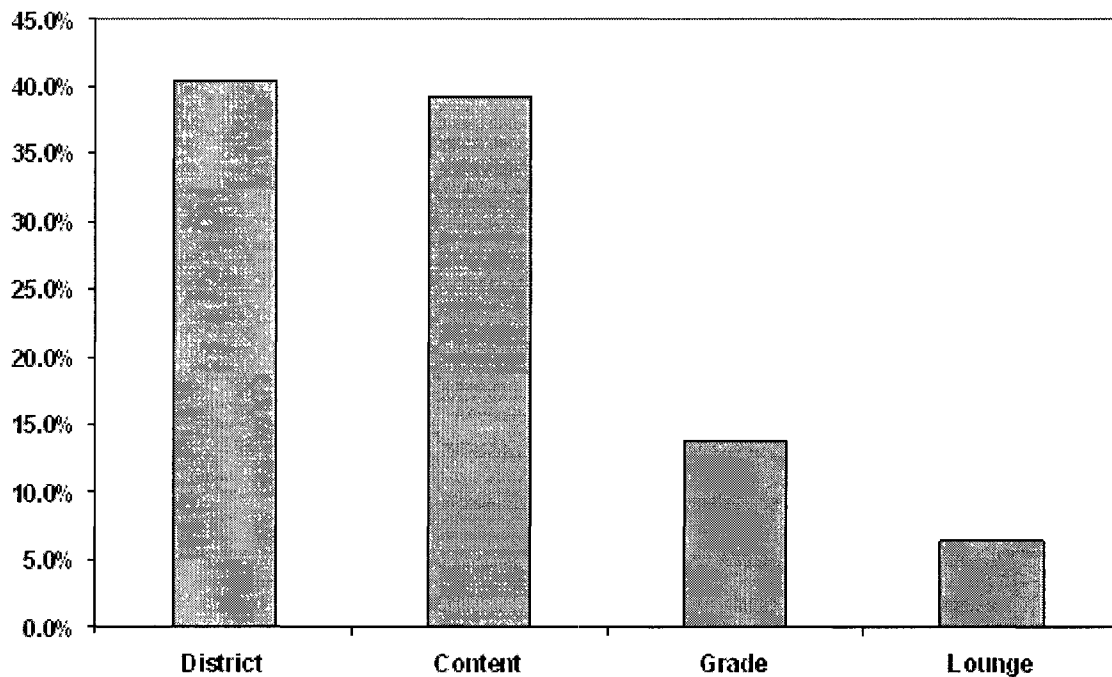
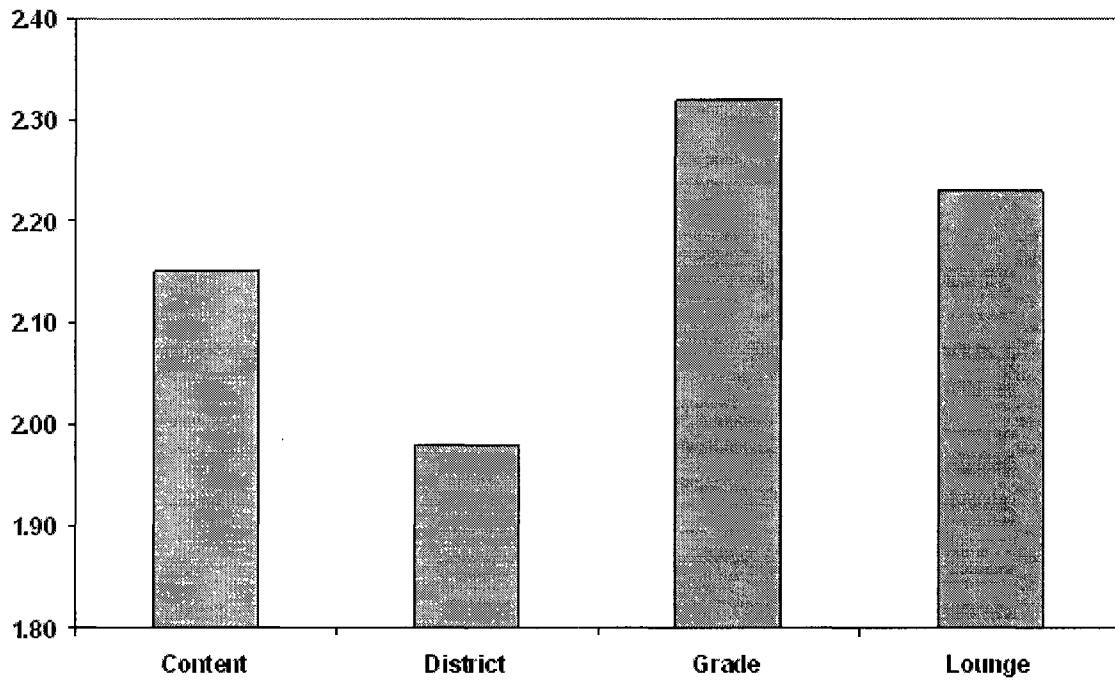


Figure 11. Mean Critical Reflection Scores in the Four Discussion Forums.



### Qualitative Data

The first issue addressed in the interviews and self-evaluation surveys was whether the online discussion board helped or hindered the personal growth of teachers. Teachers were divided on this point and identified factors that helped or hindered their learning and their critical reflections when participating in computer conferencing. Table 15 lists eleven factors that helped with learning through critical thinking reflections when participating in computer conferencing. Table 16 presents the examples of teachers' thinking.

Table 15. Factors Reported by Teachers which Helped Their Learning

Opportunities to compare similarities and differences Being able to synthesize and relate their thoughts Having a good understanding of the learning process Feeling that other teachers have the same concerns Feeling secure in sharing the ideas Feeling freer to express opinions Convenience Increasing content knowledge Gaining enrichment from varied backgrounds of others Applying ideas from others
---

Teachers who responded positively valued the variety of factors and personal experiences that were presented: "The discussion board helped me to learn outside of regular class time. I could ask questions when it was convenient for me, and look for answers when it was convenient too." Another teacher continued on this theme: "It helped because I was able to hear other perspectives and I gained enrichment from varied backgrounds." It seemed that the multiple perspectives revealed different features of computer conferencing that provided the flexibility and richness of the learning context.

It was not only the additional perspectives that contributed to the teachers' learning, but also the willingness to share and learn. As one teacher explained: "It has

Table 16. Examples Provided by Teachers that Indicated the Factors which Helped Learning

<p><u>Opportunities to compare similarities and differences</u>          “I also enjoy any and every opportunity I get to compare similarities and differences with other districts.” (SE4)</p> <p><u>Being able to synthesize and relate their thoughts</u>          “Having a good understanding of the learning helps me to then synthesize and relate my thoughts online.” (SE17)</p> <p><u>Sharing the same problem or feeling</u>          “An important thing is that we have a place to discuss learning and not feel like we are the only ones with that problem or feeling. At first I was reluctant to share because I might sound like I had a lot to learn. Now I know that we are working on our science knowledge and it's ok.” (SE15)</p> <p><u>Feeling that other teachers have the same concerns</u>          “It has been interesting to read the insights from different teachers. It sounds as if many teachers have the same concerns that I do when I teach science...ie. knowing scientific terms and concepts.” (SE10)</p> <p><u>Feeling secure in sharing ideas</u>          “Communicating with the other sites throughout the week, helped us feel more confident with each other and more secure in sharing our ideas. My content knowledge of the different science concepts increased.” (SE32)</p> <p><u>Feeling freer to express opinions</u>          “I feel a little freer to express myself as I sometimes feel on the spot when it's my turn on the ICN. I can take time to reflect and think about what I want to write or to respond to.” (SE35)</p> <p><u>Convenience</u>          “The discussion board helped me to learn outside of regular class time. I could ask questions when it was convenient for me, and look for answers when it was convenient too. Other students shared articles via attachments that I could read.” (Interviewee 1)</p> <p><u>Increased content knowledge</u>          “My content knowledge of the different science concepts increased.” (SE32)</p> <p><u>Gaining enrichment from varied backgrounds</u>          “It helped because I was able to hear other perspectives and I gained enrichment from varied backgrounds.” (SE4)</p> <p><u>Applications</u>          “The ideas presented from other sites have been interesting and given me some new ideas to try in my class.” (SE18)</p> <p><i>*SE: Self-Evaluation Respondent</i></p>
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been interesting to read the insights from different teachers. It sounds as if many teachers have the same concerns that I do when I teach science...i.e., knowing scientific terms and concepts.” Another teacher compared the learning experience on the ICN “I feel a little freer to express myself as I sometimes feel on the spot when it’s my turn on the ICN. I can take time to reflect and think about what I want to write or to respond to.” Another teacher confirmed this opinion:

An important thing is that we have a place to discuss learning and not feel like we are the only ones with that problem or feeling. At first I was reluctant to share because I might sound like I have a lot to learn. Now I know that we are working on our science knowledge and it's ok.  
[SE30]

Some teachers related the viewpoint of being more comfortable to share their opinions and ask the questions to increase their scientific knowledge. For example, one teacher said: “Communicating with teachers at the other sites throughout the week helped us feel more confident with each other and secure in sharing our ideas. My content knowledge of the different science concepts increased.” Another teacher even pointed out the applicative perspective: “The ideas presented from other sites have been interesting and given me some new ideas to try in my class.”

As learners in this course, the teachers thought the features of the computer conferencing helped them learn. First of all, it was convenient for them to access the learning system at anytime and any place. Secondly, they found other teachers were also learners with many questions and concerns. They were pleased to see that they were not the only ones who had problems. For example, the teachers often discussed “What is inquiry?” The concept of inquiry had been emphasized in many workshops and training sessions, but the teachers hardly had a chance to share their own understandings and the problems they encountered with the concept in their classrooms. Therefore, they felt freer to ask questions and also to try to find solutions together.

However, the teachers also described factors that hindered learning. Most concerns were related to access and features of the discussion board (see Tables 17 and 18).

Table 17. Factors Teachers Reported which Hindered Their Learning

<p>Difficulty with Access          Failure to use discussion boards before          Limited knowledge of discussion boards          Too Time consuming          Hard to prepare presentations with other districts          Poor Writing skills          Feeling burdened to try to come up with something to post          Feeling uncomfortable to post things that everyone can scrutinize          Delayed feedback</p>
---

Teachers who indicated factors that hindered their learning in computer conferencing raised a complaint common in computer conferencing research, which is that the online discussions take too much time. One teacher summarized this view:

I was probably hindered by the amount of time I could devote to being online reading and responding to postings. [SE5]

Some teachers related this factor to one of the course requirements: quantity of the online postings. One teacher explained: “It was also a hindrance that we were told that quantity was a criterion for our grade. This led to several postings that were repetitious and not really of a high quality.” Another teacher continued with the same opinion: “Some of it is very good. But sometimes, I think that people are just ‘putting their time in’ -quantity, rather than quality. We are required to do it and I think some people are concerned about their grade being lowered if they don’t contribute enough.” Another concerned with this view and used the metaphors of “factory worker” and “PE class”.

I just feel that we have WAY too much pressure to post and respond. We all want to receive the best grade we are capable of .....but I

really believe that sometimes quantity for the sake of quantity can be a poor goal. It might be okay if you're a factory worker on quota or in a PE class doing sit-ups. [SE8]

There were also some teachers who thought that using the online discussion board was too time consuming, which may be caused by the design of the discussion board. One teacher offered the comment: "It hindered me because there were too many forums active at once. I have limited time and I never know where to start first. If I want to respond or reread a certain topic, I can't always remember which forum it's in and some of the discussions are spread out all over the place."

One teacher complained about that delayed feedback was frustrating: "I like the online component but sometimes it's a little frustrating due to time constraints and delayed feedback." Another teacher pointed out personal factors that affected learning with computer conferencing: "The only thing that may have hindered me is my ability to 'speak' smoothly through writing."

In summary, teachers addressed some negative factors which hindered their learning with computer conferencing. These included it being too time consuming, using quantity as course requirement, the actual design of the online discussion board, feedback delayed too much, and poor personal writing ability.



Table 18. Examples of Factors Identified by Teachers which Hindered Their Learning

<p><u>Difficulty with Access</u>          “Not having internet at home, slowness of internet system.” (SE9)</p> <p><u>Failure to use discussion board before</u>          “I was hindered at first by the newness of it all. It is a computer for heavens sake. I did not know what to expect and how it would be beneficial, save time, and be useful.” (SE2)</p> <p><u>Design of discussion board</u>          “It hindered me because there were too many forums active at once. I have limited time and I never know where to start first. If I want to respond or reread a certain topic I can’t always remember which forum it’s in and some of the discussions are spread out all over the place!” (SE5)</p> <p><u>Too Time consuming</u>          “I was probably hindered by the amount of time I could devote to being online reading and responding to postings.” (SE5)</p> <p><u>Feeling Hard to prepare the presentations with other districts</u>          “It was very difficult to coordinate a presentation with more than one site over the discussion board though.” (SE20)</p> <p><u>Feeling Uncomfortable to Express Opinions</u>          “I would rather not have to constantly worry that I’m not contributing enough or that I might be saying the ‘wrong’ thing and have my grade lowered. I don’t feel that this contributes to learning. I wouldn’t want my own students to have to worry about something like this. It’s not always easy to write things that everyone else can scrutinize.” (SE1)</p> <p><u>Feeling Required to Post (Quantity but not Quality)</u>          “It was also a hindrance that we were told that quantity was a criterion for our grade. This led to several postings that were repetitious and not really of high quality.” (SE5)          “Some of it is very good. But sometimes, I think that people are just “putting their time in” - quantity, rather than quality. We are required to do it and I think some people are concerned about their grade being lowered if they don’t contribute enough.” (SE1)</p> <p><u>Delayed Feedback</u>          “I like the online component but sometimes it’s a little frustrating due to time constraints and delayed feedback. I miss the personal interaction with my colleagues but value all the feedback that is posted.” (SE35)</p> <p><i>*SE: Self-Evaluation Respondent</i></p>
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### Social-Interpersonal Rapport

One would anticipate a fair number of social interactions in the beginning as participants were getting to know each other. However the changes in social-interpersonal participation could be a reflection of the social cohesion within the group

and the feeling of belonging, or it could indicate the level of learner focus on the particular task (Henri, 1992). The results of this study indicated that most teachers offered the positive comments concerning social value of using the online discussion board. The results also indicated the number of social cues in the messages were correlated to the outcome of critical reflection.

### Quantitative Data

The total number of social cues in the messages varied during Weeks of 3, 6, and 10. The total number of social cues during the three weeks was 578. The average number of social cues per message was 0.62. The data in Chart 11 also indicated that, while there were a fair number of social cues initially (56.7%), the percentage of messages with social cues significantly increased in Week 6 (72.6%); but declined in Week 10 (55.4%) which was very close to the result in Week 3.

Similarly the average number of social cues in Week 6 was the highest as indicated in Chart 12. The most social interactions appeared during the middle of the semester.

Combining these observations with the results regarding critical reflection, Figure 13 indicates that when the number of social cues declined from Week 6 to Week 10. Further, the number of critical reflective messages also decreased during the same period.

In four different types of discussion forums (content, district, grade level and teacher lounge), the total number of social cues (see Table 19 and 20, Figure 12) in the three weeks varied in each forum. The district forum, which was basically for small group discussions, included the most social cues in the messages but resulted in a steady decrease in the number of social cues until Week 10. The content forum, which was set for course content discussions, only resulted in 29 social cues in the messages in Week 3 but the number of social cues climbed to 69 in Week 6. The teacher's lounge, which was

established for “free talk,” resulted in a smaller number of social cues compared to those postings in district and content forums. However, the average number of social cues per message was the highest in the teacher’s lounge forum as Figure 14 and 15 indicates. The results imply that teachers mainly used the teacher’s lounge forum for social purposes.

Table 19. Total Number of Social Cues in the Messages during Weeks of 3, 6 and 10 in the Four Discussion Forums

Forum	Week 3	Week 6	Week 10	Total
Content	28	69	25	122
District	74	70	31	175
Grade level	21	2	7	30
Teacher’s Lounge	13	10	9	32

Table 20. Total Number of Messages during Weeks of 3, 6, and 10 and the Total Number of Social Cues in Messages during Weeks of 3, 6, and 10

	Week 3	Week 6	Week 10
Total Number of Message Units	240	208	130
Total Social Cues	136	151	72
Total (Social) %	56.7%	72.6%	55.4%
Number of Social Cues/Message	0.57	0.73	0.55

Figure 12. Total Number of Social Cues in the Messages Posted during Weeks of 3, 6 and 10.

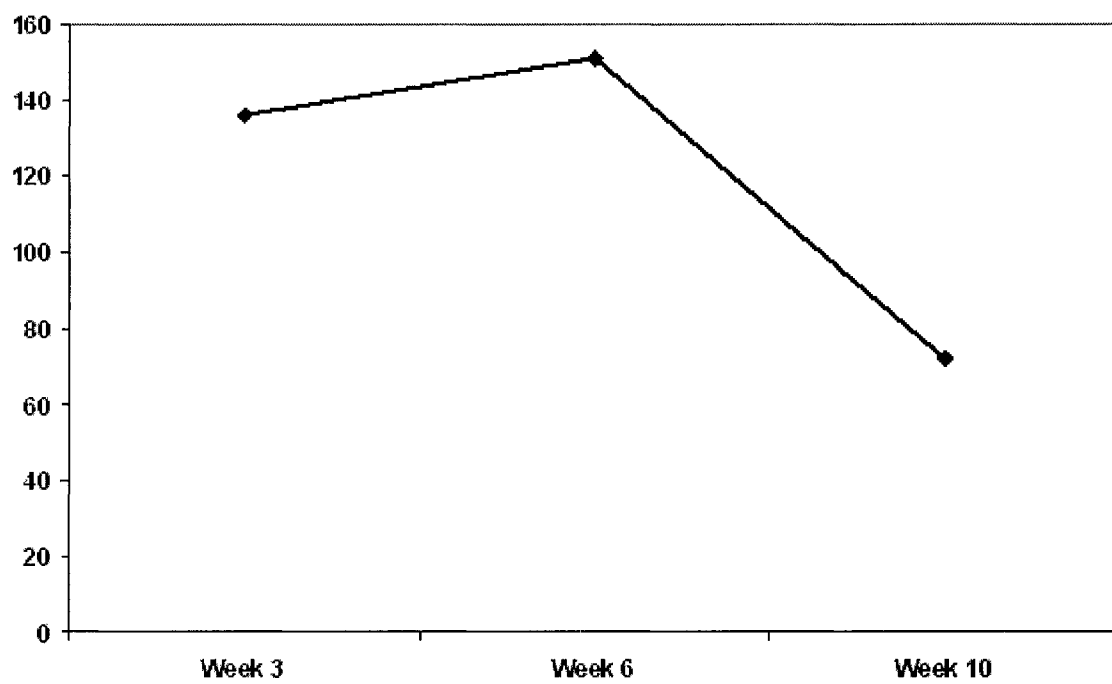


Figure 13. Total Number of Messages posted during Weeks of 3, 6, and 10 with the Critical Reflection and Social Cue Indicators.

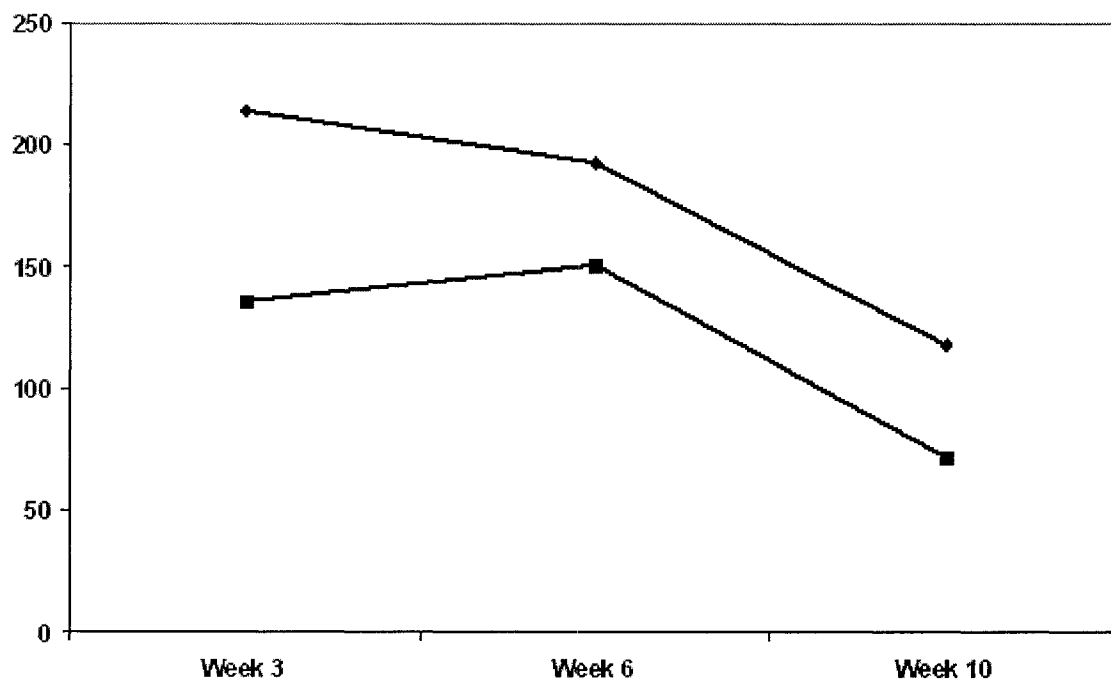


Figure 14. Total Number of Social Cues in the Messages Posted during Weeks of 3, 6 and 10 in the Four Discussion Forums.

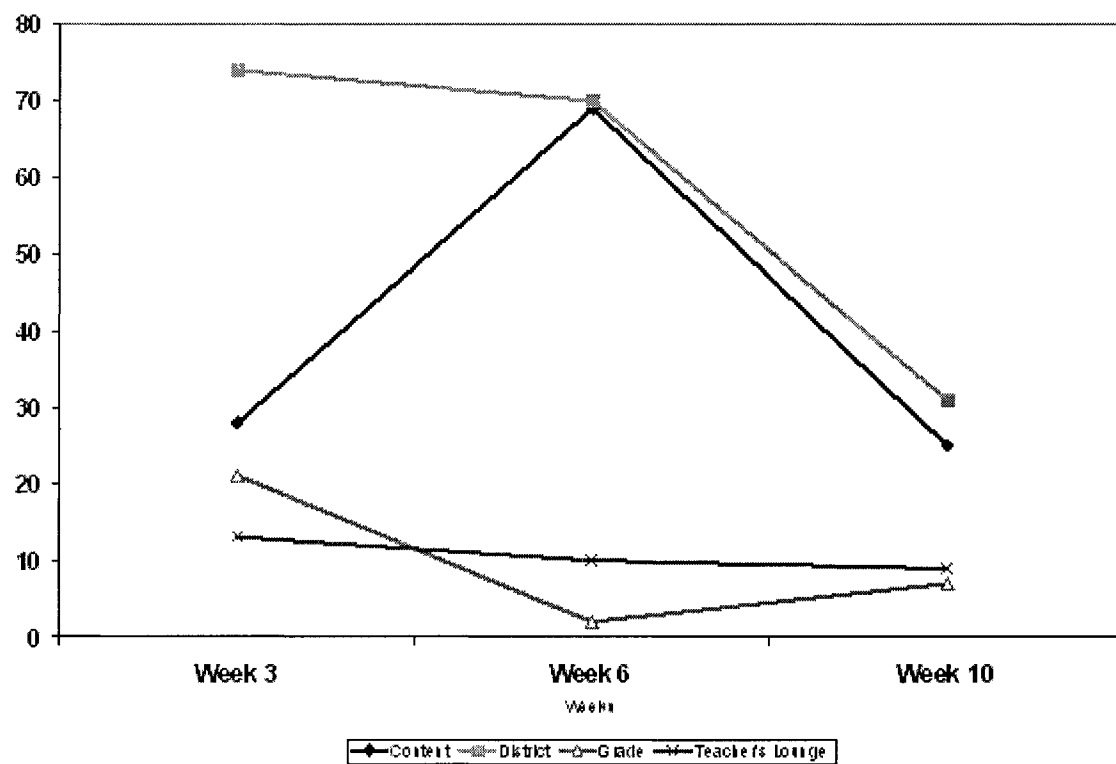
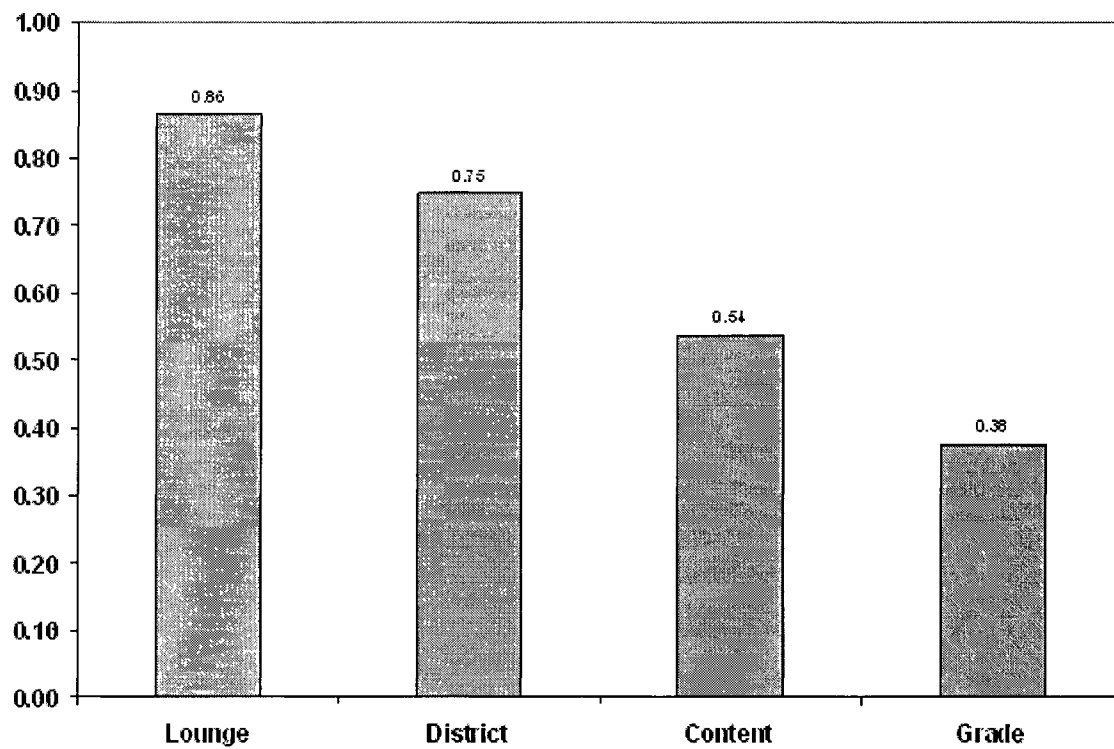


Figure 15. Average Number of Social Cues in the Messages Posted during Weeks of 3, 6, and 10 in the Four Discussion Forums.



### Qualitative Data

The teachers reported factors regarding social-interpersonal rapport in using computer conferencing in both positive and negative ways. With respect to positive aspects, there were ten interpersonal factors identified (see in Tables 21 and 22).

Table 21. Positive Factors Reported by Teachers which Affected Social-Interpersonal Rapport

<p>Enjoying social conversation          Enjoying having more discussions with the teachers among the sites          Enjoying having more discussions with the teachers within their site          Being able to know the others better          Improving relationships          Connecting names with the faces          Feeling more confident with each other          Making group more accountable          Being so involved with Everyone in the group          Enjoying being able to chat with colleagues on a daily basis          Creating a sense of community          Picking and choosing who to communicate with</p>
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*\*SE: Self-Evaluation Respondent*



Table 22. Examples of Positive Factors which Affected Teacher Social-Interpersonal Rapport

<p><u>Enjoying social conversation</u>          “It’s been fun and enlightening to share ideas with others and not be limited by distance.” (SE9)</p> <p><u>Enjoying have more discussions with the teachers among the sites</u>  <u>Enjoying have more discussions with the teachers within their site</u>          “There has been good conversation between in-house groups and out-of-house groups using the discussion board. It seems as if the comments are more “meatier” than at first.” (SE10)</p> <p><u>Being able to know the others better</u>          “I feel that I have actually been able to get to know the others better now than over the last 3 1/2 years.” (SE8)</p> <p><u>Improving the relationship</u>          “I like when teachers discuss the concepts being discussed and share their ideas or understandings. I think some very valuable learning is taking place. At first, we just seemed to communicate more with the teachers in our own districts, but that’s changing. Classmates we just saw on the ICN screen are becoming more than just faces. This exchange between individuals is strengthening our relationships.” (SE38)</p> <p><u>Feeling more confident with each other</u>          “Communicating with the other sites throughout the week, helped us feel more confident with each other.” (SE32)</p> <p><u>Making group more accountable</u>          “I think that we have much more interaction than we have had in previous ICN courses with other groups because of the discussion board. I also think it makes the group more accountable.” (SE20)</p> <p><u>Everyone in the group being so involved</u>          “I think they are going wonderfully!!! Everyone is very involved. It’s really great to have a reply submitted to one of our own entries. It gives a great feeling to have someone agree with you or compliment!!!” (SE24)</p> <p><u>Enjoying being able to chat with colleagues on a daily basis</u>          “I really enjoy being able to chat with my colleagues on a daily basis. We teach in different buildings and see each other at class or at the ICN on Tuesday nights.” (SE33)</p> <p><u>Creating a sense of community</u>          “It is very interesting to read other people’s comments about the class topics. I have learned a lot from others. I do think it creates a sense of community.” (SE35)</p> <p><u>Picking and choosing who to communicate with</u>          I like interacting with students this way. You can pick and choose whom to communicate with when they write something that you want to reply back to. (SE6)</p> <p><i>*SE: Self-Evaluation Respondent</i></p>
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When teachers were asked to describe their thinking about the group interactions, which occurred with the online discussion board, they tended to have positive feelings about social-interpersonal interactions on the discussion board. A teacher summarized this viewpoint and agreed it could be an advantage for distance education: "It's been fun and enlightening to share ideas with others and not be limited by distance."

One of the goals of adding computer conferencing as a component in the course was to initiate more social-interpersonal interactions and to increase the level of comfort in reflecting on the teachers' own thinking with other teachers. One teacher offered a positive comment regarding the online discussion board observing that the quality of the conversations was better and better: "There has been good conversation between in-house groups and out-of-house groups using the discussion board. It seems as if the comments are 'meatier' than at first."

Even though the teachers in this course had been involved in the Science CoOp Project for a few years, they did not know each other well in terms of teaching and professional backgrounds. One teacher felt s/he just got to know others better than before:

I feel that I have actually been able to get to know the others better now than over the last 3 1/2 years. [SE22]

Teachers started to feel they knew each other better than before because they had more person-to-person interactions and in-depth discussions. Some teachers thought that the online discussion board made them feel more connected with each other compared to ITV (or called "ICN") which was the only tool used for communication in the previous semesters. One teacher indicated that the use of the online discussion board had encouraged more interactions among the teachers: "I think that we have much more interaction than we have had in previous ICN courses with other groups because of the discussion board. I also think it makes the group more accountable." Another teacher continued and indicated the quality of communication was changing:

I like when teachers discuss the concepts being discussed and share their ideas or understandings. I think some very valuable learning is taking place. At first, we just seemed to communicate more with the teachers in our own districts, but that's changing. Classmates we just saw on the ICN screen are becoming more than just faces. This exchange between individuals is strengthening our relationships. [SE8]

There were various reasons for their appreciation of social interpersonal rapport, which occurred with the discussion board. For example, one teacher mentioned that getting the compliment from other teachers on the online discussion board was very encouraging: "I think they are going wonderfully!!! Everyone is very involved. It's really great to have a reply submitted to one of your own entries. It gives a great feeling to have someone agree with you and your suggestions." The easy access for contacts via the online discussion board was another reinforcement of social-interpersonal rapport. As one teacher said: "I really enjoy being able to chat with my colleagues on a daily basis. We teach in different buildings and see each other at class or at the ICN on Tuesday nights."

In summary, teachers had positive receptions to the use of the online discussion board for improving social-interpersonal rapport. Compared to ITV technologies, which they had been used for quite a long time, it was seen as more convenient and more comfortable in contacting and to interacting with other teachers in this course.

Furthermore, the social-interpersonal interactions that occurred on the online discussion board improved the relationships among the teachers and made the relationship more accountable. Interestingly, one teacher even used the term "sense of community" to describe the social presence in computer conferencing: "It is very interesting to read other people's comments about the class topics. I have learned a lot from others. I do think it creates a sense of community." A sense of community was one of the main goals that were emphasized in the current professional development standards. In National Science Education Standards there is more emphasis on the concept of a teacher as a member of a collegial professional community instead of an

individual based in a classroom (NRC, 1996). Garrison et. al. (2001) further defines three main components in “Community of Inquiry” in higher education on CMC: cognitive presence, social presence, and teaching presence. More discussions regarding teachers’ cognitive presence, and social presence in the online community are included in Chapter V.

There were three negative interpersonal factors indicated from teachers’ self-evaluations regarding the discussion board (see Tables 23 and 24).

Table 23. Negative Factors which Affected Teacher Social-Interpersonal Rapport

<p>Easier to contact people at the same site by person Harder for the sites with fewer numbers of teachers Feeling of competition</p>
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*\*SE: Self-Evaluation Respondent*

Table 24. Examples of Negative Factors which Affected Social-Interpersonal Rapport

Easier to contact people at the same site by person

“Hearing from other schools is great. Since there are only four people at our site and I teach beside two of them and the other one is down the hall, it is easier for us to discuss things face to face as opposed to getting on the discussion board.” (SE30)

Harder for the site with fewer number of the teachers

“There are only four people in our group and we have the advantage to be in the same building, same hall so we can talk to each other in person a lot.” (SE27)

Feeling of competition

“I think that people are just “putting their time in” -quantity, rather than quality. We are required to do it and I think some people are concerned about their grade being lowered if they don’t contribute enough.” (SE1)

*\*SE: Self-Evaluation Respondent*

For the district site with fewer teachers, teachers felt it was easier to talk to each other with face-to-face conversation instead of using the electronic discussion board. As one said, it is “easier for us to discuss things face to face as opposed to getting on the

discussion board” because “there are only four people at our site and I teach beside two of them and the other one is down the hall.”

The other negative interpersonal issue was related to the use of the electronic discussion board as part of the course requirement. In this course, the teachers were required to post the messages and were evaluated with both the quantity and quality of their postings. The requirement regarding the quantity disturbed the teachers’ level of comfort in using the electronic discussion board as well as increasing the level of anxiety. Moreover, it also influenced the interpersonal relationships among the teachers, especially when they thought some teachers always contributed postings in order to get better grades. The feeling of competition and discomfort hindered both learning and interpersonal relationships. However, the instructor modified the course requirement to only focusing on the quality of the postings after the teachers expressed these negative comments.

### Teaching Practices

There were five teachers who voluntarily agreed to participate in an interview. The results from the interviews are discussed in two main ways: the role of computer conferencing in changing teaching practice and in professional development.

The five interviewees were asked to share something they did on the online discussion board that really helped them teach science or other subjects. They were also asked: “Have you ever tried anything that was suggested by other teachers' online discussions in your classroom? How did it work?” The last question concerning teaching practices during the interview was: “As an educator using the discussion board, have you ever felt a sense of community of practice.”

Responses of the five interviewees regarding the role of computer conferencing in teaching practice fell into three categories namely, collaboration, evaluation of teaching,

and application. Overall, the five interviewees shared many positive perceptions of the role of computer conferencing in their teaching practices. As one teacher said during the interview:

The entire concept of the Bulletin Board and online discussion has been VERY beneficial for me! I have gained a lot of insights by reading other people's contributions. We don't often, as teachers, have the opportunity to network with each other and the Bulletin Board provides this chance, which is great! [Interviewee 4]

### Collaboration

The five interviewees all shared their perceptions of how computer conferencing affected teaching practices, such as networking with other teachers and sharing the common concerns for teaching together. The interview data are summarized in Table 25.

The collaboration among the teachers by discussing and working together was very beneficial. Interviewee 5 described her thinking by citing a sentence from an article: "It was like that article said, 'if you work on the teachers, you will get better students'. That is what it feels like to me." She continued to explain: "If you are not talking to a teacher, it is hard to explain all the "little things " that go into planning a lesson." It was very valuable to share the ideas and thinking with the teachers no matter the grade or the subject they taught. Interviewee 1 summarized her view:

As others discussed topics of kits that they were using and asked for ideas, I also was able to give some suggestions to another teacher about a kit she was using. It was interesting to "talk" to other teachers, whether or not they taught in the same area, about common observations in the classroom and common struggles in education. [Interviewee 1]

Interviewee 2 felt that the sharing was going on between the teachers was very helpful: "I think the sharing that's going on between sites right now regarding our Action Research projects has been invaluable to me! I really like the sharing that's going on among people! Their insights have helped me considerably." Moreover, interviewee 1 expressed the willingness to try out new ideas when implementing the new program in

the classroom: “I have read a lot of information on resources for a unit that I will use when I teach it in the future. Also, as I teach I reflect on the ideas about students' misconceptions and about inquiry and try to implement more inquiry-based teaching in my classroom.”

Table 25. Examples of Collaboration, as One of the Positive Factors which Improved Teaching Practices

“As others discussed topics of kits that they were using and asked for ideas, I also was able to give some suggestions to another teacher about a kit she was using. It was interesting to “talk” to other teachers, whether or not they taught in the same area, about common observations in the classroom and common struggles in education.” (Interviewee 1)

“I have read a lot of information on resources for a unit that I will use when I teach it in the future. Also, as I teach I reflect on the ideas about students' misconceptions and about inquiry and try to implement more inquiry-based teaching in my classroom.” (Interviewee 1)

“I think the sharing that's going on between sites right now regarding our Action Research projects has been invaluable to me! I really like the sharing that's going on between people! Their insights have helped me considerably.” (Interviewee 2)

“The discussion board has really helped me connect to the other teachers in the program. They're more than just faces on a TV screen. I like being able to interact with them.” (Interviewee 3)

“That is the best part of it! If you are not talking to a teacher, it is hard to explain all the “little things ” that go into planning a lesson.” (Interviewee 5)

“it was like that article said, “if you work on the teachers, you will get better students”. That is what it feels like to me.” (Interviewee 5)

### Evaluation of Teaching

Some interviewees thought that opportunity of discussing teaching practices on the discussion board provided them with a valuable chance to evaluate their own teaching (see Table 26). Interviewee 3 briefly described this viewpoint: “It caused me to evaluate my own way of thinking, form new ideas, and evaluate them until I developed a new and more accurate concept.” Interviewee 2 further explained this view by indicating both affirming and questioning her teaching: “The sharing that goes on helps affirm, for me,

some of the things I'm doing in my teaching! I've also read some things that have made me question some of my practices as well.” In addition to evaluating their teaching, the online discussions also made the teachers look more closely at how they teach in their classrooms. Interview 1 addressed this idea as:

Discussing the inquiry activities that we were assigned in class via the discussion board made me consider how to be more inquiry-oriented in my science teaching. I looked more closely at how I teach science in my classroom and thought about how students perceive inquiry. [Interviewee 1]

In some cases, the online discussions reminded the teachers of the importance of some specific instructional strategies, such as discovering misconceptions, and the meaning of constructivism. As Interviewee 3 said, the discussion about students' scientific misconceptions had the greatest impact for her:

I think that specifically the misconception discussion had the most impact on my teaching. Discussing the acorn interviews made me remember again how important it is to discover the misconceptions before I begin to teach. [Interviewee 3]

Similarly, Interviewee 5 thought the discussions reminded her to practice the theory – being more constructivist in her teaching: “The discussion board helped me to remember that I need to practice my constructivist teaching strategies; I get a lot of encouragement from the others.”



Table 26. Examples of Evaluation of Teaching which is One of the Positive Factors which Affected Teaching Practices

“Discussing the inquiry activities that we were assigned in class via the discussion board made me consider how to be more inquiry-oriented in my science teaching. I looked more closely at how I teach science in my classroom and thought about how students perceive inquiry.” (Interviewee 1)

“The sharing that goes on helps affirms, for me, some of the things I'm doing in my teaching! I've also read some things that have made me question some of my practices as well.”(Interviewee 2)

“It caused me to evaluate my own way of thinking, form new ideas, and evaluate them until I came for a final concept.” (Interviewee 3)

“I think that specifically the misconception discussion had the most impact on my teaching. Discussing the acorn interviews made me remember again how important it is to discover the misconceptions before I begin to teach.” (Interviewee 3)

“The discussion board helps me to remember that I need to practice my constructivist teaching strategies and I get a lot of encouragement from the others!” (Interviewee 5)

### Application

It was very common to see teachers contribute their own ideas and resources to other teachers on the discussion board. The interview results also showed the relationship of how teachers applied the ideas and resources from other teachers on the electronic discussion board (see Table 27).

During the interview, the interviewees were asked if they had tried any ideas from the online discussions. Half of them had started to use the concepts learned from the online discussions regarding scientific misconceptions in their classrooms. Interviewee 3 learned more about questioning from other teachers: “Previously, I checked for students’ conceptions or misconceptions before introducing new units, only sometimes. I'm more aware of the importance of this now. I also use more improved questioning techniques.” Both Interviewees 1 and 4 tried different ways of uncovering students’ misconceptions. Interviewee 4 said: “Sometimes reading other people's discussions helped me think about

what I am doing to help students learning with science concepts and inquiry.” She continued: “I have actually told a child that when he is sounding out a word wrong, he has a ‘misconception’ about that word and needs to change his thinking. I hope using those terms will help. Also, I have started thinking about having kids ask questions based on recent chats.” Similarly, Interviewee 1 had the same comment: “I used the information I learned about students' misconceptions to try to find out my students' misconceptions before I taught a unit in science, which was an idea we discussed in class and extensively on the discussion board.”

In addition, Interviewee 2 used the resources suggested by other teachers: “Another reading teacher suggested some non-fiction books that could be used with a unit she was doing ... and though I don't do units, I checked out the books and am using them with some of my kids.”

In summary, the teachers all had positive perceptions of using computer conferencing to share and improve their teaching practices. The feeling of collaboration made the teachers more comfortable in expressing their questions or ideas. It also made teachers self-evaluate their own teaching practices. Once the discussion community had more use and more in-depth conversations or sharing, the teachers felt more confident to suggest or provide possible solutions for the concerns of others. It was not because they knew more or taught better than others, but it was because they felt they were part of this community.

Table 27. Examples of the Use of Applications as a Factor for Changing Teaching Practices

“I used the information I learned about students' misconceptions to try to find out my students' misconceptions before I taught a unit in science, which was an idea we discussed in class and extensively on the discussion board.” (Interviewee 1)

“Another reading teacher suggested some non-fiction books that went along with a unit she was doing ... and though I don't do units, I checked out the books and am using them with some of my kids. There have also been some other resources cited that I've used periodically.” (Interviewee 2)

“Previously, I checked for students' conceptions or misconceptions before introducing new units, sometimes. I'm more aware of the importance of this now. I also use more improved questioning techniques.” (Interviewee 3)

“Sometimes reading other people's discussions helps me think about what I am doing to help with learning of science concepts and inquiry. As a result I have tried to put a little of that into reading. I have actually told a child that when he is sounding out a word wrong, he has a "misconception" about that word and needs to change his thinking. I hope using those terms will help. Also, I have started thinking about having kids ask questions based on the recent chats.” (Interviewee 4)

### Professional Development

The five interviewees were asked two questions regarding the role of computer conferencing in their professional development. In addition, they were asked to compare the professional developmental outcomes that they received from computer conferencing to ones that they got from other professional development programs. One interviewee shared what she had heard from some teachers in a professional development program:

At the last summer workshop, the group I was in was not at all interested in professional development. This is a direct quote from them. "We are here to get away from our kids and get \$300!" I was shocked!  
[Interviewee 2]

Most interviewees had positive perceptions of the role of computer conferencing in their professional development because of the features of computer conferencing, namely convenience, easy to network with other educators, easy to share resources, the provision for ongoing professional developmental opportunities, extending what they had learned, and developing better communicative skills.

### Convenience

Some interviewees really valued the convenience feature –in helping experiencing professional development at anytime and at any place (see Table 28). For example, Interviewee 1 thought that the easy access to the online discussion board provided the learning opportunities that rarely occurred in the traditional classes:

The online discussion board was much more convenient because I could read and respond on my own time--at any time that it was convenient for me. I could go back and reread ideas if I needed to, unlike class. [Interviewee 1]

Interviewee 4 liked being a “night owl” on the discussion board: “Being able to read the discussions anytime helps too. Because trying to build a community of learners in person when everyone has the same time would be impossible, but the discussion

board allows me to work at night, being a "night owl" and having someone else to read and work in the a.m.”

#### Network.

Teachers themselves are very important resources and components in developing a community for professional development. A network connecting more teachers will encourage more communication and interactions in the community. Thus, the interviewees sensed and felt part of the network for improving their own professional development (see Table 29).

As one interviewee said, she felt the community was wider: “I feel part of a wider educational community through the networking with other professionals.”

#### Resources

Gaining additional instructional resources is another important goal of professional development. The interviewees gained resources, such as practical ideas and insights, from other teachers in this computer network (see Table 30). One interviewee explained that the online discussions helped her to gain a deeper understanding of the course content: “I have gained a deeper understanding of concepts discussed in class and gained some practical ideas for units that I teach.” In addition, Interviewee 2 mentioned that she did not only get other people’s ideas from the online discussions but also grew professionally:

I have gained a lot of insights reading other ideas from colleagues. Their ideas have definitely helped me grow professionally! [Interviewee 2]

#### Ongoing Professional Development

Most teachers have many of opportunities to participate in different professional development programs in the past. It is not common to see the professional development

programs provide “ongoing” learning or training activities. One Interviewee used the term “ongoing” when she described her perceptions (see Table 31).

#### Extending What Teachers Learned

In adult or teacher education, the inquiry theory still plays a very important role when designing professional development activities. In professional development programs or courses, some activities should indicate teachers’ existing knowledge and encourage more conversation about their understanding. Finally, the teachers should advance to deeper understandings of specific ideas. In the interviews, some interviewees agreed that computer conferencing extended what they had learned before; and they had not seen this happened in most traditional professional developmental programs which they had attended in the past (see Table 32). For example, Interviewee 3 said: “They're extensions of what I've learned in Science Coop, and until just recently, professional development offered by our schools really didn't have as much of an impact on my teaching practices” and continued “We have a lot more repetition and reinforcement that we get in typical professional development.”

#### Better Communicative Skills

From the interactions with other teachers on the computer conferencing, one teacher thought her communicative skills were improved (see Table 33).

Interviewee 4 described what she had learned as better communicative skills from the online discussion experiences. They also impacted her communication with parents of students in her class:

I think professionally I have grown in how I am able to speak, share and collaborate with others. I am more at ease about sharing my thoughts now, and discussing something I don't really feel like I know that well. I am not as uncomfortable commenting on things like I was at first, so I feel I have grown. I think that it shows at work also and even when speaking to parents. [Interviewee 4]

In conclusion, the teachers became more involved in the community with the people who have the same concerns and really wanted to learn. However, the design of professional development was very critical in changing participating teachers' attitudes concerning the involvement. Each interviewee identified different aspects of computer conferencing as important and useful in his/her professional development. Some interviewees appreciated the aspect of developing a community of collaborators. Some interviewees liked the aspects of sharing resources. Compared to other professional development programs or courses, the teachers did not say that they felt a tremendous difference but they agreed the component of computer conferencing and the advantages of computer conferencing were not found in the typical professional development programs in which they had participated in before.

Table 28. Examples of "Convenience" as One of the Factors teachers identified as Important in Their Professional Development

"The online discussion board was much more convenient because I could read and respond on my own time--at any time that it was convenient for me. I could go back and reread ideas if I needed to, unlike class." (Interviewee 1)

"Being able to read the discussions anytime helps too. Because trying to build a community of learners in person when everyone has time would be impossible, but this allows me to work at night, being a "night owl" and someone else to read and work in the a.m." (Interviewee 4)

Table 29. Example of "Network" as One of the Factors Teachers Identified as Important Attribute for Improved Professional Development Program

"I feel part of a wider educational community through the networking with other professionals." (Interviewee 1)

Table 30. Examples of “Resources” that is One of the Factors Teachers Identified as Important Attribute for Improved Professional Development Program

“I have gained a deeper understanding of concepts discussed in class and gained some practical ideas for units that I teach.” (Interviewee 4)

“I have gained greater insights reading other ideas from colleagues. Their ideas have definitely helped me grow professionally!” (Interviewee 2)

Table 31. Example of “Ongoing Professional Development” as One of the Positive Features Arising from the Professional Development Program

“Yes ... because I feel it's on-going! I have a way to communicate ideas throughout the year instead of during a scheduled time frame!” (Interviewee 2)

Table 32. Examples of “Extending What They have Learned” as One of the Positive Features Arising from the Professional Development Program

“I feel it's stronger. We have a lot more repetition and reinforcement that we get in typical professional development.” (Interviewee 3)

“I self-evaluate my own teaching all the time. I'm more aware of formative evaluation procedures and do more performance-based evaluations. I work to incorporate inquiry based teaching into my lessons.” (Interviewee 3)

“They're extensions of what I've learned in science coop, and until just recently, our school systems professional development really didn't have as much of an impact on my teaching practices.” (Interviewee 3)

Table 33. Example of “Better Communicative Skills” as One of the Positive Features Arising from the Professional Development Program

“I think professionally I have grown in how I am able to speak, share and collaborate with others. I am more at ease about sharing my thoughts now, and discussing something I don't really feel like I know that well. I am not as uncomfortable commenting on things like I was at first, so I feel I have grown. I think that it shows at work also and even when speaking to parents.” (Interviewee 4)



### Adding Computer Conferencing to the Course

All teachers were asked to share their feelings about the online discussion component of the course by self-evaluation reports. Both positive and negative comments were reported from the teachers. Most teachers agreed that the online discussion was an asset for this course and built a better relationship between themselves and the instructor. However, many teachers complained that adding the quantity of the online discussions as a course requirement was a barrier for gaining optimally from the course. In addition, teachers also shared their thinking of attributes related computer conferencing technology as well as changes in their thinking and attitude when using this tool (see Tables 34 and 35).

Being able to communicate with the instructor and with peers was seen as easier and a plus. A teacher responded: "I like to have a professor who knows his students and what they are thinking. This has been a plus." Another teacher's echo also related this point: "I like it. I think with practice we could all learn to get better at it and manage it very well. I feel like I have contact with my peers and the professor on a regular basis."

Comparing to traditional class activities, a teacher put it this way:

Time is a hindrance for me, as I am sure for many. To sit down, log in, read and reply takes quite a bit of time for me. Though I do realize it takes no more time than if I was reading chapters out of a textbook that would not have much meaning for me. At least the online is more personal, useful, and insightful. [SE28]

Other teachers thought that typing the thoughts on the discussion board was better than writing a paper: "I think that this discussion board is a much better way of learning than writing papers and submitting them--never to see or hear about them again." Lastly, one teacher's comment summarized the positive theme: "I think that it makes an interesting addition to the class. We can follow-up on or discuss things that time does not allow in the Thursday night class time."

Table 34. A Listing of Teacher Comments about Positive Impacts of Adding Computer Conferencing to the Course

<p>Helping the instructor to know students' thinking better          Providing contact with the instructor and peers on a regular basis          More effective than reading a textbook          More useful than writing papers          Using it as a requirement is not a hindrance          Interesting addition to the class</p>
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Table 35. Examples Provided by Teachers of the Positive Impacts of Adding Computer Conferencing to the Course

<p><u>Helping the instructor to know students' thinking better</u>          "I like to have a professor that knows his students and what they are thinking. This has been a plus." (SE)</p> <p><u>Providing contact with the instructor and peers on a regular basis</u>          "I like it. I think with practice we could all learn to get better at it and manage it very well. I feel like I have contact with my peers and professor on a regular basis." (SE)</p> <p><u>More effective than reading a textbook</u>          "Time is a hindrance for me, as I am sure for many. To sit down, log in, read and reply takes quite a bit of time for me. Though I do realize it takes no more time than if I was reading chapters out of a textbook that would not have much meaning for me. At least the online is more personal, useful, and insightful." (SE)</p> <p><u>More useful than writing papers</u>          "I think that this discussion board is a much better way of learning than writing papers and submitting them--never to see or hear about them again." (SE)</p> <p><u>Using it as a requirement is not a hindrance</u>          "It is fairly hassle free and easy to use so using it as a requirement is not a hindrance." (SE)</p> <p><u>Providing an interesting addition to the class</u>          "I think that it makes an interesting addition to the class. We can follow up on or discuss things that time doesn't allow in the Thursday night class time." (SE)</p>
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However, the teachers also reported some negative impacts of using the online discussion board for the course (see Tables 36 and 37). These included the quantity requirement and low quality of many of the postings. As mentioned earlier, quantity as a course requirement was one of the factors that affected teachers' participation. It was the

main concern frequently cited. Most teachers agreed that quality of the online posting should be included in grading, but the quantity of the postings should not be included. Including quantity as the course requirement caused tremendous pressure and low-quality postings. In addition, some teachers thought the guidelines for quality and quantity of the postings were not clear. A teacher even defined what a good-quality posting was: “It is important to be brief and to the point. Make sure messages are meaningful.”

Regarding the pressure caused by the requirement of quantity, one teacher described the pressure from this course: “I am glad that we are using the discussion board; however, I do feel that there is a lot of pressure to be on it everyday. In my life it is almost impossible. I am a full-time teacher, and a full-time wife and mother. This program is only a portion of my life and is important to me. If time didn’t matter I could be discussing lots more.” She also related her feelings of pressure to having very limited time to participate in online discussions. Another teacher reported her pressure for finding something to post: “I do enjoy reading what others have to say; however, I also feel burdened to try to come up with things about which to comment at times.” Another teacher echoed this comment and summarized his view as:

I'm uncomfortable with the idea that we're partially graded on quantity of postings. I spend a considerable amount of time reading the postings, but I don't always feel I have quality responses to make.....I don't have anything new to add. [SE33]

Some teachers thought they needed more guidance concerning online discussion participation. For instance, one teacher said: “Sometimes I feel that we could use a little more guidance on what to post and what would be entailed in a quality message.” Another teacher responded similarly and thought that guidance was critical in the beginning stages: “Sometimes I think that we could use a little more guidance, especially in the beginning stages, on what to post and what things to include. Some directions are rather vague.”

Consequently, many teachers thought quantity as part of the course requirement created lots of “low-quality” postings. As one teacher mentioned: “It is also a hindrance that we are told that quantity was a criterion for our grade. This led to several postings that were repetitious and not really of high quality.” Some postings, in the opinions of these teachers, were that they were “forced conversations”:

Some people don’t communicate as clearly through a written format. Sometimes it seems like a very “forced” conversation through this means. [SE3]

Additionally, low-quality postings included some “chatty” conversations. One teacher felt some chatty postings would not help his learning:

People are just chatting and messages just stack up; to go through that really do not say anything of value. A few are o.k. and it normally is nice to respond with an “I agree”, but there are just too many comments to go through to do a good job. I was having trouble “weeding” through so much and finding the comments that would help my growth and understanding. [SE26]

Table 36. Positive Impact of Adding Computer Conferencing to the professional Development Course

- Quantity requirement
  - Pressure
    - To receive better grade
    - To read the postings everyday
    - To perform
    - Don't have anything new to add
  - No guidelines for quantity and quality
  - Standards for good postings
    - Brief
    - To the point
    - Meaningful
    - Informational
    - Not used to post personal messages
- Low-quality postings
  - Redundant postings
  - Only chat without value
  - Forced conversation
  - People don't communicate as clearly through a written format
  - Just put time in
  - Too much repetition
  - Too many positive comments
- Need directions for the postings
- Announce the things to post too late
- Hard to read all postings in one week
- Hard to view and reply to the postings under too many forums
- Categorize the forums by weeks of the class

Table 37. Examples of Negative Comments about Adding Computer Conferencing in the Course

<p><u>Quantity requirement</u></p> <p><u>Pressure (To receive better grade, To read the postings everyday, To perform, Don't have anything new to add)</u></p> <p>"I just feel that we have WAY too much pressure to post and respond. We all want to receive the best grade we are capable of .....but I really believe that sometimes quantity for the sake of quantity can be a poor goal. It might be okay if you're a factory worker on quota or in a PE class doing sit-ups." (SE11)</p> <p>"I am glad that we are using the discussion board, however, I do feel that there is a lot of pressure to be on it everyday. In my life it is almost impossible. I am a full time teacher, and a full time wife and mother. This program is only a portion of my life and is important to me. If time didn't matter I could be discussing lots more." (SE4)</p> <p>"I do enjoy reading what others have to say, however I also feel burdened to try to come up with things to comment at times." (SE31)</p> <p>"I'm uncomfortable with the idea that we're partially graded on quantity of postings. I spend a considerable amount of time reading the postings, but I don't always feel I have quality responses to make.....I don't have anything new to add." (SE33)</p> <p><u>No guidelines for Quantity and quality</u></p> <p>"Sometimes I felt that we could use a little more guidance on what to post and what would be entailed in a quality message." (SE36)</p> <p><u>Low-quality postings</u></p> <p><u>Redundant postings</u></p> <p>"It was also a hindrance that we were told that quantity was a criteria of our grade. This led to several postings that were repetitious and not really high quality." (SE10)</p> <p><u>Only chat without value</u></p> <p>"People just chatting and messages stacking up to go through that really don't say anything of value. A few are o.k. and it normally is nice to respond with an "I agree", but there are just too many comments to go through to do a good job. I was having trouble "weeding" through so much and finding the comments that would help my growth and understanding." (SE26)</p> <p><u>Forced conversation</u></p> <p>"some people don't communicate as clearly through a written format. Sometimes it seems like a very "forced" conversation through this means." (SE14)</p> <p><u>Lots of repetition</u></p> <p>"there was a lot of repetition. It might have been helpful to limit the forums in which we were to post each week.....that way the same conversations wouldn't have been going on in different forums." (SE17)</p> <p><u>Hard to view and reply the postings under too many forums</u></p> <p>"Time is a hindrance for me, as I am sure for many. To sit down, log in, read and reply takes quite a bit of time for me." (SE1)</p>
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## CHAPTER V

### DISCUSSION

The results reported in Chapter IV clearly describe teachers' overall participation with computer conferencing, the patterns of the content in computer conferencing forums (e.g., in terms of levels of critical reflection and efforts to social-interpersonal rapport), factors that affect participation and learning interactions in computer conferencing, and teachers' perceptions of the role of computer conferencing in thinking about teaching practices and the overall professional development of the teacher participants. Even though the overall participation rate declined over time during the course, the quality of teachers' critical reflections developed more fully over time. However, most critical reflections were illustrated by using lower-level critical thinking skills. The use of higher-level critical thinking skills grew over the course of the study. From teachers' self-evaluation reports, it was apparent that most appreciated the social-interpersonal interactions which occurred in computer conferencing. Further, the teachers felt that they knew each other better than had been the case in past years. Lastly, teachers shared many positive perceptions of the role of computer conferencing in their thinking of their teaching practices and professional development.

This chapter focuses upon the results secured for each research question and how they indicated the impacts on the use of computer conferencing in the course (e.g., in terms of participation, critical reflection, social-interpersonal rapport, and teaching practices). This chapter will also relate the results to those found in previous research reports. The discussion will be based on four themes: a) participation; b) critical reflection; c) social-interpersonal rapport; and d) teaching practices and professional development.

### Participation

Participation is a key factor in developing an interactive and ongoing community in a computer conferencing network. In Garrison's (1991) critical thinking model, the initiation phase includes a triggering event such as reflecting on the issue, dilemma, or problem emerging from participants' own experiences. To add and shape triggering events in order to initiate more discussions becomes very critical to increasing the level of participation in computer conferencing.

### Instructional and Technical Efforts

The instructor in this course spent much time during the first class session introducing the use of the online discussion board and purpose of adding this new communicative tool in the course. During the rest of class sessions, the instructor also spent a short period of time highlighting some interesting or thoughtful postings and assigned the online discussion tasks every class session. At the beginning of the semester, the instructor served as a facilitator who guided the teachers to use the online discussion board for course activities while also establishing the triggering context in order to encourage even more participation. When teachers got better and better in using this tool for learning and professional development, the instructor comparably took less time in guiding and let teachers decide the way they wanted to use it instead. In addition, technical assistance was also provided to encourage use of the online discussion board for teachers in this course. As a result of this, the effort from both instructional and technical perspectives played a significant role in making the online discussion effective and successful in this course.

### Participation as Course Requirement

In most of the cases, it is hard to initiate discussions both in computer-conferencing classrooms and in face-to-face situations at least in beginning stages.



Harasim (1993) suggested that it is critical to make participation a course requirement in CMC-based class settings. The participants need to become familiar and comfortable with an online sharing context before they can reflect on their own thinking in more depth. Feenberg and Bellman (1990) also reported a similar finding in their project where students were asked to interact without clear directions as to quality or quantity of participation and no commonality of purpose was established between faculty and students or among students. For project evaluation, he recommended that participation be built into the course as a requirement.

In this study, since most teachers had never used an online discussion board before, they were required to participate in online discussions in order to get more familiar with this new learning environment. In the first half of the course period, both quality and quantity of the online participation were graded. In Week 7 (around the middle of the semester), the teachers were told by the instructor that only quality of the online participation would be graded for the rest of the semester. According to teachers' feedback, they got more and more used to reflecting and sharing their opinions on the discussion board until consistent participation was established. However, even though they agreed that quality of their online postings should be included in grading, quantity of their postings became the hindrance for their participation and for gaining real learning. As a result of this, quantity of the participation was not graded after Week 7. It was encouraging to see that the level of participation still climbed after Week 7 until Week 9 (Week 7 = 112, Week 8 = 119, Week 9 = 136), and then start to decline in Week 10 (N=97). It is implied that once the online community has been built and participants involve more actively, participation does not become very critical as a requirement for the course. In addition, the quantity of participation built into the course as a requirement caused some stress and low-quality postings, which were not the intended learning outcomes in terms of course objectives. Sometimes, it created unnecessary feelings of

competition in the learning community and consequently affected the social-interpersonal rapport among the participants.

### Level of Participation in a Learning Community

Historically, practitioners in asynchronous computer conferencing have reported the level of participation is high initially but declines after the novelty effect has worn off (McDonald, 1998). The level of participation (number of messages) found in this study over the thirteen weeks resulted in a very similar trend as McDonald described. There was a downward trend found in the level of participation from Week 1 to Week 13. The peak of participation appeared in Week 2 and the low point of participation occurred in Week 13.

The results only show that the quantity of participation was less emphasized in the course. The quality of participation, including critical reflection and social-interpersonal rapport, was the main focus. As indicated in chapter IV, there was a significant growth in both teachers' critical reflection and social-interpersonal rapport. However, how to establish an ongoing and growing community while increasing the level of quality and quantity of participation remains as a major challenge.

Ideally, teachers will perceive the advantages for themselves as a member of the community of practice where they can discuss and share ideas about teaching and learning instead of merely feeling an obligation to participate. Moreover, teachers as they are involved more actively in developing the community will eventually grow professionally with it. As an idea addressed in National Science Education Standards (1996) for professional development for science teachers, a qualified community member should participate in professional development activities in order to extend their understanding of student science learning and of the roles and responsibilities of teachers. Hence, teacher's participation in the community results in mutual reactions, including

receiving and contributing. The teacher's role should also transform from a consumer of knowledge to that of a reflective practitioner.

#### Participation in Different Types of Discussion Forums

As mentioned in Chapter III, there were four types of discussion forums identified and used in this study: content, district, grade level, and teacher's lounge. Teachers tend to participate frequently in two types of forums: content and district. It was not surprising to see that more participation occurred in the content forum because this forum was basically discussions regarding the course.

The district forum was mainly for the teachers who were in the same school district, to share and discuss more specific educational or organizational issues. It was also interesting to find the high amount of interactions which occurred in small groups. There were nine school districts involved in this study and each school district included different numbers of teachers (Highest = 8, Lowest = 3). Even though there were no obvious correlations found between the number of teachers and the level of participation, the highest average number (N=21) of postings was found in the school district with a larger number of teachers (N=7). One teacher from a larger group described the group interactions:

I think that our interaction has been good and is always helpful for understanding. Our group has made many contacts through the discussion board and it is good to be able to ask questions and receive help from some of those people at different schools. [SE8]

In addition, the lowest average number of postings (N=8) was found in the school district with the smaller number of teachers (N=4). A teacher from a smaller group said:

There are only four people in our group and we have the advantage to be in the same building, and same hall so we can talk to each other in person a lot. [SE13]

Hence, teachers in a larger group perceived more advantages of the online communication and enjoyed it as well as participating more in the online interactions.

Interestingly, it was also found that the quality of collaboration and the level of in-class participation (ITV) were better in the larger groups. This is probably because the learning context in the larger groups seems richer in terms of more variety in the people, experiences, and resources than found smaller groups.

The level of participation in terms of quantity increased initially with a subsequent decline over time during the semester as has been reported in other studies. However, the quality of participation, such as critical reflection and social-interpersonal rapport, will be discussed later.

### Critical Reflection

Content analysis was used to assess the degree to which online messages appeared to reflect the use of critical thinking skills as well as the level of such critical thinking skills. The analysis procedure is described in detail in Chapter III. The message posted on the discussion board with the indicator of critical thinking skill, which was also called a critical reflection, is the main outcome expected to occur in most asynchronous computer conferencing classes.

### Factors That Support Critical Reflection

Teacher education is a major research focus in adult education. In adult learning theories, a maturing adult learner is defined by Knowles (1970) as one who:

1. Is self-directing;
2. Can utilize his experience in learning;
3. Can identify his own readiness to learn;
4. Can organize his learning around life problems?

In 1990, Knowles further indicated additional research findings, which established the assumptions underpinning adult education:

1. Adults need to know why they need to learn something before undertaking to learning;
2. Adults have a self-concept of being responsible for their own decisions, for their own lives;
3. Adults become ready to learn things they need to know and be able to do it in order to cope effectively with real-life situations.

Understanding adult learning processes can also help teacher educators to figure out what factors might facilitate teachers to be intellectual and reflective practitioners and to apply higher-order critical thinking skills while reflecting. For example, teachers should see the reasons why they need to learn; they want to gain things that will help them to solve real-life problems in their classrooms. Besides that, adult-learning theories also can serve as a framework for designing learning contexts with essential components that will foster more critical reflective learning.

In Levin's (1999) study where thirty-five prospective elementary teachers enrolled in an undergraduate teacher education program and used a network-based environment, there were three reasons reported as to why web-based discussion support reflection. These include: a) an appreciation of the chance to learn from others, b) a sense of validation because their feelings and experiences were similar to others, and c) enjoying feedback on their ideas from more than one person.

In this study, similar results were found regarding reasons, which supported critical reflection. An appreciation of the chance to learn from others was very common feedback from the teachers in this study. More specifically, the teachers' reflections showed that the use of different levels of learning about critical thinking concerning processes in computer conferencing. There were four examples of lower-level learning of critical thinking in computer conferencing: increased content knowledge, gaining enrichment from varied backgrounds, feeling secure in sharing the ideas, feeling free to

express opinions. In addition, the second reason, namely gaining enrichment from varied backgrounds, was very similar to another reason mentioned in Levin's study, i.e., enjoying feedback concerning their ideas from more than one person. One teacher in this study summarized her view of "gaining feedback from varied backgrounds" in this way: "It helped because I was able to hear other perspectives and I gained enrichment from varied backgrounds."

There were also examples of use of higher-level critical thinking skills in reflections reported in this study. Besides just getting resources or ideas from other teachers in this course, the teachers also compared the similarities and differences in the reflections, syntheses, and related thoughts from others. One of the interview questions was to ask teachers if they would apply what they learned in computer conferencing in their own classrooms. It was encouraging to read what one teacher said regarding this course: "The ideas presented from other sites have been interesting and given me some new ideas to try in my class."

Most of the teachers in this study never used the computer conferencing tool before. The main purpose of using the computer conferencing in this course was to encourage the teachers to reflect on their questions or experiences about science teaching and learning. Further, it was an aim to provide and to develop an ongoing learning community for them. Even though the teachers were expected to use higher-level critical thinking skills eventually, feeling secure and free to reflect in computer conferencing was very critical in making teachers feel more comfortable and willing to reflect "online" with "unseen" people. Consequently, it became easier to see the teachers apply more critical thinking skills from lower levels to higher levels. As one teacher described: "I think it is going well and we are all becoming more comfortable with using it. I like having the opportunity to see/ read what others are thinking. It is nice to be able to respond to them." She appreciated the ability to respond to other teachers' opinions. In

most traditional classes, sometimes it is hard to have the opportunity to know other people's thinking and to reflect on it because of limited class time and diverse geographical settings.

Levin (1999) also discovered that the students felt encouraged to reflect on their own thinking because they had similar experiences or problems. This was also found in this study. A teacher in this study stated it this way: "An important thing is that we have a place to discuss learning and not feel like we are the only ones with that problem or feeling. At first I was reluctant to share because I feared I might sound like I have a lot to learn. Now I know that we are working on our science knowledge and it's ok."

According to Knowles' (1970) four components of maturing adult learners include: self-directed in utilizing one's own experiences, identifying one's own readiness to learn, and organizing one's own learning around life problems. Almost all factors supporting critical reflection that were identified by teachers are beneficial in helping teachers to fulfill the four components in the same ways (see Table 38). For example, the factor "feeling that other teachers have the same concern" might facilitate teachers, as adult learners, to be more self-directed because they could share their concerns more actively instead of completing the things required for the course passively. Feeling that others have the same concerns also makes teachers feel more comfortable in utilizing their own experiences as they reflect as well as in organizing their own learning around real problems in the classrooms.

Table 38. Factors Affecting Critical Reflection Learning and Adult Learning Components

Factors Affecting Critical Reflection Learning	Adult Learning Components
<ul style="list-style-type: none"> <li>• Opportunities to compare similarities and differences</li> <li>• Being able to synthesize and relate their thoughts</li> <li>• Having a good understanding of learning</li> <li>• Feeling that other teachers have the same concerns</li> <li>• Feeling secure in sharing ideas</li> <li>• Feeling freer to express opinions</li> <li>• Convenience</li> <li>• Increasing content knowledge</li> <li>• Gaining enrichment from varied backgrounds</li> <li>• Application</li> </ul>	<ul style="list-style-type: none"> <li>➤ Being self-directed</li> <li>➤ Utilizing his own experience</li> <li>➤ Identifying his own readiness to learn</li> <li>➤ Organizing his learning around life problems</li> </ul>

#### Quantitative and Qualitative Changes in Critical Reflection

The quantitative data presented in this study also echo the findings discussed in the previous section. The number of critical reflective messages declined from the beginning till the end of the semester (Week 3=214, Week 6=193, Week 10=118). Similarly, the level of participation mentioned earlier also resulted in the same declining trend over the semester. However, the mean score (MS) for critical reflective messages calculated based on four-point scale, (as explained in detail in Chapter III), showed an upward trend from Week 3 (MS=2.02) to Week 10 (MS=2.19). From time to time, when the teachers' level of comfort increased, the quality of their critical reflection, in terms of the level of using critical thinking skills, also improved over time.



In previous studies, most researchers examined either quantitative change in critical reflective messages or qualitative changes in critical reflective messages. This researcher found a few problems with the current study. First of all, the growth of critical reflection is hardly evaluated by the results only in this regard with quantitative changes or only with qualitative changes. Including both qualitative and quantitative results in critical reflection is more likely to represent the comprehensive picture of growth. For instance, Hawkes (2001) conducted a study examining the reflective outcomes of asynchronous CMC on inservice teacher development. He only analyzed the quality of reflective outcomes in terms of mean reflective scores. The study results indicated that the mean reflective score dropped from 2.751 (beginning) to 2.183 (middle) but climbed to 3.289 till the end based on a seven-point scale (Score 1-7, Low Reflective-High Reflective). Without knowing the quantity of critical reflection found in his study, it is hard to see the patterns of reflective outcomes. For example, does the number of reflective messages (quantity) result in similar trends over three observation periods? Does the rate in quantity of critical reflection affect the quality of critical reflection? In other words, does the study show that when teacher participation in critical reflections develop, that the quality of their critical reflections improves as well? Combining the quantity of critical reflection to his existing result of mean reflective scores will probably provide a better context for understanding how teachers' critical thinking develops over time.

Secondly, it is also critical to examine the changes in critical reflection over time, in terms of beginning, middle, and end of the study period. Therefore, examining both qualitative and quantitative changes in critical reflection over time should be emphasized for research in this field. Comprehensive results can provide possible solutions by encouraging more critical reflections or by improving the quality of critical reflections.

### Levels of Critical Reflection

In the three selected weeks, most critical reflective messages were in the lower phase: exploration, which was defined as the second phase in Garrison's (1991) critical thinking process. In this phase, participants shifted between the two worlds: private reflective world and the social/shared world. Participants were involved with: brainstorming, questioning and exchange of information. In all three selected weeks, there was always the highest percentage of critical reflective messages in the exploration phase (Week 3=82.7%, Week 6=73.6%, Week 10=71.2%) even though the percentage kept declining over time. In project SENco (Special Needs Coordinators forum) conducted by Selwyn (2000), it was also found that the online forum was mainly for information and resource exchanges.

Compared to the exploration phase, the fourth phase, resolution was the highest phase in the critical thinking process. It resulted in the lowest percentages during the weeks of 3, 6, and 10 (Week 3=2.8%, Week 6=4.1%, Week 10=10.2%). However, there was a significant upward trend found with respect to the resolution phase in this study.

The overall quality of critical reflection, in terms of mean critical thinking scores, increased over time as indicated in the results of this study. There was a trend toward a high quality of critical reflection over time. In other words, the teachers seemed to use more high-level critical thinking skills as the semester continued. The results regarding the quality of critical reflection was different from that reported by Hawkes (2001) and Bullen (1998) in their studies in this area (see Table 39). In Hawkes' study, the mean score of critical reflection dropped from beginning to the middle but had the highest mean value at the end. The average mean score in his study is lower than 3, which is the third level in the score scale. Similarly, Bullen (1998) found that critical thinking tends to be highest at the beginning and end of the course. In the middle of the course, there was

also a down point. The average mean score tended to be around 2, which is the second level of the score scale.

In this study, the researcher found similar result as those of Hawkes (2001) and Bullen (1998). The average mean score of critical reflection fell within the lower-level critical thinking scale. Encouragingly, there was a stable growth trend in critical thinking found as this study progressed. This was different from what Hawkes and Bullen found. Learning trends that increase are the intended outcomes that one hopes to see in studies in this field.

However, according to the three studies mentioned above, most messages in computer conferencing are found with the use of lower-level critical skills. This is not the only problem which appeared in online classrooms but also found in traditional face-to-face classrooms. Thus, facilitating students to develop their critical thinking skills has been studied widely in educational research. First of all, students need to feel comfortable and ready to reflect on their own thinking with peers and the instructor. In the traditional face-to-face setting, students are often concerned with public-speaking strategies, with too little time to reflect. These concerns seem minor in a computer conferencing setting. For example, a shy student might feel more encouraged to share in a computer conferencing class. Eventually, students are expected to synthesize and to apply the ideas generated by their peers or the instructor. Normally it takes more time at this stage. This is also why it is difficult to reach in a traditional classroom. The computer conferencing classroom seems a likely solution for achieving this goal because students can pick time and go back to review the messages and find the similarities and differences among the ideas. For the next step -- construction of meaning, teachers need to reflect not only their own understanding but also combine these with other ideas and resources. Facilitating the diagnosing of misconceptions, reformulating questions, and providing additional information, all play very important roles in facilitating this stage. These can be

performed by the instructor and the peers but is frequently missed in most classes in a computer conferencing setting. Besides, it takes more effort and understanding to accomplish this stage. For example, participants in this study were schoolteachers who normally have more complimentary conversations instead of critiques. Even when they sensed some contradictions or misconceptions, they often tended not discuss further points of differences in order to maintain conventional social-interpersonal rapport. As one teacher commented in this study, the chatty conversation hardly helped with personal growth:

People just chatting and messages stacking up to go through that really don't say anything of value. A few are o.k. and it normally is nice to respond with an "I agree", but there are just too many comments to go through to do a good job. I was having trouble "weeding" through so much and finding the comments that would help my growth and understanding. [a teacher's posting within BlackBoard]

Therefore, to find out how to initiate more higher-level critical reflections instead of too much chatty conversations often makes the use of computer conferencing more effective. These characteristics can be analyzed in future studies.

Table 39. Results Reported in Three Studies which Applied Content Analysis in Computer Conferencing Discussions

	Beginning	Middle	End	Rubric Model
Hawkes (2001)	2.751	2.183	3.289	Simmons et. al., (1989) Taxonomy of Reflective Thinking (7-Point Scale)
Bullen (1998)	2.125	1.55	2.75	Norris and Ennis' (1989) Critical Thinking Model (4-Point Scale)
Chung (2003)	2.02	2.15	2.19	Garrison's (1991) Model of Critical Thinking (4-Point Scale)

### Critical Reflection in Focused and Unfocused Forums

Hawkes was interested in studying reflective discussion patterns in focused and unfocused discussion forums to see which type of discussion forum would promote more reflective discussions. What was revealed in his study concerning discussion forums was that conversations which were immediately related to the classrooms, subjects, and grade levels, promoted more reflective discussions (Hawkes, 2001). In addition, Schlagel, Trathen and Blaton (1996) also examined the online conversations in their study and found that more reflective conversation occurred when preservice teachers had open, thematic prompts and focused messages, and time to reflect.

In this study, there were two focused discussion forums: content forum (large-group) and grade level forum (small-group), as well as two unfocused discussion forums: teacher's lounge (large-group) and district (small-group). Similar to what Hawkes found, the focused discussion forum, that was a content forum, resulted the second highest percentage of critical reflective messages (39.3%, 1<sup>st</sup>=40.5%, 3<sup>rd</sup>=13.8%, 4<sup>th</sup>=6.45) and produced the second highest mean critical thinking score (2.15, 1<sup>st</sup>=2.32, 3<sup>rd</sup>=2.23, 4<sup>th</sup>=1.98). It was not surprising to see more critical reflective discussions occurring in the content forum since it was mainly for course content discussions. Another focused discussion forum, that was grade level forum, resulted in only 13.8% critical reflective messages but it resulted in the highest mean critical thinking score (MS=2.32) of all the discussion forums. The teachers tended to ask very specific questions and provided direct resources or support related to the topic that was taught in the same grade level in grade level forums. For example, one teacher asked the following question:

My third graders did not grasp the meaning of carbon dioxide. They really stuck to their beliefs that water, soil, and sunlight were the reasons it was so big. They did know that the tree gives off oxygen and takes in carbon dioxide but I do not think they fully understood the whole carbon in the air bit. I wish there was a way I could explain it to them in their simple third grade minds. Any ideas? [a teacher's posting within BlackBoard]

It was very common to have teachers in this study ask this kind of question in grade level forums. Teachers also discussed in depth what and how they taught some specific science topics. The following teacher tried to explain to other teachers how she adopted a “project approach” in her class:

We've done research projects in first grade, based on the Project Approach. We were trained by Lillian Katz and Sylvia Chard a few years ago at the U of Illinois-Champaign. A lot of the theories are similar to K-W-L. You brainstorm and list things the kids know about a topic, and questions they have. You choose questions for groups of kids to study. They do research and decide how to present their information to teach the rest of the class about their topic. There are many ways they can choose to present their information. We really enjoyed when we used it for summer projects and were able to take kids to various sites around town and do hands on research. We had multi-age groups. Last year my first grade teaching partner and I used the Project Approach with our weather unit, mixing the two classes together in groups, researching their questions. We have small classes and are able to handle it. But it's not as effective if you have a larger class and only one teacher. I do really enjoy the projects. So do the kids. [a teacher's posting within BlackBoard]

District forums, which were examples of the unfocused discussion forums for the teachers at the same school district, resulted in the highest percentage of critical reflective messages (40.5%) but they resulted in the lowest mean critical thinking score (MS=1.98) of all discussion forums. From teachers' online postings, the following messages represented a typical example of organizational issues, which were reported frequently in the district forums:

I will be there at 3:45 and we can talk about possible revisions. [a teacher's posting within BlackBoard]

Whose bringing treats tomorrow? You know we need to keep up our strength!!! :) See you all tomorrow night. [a teacher's posting within BlackBoard]

Both quality and quantity of critical reflection in the focused and unfocused forums presented the comprehensive pattern of teachers' interactions in computer conferencing. In conclusion, the focused discussion forums (content, grade level) served as the main places where more cognitive presence, in terms of higher-order critical

reflection, appeared. In addition, the unfocused discussion forums (district and teacher's lounge) served as the places for social presence, which resulted in a higher number of social cues per message (see Table 40). According to the model of "Community of Inquiry" that is applied to the practice of computer conferencing in higher education (Garrison, et. al., 2001), the three elements of this community are cognitive presence, social presence, and teaching presence. Both the examination of cognitive and social presences is discussed in this section and the next section.

Cognitive presence and social presence are addressed in Piaget and Vygotsky's research contributions. In Piaget's cognitive constructivist theory, learning in social contexts is largely a matter of cognitive development and the social interaction leads to confrontation, contradiction, and cognitive change. Furthermore, Vygotsky (Rogoff, 1990; Tharp and Gallimore, 1988) developed the socio-constructive learning theory and introduced the concept of ZPD, zone of proximal development, where collaborative learning and social interactions serve as fundamentals for cognitive development.

Therefore, the results of critical reflection in different types of discussion forums in this study provided the evidences (cognitive and social presence) for examining effective learning in teacher education. Moreover, in order to pursue intended learning outcomes in computer conferencing, it is critical to create appropriate discussion forums that address different discussion focuses, course objectives, and participants.

As in traditional classrooms, students will need a place or activities for cognitive learning as well as a place or activities for social interactions. Compared to a traditional classroom, the advantages of an online classroom are:

1. Students can go to the discussion forums to do cognitive learning at anytime and any place and can participate as much they want;
2. Students can go to the discussion forums to have social interactions at anytime and any place and can participate as much they want;

3. Instructors can go to the discussion forums to add instructional materials at anytime and any place and can add as much s/he want;
4. Students can go to the discussion forums to do both cognitive learning and social interactions at the same time without time and distance constraints;
5. Students will be able to go back to track the cognitive, social, and teaching presences in the previous classes. Therefore, the cognitive, social, and teaching presences become accumulative and traceable for the students, which are not possible in a traditional face-to-face classroom.

Table 40. Critical Reflection in Focused and Unfocused Discussion Forums

Forums	Focused Forums (Cognitive Presence)		Unfocused Forums (Social Presence)	
	Content	Grade level	District	Teacher's lounge
Percentage of Total Critical Reflection	40.5%	13.8%	39.3%	6.4%
Mean Critical Thinking Score	2.15	2.32	1.98	2.23
Average Number of Social Cues Per Message	0.54	0.38	0.75	0.86

#### Length of Critical Reflection

It was interesting to see that the length of different types of messages varied over the course of this study. In general, the length of higher-level critical reflection (triggering, exploration) was longer than lower-level critical reflections (integration, resolution). For example, in most critical reflection in the phase “triggering”, teachers



rarely asked a question or provided only a little background for the question. The following two examples were examples of triggering in the content forum:

I really enjoyed your activity with the CO<sub>2</sub>. This is an activity I'd like to try at home. Do you think you could post the instructions? Thanks. [a teacher's posting within BlackBoard]

After thinking about this - if a tree would get all its weight from the soil (nutrients) and water wouldn't the soil be less around the tree, to create that much weight? [a teacher's posting within BlackBoard]

As mentioned earlier, most critical reflection was in the exploration phase where teachers would try to connect their own experiences in the private world to the discussion question in the shared world. One teacher shared her experiences about using the "concept map approach" in her class:

We're doing plant classification in my fourth grade science class. I thought it would work well with concept mapping. I did some mapping with my class last year but haven't tried it this year yet. I know it's a great way to check for understanding. [a teacher's posting within BlackBoard]

However, when teachers used higher-level critical thinking skills in their reflections, they would not simply ask questions, or share their experiences and information. Instead, they tended to synthesize the opinions from different persons, to integrate more resources, and to come up with their own conclusions or resolutions. Therefore, the length of the reflection was longer. For instance, the teacher in the following example reflected on the same issue "concept map approach" as the previous teacher but he integrated more resources and added his own conclusions regarding this issue:

I just did a concept map with my fourth graders on the National Government, which we were discussing in Social Studies. My students did a great job once they got going. I gave each of my students the verb list that Dr. Romance handed out so they had a visual to look at for the connecting words. After we finished the map they were able to read it like sentences. The students were really proud of themselves, as I was proud of them. For a follow up, I had cards made for the Local Government and State Government. They worked in groups to see if they could make their own map of the SE2. It took a little guidance, but the more we do them, the easier it will become. I see a real value in this. Thanks to the Science

Coop, I wouldn't have had a clue what Dr. Romance was talking about, but since we have made 2 concept maps during the summer workshop, it is getting easier for me too. I do think prior knowledge is a key. My kids didn't have too much knowledge at all about the government, so now I hope they can recall a few things. [a teacher's posting within BlackBoard]

However, it was hoped that higher-level critical reflections would occur more frequently over time, but there was only a low percentage of this type of critical reflection in all discussion forums. Dimauro and Gal (1994) also examined the length of different types of messages and found reflective messages were normally the longest, but they were rarely found in network-based discussions. Their results were very similar to what the researcher found in this study.

#### Teachers as Learners

Teacher learning process was exactly the same as the one which their students learned in their classrooms. The teacher learning experiences on the computer conferencing not only affected their learning but also their teaching as well. According to Tharp and Gallimore (1988), teachers are lifelong learners and researchers in terms of learning about teaching as well as the conception of teachers as learners alongside their students. Some traditions about teaching have conceptualized the teacher as the transmitter or consumer of expert knowledge. In National Science Education Standards for professional development, less emphasis is placed on making science teachers learn by merits of transmission of teaching knowledge and skills, but more emphasis is on letting science teachers learn through inquiry into teaching and learning. Therefore, teachers need a place to be learners who do not only learn professional knowledge but also experience the learning processes. For example, some teachers found they were not the experts in all areas. One teacher posted the following message to express her overwhelming feeling:

At times, I feel inadequate as a teacher because as an elementary teacher, I wear so many hats. I feel the need to be an expert in many areas, but I'm not! Sometimes I don't know where or how to come up with the

right probing questions for all areas of the curriculum. [a teacher's posting within BlackBoard]

It is hoped that the online community of teacher educators will provide an appropriate learning environment helping meet teachers' real needs.

In conclusion, the factors that affected critical reflection in computer conferencing also influenced positively in four components of adult learners: being self-directed, utilizing his own experience, identifying his own readiness to learn, organizing his/her learning around life problems.

Both quality and quantity of critical reflection should be emphasized in future research in order to get a more comprehensive picture of learning patterns and interactions in computer conferencing. Even though the growing trend was for better quality of critical reflection in this study as well as previous studies, the majority of critical reflection tends to be at lower levels of critical thinking. In general, the length of messages in these phases was shorter. In other words, teachers tended to have more surface talk or information exchanges in the discussion forums. More research is needed to discover how to facilitate participants in developing their critical thinking over time.

In the community of teacher educators with respect to computer conferencing, cognitive presence was found mostly in focused discussion forums (content and grade level). In addition, social presence mainly existed in the unfocused discussion forums (district and teacher's lounge).

#### Social-Interpersonal Rapport

Vygotsky's approach to understanding learning as a social process (Vygotsky, 1978) has been applied widely to design and implement many online learning settings that facilitate socially negotiated learning (Bonk and King, 1998). According to Vygotskian socio-cultural principles, both student peers and the instructor will provide scaffolded instruction at various intellectual levels (Hedegaard, 1990, Vygotsky, 1978).

One of the key attributes of a social-constructivist environment is allowing all students to engage in discourse at the appropriate level. In Garrison's et. al (2001) model of community of inquiry in higher education, social presence is one the three fundamental elements for successful online instruction.

Henri's model of social cues was applied to examine social presence in this study, including factors affecting social presence and change in social presence over time. In addition, social presence in focused and unfocused discussion forums is also discussed here.

#### Factors That Affect Social Presence

In Dutt-Donner and Powers' (2000) study, the students were found to rely upon one another for support, teaching skills, and ideas if they were afforded the opportunity for self-directed discussions and participation. Most teachers in this study expressed on appreciation for the social-interpersonal interactions, which happened in computer conferencing. Further, they thought that the social interactions affected the relationship among the teachers very positively. One teacher summarized this viewpoint as below:

I like when teachers discuss the concepts being discussed and share their ideas or understandings. I think some very valuable learning is taking place. At first, we just seemed to communicate more with the teachers in our own districts, but that's changing. Classmates we just saw on the ICN screen are becoming more than just faces. This exchange between individuals is strengthening our relationships. [a teacher's posting within BlackBoard]

Likewise, Merseth (1991) found that computer networking allays feelings of helplessness and embarrassment and provides moral support for beginning teachers. Similarly, Tannehill, Berkowitz and LeMaster (1995) explored the perceptions of teachers about technology as an important factor in their feelings regarding isolation and providing them with valuable access to expertise. The teachers in this study felt much the same way. They reported the factors in computer conferencing that affected their social-

interpersonal rapport. These were: feeling more able to contact each other, enjoying social conversation within or among the school districts, knowing each other better and improving their relationships, and making them feel more confident and secure in sharing with each other, especially when they found other teachers who had the same feelings or concerns.

McGinnis (1996) found that students believed that using computer-mediated communication could foster a sense of community. One teacher in this study pointed out the term “sense of community” during the interview: “It is very interesting to read other people’s comments about the class topics. I have learned a lot from others. I do think it creates a sense of community.” Establishing a sense of community was one of the emphases addressed in the research goals. However, it was rarely indicated by the teachers either in their feedback or during personal interviews. Selwyn (2000) also found that there was little evidence to show the online messages constituted a shared sense of community in the online forum. How to establish a stronger sense of community progressively and naturally in computer conferencing is a suggestion for the future research in this field.

The factors that affected social-interpersonal rapport can also facilitate teachers in meeting the four adult learning characteristics defined by Knowles (1978) (see Table 41). For example, the factor “picking and choosing whom to communicate with” might make teachers feel more comfortable in sharing their own experiences with some teachers who teach the same topic. In addition, teachers might identify more specific problems when teaching that topic.

Table 41. Factors Affecting Social-interpersonal Rapport and Adult Learning Characteristics

Factors Affecting Social-interpersonal Rapport	Adult Learning Characteristics
<ul style="list-style-type: none"> <li>• Enjoying social conversation</li> <li>• Enjoying have more discussions with the teachers among the sites</li> <li>• Enjoying have more discussions with the teachers within their site</li> <li>• Being able to know the others better</li> <li>• Connecting the names with the faces</li> <li>• Feeling more confident with each other</li> <li>• Making group more accountable</li> <li>• Enjoying being able to chat with colleagues on a daily basis</li> <li>• Creating a sense of community</li> <li>• Picking and choosing who to communicate with</li> </ul>	<ul style="list-style-type: none"> <li>➤ Being self-directed</li> <li>➤ Utilizing his own experience</li> <li>➤ Identifying his own readiness to learn</li> <li>➤ Organizing his learning around life problems</li> </ul>

#### Social Presence Over Time

Social presence was one of areas that were examined in this study. As found in the previous studies, the number of social cues in the online discussions, in terms of social presence, increased initially but significantly declined over time. McDonald (1998) found that while there was a fair amount of social segment initially (23%), the amount kept declining over time. Another similar finding to Hara et al. (2000) was the decrease in the presence of social cues in messages over the course of a semester. As a semester progresses, students participated more on focused discussions and included fewer social cues in their discussions perhaps because they may actually know each other better than before.

In the present study, the percentage of social cues in the messages increased from Week 3 (56.7%) to Week 6 (72.6%), but declined significantly from Week 6 to Week 10 (55.4%). The results were very similar to patterns reported in McDonald's (1998) and Hara's (2000) studies. Walther (1996) argues that the more effective CMC is the less socio-emotional communication exists. From this viewpoint, early social cues and signals are needed to help teachers to feel more comfortable working together and building a new community. Not surprisingly, social cues in this course were most frequently during week after the group presentations in Week 5. The teachers posted many compliments for each other on the discussion board during Week 6 such as "Hello Everyone!! First, great job with the presentations last Thursday." After Week 6, teachers knew each other well enough and focused more on the tasks at hand.

#### Social Presence and Cognitive Presence

In one of the earliest studies on the use of electronic communication by teachers, Kimmel, Kerr, and O'Shea (1988) found there was increased collaboration (social interactions) and increased sharing of classroom materials and ideas between teachers in developing activities for professional development workshops. In the present study, the researcher found there was a decreased number of social cues and decreased critical reflective indicators in the messages from Week 6 to Week 10. Combining these results to what Kimmel et al. found, an interrelationship between the social participation and critical reflection may exist. Perhaps, the increase or decrease of social participation should affect the amount of critical reflection. Piaget's (1973) learning theory supports this assumption. Piaget's reported that social interaction leads cognitive development. Therefore, the change of social presence would also affect the cognitive presence in the community of teacher educators on CMC.

Schlager (1997) and his colleagues' project called TAPPED IN provide another example of social presence and cognitive presence in online learning community. In their project, they found that teachers in the online collaborative community appeared to be more engaged in thoughtful, focused, and reflective discussions surrounding their everyday experiences. They developed their own activities in this online system. Social presence in the online collaborative community supplements teachers' cognitive development.

#### Social Presence in Focused and Unfocused Forums

There are few research reports associated with the social presence in focused and unfocused discussion forums. The results of this study provide evidence that the average number of social cues per message is higher in unfocused discussion forums: teacher's lounge forum (N=0.86) and district forum (N=0.75). Consequently, the focused discussion forums, such as content forum (N=0.54) and grade level forum (N=0.38) have lower average number of social cues per message. In the previous discussion regarding critical reflection, it was reported that focused discussion forums resulted in higher rates and quality of critical reflection. Combining this to the result of social presence, it can be seen that teachers did not involve many social interactions in the focused discussion forums when they participated more on-task and used more focused conversations.

The number of social cues in the messages increased initially but declined significantly over time. When teachers focused more on-task discussions or critical reflection, less social conversation existed. However, most of the teachers held positive perceptions about the social-interpersonal interactions on CMC and thought the social interactions would help their personal growth. These factors also served as facilitators for helping teachers in becoming mature adult learners. Lastly, unfocused discussion forums



(district, teacher's lounge) tended to indicate more social presence compared to focused discussion forums.

### Teaching Practices and Professional Development

Cognitive presence (critical reflection) and social presence are two main facets that have been studied thoroughly in previous computer conferencing research. There is little evidence regarding the impact of computer conferencing network on teachers' teaching practices found in recent studies. However, how computer conferencing network influences teachers' teaching practices in the classrooms is very critical in deciding the way to apply computer conferencing network in teacher education. Consequently, computer conferencing which results in positive impacts on students' learning and achievement is something needed to establish the power by computer conferencing. Therefore, the researcher conducted interviews with a sample of teachers to reveal teachers' perceptions of the role of computer conferencing in their thinking about improved teaching practices.

### Factors That Affect Teaching Practices

Teachers reported different facets of computer conferencing network that impacted their teaching practices, including collaboration, evaluation of teaching, and application. Among these factors that teachers indicated are the importance of collaboration and evaluation of teaching. These have also been reported in some of the previous studies. For example, in Thorensen's (1996) study, he evaluated how rural inservice and preservice teachers could share and discuss teaching strategies and concerns with an electronic network. Both mentor and mentee teachers in her study considered the electronic network valuable for discussing teaching practices and for sharing information. Along similar lines, Levin and Waugh (1998) responded that CMC

community provided beginning teachers with the opportunities for requesting help as well as discussing their own teaching and reflecting on the processes.

### Convenience

Because of the convenient feature of the computer conferencing, teachers are able to collaborate and learn together without a concern for neither distance nor time constraints. It is especially beneficial for teacher educators in rural school districts where there are fewer resources and opportunities for professional development. In addition, no matter whether in rural or urban school districts, the budget for improving computer technologies has increased in many places. Therefore, more and more teachers and students have more effective and quick accesses available to use the computer technologies for teaching and learning. It becomes more possible to connect teachers together and to provide more online opportunities for professional development than before. As long as teachers get used to attending professional developmental activities from the Internet, they will feel more comfortable to share and bring up more things which happen in their classrooms. Without traveling, teachers can even “visit” or easily imagine what is going on in other teachers’ classrooms by browsing the websites. As a result of this, the design of online professional development should consider teachers’ real needs. In National Science Education Standards (NRC 1996), it stated that one of the challenges of professional development is stated as following:

“is to create optimal collaborative leaning situations in which the next sources of expertise are linked with the experiences and current needs of the teachers.” (p. 58)

The teachers in this study were from nine different rural school districts in Iowa and the school districts were geographically far from each other. According to the results of the pilot study, teachers enjoyed and learned much from other teachers. One of the main reasons was learning about other teachers’ problems and strategies for teaching.

### Evaluation of Teaching and Application

The National Science Education Standards (NRC 1996) for professional development urge more emphasis on “Teachers as intellectual, reflective practitioners” but less emphasis on “Teachers as consumers of knowledge about teaching.” Teachers need the opportunity and an appropriate context to evaluate their own teaching and to reflect on their teaching. The impact of CMC on facilitating teacher evaluate their own teaching has been found in the following studies.

Bliss and Mazur (1996) examined the interactions between six experienced history teachers and six student teachers as they used computer videoconferencing to discuss how to teach history in their classrooms. They found that the inservice teachers like having opportunities to discuss history teaching with student teachers and to think more deeply about their practices and how they could improve their teaching.

In an ongoing project called the Inquiry Learning Forum (ILF), Barab and colleagues (in press) have found that teachers in their project believed that the participation was helpful in getting them to think more about their practices even though the results did not yet show the impact on how teachers actually changed their teaching.

Teachers in this study commented that learning from other teachers’ experiences or reflections made them think more in depth about their own teaching. As one teacher mentioned during the interview:

The sharing that goes on helps affirm, for me, some of the things I'm doing in my teaching! I've also read some things that have made me question some of my practices as well. [Interviewee 2]

However, how to accomplish an intellectual and reflective discussion as a practitioner was a challenge. Some teachers were reflective practitioners but did not use higher-order critical thinking skills in their reflections. Most of the time, they just simply described a fact without adding their own value or synthesizing different observations. For example, one teacher explained what he observed in his class:

I found that all the third graders were convinced that water was the most important thing for the acorn to grow into the tree and it also made the tree weigh a lot. Interesting..... [a teacher's posting within BlackBoard]

Or sometimes, they just simply asked a question without further explanation:

Looking for very basic ideas to use in these areas to increase my inquiry based methods with health. Any neat resources you could share would be appreciated. Thanks. [a teacher's posting within BlackBoard]

On the other hand, some teachers tried to use higher-order critical thinking skills when reflecting on their teaching or observations. For example, one teacher described the importance of appropriate vocabulary and concepts:

I've been thinking about this and I think kids are probably just like us. When we ask questions, we want certain answers and if we get more information than we want, or that we can understand based on our concept formation, we tune it out and make a mental note not to ask that person a question again! So with our students I think appropriate vocabulary and concepts are okay as long as we keep checking with them on where their conceptions are. [a teacher's posting within BlackBoard]

Another example was a teacher who reflected according to what the previous teacher said:

Hi! I also teach first grade and I agree with you. My students were also very apprehensive to answer and looked to me for visual clues as to what "correct" answer I was looking for. It bothers me at this young age they already feel the world is a right or wrong answer. I think we as adults and teachers have probably fostered that idea. I was impressed with one of my students who knew that the Oak tree was the state tree. One of my other students told me that the cap on the acorn was what fairies wore on their head! Their grandpa had shared that with them on a walk! [a teacher's posting within BlackBoard]

Teachers need to learn not only how to reflect but also how to reflect intellectually. Interestingly, teachers who teach at lower grade levels tend to explain their observations or teaching in more detail and with more interactions with other teachers at higher-grade levels.

More teachers need to learn to apply the ideas they have learned and have impact on their teaching. Sunal and Sunal's (1992) found that preservice teachers developed a more favorable attitude toward use of technology in schools, communicated more

frequently with their peers, and were more willing to try innovative practices in their classrooms with use of computer conferencing.

Even though teachers in this study identified that they would try the ideas learned from other teachers in their classrooms, most merely used the book or website that other teacher suggested instead of trying their own teaching strategies or lesson plans which normally would require more changes in their own teaching or classrooms. In other words, teachers were only willing to try some small changes in their teaching practices and did not want to take too many risks with the changes.

### Professional Development

The efforts in this study were to establish an ongoing community of science teachers for professional development that match the characteristics of quality teacher education programs addressed in National Science Education Standards for Professional Development (NSES, 1996, p.70). Major visions of quality preservice and inservice programs addressed in Professional Development Standards which are related to teacher perceptions concerning professional development in this study include the following:

#### Clear and Shared Goals

Quality professional development programs require practioners from various levels to achieve a common set of goals presented by the NSES. The course in which teachers participated focused on current science education reforms, such as use of scientific misconceptions, science as inquiry, constructivist learning, and involvement with action research. The course focused on the discussion of the applied curriculum and its implementation, resulting in action research. The emphasis of the course was placed upon aligning curricula with the National Science Education Standards (NSES). Computer conferencing, called online discussion board, was applied to facilitate teachers to meet the course objectives. All course topics were listed under different online

discussion forums. Teachers were very clear about what they were expected to learn and complete, and they contributed many ideas of their own related to science teaching, learning, and teacher development.

#### Integration and Coordination of the Program Components

Quality professional development programs require integrating all program components “so that understanding and ability can be built over time, reinforced continuously, and practiced in a variety of situations” (NSES, 1996, p. 70).

The study was to provide opportunities for ongoing learning and professional development for teachers. Since the online discussion board had the ability to save all current or previous conversations, it became easier for teachers to review or compare different ideas and to reformulate their own understandings continuously at anytime and any place.

However, it was the first time for most to use an online discussion board in the course. Teachers spent a few weeks getting used to its use. In addition, the instructor and the course assistant were new to this tool and had to learn how to facilitate the use of the online discussion board meanwhile. Teachers were the main users, and the instructor and the assistant served as observers. Therefore, teachers did not get the reinforcement from peers or the instructor continuously; sometimes they even faced problems such as delayed responses or technical difficulties.

#### Professional Growth and Individual/Group Interests

Quality professional development programs require providing options that recognize the developmental nature of teacher professional growth and individual/group interests, as well as the needs of teachers who have varying backgrounds.

As discussed in the previous sections, the factors which affected learning and collaboration in computer conferencing identified by the teachers were interrelated to

Knowles' four components of maturing adult learners. In other words, participation in computer conferencing could help teachers become successful adult learners in many ways. The technical features also influenced learning behaviors and provided a new learning context. For example, teachers could read through all messages and choose the ones in which they felt interested to respond because the messages were posted by teachers from varied backgrounds and with different interests. In addition, each teacher could raise any new discussion topic they felt interested at anytime. Therefore, it was observed that some discussion topics kept growing and lasting over time. For example, there was a teacher raising a discussion topic "My Dad" in the content forum. She shared her story about her dad who only finished eighth grade but was so knowledgeable in science:

On Friday morning I had breakfast with my dad and I was explaining to him how my brain has to be getting heavier with all of the new knowledge I have been learning lately. Plus how I was beginning to think beyond what I know and trying to accept new concepts. So I started to tell him about the CO<sub>2</sub> experiment and the bananas. I asked him about the bananas and he had the answers. I asked him how in the world he knew that when he hadn't had any formal college training. He said that when he was a boy on the farm there was just natural exposure to lots of life's experiments. He spoke about gravity and length of the string and more. I was once again amazed by my dad and that morning I paid for breakfast. [a teacher's posting within BlackBoard]

The topic "My Dad" was very popular and many teachers posted their own stories about how elderly people relatively uneducated learned science so well through daily lives and hands-on experiences.

#### Collaboration among the People Involved in Programs

Quality professional development programs require integrating professionals from various backgrounds, namely school districts, individual schools, professional associations, unions, business and industry, regional service centers, publishing

companies, local universities, nearby research laboratories, museums, and federal and state agencies.

Teachers used the online discussion board for collaboration, including working on group projects, discussing the problems in science teaching and learning, and issues involved with learning science. The science backgrounds of teachers in the course varied significantly. Some had strong science backgrounds but many did not. Therefore, teachers with weaker science backgrounds felt more comfortable to ask other science teachers for information if they had more scientific knowledge.

However, one of the limitations of the study was that the participants mainly included teachers, the instructor and the course assistant. Even though the Science Co-Op Project included more than 1,500 teachers, several university professors and scientists for one or more appearance, and facilitators from local professional developmental agencies, the online discussion board was not open for all participants in the project but only for the teachers in the graduate course during the pilot stage. Ideally, all involved with project should be included as part of the online community in offering strong encouragement for teachers to participate more actively. It should be possible to create more in-depth discussions instead of chatty conversations because teachers will have more ideas of what questions they can ask the scientists or other educational consultants. Consequently, to establish a larger community of professional development providers has been set as a future goal for this project.

Table 42 summarizes the emphases in National Science Education Standards for Professional Development and the findings resulting from this study. The central questions are “Can CMC-based program be a quality teacher education program addressing more emphases advanced in NSES?” and “If there is some possibility, how?”

The researcher, the instructor and teachers found advantages focusing on CMC-based tools, such as computer conferencing, in professional developmental programs



from different perspectives. The application of CMC technologies provides ways solve some of the problems in the existing professional developmental programs (problems listed in Chapter I). However, more studies are needed to find out how to design greater variety in the online activities in CMC settings and how to improve teachers' critical thinking more effectively. Eventually, we want to know what professional developmental experiences with CMC will impact positively on students' science learning and achievement.

Table 42. NSES More Emphases for Professional Development and How They Were Related in this Study

NSES <u>Less</u> Emphasis On (NRC, 1996)	NSES <u>More</u> Emphasis On (NRC, 1996)	CMC Study Findings
Transmission of teaching knowledge and skills by lectures	Inquiry into teaching and learning	<ul style="list-style-type: none"> <li>• Factors which affected:               <ul style="list-style-type: none"> <li>➤ Participation</li> <li>➤ Critical Reflection</li> <li>➤ Social-Interpersonal Rapport</li> <li>➤ Course Design</li> <li>➤ Teaching Practice</li> </ul> </li> <li>• Quality and Quantity of Critical Reflection (Cognitive Presence)</li> <li>• Quantity of Social Presence</li> <li>• Teachers' Perceptions of The Role of Computer Conferencing in Teaching Practices and Professional Development</li> </ul>
Learning science by lecture and reading	Learning science through investigation and inquiry	
Separation of science and teaching knowledge	Integration of science and teaching knowledge	
Separation of theory and practice	Integration of theory and practice in school settings	
Individual learning	Collegial and collaborative learning	
Fragmented, one-shot sessions	Long-term coherent plans	
Courses and workshops	A variety of professional developmental activities	
Reliance on external expertise	Mix of internal and external expertise	
Reliance on external expertise	Staff developers as facilitators, consultants, and planners	
Staff developers as educators	Teacher as intellectual, reflective practitioner	
Teacher as technician	Teacher as producer of knowledge about teaching	
Teacher as consumer of knowledge about teaching	Teacher as leader	
Teacher as an individual based in a classroom	Teacher as a member of a collegial professional community	
Teacher as target of change	Teacher as source and facilitator of change	

## CHAPTER VI

### CONCLUSIONS AND FUTURE RESEARCH

Based on constructivist learning theories, this study focused on examining the use of an online discussion board in a graduate course as a place where forty-six inservice teachers could share experiences and ideas. Discussions held outside class were conducted by computer conferencing software. Data collection focused on online discussion transcripts of all the messages for three separate weeks and was supplemented by interviews and teacher self-evaluation reports. The study examined the nature and development of the discussions over one semester by analyzing teachers' online discussions in two domains: critical reflections and social interpersonal rapport. Additionally, teacher perceptions of using the online discussion board were revealed by interviews and teacher evaluation reports. The results of the study identified four major benefits for computer conferencing, namely, a) teachers' reflective thinking developed over time as result of the online discussion board; b) teachers' social-interpersonal rapport improved as a result of the online discussion board; c) focused discussion forums served as the place for critical reflection (cognitive presence) and unfocused discussion forums served as the place for social presence; and d) experiences of using the online discussion board had a positive impact on teachers' teaching practices and their professional development.

#### Purpose of Study

The main focus of this study was to examine the impact of applying computer conferencing network in facilitating teachers' growth in critical reflection and in establishing social-interpersonal rapport among teachers. In addition, teachers' perceptions of the role of computer conferencing concerning their thinking about teaching practices and professional development were explored. Two components of

Garrison's et al. (2001) model of "Community of Inquiry" in higher education were investigated, specifically cognitive presence and social presence. Finally teacher voices were recorded and analyzed regarding the use of CMC for professional development.

### Research Questions

The following research questions guided this study:

1. How frequently and how much did participating teachers contribute to computer conferencing in this course?
2. What patterns characterize the content of the teachers' postings to the computer conferencing (e.g., in terms of levels of critical reflection and their efforts to establish social-interpersonal rapport)?
3. What were the participating teachers' perceptions of the factors that affected participation and learning interactions in computer conferencing?
4. What were the participating teachers' perceptions of the role of computer conferencing in their thinking about their teaching practices and in advancing their overall professional development?

### Conceptual Framework

Constructivist learning theory views knowledge as constructed by people, or groups of people, in a shared context based upon interpretation of experience and knowledge (Bruner, 1960; Jonassen, 1992; Vygotsky, 1978). Constructivism highlights the social nature of knowledge, which means that meaning is constructed as a result of social interaction (Dean 1994; Granger, 1990; Piaget, 1973; Saba and Shearer, 1994).

According to Piaget (1973), learning in social contexts is largely a matter of cognitive development and social interaction leads to confrontative and contradictive conversation and cognitive changes. Vygotsky (Rogoff, 1990, Tharp and Gallimore, 1988) developed the socio-constructive approach to mental functioning. This means that

higher forms of mental activity are derived from social and cultural contexts and are shared by members in those contexts because these mental processes are adaptive. They lead to knowledge and skills that are essential for successful learning within a particular social-cultural context.

Critical thinking is another field that is emphasized more and more in educational research. Critical thinking is essential in cognitive presence, which is defined as “the extent to which learners are able to construct and confirm meaning through sustained discourse in a critical community of inquiry” (Garrison et al., 2001). In other words, cognitive presence reflects higher-order knowledge construction and application, or critical reflection.

Much effort has been invested in addressing theories in education from social, cultural, and critical thinking learning contexts. The application of computer-mediated communication (CMC) technology is an example of creating such a context for human learning, especially in teacher education.

#### Research Context

This study was conducted in a thirteen-week graduate level course sponsored by the Science Co-Op Project. There were forty-six teachers enrolled in this course that was taught by one university professor through ITV technologies in the Fall of 2003. The course focused on the discussion of an applied curriculum (using FOSS, STC, INSIGHT as models) and its implementation, resulting in action research. One computer conferencing technology, namely an online discussion board, was applied mainly for monitoring and evaluating course discussions and forms of communication.

#### Methodology

Many studies have been completed to evaluate the impact of using computer conferencing networks on teacher professional development. These studies have

contributed to understanding: critical reflection, social-interpersonal rapport, and factors affecting participation. The researcher included the three study areas mentioned above in data collection and data analysis based on both qualitative and quantitative methodologies. In addition, teachers' perceptions regarding the role of computer conferencing in teaching practices and professional development, which was rarely found in former studies, was also examined and documented qualitatively in this study.

Qualitative data were collected from online discussion transcripts, interviews, and self-evaluation reports while quantitative data were obtained from online discussion transcripts. Online discussion transcripts were collected during the semester. Online discussion transcripts for a semester period were analyzed quantitatively to explore the patterns of participation. However, only three selected weeks of online discussion transcripts were analyzed both qualitatively and quantitatively to reveal changes in cognitive presence and social presence.

In addition, five interviews were conducted via the online chat room, which was synchronous and could record the transcript. Further evidence was gathered through self-evaluations secured from thirty-six out of forty-six teacher participants.

### Key Findings

The results of teachers' experiences of learning in computer conferencing within a distance education environment produced significant growth in critical reflection and social-interpersonal rapport and had a positive impact on teacher practices and their professional development. The growing trend of improved quality of critical reflection during the semester was found. In addition, more critical reflection messages but less social cues were found in the focused discussion forums. Consequently, less critical reflection messages but more social cues were found in unfocused discussion forums. Lastly, many positive comments were found from teacher perceptions regarding social-

interpersonal rapport caused by online discussions as well as impact of online discussions on teaching practices and their professional development. However, the results also revealed some limitations of the study and identified teacher concerns for using computer conferencing in professional development.

#### Participation

The level of participation varied during the semester but was higher at the beginning of the semester and lower at the end of the semester. After Week 7, the quantity of online discussion participation was not included as a course requirement anymore and the level of participation still increased after Week 7 until Week 9.

#### Critical Reflection

Teachers' critical reflection developed over time as a result of the online discussion board according to mean critical thinking scores during the three selected weeks. Even though the growing trend of improved quality of critical reflection was found in this study, the majority of critical reflection was still at a low level of critical thinking, as described terms of the triggering and exploration phases in Garrison's critical thinking model. In addition, the length of the messages in these phases was shorter in general. In other words, teachers tended to have more surface talk or information exchange in the discussion forums.

Teachers identified many positive factors that affected their learning and use of critical thinking skills. Being able to gain ideas, to share experiences, and to feel more willing to reflect on their own thinking were the main factors that helped teachers develop in terms of cognitive learning. The factors that affected critical reflection in computer conferencing also influenced positively in four components used to describe adult learners. These included: being self-directed, utilizing their own experiences, identifying their own readiness to learn, and organizing their learning around life

problems. However, time-consuming and quantity of posting as a course requirement were the two main factors that hindered their learning in some ways. To read and to respond to messages of other teachers took tremendous time, especially for reading low-quality messages, which were forced conversation caused by course requirements.

In the community of teacher educators involved with computer conferencing, cognitive presence was found mostly in focused discussion forums (content, grade level). In addition, social presence mainly existed in the unfocused discussion forums (district, teacher's lounge).

#### Social-Interpersonal Rapport

The number of social cues in the messages increased initially but declined significantly over time. When teachers focused more on on-task discussions or critical reflection, there was less social conversation. However, most of the teachers held positive perceptions about the social-interpersonal interactions regarding computer conferencing and thought that social interactions helped with their professional growth. Lastly, unfocused discussion forums (district, teacher's lounge) tended to focus more on social presence compared to focused discussion forums.

#### Teaching Practices and Professional Development

The researcher, the instructor, and teachers identified some advantages for using computer conferencing for improving teaching practices and for professional development. Discussions regarding science teaching and learning made teachers evaluate more of their own teaching and they became more aware of the importance of teaching strategies, including the use of misconceptions and constructivist pedagogy. Teachers experienced the philosophy of the learning processes when participating in computer conferencing. However, teachers rarely mentioned that they applied the things they learned from computer conferencing in their classrooms.



Most teachers thought participating with computer conferencing was beneficial and better than traditional face-to-face professional developmental workshops because:

1. They could participate at any time and any place;
2. They could discuss science teaching and learning more in depth continuously;
3. They felt more comfortable in sharing their problems or experiences;
4. They felt they knew others better and their relationships improved.

In summary, the results revealed that:

1. Teachers' critical thinking developed over time as a result of the online discussion board;
2. Teachers' social-interpersonal rapport improved as a result of the online discussion board;
3. Focused discussion forums served as the place for critical reflection (cognitive presence) and unfocused discussion forums served as the place for social presence;
4. Experiences with using the online discussion board had a positive impact on the teaching practices and professional development of teachers.

#### Limitations of the Study

It is encouraging to see teachers' growth in critical reflection and social relationships and to find teachers appreciate the form of professional development with computer conferencing. However, there are some limitations found in this study and should be considered in future studies.

First of all, the level of participation and the number of critical reflective messages both declined over the semester. Even though, the quality of critical reflection, in terms of mean critical score, increased over time, teachers' use of online discussion board did not grow continuously over time. Moreover, according to the level of

participation, the average number of messages per teacher was 32.1 (within a semester) and the range of the number of messages among the teachers was 68 (70 was the highest and 2 was the lowest). Some of the teachers did not really use the online discussion board even though the participation in the online discussions was part of course requirements. There were no data that could explain the reasons for low participation.

Secondly, in order to maintain the basic level of participation, teachers were required to post the messages continuously and their messages were graded by themselves and the instructor. Even though there were no specific grading standards to evaluate teachers' performance, teachers felt stress and pressure because they all wanted to get a better grade. However, since quantity of postings was part of the course requirement, the involvement became a hindrance for teachers concerning cognitive learning and social relationship. These were not the expected outcomes, but they occurred.

Thirdly, teachers were the main members of the online community. Even though the instructor and the course assistant also participated minimally in the online discussions, people from a variety of backgrounds, such as scientists, university professors, local education consultants, and parents, should also be included in the community. A richer social-cultural context of the community would likely be an asset and teachers would be able to discuss issues from more perspectives. Some teachers' commented that they did not get any feedback or advice for the problems they posted. For example, teachers asked some science questions but no teacher was able to answer or advice. Consequently, teachers tended to ask easier questions with which they thought other teachers might be able to help. Thus, members of the community also seemed to affect the content and the quality of teachers' reflections. For instance, the community with different groups of teachers, including some with extensive and successful

experiences of using online discussion boards might result in more participation and the richer content of reflections.

### Implications for Future Research

The results of this study strongly suggest some interesting and exciting aspects of critical reflection, social-interpersonal rapport, and teaching practices with computer conferencing. This supports Garrison's et al. (2001) model of "Community of Inquiry" that is specifically applied to the practice of computer conferencing in higher education. Cognitive presence, social presence, and teaching presence are essential for successful development of community. Cognitive and social presences have been studied in depth in this study and identified as very important for knowledge construction and formulation of understanding. Teaching presence is addressed briefly in two parts of this study (Chapters III and IV) and found critical for successful facilitation of effective learning in computer conferencing. However, many questions in applying computer conferencing or other CMC-based technologies in education are left unanswered.

The results support the conceptual framework – Community of Inquiry in Higher Education Model (Garrison, et al. 2001), which guided the study. Participation was conceptualized as resulting from the interactions among teachers from different backgrounds, with different conceptions regard computer conferencing, and with different successes with facilitating learning. However, because this was a case study, isolating the impact of particular factors was not possible. Future research could build on the results of this study by focusing on one or more factors. For example, it would be useful to know what impact different learning styles of students have on participation in computer conferencing. In this course teachers were the learners with varied learning styles and the participation rate of teachers also was significantly different. For example, it was really time-consuming to read and respond to the messages for so many teachers.

Some teachers, who tended to learn passively, felt they wasted time on discussions. However, some teachers who were more active learners, commented that they preferred to participate in online discussions as the assignment instead of writing papers that they never went back to read. Another example was, teachers who did not feel comfortable to speak in public chose to share their thinking on the discussion board where they could spend as much time as they needed to formulate their thinking. Future research might focus on particular learning styles of students and their impact on student participation.

In addition to learning style, the impact students with special needs for inclusion and participation could also be considered for future research. There was one teacher with special needs in this course and she participated very actively in computer conferencing compared to others. The researcher also found that the length of the message posted by this teacher was always longer and with use of higher-order critical thinking skills. Future research might focus on the potential of using computer conferencing in facilitating students with special needs to learn. Applying computer conferencing technologies might provide the solution for some existing problems, which occurred in special education.

Two other related factors that emerged from this study were the lack of experience with participating computer conferencing and difficulty of using this type of technology. These factors could serve as the basis for a future study that compared the participation of students who have used computer conferencing in other courses with those who have never used this tool. Do students who have used computer conferencing before tend to participate in more actively than students who have never used computer conferencing? And, do students with higher technology literacy find it easier to participate?

There also appears to be a need for research that compares the participation of the community with more varied backgrounds with the participants of the community with participants with more similar backgrounds. As mentioned in the study limitations,

participants in the course were all schoolteachers and this tended to limit the range of the discussions. A comparative study might help to isolate the impact of the richness of the community concerning participation and critical reflections. Do students in a community with varied participants find more encouragement to participate than those in a community of more uniform participants? Is the quality of critical reflection of students in a community of uniform participants less effective than the critical reflection of students in a more heterogeneous group?

In this study, the quantity of critical reflection declined over time but the quality of critical reflection increased over time. A few questions may be asked in future research including:

1. Why did the quantity of critical reflection decrease over time? How can we explain dropping rates at the different periods of time? What reasons might cause the decrease? How can we encourage more critical reflection?
2. Why did the quality of critical reflection increase over time? What caused the varying rates at the different periods of time? What reasons might cause such increases?
3. What factors caused the high-volume but low quality of critical reflections at the beginning of the period? Conversely, what factors caused the low-volume (but better quality) of critical reflection at the end of the course?

Lastly, teacher understanding of quality reflection is one issue that appeared to have played a role in teachers' abilities to participate. In this study, both the instructor and the teachers did not spend time discussing what quality reflection was during the class period. This could prove useful as a basis for future research. The instructor in this course provided a brief explanation of what he meant by quality reflection and how he expected teachers to use the online discussion board. However, no extended instruction or guidance related to quality reflection was provided. A future study might examine

whether or not offering more guidance in making quality reflection is effective. Studying the effect of guidance on the quality of student reflections and the types of facilitation that could lead the students to understand what quality reflection is will be other needed research.

### Implications for Practice

While there is obviously much to learn about teachers' growth in cognitive and social presences and their perceptions of teaching practices and professional development while engaged in computer conferencing, the findings of this study can inform the use of computer conferencing in teacher education programs or professional development activities. These findings can be of benefit to designers and instructors of computer conferencing courses in teacher education.

Awareness of the theoretical basis for cognitive growth and development as well as the social-interpersonal issues involved hopefully will encourage designers of programs and computer conferencing systems to consider learning activities and interactions in their designs. Realizing the phases in the critical thinking process from the earlier stages to later stages, program designers can incorporate activities that facilitate and enhance success. For example, the four phases in Garrison's (1991) critical thinking model from earlier to later stages include triggering, exploration, integration and resolution. Thus, the activities should provide the opportunities for students to learn different critical thinking skills. Additionally, these activities need to be supported by the capabilities of the computer conferencing system. Understanding learning processes and theories could help courseware designers create functions and interactive capabilities specifically for critical thinking learning and social interactions.

Similarly, if instructors appreciate the importance of critical reflection and social-interpersonal domain, they will be able to facilitate and manage cognitive and social

interactions more productively. By recognizing different phases of the critical thinking process and behavior indicators in specific phases, instructors will be better able to help students to overcome the learning difficulties when shifting from one phase to another phase.

It has been reported that only instructors and students who log on regularly can make the advantages of computer conferencing accrue (McComb, 1993). Therefore, participation with computer conferencing was built as course requirement and participation was graded in terms of quantity and quality. The level of participation remained constant over time, perhaps because it was a course requirement. However, quantity of participation as part of course requirement was mentioned by many teachers as it became a hindrance for learning. Moreover, it caused many low-quality reflections and feelings of competition among teachers. Future programs interested in critical reflection through computer conferencing would be well advised to emphasize more quality of participation in any course requirement and to provide clear guidance concerning quality reflection at the beginning stages. Quantity of participation is still critical for maintaining the use of computer conferencing, but the instructors may not want to emphasize it in terms of grading.

The results of this study indicate that teachers do not necessarily adapt easily to the online learning environment. Almost all teachers admitted to some discomfort with asynchronous communication. This suggests that teachers, like students, need adequate learning time before they can work online effectively, especially in many situations as identified in this study. Teachers were so busy with schoolwork, their families, and professional developmental activities that they had difficulty in providing adequate time to work with the online discussion board. Most of the teachers were newcomers to online communication and instruction. They sometimes felt inhibited by this form of communication. As a result of this, the instructors needed to consider strategies for

preparing students to make effective use of computer conferencing. It may be necessary to allow longer period of adjustment and practice for success. Future courses should include introductions or face-to-face meetings to help students gain ease for participating in computer conferencing. In addition, technical support and feedback should be included to facilitate success.

Student understanding of the broad picture of an effective learning community may affect participation. Students should be aware of the members involved in the learning community and be encouraged to interact with all participants in the community. For example, some teachers from smaller groups even asked, “Why should we use this online discussion board when we can easily talk with each other by walking across the hallway?” It was obvious that they thought it was easier to communicate with each other with person-to-person contact. On the other hand, they did not see the advantages offered by an expanded learning community, including all the teachers from different school districts. Instead they thought they only needed to discuss or communicate with the teachers in the same school district. Consequently, these teachers used computer conferencing less and less to interact and communicate with others. Developers of future courses might want to consider the activities that will involve students as well as teachers from different groups in collaborating together.

#### Significance of the Study

The main purpose of this study was to explore teachers’ growth in critical reflection and social-interpersonal rapport within a computer conferencing context and to study teachers’ perceptions of the role of computer conferencing in their thinking about teaching practices and professional development. There are some questions in the literature as to whether a computer conferencing-based environment can support critical reflection and sustain social-interpersonal rapport. There has been little evidence in the



literature indicating that participation with computer conferencing can be beneficial for improving teaching practices and providing professional development more effectively. Finally, there is very limited evidence of applying qualitative and quantitative research methodologies in the literature to discover the complexity of critical reflection and social-interpersonal rapport.

This study combined qualitative and quantitative data collections and analyses to examine the patterns of participants' critical reflection and social-interpersonal rapport in a more understandable and comprehensive way. Further, by analyzing the content of the online discussion transcripts to assess critical reflection and social-interpersonal rapport, it was possible to identify and describe predictable patterns of cognitive presence and social presence in the community of inquiry that is associated with the practice of computer conferencing. We now have a better understanding of how critical reflection and social-interpersonal rapport can be developed in computer conferencing, and of what role computer conferencing can play in improving teaching practices and professional development. With this knowledge perhaps practitioners will know better how to facilitate and sustain cognitive and social presences in computer conferencing and thereby encourage the development of critical thinking and social-cultural learning contexts with peers and instructors, which in turn can enhance learning.

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APPENDIX A  
ONLINE DISCUSSION SURVEY

Self-Evaluation Report

Have you ever collaborated with a group using the online discussion board?

Yes\_\_\_ No\_\_\_

How many years have you taught? \_\_\_\_\_ Years

Instructions: Please provide your answers in the following four questions. Your comments and suggestions will be very important to improve the course activities in this Fall and coming Spring semesters. This is NOT related to the grading. The only purpose is to collect your ideas for course improvement. Thank you.

1. Please share what helped or hindered your personal growth through the online discussions.

2. What is your thinking about group's interactions in the online discussion board?

3. Please share your feelings about the online discussion component of the course at this time.

4. If you could change your experiences with the online discussions in any way, what would you have done differently? (Any suggestion or comment for technical design would also be welcome.)

## APPENDIX B

## EXAMPLE OF ONLINE DISCUSSION MESSAGE

Current Forum: Wilton Read 27 times

Date: Sun Sep 21 2003 3:01 pm

Author:

Subject: Re: check this out!!

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Did any of your Kindergarten students have any ideas on this experiment. So far, it sounds as if we don't teach plant units at all and I know that we do!!! But, like Lori, I am not sure how to answer their questions when they ask them to me about how the carbon makes the mass, and all of the other questions. I'm afraid that I'll answer with the wrong answer and add to their misconceptions!!!

Current Forum: Science Lesson Design (Inquiry-Based Teaching/Learning (IBT/L). Read 59 times

Date: Tue Oct 14 2003 12:14 pm

Author:

Subject: Zoom Website

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This is a website from the show ZOOM. That's where I first saw this experiment done. It's a great show, maybe we can get some more ideas from the website!  
<http://pbskids.org/zoom/sci/bakingsodabubbles.html>