AN EXAMINATION OF THE SOCIO-COGNITIVE CONSTRUCTIVIST ACTIVITY EXHIBITED BY PARTICIPANTS OF A WEBCT COMPUTER CONFERENCE

JOY SKANES

AN EXAMINATION OF THE SOCIO-COGNITIVE CONSTRUCTIVIST ACTIVITY EXHIBITED BY PARTICIPANTS OF A WEBCT COMPUTER CONFERENCE

by

Joy Skanes, B.Ed.

A thesis submitted to the Faculty of Graduate Studies and Research
in partial fulfillment of the requirements for the degree of Master's of Education

Department of Teaching and Learning
Faculty of Education
Memorial University of Newfoundland
2000

St. John's Newfoundland

Abstract

This study investigated whether students constructed understanding while engaged in electronic dialogue using WebCT computer conferencing software. The postings of graduate education students participating in the computer conference as a mandatory component of their university course were analyzed in order for me to make this determination. Transcripts from the entire computer conference constituted the major source of data for this research: these were printed at the end of the course and analyzed for indication of knowledge construction.

Qualitative research methods were employed in this investigation. Information collected from a review of constructivist literature was utilized to devise an analytical model of socio-cognitive constructivist behaviors for deductively analyzing computer conference transcripts. The computer conference exchanges were also analyzed inductively whereby patterns of socio-cognitive constructivist behaviors emerged from them.

Questionnaires were administered to participants in order to obtain a sense of their computer background as well as their impression of learning via electronic dialogue. The questionnaires consisted of both pre-structured and open-ended questions. Responses to the questionnaire were utilized as a means of verifying the researcher's interpretation of the results.

It was concluded that knowledge was constructed by participants in this study as participants were seen to exhibit numerous forms of socio-cognitive constructivist behaviors. Although it was initially believed that knowledge construction would

result from participants debating conflicting viewpoints, socio-cognitive constructivist behaviors observed in this investigation resulted from participants sharing and co-elaborating ideas online.

Acknowledgments

I would like to express a special thanks to my supervisor, Dr. Roberta Hammett for her recommendations and supporting comments that she so kindly offered me throughout the writing of this thesis. By making herself so readily available and offering unlimited assistance in answering my questions and addressing my concerns, Dr. Hammett provided me with the guidance I needed to complete this work.

I also wish to thank my daughter Jacqueline, whose tolerance during times when I was too busy to help her with her homework, made the writing of this thesis possible.

Last but by no means least, I wish to thank my dear friend, Alexander Lebedev whose words of encouragement kept me believing through times when I could see no end, that I could complete this task.

Table of Contents

Chapter I

Introduction

Rationale

Throughout human history advances in technology have powered paradigmatic shifts in education (Chandler, 1996). That is, as society responded to technological advances, so did the educational systems operating within it. In preparing students for the world in which they live (Wallis, 1995) educators must therefore consider the fact that current technological developments are rapidly moving the world into a new era often referred to as the "Information Age" (Ward & Davis, 1996). Traditional educational facilities, beliefs and values will likely not sustain the technological impact of this new age (Grabe & Grabe, 1996).

Characteristic of the Information Age is that academic, community, business, and government leaders are calling upon our schools, colleges, and universities to produce a different kind of student than a generation ago (Owston, 1997). Furthermore, Berge (1995) notes that today information is increasing at an unimaginable rate and goes on to suggest that during formal schooling individuals can only begin to take in the amount of information they will need during their career life times. In the information age, then, educational systems need to provide an environment where students are actively involved in the learning process and have access to the world's information sources (Ward & Davis, 1996). Today, as "knowledge in many fields increases exponentially, educators cannot hope to treat students as if they were passive, empty vessels" (Berge, 1995, p. 2). Time might be better spent helping students access information and working with them to construct

knowledge of personal significance (Grabe and Grabe, 1996). Consequently, traditional learning systems where students are viewed as recipients of instruction rather than active participants in learning (Gore, 1994) are not suitable for today's students.

It is fairly evident that today's technology will transform the way we live and learn. The Internet and communication technology, for example, both supported through the World Wide Web (WWW), not only give individuals immediate and easy access to information but also link individuals, businesses, and professionals throughout the world via their home, school, or office computer. With such immense capacity to access information and communicate, technology is essentially forcing educators to rethink how they teach and learn. Bonk and King (1998, p. 5) suggest, "computer- mediated communication has great potential for changing the ways students and instructors interact and may prove influential in reorganizing the entire learning process."

Ward and Davis (1996, p. 1) suggest that today "working with information must become second nature." To serve the needs of students in the information age the role of teachers must shift from one who transmits information to one who helps students develop the skills to actively process information and construct plausible interpretations for themselves. Dick (1991) suggests for example that

> Perkins presents an interesting contrast between the changing classroom of the past, present and the electronic classroom of the future. He indicates that computer-based classrooms will support the use of data bases, microworlds, word processors, intelligent tutors and laboratory simulations. The roles of the

teacher and students will change dramatically in learning based more on an interactive process. The classroom of the future will support the constructivist belief (p. 41).

As previously suggested, students growing up in the Information Age face an ever-increasing body of information. As we move further into the information age the notion that learning is a process of transmitting ideas to students from an external source is challenged. Constructivist principles may very well offer the most useful and appropriate approaches to critically inform the use of technology in the classroom (Carr, Jonassen, Litinger, and Marra, 1998).

Methods consistent with constructivism provide educational settings where teachers and students use computers to move beyond the confines of the school to gain access to each other and information both locally and around the globe. Current learning systems confined mostly to the classroom, where educational success is measured by the absorption of textbook content and where students passively receive information transmitted to them by others, will be of little consequence to students growing up in today's technologically advanced society. If students hope to become successful participants of society in the Information Age, a variety of new skills are required.

Grabe and Grabe (1996, p. 18) suggest that today's "learners are going to need to acquire skills related to getting, understanding, and manipulating information." Furthermore, Owston (1997) notes that the skills required by today's students are critical thinking, problem-solving, written communication, and the ability to work collaboratively" (Owston 1997, p. 31). To effectively encourage the development of

such skills, students should be educated in a qualitatively different kind of instructional setting. To move in the direction of helping students meet these educational demands, educators should expose learners to instructional environments where students interact with information and each other, as well as critically assess ideas in an effort to construct understanding for themselves.

Another growing demand placed on learners today relates to the idea that individuals will undoubtedly be exposed to a variety of viewpoints as they use computers to access information. Developing the skills to effectively manage varying viewpoints is of paramount importance if individuals are to become effective users of information. In an age where new ideas and varying perspectives are readily encountered, learners must develop the skills to evaluate alternative understanding in terms of their strengths and weaknesses and "adopt the perspective that is most useful, meaningful, or relevant to them in the particular context," (Bednar, Cunningham, Duffy, & Perry 1992, p. 28). Computer conferences may very well assist educators in helping learners develop these abilities.

Prior to conducting this study, I had organized, moderated, and graded an asynchronous computer conference for a university graduate course. This particular conference utilized the Alta Vista discussion forum and ran for a two-week period. It involved professors and students from a number of universities in Canada and a university in the United States. The topics discussed in this forum were related to constructivist approaches to learning and throughout the computer conference a variety of perspectives were presented by the participants.

In this conference my role as a moderator included: a) creating a friendly social

environment for learning, b) focusing discussion on crucial points by asking questions, and c) probing for responses to encourage students to expand and build comments (Paulsen, 1995). Through the process of moderating the computer conference I was often challenged to defend and elaborate my beliefs, causing me to develop a more in-depth understanding of the topics discussed. As a moderator, I developed a strong interest in computer conferencing as a form of communication and as a way of learning. I felt that, for me, computer conferencing enhanced the quality and the level of my participation in discussion as compared to my performance had the discussions been conducted in a traditional classroom settings. Furthermore I found that by exchanging ideas and reflecting upon the ideas brought out in discussion I was lead to actively process information in such a way that I constructed a personal understanding of the issues for myself. As the moderator I was extremely motivated to participate in the conference and often researched topics and ideas that I had not previously encountered in order to create meaningful and thought-provoking responses.

My interest in teaching and learning has always primarily centered around methods that encourage active learning and long-term understanding through knowledge construction. While paying close attention to how I was learning while participating in the Alta Vista computer conference, I came to believe that electronic conferencing is conducive to knowledge construction. It was shortly after my experience as a moderator of a computer conference that I decided to conduct an investigation related to computer conferencing as a constructivist learning environment.

Although I concluded from my own experiences that computer conferencing is

conducive to knowledge construction and found electronic discussion to be a very favorable form of communication and an effective way to learn, I was not sure if other individuals perceived computer conferencing in this way. Therefore, as a graduate student preparing to write a thesis, I decided to conduct a study that would help determine whether individuals engaged in computer conferencing are encouraged to actively process information to the extent that they generate understanding or knowledge of topics under discussion.

Purpose

The purpose of this study was to determine if students constructed knowledge while engaged in electronic dialogue, using WebCT computer conferencing software. Many researchers view social interaction as a critical component of constructivist theory (Bauerfeld, 1988; Jonassen, 1991; Nyikos & Hashimoto, 1997; Vygotsky, 1978), and therefore it was assumed that learning environments which support collaborative interaction should facilitate the knowledge construction process. "Collaborative learning theories view the learner as an active participant in the learning process, involved in constructing knowledge through a process of discussion and interaction with their peers" (Harasim, 1989, p. 51). Duffy and Jonassen (1992, p. 11) also suggests that "one of the most distinguishing features of constructivism is its emphasis on social interaction in the form of argument, discussion, and debate, because from that debate emerges some socially constructed meaning."

It was expected that based upon the potential for collaborative interaction through computer conferencing, participants engaged in electronic dialogue would

simultaneously be encouraged to engage in meaning making through dialogue with their peers. With a constructivist perspective in mind this study involved an analysis of the interactive activity which students engaged in as they participated in electronic discussion. In order to determine any relationship between online conferencing and knowledge building, all interactive exchanges from the computer conference were analyzed according to criteria developed from social and cognitive constructivist learning theory. I developed a model of knowledge construction for analyzing computer conference transcripts, based upon a thorough review constructivist literature.

Although there have been studies conducted on the use of computer conferencing in education, they have typically focused on the number and type of topics discussed (Mowrer, 1996), or the gathering of quantitative analysis of participation in an online conference (Mason, 1991). Few studies have been conducted that examine student cognition within a text-based environment. Mason, 1991) describes a number of methodologies that have been used to evaluate computer conferencing systems; none of them involve an examination of student dialogue for evidence of meaning making. Mason suggests that survey questionnaires, interviews, empirical experimentation, participant observation and case studies have been applied to electronic conferencing environments. As Newman, Johnson, Webb, and Cochrane (1997) point out, however, such techniques reveal nothing about how individuals grow cognitively as they engage in online discussion. Consequently there exists little description of the type of learning that occurs while students engage in computer conferencing.

There are two models already developed for classifying and analyzing computer conference transcripts. Both Newman et al. (1997) and Henri (1991) developed analytical models that sought to determine the forms of cognitive activity exhibited during electronic discussions. Neither of their models for analyzing computer conference transcripts, however, specifically related their findings to the knowledge construction process. Unlike previous studies then, study will focus on knowledge construction and will attempt to determine if students engage in constructing understanding while participating in electronic conferencing.

Significance of the Study

As the use of communication technology becomes more prevalent in society and in our schools, educators need to become aware of how best to integrate computers into their classroom in the Information Age to effectively support the teaching and learning process. From an analysis of transcripts from a computer conference as well as information obtained from a questionnaire, this study provides insight into the relationship between student learning and computer conferencing. This insight allows the researcher to make recommendations aimed at helping educators integrate communication technology to develop the type of student required in the Information Age.

Participants also benefited from participating in the study. By participating, students were encouraged to generate insight into their own use of computer conferencing in an educational context. That is, by completing the questionnaire, student participants were required to reflect upon the conferencing experience

regarding how they learned while engaged in online discussion.

Limitations of the study

As a qualitative approach to inquiry the findings from this study apply only to the computer conference that was investigated. The results were not intended to be generalized to other computer conferences. Additionally, although the questionnaire provided some insight into how participants viewed their learning while engaged in computer conferencing, a more accurate account of the participant's perspective on their learning with respect to knowledge construction could have been achieved by actually going back to the students and discussing the results of this research with them.

Chapter II

Literature Review

Constructivist learning through computer conferencing

Computer conferencing is group communication that utilizes an electronic environment to "mediate text-based interaction" (Harasism, 1993) between participants. As participants interact to exchange ideas online there is opportunity to collaboratively discuss information. In the context of face-to-face interaction, collaborative learning is viewed as an interactive group process whereby learners actively construct knowledge by formulating ideas into words and where ideas and concepts are built upon through reactions and responses of group members (Harasim, 1993; Schroeden & Zarinmia, 1999). However, in the context of online interaction, and in this study, collaborative learning was viewed as the constructive development of connected ideas through the formulation of concepts into written communication articulated in a group space and built upon by members of the conference through written reactions and responses (Harasim, 1993).

For collaborative learning to be effective, individuals must engage in active dialogue whereby they build on ideas and concepts in a process of constructing knowledge and understanding for themselves (Gunawardena, 1992). As a place to share ideas and understanding through written communication, electronic conferencing offers the potential to facilitate such collaborative interactive knowledge building. Harasim (1989) argues, for example, that interactivity is the most striking characteristic of computer-mediated communication (CMC) with the greatest

influence on learning. The interactive environment provided through computer conferencing provides access to local, national, and international networks, thereby providing increased opportunities for collaborative interaction among students, their teachers, peers, parents, and other members of the world community (Berge, 1995).

Hannifin, Hannifin, Land, and Oliver (1997) suggest that "methods consistent with constructivist foundations and assumptions typically emphasize teacher-student or student-student interactions" and "provide a rich context within which meaning can be negotiated and ways of understanding can emerge and evolve" (Hannifin et al., 1997, p. 109). Knowledge construction emerging from conversation is as Simich-Dudgeon (1999) suggests an interactional achievement. As "a place to hold open discussions on questions of mutual interest" (Berge & Collins, 1995, p. 185), then, computer conferencing systems are environments where individuals have the opportunity to interact, share, negotiate, and actively construct understanding for themselves. Fundamentally through discussion with peers, tutors, and teachers, learners engaged in computer conferencing are encouraged to construct concepts built upon by both themselves and other learners (Henri, 1995) and in this process use relevant personal experiences as the bases for constructing more elaborate knowledge structures.

Computer conferencing as an interactive environment can be seen to support learning through knowledge construction (Bonk & King, 1998; Tuckey, 1993). Prawat (1992) notes three curricular assumptions supported by electronic conferencing which can be seen to derive from a constructivist point of view. These assumptions are: a) the focal point in the curriculum, should emphasize the ability of students to

structure and organize their own experiences, b) students need to consider alternative viewpoints, that is, to disagree and to reflect on information, and c) the curriculum should be student centered, taking a much more interactive approach, such that important aspects of the curriculum emerge through negotiation with students. It can be argued then that through electronic interaction participants exchange personal viewpoints and ideas and build upon them through text-based discussion and debate. Consequently computer conferencing potentially offers enormous benefit to educators and students faced with the educational challenges related to knowledge construction apparently inherent within the Information Age.

Computer conferencing, as an educational tool, offers a wide range of possibilities concerning knowledge construction through collaborative activity. Morttunen (1992) implies that learning within a computer conference is a social process occurring through discussion and debate; such processes are seen to encourage the development of higher mental processes conducive to a type of learning based upon individual meaning making. During social interaction individual understanding is encouraged as a result of dialogical thinking, or assessing issues from various points of view (Wertsch, 1985). Such individual meaning making results in learning that is effective, meaningful, and long lasting.

The open and socially interactive environment of a computer conference system offers numerous educational advantages for student learning in the Information Age. Several researchers discuss computer conferencing systems as environments that facilitate learning as an interactive constructive process. For example computer conferencing is viewed as a many-to-many communication tool and is seen to support

and facilitate collaborative interaction (Pearson, 1999). Furthermore as participants can access discussions any time of day, at their own convenience, they are provided with a greater access to members of the discussion than in any other group setting (Harasim, 1990).

Another educational advantage of computer conferencing related to knowledge construction is that electronic dialogue is seen to support global networking and the presentation of multiple perspectives (Harasim, Hiltz, Teles, & Turoff, 1995; Turoff, A.D., Hiltz, K.A., Hiltz, & Turoff, 1993;). Individuals are no longer restricted by geographical location but have ready access to other students, ideas, information as well as content specialists around the world (Gore, 1994). In such an open and networked environment individuals have ready exposure to various viewpoints on an issue.

Additionally, with respect to individual learning, computer conferencing is believed to support democratic discussion because communication within an electronic environment is asynchronous and therefore participants can take time to reflect and develop their thoughts before contributing them to a discussion (Andrusyszyn, Iwasiw & Golden, 1999; Burge, 1994; Harasim, et al., 1995; Turoff et al., 1993). A deeper more critical treatment of the topic results (Morttunen, 1992) as participants can openly ask questions, introduce any assertion, and express their own attitudes, desires and needs without being coerced into silence or compliance by other participants (Kling, 1996). Exposing learners to computer conferencing then appears likely to encourage all participants to contribute to the discussion such that all members have equal opportunity to critically assess and discuss issues and thereby individually

generate more elaborate cognitive structures.

A further educational advantage of computer conferencing useful for the Information Age is that computer conferencing is seen to encourage critical analysis of discourse. That is, in text based conferencing students "must formulate their ideas into words, and in doing so they often engage in deliberate analytical action such as examining what they have written for coherency of structure and clarity of thought (Harasism, 1990, p.49). Students engaged in group discussion are often challenged to explain, elaborate, or defend their position to others as well as themselves, which provides fruitful grounds for the integration and elaboration of information in new ways.

Finally, computer conferencing is seen to encourage active participation in the learning process by requiring participants to construct text from thought which in itself is a cognitive act that engages the student in the learning process (Harasim, 1990). Rather than passively listening to others, students contributing to a computer conferencing are believed to learn more effectively, for as a form of communication, writing holds us responsible for our words and ultimately makes us more thoughtful human beings (Quellmaiz, 1987).

As an interactive learning environment in which to conduct discussion and debate, computer conferencing then should facilitate knowledge construction through collaborative interaction. That is, as participants engage in asynchronous "many-to-many" communication, they encounter a variety of viewpoints. More so than in a face to face setting, students engaged in online discussion have the opportunity to engage in reflective thinking and to critically discuss a variety of viewpoints. Consequently,

there is ample opportunity for educators to encourage meaning making through active knowledge building among students participating in an online conference.

Constructivism as educational approach to learning

Constructivism is not new to the field of education. The learning theories of both Piaget (1997) and Vygotsky (1978) discussed learning as a constructive process as both theories suggest that humans have no access to an objective reality but constantly construct their own version of it (Fosnot, 1996). For the purpose of this investigation, I viewed knowledge and understanding to be the same for both emerge as one interprets new incoming information (Bednar, et al., 1992). Furthermore, in this study I use Piaget's, Vygotsky's, and contemporary constructivist theories of learning to suggest that computer conferencing, by facilitating open discussion and debate, supports learning that arises from constructing understanding. The aspects of Piaget's and Vygotsky's theories upon which this study is based are briefly summarized in the following paragraphs.

Piaget discussed learning as the progressive re-organization of mental constructs known as "cognitive structures" (Wood, 1995). Furthermore, he related cognitive structures to knowledge by suggesting that knowledge consists of mental representations of ideas that are constantly constructed and modified to reflect one's personal interpretation of experience. Through successive mental constructions (Piaget, 1977), individuals actively build up knowledge (Wood, 1995). Piaget's primary emphasis was on cognitive activity in terms of the re-organization of cognitive structures and it is from Piaget's ideas of cognitive development that

cognitive constructivism evolved.

Unlike Piaget, Vygotsky's theory is rooted in sociocultural activity whereby knowledge is jointly constructed by individuals engaged in social negotiation or collaborative sense making (Zhu, 1998). Vygotsky's theory of socially constructed knowledge emphasizes the importance of social interaction or discussion with more knowledgeable others (Cobb, 1996) as the basis for individual knowledge construction. Essentially, Vygotsky asserts that "human learning presupposes a specific social nature" whereby "all higher-order functions develop out of language-based social interaction" (Vygotsky 1978 p. 88). Individuals, that is, build upon their knowledge through interaction and co-operation with their peers (Hillman 1998).

Although the role of conversation and debate still remain fundamental to constructivist theory as is evident in the suggestion that "dialogue between individuals is the primary mechanism that allows the social construction of meaning" (Knuth & Cunningham, 1993, p. 171), knowledge construction is more typically viewed as a process involving both social and cognitive behaviors. That is, cognitive or thinking processes result from specific forms of social activity such as when individuals question and prompt each other about a topic such that they are lead to think more deeply about it. Viewing learning as a product of social and cognitive activity, knowledge can be seen to emerge out of social interaction whereby individuals integrate new ideas, perspectives, and values into their existing cognitive structures and justify the resulting understanding through collaborative critical dialogue (Garrison, 1992). As individuals engage in critical dialogue, they often think about material in such a way that they transform it in some manner while constructing

understanding for themselves (King & Rosenhine, 1993).

Constructivist learning defines meaning as a socio-cognitive act in that constructed knowledge is viewed as a "product of cognitive activity preformed in social acts of communication" (Spivey 1995, p. 314). Knowledge construction, that is, results from particular forms of socio-cognitive behaviors leading individuals to consider a variety of perspectives on an issue. The purpose of learning in an interactive constructivist environment is to show the multiple perspectives that can be brought to bear on a problem and to encourage individuals to arrive at a self-chosen position to which they can commit (Merrill, 1992).

The importance of viewing an issue from multiple perspectives is widely recognized in constructivist literature. For example, according to Fosnot, (1996) Piaget's theory emphasizes the importance of exposing multiple viewpoints on an issue as a means of encouraging an individuals ability to think and thereby grow cognitively. Cobb (1996) and von Glasersfeld (1995) discuss constructivism with reference to multiple perspectives and suggest that when experiences foster contradictions to one's present understanding they essentially create cognitive perturbation whereby individuals are lead to construct new, more encompassing notions that explain and resolves the prior contradiction. Accordingly, as suggested by Fosnot (1996, p. 13), Piaget states that "new experiences sometimes foster contradictions to our present understandings, making them insufficient and thus perturbing and disequilibrating the structure, causing us to accommodate". As individuals think critically or analyze issues from different view points, constructed knowledge emerges through accommodation of new ideas or points of view into one's

own cognitive framework (Nyikos & Hashimoto, 1997).

King (1990) suggests that cognitive restructuring occurs as individuals gain understanding by constructing new knowledge or by transforming old knowledge into new through a process facilitated through peer interaction during which individual perceptions arise and are reconciled. Although cognitive restructuring can be seen as a "solitary act apart from the social context" (Nyikos & Hashimoto, 1997, p. 507), "interaction with others is its most frequent source for the developing cognitive subject" (Cobb 1996, p. 38). Through social interaction and exposure to conflicting viewpoints, cognitive discrepancies arise (King, 1990; Vygotsky, 1978). With reference to socio-cognitive conflict Cobb, (1996) suggests that learning is a process of self-organization in which the cognizing subject reorganizes his or her activity in order to eliminate perturbations. King (1990, p. 666) claims that "it is the resolution of these socio-cognitive conflicts that results in the socio- cognitive construction of knowledge and the social co-ordination of conflicting individual perspectives is the process through which new understanding is formed."

The importance of the "interplay" between social interaction and cognition is well recognized by advocates of meaningful learning through knowledge construction. Kaye (1991, p. 3) asserts that "much deep-level understanding and learning arises from conversation, argument, debate and discussion (often unplanned and unstructured) amongst and between learners, peers, colleagues, experts and teachers". Social settings, that is, provide an audience for an individual's perspective to be shared. and as Resnick (1989) suggests, audiences can request clarifications, justifications, and elaboration. Learning fostered in environments that require individuals to explain and

elaborate their position to others as well as themselves results in building knowledge that is personal and meaningful to the individual (Grabe, & Grabe, 1996).

Researchers studying the effect of elaboration on achievement levels in fact suggest that elaboration leads to knowledge construction as it requires individuals to organize new information and integrate it with their prior knowledge structures (King, 1990). King & Rosenshine (1993) imply that elaboration is explaining oneself more fully when prompted by others with questions. that require one to As well, during effective social negotiation, "individuals are often required to think about and present material in ways that relate concepts to other's prior knowledge or experience, translating vocabulary into terms familiar to the others, noting relationships among ideas, or generating new examples" (King 1990, p. 666). Such discourse forces the individual to critically evaluate, integrate and elaborate knowledge in new ways. More so than passively receiving information from others, individuals engaged in knowledge building are encouraged to actively process information through elaboration by evaluating and analyzing the issues being discussed.

As Resnick (1989) points out, weaker learners often do not engage spontaneously in elaboration or develop self explanations that extend beyond the given information. She further notes that "the differences in elaboration tendency are widely reported as distinguishing weaker from stronger readers, poor from good memorizers, and individuals with greater from those with lesser knowledge of the topic being studied" (Resnick, 1989, p. 8). However, if communication is carried out within ones "zone of proximal development" (ZPD), higher levels of cognitive functioning may be developed in weaker individuals as they collaboratively interact with more capable

others (Wertsch, 1985). Vygotsky (1978, p. 86) who situated learning in ones ZPD claimed zones of proximal development to be the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers. Since in group discussions members are generally exposed to various cognitive processes such as defining a problem, isolating important contributing variables, referring to context, past knowledge, data, or general principles, and evaluating progress (Brown & Palincsar, 1989), ZPDs may be utilized within electronic discussion to foster cognitive skills in less capable others (Bonk & Cunningham, 1998). In such instances the conferencing software serves as the mediating tool through which higher forms of cognitive functioning may develop.

Constructivism and critical thinking

Critical thinking has been related to knowledge construction (Garrison, 1992; Newman et al., 1997; Nyikos & Hashimoto, 1997). Garrison for example, discusses knowledge construction with regards to internal cognitive processing prompted by external social influences such as critical dialogue and further suggests that the process of knowledge building must inherently be collaborative (Garrison, 1992, p. 144). Learning with an emphasis on social collaboration exposes individuals to "alternative viewpoints that challenge their initial understanding" (Jonassen, Mayers, & McAleese, 1993, p. 234). Exposure to a variety of perspectives in the presence of sustained critical discourse constitute activities necessary for knowledge building through critical thinking (Quellmalz, 1987). Fundamentally, through prolonged critical

discourse with peers, tutors, teachers and experts, learners are encouraged to construct new knowledge from the formulation of new ideas and the construction of concepts and ideas born of messages elaborated by other learners (Henri, 1995).

Critical thinking is thus an important aspect of constructivist learning for viewing "issues from a variety of perspectives is an important pedagogical strategy for constructivist environments" (Bednar et al., 1992, p. 28). That is, knowledge construction is encouraged when individuals are required to search for and evaluate evidence for various viewpoints. Additionally, in order to gain a rich understanding, knowledge construction should involve individuals learning to construct multiple perspectives on issues and attempting to see them from different vantage points (Bednar et al., 1992).

The presentation of alternate viewpoints during social discourse challenges individuals, and encourages them to think more deeply on issues. Although "Piaget stressed the primacy of individual cognitive development as a relatively solitary act apart from the social context" (Nyikos & Hashimoto, 1997, p. 507), King (1990, p. 666) claims that, "as a result of scio-cognitive activity individual learners not only construct new meaning but gain a deeper understanding as well." This deeper understanding can be attributed to participating in critical dialogue, for individuals engaged in critical thinking have been found to anchor their learning more deeply (Newman, et al., 1997). Based upon their research, Newman et al. (1997) suggest, for example, that the social environment of a computer conference system supports deep approaches to learning by encouraging critical evaluation and understanding of content through discussion. Furthermore, by critically analyzing, validating, and actively

integrating new information with prior knowledge, individuals develop new knowledge and gain a more meaningful and long term understanding (Garrison 1992, p 142).

Computer conferencing, constructivism, and critical thinking

To understand the impact of computer conferencing on learning as examined in this study it is crucial to recognize the interplay between cognitive and social behaviors as they relate to the meaning making process. For example, during sustained social interaction where individuals are exposed to a variety of perspectives, critical thinking is often encouraged (Nyikos & Hashimoto, 1997). Critical dialogue in this respect requires that individuals be exposed to a variety of perspectives for critical thinkers do not see out of the eye of one argument alone (monoscopic vision), but must see a hypothesis from the point of view of two or more arguments or lenses" (Missimer, 1994). Through the course of discussing and debating various viewpoints individuals are often lead to construct a new understanding of issues.

In computer conferencing alternative view points are most often realized as a result of individuals possessing more or less information or from holding completely opposing and contradictory views (King, 1990). One of the greatest advantages of learning networks is the opportunity they provide for discussion of a variety of points of view (Harasim et al., 1995, p. 206). When individuals are challenged with varying perspectives through discussion, they are lead to think critically and to collaboratively assess the merits of each varying perspective and through prolonged discussion are encouraged to integrate new ideas into their cognitive framework (Garrison, 1992;

Nyikos & Hashimoto, 1997).

Harasim's (1993) analysis of the content from a computer conference used in a university credit course revealed that student interaction generally consisted of students formulating positions, responding to their peers with activating questions, elaboration, and/or debate. Constructivist teachers typically seek elaboration of student responses by presenting various viewpoints in discussion and encouraging critical dialogue such that students are lead to assess their own errors and re-conceptualize their thinking. Critical thinkers, then, often develop understanding that is more meaningful to them, for, although they generate knowledge in a social context, they do so in ways that are intricately linked to their own cognitive framework.

In her study of a computer conference environment, Burge (1994, p. 35) noted that "subjects reported the strengths of peer interaction came from the giving of help or from thorough and critical feedback." As a key factor in knowledge construction, critical feedback forces individuals to view and assess issues from others' point of view. Negotiating from multiple perspectives leads to conceptual growth by encouraging individuals to alter their internal representation in response to the various views encountered in discussion. In this regard, computer conferences can be seen to support socio-cognitive knowledge construction through critical dialogue where individuals critically evaluate and discuss issues and generate a more complex cognitive framework (Jonassen et al., 1993).

Computer conferencing as a network of individuals brought together for the purpose of collaboratively discussing ideas, supports idea analysis through critical debate. Harasim et al. (1995) state that in computer conferencing

> making comments requires the learner to pull ideas and thoughts into a coherent form; this is an intellectual act. Once the statement has been made and presented in the public forum of a conference or email network, it may well receive follow-up comments, such as requesting clarification and expansion or expressing disagreement for various reasons. Such exchange on an idea will require the original author or another participant to defend, refine, or acknowledge some fault in the position in a process of cognitive restructuring (p. 29).

Furthermore, as suggested, communication within a computer conference is asynchronous thus "allowing for extensive interactive contact with few limitations of time and space" (Henri, 1995, p. 149). Higher levels of cognitive functioning such as the development of critical thinking have indeed been associated with asynchronous forms of electronic communication (Kearsley, Lynch, & Wizer, 1995). Because all contributions made to a computer conference are stored within the conference software and easily accessed, participants may take advantage of increased time to critically reflect upon their own ideas as well as the opinions and ideas of others contributed to the discussion forum (O' Malley, 1992; Wiesenberg & Hutton, 1996). Participants therefore have time to critically evaluate the thoughts and opinions of others while simultaneously reexamining their own understanding and interpretations. Wisenberg and Hutton (1996) also suggest, that computer conferencing allows time for individuals to think, especially to think critically about material before presenting it and discussing it within the computer conference. Along this line of thinking Garrison (1997) argues that:

> since computer conferencing is based upon written communication, it too may well be a potentially powerful technological ally in facilitating higher-order thinking and learning. It would appear that the asynchronous (i.e. reflective) and precise nature of this means of communication is consistent with higher-order thinking and cognitive development. Since the exchange of messages is less rapid and are stored, learners do not have the burden of remembering the points made by other speakers while waiting for one's turn to speak. For this reason, it allows time for reflection and, thereby, facilitates learners making connections amongst ideas and constructing coherent knowledge structures (p. 5).

In addition to facilitating critical thinking, asynchronous communication also tends to encourage higher levels of participation from students in group discussion. Higher levels of participation appear to occur because participants can "contribute to a discussion at a time that is convenient for them in a location of their choice" (Wiesenberg & Hutton, 1996, p. 86). As "time-independent communication," computer conferencing, then, is believed to provide "considerable advantages for group interactivity and discussion" (Pearson, 1991, p. 225). (McIsaac, Blocher, Mahes, and Vrasidad (1999) and for example, concluded from their study on student interactions in a university Web-based course, that students participated more in computer mediated discussions than those conducted face to face, due to the fact that they could be present in the learning environment when they were ready to participate and contribute to it. By students having the opportunity to take the time required to reflect upon their thoughts and generate a response group discussions were therefore

essentially enhanced.

In the context of knowledge building, reflective thinking involves the active internalization of ideas and concepts and their subsequent transformation into personal understanding. As suggested by Vygotsky (1978), the process of knowledge building involves both interpsychological and intrapsychological processes. Interpsychological functioning occurs as learners interact with others to negotiate meaning. In intrapsychological functioning learners interact with their belief system through internal dialogue and self-reflective thought (Angeli & Cunningham, 1998). This increased time for reflection afforded by a computer conference environment allows participants as much time as they personally require to critically reread ideas presented, evaluate their own and alternative viewpoints, as well as generate more thoughtful and meaningful responses. Consequently participants engaged in electronic discussions have ample opportunity to internalize higher levels of cognition as well as construct self-reasoned positions on issues brought out in the conference. In this respect reflexivity can be seen as emerging naturally as one participates in asynchronous online interaction (Knuth & Cunningham, 1993).

Participants of online conferences have indeed reported the opportunity to reflect on discussions as one of the major benefits of learning online. Students in a study conducted by Burge (1994) claimed that they engaged in more reflective activity than in the regular fact to face classroom, and that they were able to learn better because of the opportunity to reflect on content. Furthemore, Harasim et al. (1995, p. 194) likewise reported that students found that time independence was a contributing factor to their learning in that they could "take as long as needed to reflect on what

they were reading and decide what questions to ask or comments to contribute to the discussion." These same students reported that asynchronous communication meant that "no one in the class could observe how long it took or how much effort went into an individual student's response, a characteristic that provides the slow learner with a virtual equality that is not usually available in the face-to face class" (Harasim et al., 1995, p. 194).

One may further argue that asynchronicity not only lends itself to knowledge construction but also encourages more active participation from all students in the group. Wiesenberg & Hutton (1996, p. 95) did indeed report that "students find it easier to comment in CMC environments than in a regular classroom setting." In discussing asynchronous group learning through CMC Harasim (1992, p. 47) contends that "unlike in a traditional classroom setting students need not fear going unheard because they require additional time to formulate their ideas, or because they are timid speakers when in a face to face environment." In the context of encouraging equal participation many researchers suggest that computer conference systems possess a democratizing potential (Garrison, 1997; Harasim, 1987; Kling, 1996; Wiesenberg & Hutton, 1996) that is, they potentially individualize learning by providing an environment in which all learners are equally encouraged to participate in the learning process. In this sense active participation is not just simply posting messages, but involves the social and cognitive engagement of participants as they critically assess and formulate ideas into words and receive feedback and evaluation on their formulations from their peers (Harasim et al., 1995).

Further cognitive benefits to text based interaction also relate to knowledge

building. The lack of social or physical cues to distract from the cognitive content of the message is of educational significance and characteristic of interacting through a text-based medium. Ideas, that is, are examined with little or no reference to the sender such that stereotyping associated with social status or physical appearance are removed (Harasim, 1990). "The advantage of this decreased attention to social convention in an educational environment is that it changes previously-established structures of power, encouraging students to think for themselves and stand by their thoughts" (Hillman, 1996). Furthermore, the reduction of social cues often encourages people to communicate more openly with less inhibition, making it easier for participants to confront others' opinions (Sproull & Kiesler, 1991). In Harrington's study a student reported feeling less inhibited in a computer conference because no one knew who she was so it was easy for her to say what she really wanted to say (Harrington, 1992).

Although much has been written about the potential for higher levels of learning through discussion based interaction (Ennis, 1986; Vygotsky, 1978; Wertsch, 1985), little is still known about the effect of computer conferencing on knowledge construction. In order to adequately determine then how computer conferencing impacts student learning with respect to knowledge building, an analysis regarding the extent that student dialogue reflects socio-cognitive constructivist activity was required on all interactive exchanges occurring within a computer conference. In an effort to conduct such an analysis, I devised a model of knowledge construction (Appendix E) based upon a thorough review of constructivist learning and critical thinking literature. The idea of devising such an analytical model for computer

conference content came from a review of two already developed methods (Newman et al., 1997; Henri, 1991) of classifying and analyzing interactive exchanges from a computer conference. I reviewed both Henri's analytical framework (Appendix A) and Newman et al's. analytical model of indicators (Appendix B) to help me formulate some notion of how to approach computer conference content analysis as well as what I might look for with regards to indicators of critical thinking.

Previously developed models for analyzing computer conferencing content

Henri's analytical framework (Appendix A) outlines five dimensions comprising five categories of interactive exchanges for analyzing computer conference content: participative, social, interactive, cognitive, and metacognitive. Each dimension is developed into an analytical model for analyzing the "learning process exteriorized in computer conference content" (Henri, 1991). The cognitive dimension, for example, is developed into a model outlining both definitions and indicators of five hierarchical levels of critical reasoning skills arising from the recognition of a problematic issue (Appendix C).

According to Henri (1991), the cognitive dimension refers to the psychological processes of learning involving a variety of critical reasoning skills selected or developed by participants as they address a problematic issue. Providing indicators of critical thinking arising from discussing a problematic issue, Henri's model was useful for determining how actively individuals engaged in online dialogue, acquire information, as well as the extent to which they process it. Conceptualizing participant online activity as five single identifiable dimensions, Henri's model provided me with

useful information concerning the social and mental activity associated with active learning. With little reference to the knowledge construction process, however, Henri's model did not provide an adequate description of the socio-cognitive behaviors individuals engage in as they construct meaning and understanding for themselves. As my research was aimed at examining computer conference exchanges for indication of knowledge construction, I decided a model more specific to the knowledge construction process was required.

Another approach to analyzing computer conference transcripts reviewed for this investigation was developed by Newman et al. (1997). Their model (Appendix D) draws upon Henri's research by corresponding Henri's (1991) cognitive reasoning skills with Garrison's (1991) stages of critical thinking. Although the models of both Henri and Newman et al. focused on critical thinking, neither researcher had established any relationship within their models to constructivist learning principles. I therefore felt that a model more suited to the knowledge construction process was necessary for me to conduct my study. Meanwhile, because both Henri and Newman et al.'s models provided indicators for determining the level to which participants processed information, I frequently referred to each of the models when devising my first model of knowledge construction (Appendix E) which I then utilized for deductive analysis on the transcripts. However, in developing my model, I inter-related theories of critical thinking with those of social and cognitive constructivist learning.

Chapter III

Methodology

My long term interest in conducting this study was to establish a starting point for seeking possibilities for developing alternate methods of instruction that incorporate constructivist approaches to learning that might be useful across all educational levels. As a junior high science teacher in an inner city school I was hoping that my experience with this investigation could contribute to my thinking about developing instructional methods that could be effectively employed in such an educational context. When initially considering the context for this study I decided against conducting it within a junior high setting, for most teachers I had contacted were not comfortable enough with implementing computer conferencing in their teaching and therefore were not in a position to assist me in this endeavor. Because computer conferencing had been incorporated within courses at the university level I decided to conduct my study at the post secondary level. .

A qualitative approach to inquiry was utilized in this study for, as previously mentioned, there is currently little known about how individuals make sense or understand new information as they engage in electronic dialogue. In instances where there exists little knowledge about the question under study, qualitative methods are most appropriate for as Stainback (1988) suggests, qualitative research methods can be effectively employed to explain particular human phenomena in circumstances where there is a lack of theory. Additionally, because qualitative inquiry is flexible, exploratory, and discovery oriented (Patton, 1990) and incorporates an inductive

approach to data analysis, it is quite effective when the research terrain is unfamiliar and or excessively complex (Huberman & Miles, 1994).

Although a qualitative study, this research nonetheless utilized pre-conceived theoretical constructs for the purpose of data analysis. Theoretical constructs, however, were employed only to initiate transcript analysis. In keeping within the parameters of an interpretative inquiry, this study also involved generative theoretical analysis. During generative theoretical analysis patterns of behavior discovered within the transcript data but not accounted for the initial data analysis were noted, categorized, and used to explain the under study.

I incorporated inductive analysis whereby I read and re-read the data in order to generate general assertions from it (McIsaac, et. al., 1999). Inductive analysis is the process of inferring generalizations from a variety of instances and examples (Lincoln & Guba, 1985). My inductive analysis employed constant comparative methods of examining data as outlined by Glaser & Strauss (1967). Constant comparative methodology was conducted in two areas of this study. Information in the library was inductively analyzed in order to develop my first model of knowledge construction . Additionally, transcript data was inductively analyzed in order to discover indicators of knowledge construction not accounted for in my theoretical model but none the less present within the student dialogue. Any patterns of interactive behaviors that emerged within the transcripts were used to revise my original model of knowledge construction. The following section reports how inductive analysis was employed both to develop my first model of knowledge construction and to conduct my second approach to analysis of transcripts from the computer conference.

Developing my first model of knowledge construction through inductive analysis

The purpose of this thesis was to attempt to determine whether knowledge was constructed in an electronic conferencing environment. In order to make this determination, I decided to analyze all postings from a computer conference using a model of knowledge construction developed from the research literature (Appendix E). Developing my first model of knowledge construction to use for transcript analysis involved extensive research of both constructivist and critical thinking theory. Initially my library research was conducted in order to determine general manifestations of constructivist behaviors. As I continued to read through the literature on constructivist learning, categories of both social and cognitive constructivist behaviors emerged. While coding incidents of social and cognitive behaviors for each category represented in the literature, I compared new descriptions of actions/interactions with previously documented incidents of knowledge construction and categorized them accordingly.

In the early stages of library research, general indicators of knowledge construction were categorized according to the type of cognitive and social constructivist behavior they seemed to reflect. In this sense I treated books and journals as one would an interviewee while gathering research data. Glaser and Strauss (1967), for example, suggest that:

> There are some striking similarities sometimes obvious although often overlooked between field work and library research. When someone stands in the library stacks, he is metaphorically, surrounded by voices begging to be

> heard. Every book, magazine article, represents at least one person who is equivalent to the anthropologist's informant or the sociologist's interviewee. In those publications, people verse, announce positions, argue with a range of eloquence, and describe events or scenes in ways entirely comparable to what are seen and heard during fieldwork. The researcher only needs to discover the voices in the library to release them for his analytic use (p. 163).

As I continued to review the literature on constructivism, new information was compared to indicators previously categorized and either placed in an existing category or used to form a new one. A relationship between social interaction and cognition was noted such that socio-cognitive constructivist behavior emerged as the central category that would represent the phenomenon which I was studying. By continually recording and classifying indicators of knowledge construction and drawing comparisons between behaviors, five general categories representing the stages of socio-cognitive constructivist behavior emerged: dissatisfaction with existing knowledge, exploring alternative viewpoints, generating perspective, metacognitive strategies, and cognitive restructuring.

Although constructed knowledge or cognitive restructuring is not a concrete and observable entity, one can infer that knowledge construction occurs by observing the cognitive behaviors exhibited by individuals engaged in social acts of communication (Spivey, 1995). In developing my first model of knowledge construction, I viewed the social and cognitive behaviors that I believed would lead to a constructed understanding as the socio-cognitive processes of knowledge construction. When individuals debate conflicting viewpoints, for example, they were

seen to engage in a particular type of socio-cognitive activity that would ultimately encourage them to construct a new understanding of the issue. Furthermore, I believed that discourse for the purpose of critically debating issues would encourage individuals to develop and enhance their cognitive ability such that higher forms of thought would develop. Vygotsky (1985) argued for example that

> any higher mental function necessarily goes through an external stage in its development because it is initially a social function.... When we speak of a process, "external" means "social." Any higher mental function was external because it was social at some point before becoming an internal, truly mental function (p. 62).

As I continued to devise my first model of knowledge construction, Garrison's (1991) stages of critical thinking (Appendix F) were reviewed for behaviors that might be similar to particular socio-cognitive behaviors of knowledge construction. As I believed that during social interaction individuals think critically, or from differing point of view often discover and transform complex information and make it their own (Nyikos & Hashimoto, 1997), I considered critical thinking to be an internal cognitive process of sense making. Knowledge, that is, would result as individuals analyzed and debated issues (Garrison, 1992) such that constructed understanding derived from critical thinking was a sequential process. Consequently, by relating Garrison's stages of critical thinking (Appendix F) to the knowledge construction, indicators of constructed understanding were devised.

My first theoretical model describing socio-cognitive indicators of knowledge construction (Appendix E) involved identifiable forms of cognitive behaviors arising from particular forms of social interaction, where social interaction was viewed as that which occurs during prolonged debate. With a socio-cognitive constructivist view in mind, I intended to analyze the ways in which people jointly construct understanding under particular conditions of social purpose and interaction (Resnick, 1991). Utilizing socio-cognitive indicators of constructivist behaviors, interaction was defined according to Bretz's operational definition, as stated by Henri (1991). Interaction, that is, was seen to occur as a multi-step process consisting of the following sequence:

Step 1: communication of information
Step 2: a first response to this information
Step 3: a second answer relating to the first.

According to Henri (1991), interaction occurs within a discussion when individual A, for example, makes a comment, which is responded to by individual B, who in turn is subsequently responded to by individual A. The more steps contained in the discussion the higher the response level and therefore the higher the level of interaction. As mentioned, according to Henri (1991), a high level of interaction is required for critical thinking through prolonged debate. A high level of interaction can be seen to occur in prolonged discussion and debate where participants engage in exchanging numerous comments on a particular issue. According to my first model of knowledge construction, then, individuals engaged in exploring, generating, and assessing viewpoints, as well as reformulating their personal perspective were expected to engage in a high level of interaction.

Theoretical background for the socio-cognitive behaviors in my first model of knowledge construction

Of primary significance to developing my first model of knowledge construction (Appendix E) was the notion that knowledge construction resulted as participants debated conflicting or alternate viewpoints. Furthermore, in developing my first model of knowledge construction, I viewed critical thinking as a crucial part of the knowledge construction process, in that while processing incoming information individuals construct understanding by engaging in particular types of social and cognitive behaviors associated with the critical thinking process. I further believed that such social and cognitive behaviors arise when participants experience personal dissonance due to their viewpoint conflicting with the viewpoint of another participant in the discussion. Cognitive conflict resulted and participants began to consider and assess the alternative viewpoints as well as question their current understanding. Initial questioning of an issue then indicated to me that participants were beginning to rethink their understanding and was therefore categorized as dissatisfaction with existing knowledge.

Once conflicting viewpoints were exposed, individuals would continue debate by critically evaluating, comparing and opposing the new information to their previously held beliefs (Schmech, 1983). During this process of prolonged debate, further questioning would occur as participants attempted to clarify the issue under discussion. Behaviors aimed at evaluating and clarifying an issue were categorized as exploring an alternate viewpoint.

While exploring the views of others presented to the discussion, participants would engage in further critical thought and debate by attempting to relate the new information to their prior understanding. During this stage of constructing understanding, participants would be seen elaborating on issues by drawing upon outside information, suggesting plausible relationships between the conflicting viewpoints, and/or suggesting solutions to reconcile them. I believed that such elaboration would encourage participants to establish relationships between the new ideas brought out in discussion and their prior knowledge and I therefore categorized the behaviors as generating a perspective.

Further constructivist activity outlined in my model of knowledge construction suggested that individuals might engage in metacognitive strategies. While engaged in critically thinking about the issue under discussion, that is, participants would likely be observed assessing the quality of their new ideas, judgements, and decisions, as well as the skills and processes used to arrive at them (Jonassen et al., 1993). Such self-reflective behaviors were therefore categorized as metacognitive strategies.

Finally I expected that participants engaged in constructing new knowledge would transform their newly acquired information into their own terms by reformulating their personal perspective to accommodate the new information (Piaget, 1977). I believed that participants reformulating their personal perspective in terms of alternate viewpoints might engage in reformulating their opinion as they refer to new information with respect to their prior understanding. Reformulating one's opinion was therefore categorized as cognitive restructuring .

Because I viewed learning through electronic conferencing as a cumulative act

occurring as individuals discuss and debate opinions and ideas online (Harasim, 1993) I believed that a model of knowledge construction such as mine would be appropriate for analyzing computer conference transcripts for evidence of constructed understanding. Through discussion based interaction, that is, I believed that individuals would encounter a variety of perspectives and therefore be encouraged to think more deeply and critically about issues and engage in a series of socio-cognitive behaviors consistent with the construction of new ideas and ways of thinking. During in-depth processing, I expected that cognitive growth would occur as participants rethought their position and connected the newly acquired information to their prior knowledge (Jonassen et al., 1993; King, 1990). My first model of knowledge construction (Appendix E) was therefore based upon the notion that knowledge construction occurs as individuals critically debate issues and integrate the new ideas or points of view into their current cognitive framework (Nyikos & Hashimoto, 1997).

Deductive analysis of the transcript data

Transcript data were analyzed both deductively and inductively. Transcript data were initially analyzed deductively with the intent of describing the computer conference exchanges according to my previously defined categories outlined within my first theoretical model (Appendix E). The deductive analytical phase consisted of verificative research (Goetz & LeCompt, 1984) in that verification of the socio-cognitive indicators of knowledge construction, devised through my research of the literature, were sought within in my transcript data. However, after reading through the transcript data numerous times and examining them for the predetermined socio-

cognitive constructivist behaviors, there still remained a lot of data not coded and therefore unaccounted for. Consequently I again re-examined the transcripts but this time inductively with no previously defined socio-cognitive constructivist categories in mind.

Inductive analysis of the transcript data

As mentioned, inductive analysis occurred after the transcript data was read through numerous times and analyzed for the indicators of knowledge construction outlined in my first theoretical model. Inductive analysis of the transcript data again involved reading through the transcripts but this time in order to categorize patterns of interactive exchanges that emerged but could not be accounted for in my first model of knowledge construction. During this stage of analysis I allowed additional categories of socio-cognitive constructivist behaviors to emerge and be cross-checked within the data (Patton, 1990). By constantly returning to the transcripts and comparing categorized indicators with new indicators noticed in the data, new patterns and categories emerged, so that all final categories of socio-cognitive constructivist behaviors reflected my data and addressed the phenomena I was studying. Once all inductively determined behavioral patterns were categorized, I returned to the literature on knowledge construction to verify whether the behaviors reflected socio-cognitive activities indicative of knowledge construction. In utilizing an inductive approach to transcript analysis I essentially organized my transcript data into categories that represented indicators of knowledge construction so that any substantive theory I developed (Glaser & Struass, 1967) from my inquiry would

explain the nature of student interactions within a WebCT computer conference. Through this process of inductively analyzing the transcript data a second model of knowledge construction was developed (Appendix G). The theory reflected in my second model of knowledge construction was thus grounded in my research data.

Verificative/deductive - generative/inductive analysis

In qualitative inquiry, one may argue that rules and procedures for analyzing data are determined through the analytical process itself. That is, analysis begins with the data themselves and arrives at theoretical categories and hypothesis (Linclon & Guba, 1985). In this study however, transcript data was analyzed using the prior categories outlined in my model of knowledge construction developed through the library research. Using some a priori theory in qualitative inquiry is acceptable as long as "the researcher is mindful of the possibility that at some later time in the inquiry the degree of fit for the predetermined theory is no longer close enough to warrant its continuation (Glaser & Strauss, 1967). Qualitative inquiry then conforms to the idea that rules and procedures for analyzing data can be formulated before analysis is undertaken, but the rules need not be finally formulated until the end of the inquiry (Linclon & Guba,1985). This was the case in this study. My first model of knowledge construction served only to focus my inquiry and provide the boundaries for further identifying and developing theoretical constructs sought within the computer conference transcripts.

Because rules for assigning behavioral incidents to categories of socio-cognitive knowledge construction were formulated prior to data analysis, my inquiry

involved verificative methods in that I attempted to verify the a priori categories developed in my first model within the conference transcripts. However, my inquiry can also be characterized as generative in that through my inductive analysis of the conference transcripts I attempted to discover indicators of knowledge construction or theoretical constructs using the data themselves (Goetz & Lecompte, 1984). Forms of student dialogue that had not been previously accounted for in my first model of knowledge construction but were repeatedly observed in the transcripts and later confirmed through constructivist literature were thereby deemed behaviors relevant to my research question and accounted for in my developing theory (Corbin & Strauss, 1990). In this sense, my investigation into computer conferencing fell within a generative/inductive - verificative/deductive continuum in that it was neither purely inductive nor deductive but a combination of both (Goetz & LeCompte, 1984). Throughout the entire analytical process I kept in mind that all behavioral categories formulated through my research must be able to explain the student behaviors under study and address the research question (Lincoln & Guba, 1985).

Sampling

Theoretical sampling (Glaser & Strauss, 1967) strategies were employed in this research whereby sources of data were chosen for their ability to address the research question. For example, while conducting library research I purposefully selected materials that I expected and hoped would contribute to the evolution of behavioral constructs concerning knowledge construction (Creswell, 1998, p. 118). In the initial stages of developing a model of constructivist behaviors I was looking for general

information about constructivist learning that might possibly be relevant to my research question. As categories emerged they formed the bases for sampling (Corbin & Strauss, 1990) by determining what I should look for about specific areas of social and cognitive constructivist theory.

Theoretical sampling also directed my analysis of the conference transcripts. As mentioned, the first contact with transcript data was verificatory as it involved confirming or disconfirming the presence or absence of incidents of socio-cognitive indicators to support the categories developed from the library information. However in order to account for all known cases without exception (Lincoln & Guba, 1985, p. 309) I constantly checked the viability of my findings with new data and additional cases (Patton, 1990) by looking for indicators that would confirm or disconfirm the categories that emerged. Any new categories that emerged within the transcripts directed my further examination of the student exchanges within the computer conference.

Role of the Researcher

As mentioned previously, this study was conducted within a computer conference setting, and therefore the primary data was collected electronically through the computer conference software. During my initial meeting to gain consent to conduct this study students gave me verbal assurance that they felt comfortable with me observing and analyzing their comments posted to the conference forum. Other than this initial meeting with students in their classroom and meeting them again at the end of the course to distribute questionnaires, I had virtually no need to make face-to-

face contact with the student participants throughout the study. I, however, informed participants during our initial meeting that I would be periodically reading through the conference, but no specific times were assigned. As my presence would not be obvious to the participants I did not concern myself with blending into the research setting (Bogden & Biklen, 1992) in an effort to reduce any reactivity induced in respondents by the presence of an investigator. However, I did consider the fact that some amount of distortion to the data could occur as a result of what Lincoln & Guba (1985 p. 392), refer to as "situated motives" such as participants wanting to please the researcher or feeling reluctant to contribute to the conference forum. However, as the conference software recorded all interactive exchanges, my relationship with the study site was considered one of prolonged engagement and persistent observation. Through both prolonged engagement and persistent observation I was enabled to first identify any distortions in the data, and second, determine what actions could be taken to combat them if they did arise (Lincoln & Guba, 1985). At the same time, however, pleasing the investigator would not render my data less credible. Because this study purported to determine if individuals constructed knowledge while engaged in electronic discussion, any factor seen to encourage students to produce more thoughtful responses would be considered part of the natural context for this investigation.

Participants

Participants in this study were seasoned teachers whose teaching backgrounds ranged from teaching primary to post-secondary education. All had recently enrolled

in a masters education program at a Canadian university. Participants were all from the same geographic location and were required to meet every Tuesday and Thursday evenings to participate in face-to-face discussions in a traditional classroom setting. The course ran for six weeks during the summer semester of July and August. In addition to meeting face-to-face, student participants also discussed material for this course online. For all intents and purposes participants were studied in their natural setting. That is, as an adjunct to regular classroom sessions, the computer conference setting was the regular environment in which electronic dialogue for the course was to occur.

Online dialogue through computer conferencing can be utilized in a variety of ways to support the educational process. It can be utilized as an adjunct to regular face-to-face meetings, as a mixed mode where both face-to-face and computer conferencing are used to deliver instruction, or computer conferencing can be used as the only means for course delivery (Harasim et al., 1995; Turoff, et al., 1993). In this study, a mixed mode was employed. Computer conferencing was combined with regular face-to-face meetings to cover course objectives.

All student participants had met face-to-face prior to commencing the computer conference sessions, and continued with regular classroom meetings for the duration of this study. The computer conference did not utilize a chat room as the professor felt that students could use their email if they wished to communicate for the purpose of "informal chat." Most participants had used computers for email before participating in this study. However, a few had either a little or no pervious

experience using the World Wide Web or using computers to participate in discussions through chat rooms on the internet.

As consistent with a mixed mode of delivery, conference participation constituted part of the students' overall performance for the course, for which a grade was assigned. In a meeting with the professor to discuss his role in the computer conference and information concerning his expectations for the computer conferencing aspect of the course, I was informed that online conferencing was utilized to facilitate student's active engagement in dialogue concerning articles discussed in class and material covered in the course. Additionally, conference participants were considered self-directed learners and were expected to engage in active dialogue with their classmates to discuss and debate material covered throughout the semester.

The bulletin board was the only feature of WebCT conference software incorporated in the course. The professor suggested that computer conferencing gave students the opportunity to continue with their discussion of journal articles and other materials discussed during class time. Students were required to comment on the journal articles but no set number of responses were required. Although it was not required, students were strongly encouraged to respond to other students' comments. The professor of the course also posted articles to the bulletin board that students could use as resource material when creating their own response to the required topics. Participants were not required to respond to these resource materials.

Students were constantly reminded by the professor during in class time of the requirement for quality postings. The professor primarily posted questions to the conference to which all students were required to respond. Participants were asked by

the professor to provide sound backing for their responses to questions and postings were graded for logical reasoning as well as whether ideas were supported by articles and/or the opinions of others.

Role of the professor in the computer conference

It was expected by the professor that student participants would monitor their own activity within the computer conference with regards to keeping themselves on topic and within the focus of the course. In this respect the computer conference was not moderated by the professor. Individual students were not questioned on their responses or probed for deeper understanding of the issues under discussion. Furthermore, scaffolding strategies whereby the professor could have encouraged the student participant within his or her zone of proximal development and provided just enough pedagogical support until he or she acquired the requisite ways of reasoning (Perkins, 1992) were not incorporated in the conference.

Consent

Student participants in this study consisted of 7 females and 8 males. Ethics approval was granted by the ethics committee for the university in which the study was conducted (Appendix H). Consent for students to participate in the study was obtained using a consent form (Appendix I) requesting the approval of students to use their contributions posted to the WebCT bulletin board as data for a qualitative study on learning within the computer conference. All participants agreed through this written consent form to have their contributions to the computer conference used as

data for investigating whether or not they engaged in socio-cognitive constructivist activities while participating in electronic dialogue. Participants were given the option to have both their postings to the bulletin board and their completed questionnaire used for the investigation, or they could agree to either method of providing the researcher with data for the study. Completed consent forms were copied so that the researcher held one copy and the other was retained by the participant. All students in the course gave their consent to fully participate in the study and expressed a willingness to offer their full cooperation, suggesting that one day they may be looking for the same "favor" from other students.

Participants were given consent forms at the beginning of the course during their regular in class time. At this time they were informed the name of a person affiliated with the university, but independent of the study, that they could contact if they had concerns about the investigation. During the class in which the consent forms were distributed, however, the purpose and procedures of the study were explained to the participants and they were given the opportunity to address any questions or concerns about their participation in the study. Participants were also informed both orally and through the consent form that they could withdraw from the study at any time without academic penalty.

Borg and Gall (1989) suggest that an examination of issues that are sensitive to an individual may decrease the number of subjects willing to participant in a study. Although all students in the course agreed to participate in the study I was nonetheless concerned that some student participants might feel uncomfortable with their discussion contributions being analyzed for evidence of knowledge construction and

thereby be reluctant to offer their full participation in the computer conference. I felt that any reluctance to participate in the computer conference might not only impact upon the individual's course mark but could also potentially impact upon the amount and therefore the accuracy of the data collected. In an effort to assure a comfort level for the student participants I rigidly adhered to confidentiality guidelines as suggested by Borg and Gall (1989). That is, to insure that confidentiality was maintained, student participants were encouraged to conceal their identity by choosing a pseudonym that I would use when referring to their particular postings. Furthermore, to prevent against any concern about the quality of their contributions with regards to knowledge construction, participants were informed that conference transcripts would not be discussed with the professor of the course until all grades had been submitted to the registrar's office.

Data Collection

Transcript Data

Transcript data was electronically collected and stored in the server that ran the computer conference. At the end of the course, when all student exchanges for the computer conference had finished, the conference transcript was copied to a computer disk by the professor and given to me. The transcript was then printed and considered written material to be used for analysis. According to Lincoln and Guba (1985), written material is essentially a document that can be subjected to an analytic process. The transcript document was the primary source and data for this research and like any document used in basic research it enabled the researcher to obtain the language and

words of the informants (Creswell, 1994) and thereby provided useful information regarding the phenomena under investigation.

Questionnaire

In addition to transcript data, a questionnaire (Appendix J) was administered at the end of the course to all students who agreed to participate in the study. The purpose of the questionnaire was to ascertain student's prior experience with computers and computer conferencing. Questions were designed to determine participant's attitudes and their experience with learning via online conferencing. To maximize response level, the questionnaire was administered in class following the final computer conference session. I remained in the room while students completed the questionnaire and they were given the opportunity to ask any questions about the questionnaire they felt were necessary. I encouraged all participants present to answer all questions and to take as long as required to do so. During the last class for the semester, questionnaires were completed and obtained from all participants who were present. Of the 15 participants who agreed to participate in the study, 13 were present during this last class and completed the questionnaire.

The questionnaire format was based upon the one described by Borg and Gall (1989), consisting of a mixture of pre-structured and open-ended questions. The open-ended questions offered a form of self report for participants as these questions probed for information concerning participants' feelings and attitudes about learning via computer conferencing. The pre-structured questions incorporated rating scales and sought information related to both participants' prior experience with computers and

information describing their experience regarding learning within a computer conference environment.

It was expected the questionnaires would assist me in establishing a context in which to more accurately analyze the transcript data. As an electronic environment, computer conferencing does not provide an obvious observable context in which to conduct a study. Establishing a study context was important to this investigation because using written text, as in electronically collected transcripts, the gap between the participants and the researcher was widened (Hodder, 1994, p. 393). Consequently, to more accurately situate the participants within their research setting (Creswell, 1998) a questionnaire was deemed useful.

As an additional source of data it was hoped that the questionnaire would also provide information to help interpret the degree of participation demonstrated in the conference transcripts. Harasism et al. (1995, p. 194), for example, claim that previous computer experience produces no significant difference in outcomes for online courses. However, I felt that if students had little previous experience with computers and or computer conferencing they might take time to acclimatize to an electronic medium and therefore spend more time reading the online discourse then actually contributing to the discussions (Harasim et al., 1995, p. 193).

Methods of Verification

There are multiple perspectives regarding the definition of and procedures for establishing verification in qualitative research (Creswell, 1998). However, because grounded theory is a methodology "for developing theory that is grounded in data

systematically gathered and analyzed" (Strauss et al., 1998, p. 158), an important aspect for insuring the credibility of my findings was to focus on employing rigorous strategies of analyzing and coding data. As mentioned, data analysis proceeded utilizing a constant comparative method for creating categories to explain the nature of student interactions present in the transcript data.

A rigorously conducted constant comparative analysis for classifying data is in itself a method of verification for, as Corbins & Strauss (1990) state:

> constant comparison enables investigators to break through subjectivity and bias. Fracturing the data forces preconceived notions and ideas to be examined against the data themselves. A researcher may inadvertently place data in a category where they do not analytically belong, but by means of systematic comparisons, the errors will eventually be located and the data concepts arranged in appropriate classifications (p. 13).

In this sense my interpretations were constantly subjected to validation procedures in that I constantly compared emerging categories against actual data and made any necessary modifications or additions that validated or negated my findings (Strauss & Corbin, 1998). This method of verification of grounded theory involved as Corbin and Strauss (1990) suggest confirming categories by repeatedly returning to the data source until categories hold true for all the evidence concerning the phenomena under study.

An important task in this research was linking constructivist and critical thinking theories. By linking these two theories I was able to develop a model of knowledge construction for examining student dialogue for evidence of knowledge

construction. In the early stages of this investigation extensive library research was conducted on constructivist and critical thinking theories in order to develop categories of behavioral manifestations constructivist theory. Both constructivist and critical thinking theories were then integrated by associating categories of critical thinking with those of knowledge construction. Throughout my library research I constantly developed and revised relationships between constructivism and critical thinking by constantly revisiting the literature until all apparent behaviors that could be related to critical thinking and knowledge construction were accounted for.

As a result of previous experience with computer conferencing and reflecting upon my learning while engaged in it, I had developed some personal meaning for constructing understanding through electronic dialogue. Such background knowledge and experiences are referred to as theoretical sensitivity (Strauss & Corbin, 1998). Through moderating the computer conference described earlier in this paper I had developed some theoretical sensitivity regarding my research question.

Theoretical sensitivity assisted me in conducting constant comparative analysis for it allowed me to make decisions about what was relevant to the purpose and focus of my study. Strauss & Corbin (1998, p. 173) state, for example, that procedures of theoretical sampling and constant comparison are allied with theoretical sensitivity. Consequently my personal experiences and knowledge of learning within a computer conference may have enhanced the formation of theoretical categories (Strauss & Corbin, 1998) and helped to validate the findings.

Triangulation was used in this study. To insure the development of credible categories multiple perspectives pertaining to constructivist and critical thinking

theories were systematically sought out. That is, different literature sources of the same information were sought and incorporated into theory development (Lincoln and Guba, 1985). By incorporating the multiple viewpoints present in constructivist literature I protected my interpretations against researcher biases and prevented relevant data from being omitted from theory development. That is, by reading multiple viewpoints on constructivism I broadened my understanding of the topic and was prevented from being captured by lay conceptions of it (Strauss & Corbin, 1998, p. 172).

Triangulation also involved using different methods of collecting data (Creswell, 1994). Data was collected from the participants in the form of computer recorded transcripts as well as a questionnaire. All transcript data were very accurate as they were electronically compiled and could be reproduced in exactly the manner that they became evident (Lincoln & Guba, 1985 p. 241). In addition to obtaining accurate transcript data, the questionnaire provided contextual information about each participant. Participant self-report established through the questionnaire helped to confirm my interpretations.

In order to help explain the behavior under study in this investigation, participant perspectives were considered (Bogdan & Biklen, 1992; Creswell, 1998). The questionnaire administered at the end of the computer conference provided the researcher with insight into the participants' background experience with computers and computer conferencing as well as their feelings and attitudes about learning within a computer conference environment. The questionnaire contained open ended items designed to obtain information from student participants that would help determine if

they felt they had constructed knowledge while engaged in electronic dialogue via WebCT conferencing software. In a sense the questionnaire served to verify my interpretation of the transcripts with regards to whether student actions/interactions represented behaviors reflective of knowledge construction.

Coding of data

Transcript data

All transcript data was coded and analyzed using Ethnograph v5.0 (Qualis Research Associates, 1998), a computer program developed for analysis of text-based qualitative data. All messages were coded at the paragraph level, as I thought that phrases would not always allow me to as accurately interpret the meaning of the student's posting. Once the conference transcripts were coded I used the Ethnograph v5.0 program to search for the coded segments so that I could easily determine types of participant interactions that were most prevalent in my data.

Before utilizing Ethnograph v5.0, transcripts were read numerous times as a Microsoft Word file in order to obtain a sense of the types and the level of interaction exhibited by the participants in the computer conference. Once a sense of the data was obtained I imported the transcripts into Ethnograph v5.0 for coding. During coding procedures the transcript was again read through numerous times. The coded transcript and the coded segments were than printed from the Ethnograph program. To easily determine the frequency of each category of interactive behaviors, a frequency list of each coded segment was compiled in Ethnograph v5.0 and printed for use during analysis.

Analysis of questionnaire

The questionnaire consisted of both pre-structured and opened-ended questions. Responses to the pre-structured questions were tallied and placed in a frequency table (Appendix K) constructed in Microsoft Word 97. Tallied responses allowed me to obtain a general sense of how participants responded to each question. Responses to the open-ended questions were categorized according to particular themes that emerged within them. In categorizing responses to the open-ended questions, responses for each question were read through numerous times whereby I recorded the gist of each response on an index card. Similar responses to each question were then complied so that when all responses were grouped in this manner I was able to determine the overall theme that emerged within the responses to each question.

Chapter IV

Analysis

This study incorporated qualitative methodology to investigate whether students constructed understanding while engaged in electronic dialogue using WebCT computer conferencing software. Analysis of the transcript data involved both deductive and inductive approaches. Deductive analysis was incorporated as a means of initiating examination of the conference exchanges and involved examining the transcript data for predetermined indicators of constructivist behaviors as outlined in my first model of knowledge construction (Appendix E). Inductive analysis involved re-examining the transcripts for patterns of behaviors not accounted for in my model of knowledge construction but which emerged from the data. Analysis of the transcript data then essentially consisted of two main tasks: a) verification of the categories of constructivist behaviors outlined in my original model of knowledge construction, b) noting and recording patterns of constructivist behaviors which emerged from the transcript data but were not accounted for in the model. Upon completing my data analysis I devised a second model of knowledge construction so that the socio-cognitive constructivist indicators developed through my research reflected the interactive exchanges under investigation.

In reporting the findings of this research I first discuss how transcript analysis was conducted with the intent of verifying pre-determined indicators of constructivist behaviors. Further discussion consists of reporting the development of my second model of knowledge construction (Appendix G) as a result of inductively analyzing

the transcript data. The section dealing with the development of my second theoretical model involves a discussion of patterns of interactive behaviors that were noticed while examining the transcripts with no particular categories of socio-cognitive constructivist behaviors in mind. While discussing the inductive development of my second theoretical model, responses to the questionnaire are referred to with the intent of verifying my analysis of the transcript data.

When reporting participant responses in this research, pseudonyms provided by the student participants are used. Furthermore, comments from both the questionnaire and the computer conference are quoted verbatim. The presence of spelling or grammatical errors therefore may be noticed in the comments illustrated in this report. However, the professor for the course had previously informed me that he was not concerned with student's spelling and grammar as he recognized that most students were just becoming accustomed to computers. As indicated in the questionnaire, a number of the participants had little previous computer experience. It is likely, then, that most participants were more intent on working with the technology and getting their comments online as opposed to concentrating on spelling and grammar. Furthermore, as online discussions may be viewed as talking with one's finger rather than formal writing, discussions need not be inhibited by concern about formal grammar or typos. As long as messages are readable, it is the flow of ideas that should be important. Consequently, it appeared that semantics dominated over syntax (Harasim et al., 1995).

Deductive Analysis of the computer conference transcripts

As mentioned, I began analyzing transcript data by looking for indicators of constructing understanding as outlined in my first model of knowledge construction (Appendix E) developed in the earlier part of this study. In order for individuals to construct understanding according to this model, it was necessary for participants to engage in particular kinds of social and cognitive activity arising from debating conflicting viewpoints. Furthermore, with respect to my first model, the knowledge construction process consisted of a hierarchical process of five identifiable stages: Dissatisfaction with existing knowledge, exploration of alternate viewpoints, generation of perspective, metacognitive strategies, and cognitive restructuring.

Expecting to notice identifiable stages, I began my deductive analysis looking for indicators categorized as "dissatisfaction with existing knowledge." However, because in the computer conference investigated for this study very few participants disagreed with what other members of the discussion group suggested, there appeared to be few opportunities for critical debate to occur. Also, I noticed that when participants disagreed with each other, they failed to engage in any prolonged discussion of the issue. With a lack of prolonged debate, no indication of the five stages was possible. In this respect, participants in the discussion did not exhibit any indication that they had experienced cognitive conflict nor had become dissatisfied with their existing belief.

Lack of debate

For knowledge construction to have occurred as outlined in my first theoretical model it was necessary for opposing viewpoints to be debated. Although at times participants did hold conflicting viewpoints on an issue, they nonetheless failed to engage in debating them. Although rich [*sic*] and Chesley demonstrated that they possessed alternate viewpoints, neither indicated any interest in debating them. Chesley suggested for example, that:

> new teachers leaving training programs, I feel have a significant advantage over those already in the system. By this I mean that they have been exposed to technology and it's furture applicatios in education (Chesley, Article No. 27: Jul. 3, 1999,17:10)

rich then replied to Chesley by stating:

> Well said Chesley. The only point I would make is that while our recent graduates (B.Ed) have the opportunity to avail of technology, many still leave this faculty with little or no computer skills. At the recent Tech Ed Special Interest Council AGM a motion was carried that there should be a technology course included in the requirements for any B.(rich, Article No. 39: Jul. 5, 1999, 16:21).

Although rich initially acknowledged Chesley's point of view, ("Well said Chesley") he nonetheless appeared to disagree with it. Discussion of this issue between Chesley and rich however ended with rich's comment; these participants did not continue in the

discussion to debate their obvious conflicting viewpoints and therefore no indication that they were dissatisfied with their existing knowledge was made apparent.

As mentioned, participants in the conference who held conflicting viewpoints on an issue generally did not engage in discussing their different perspectives to any prolonged extent. For example, similar to the above discussion with regards to a lack of any high level of interaction necessary for debate, the level of exchange between Sarah and Paul demonstrated again that students holding conflicting viewpoints did not engage in debating the problematic issue. Failing to debate their conflicting viewpoints, Sarah and Paul did not demonstrate that they were dissatisfied with their existing knowledge. In initiating a topic on WinGuardian, for example, Sarah stated:

> This morning we discussed the program WinGuardian (available through www.webroot.com). The program is designed to "spy" on internet users, ensuring that the children are surfing appropriate internet sites.
>
> Please respond. (Sarah, WebCT: No. 59, Thu, Jul. 8, 1999, 10:41).

Paul replied to Sarah's concern about spying by acknowledging and then questioning it when he commented:

> Sarah As discussed in class there is a definite need for some monitoring but I question if it is neccessary to this extent. Often, just mentioning to students that they are being monitored electronically (a little white lie) is deterent enough. I know that in the elementary system there is not as much concern as it would in the higher levels (Paul, WebCT: No. 144, Jul. 25, 1999, 12:48).

Communication on this topic ended with Paul's comment. These two students did not debate their viewpoints nor appear to experience any cognitive conflict as a result of possessing opposing perspectives.

Overall, the few instances where participants directly responded to another participant's comment with a conflicting perspective, discussion of the perspectives was generally limited to one reply only. With no debate of conflicting viewpoints, discussions of alternate perspectives in the computer conference did incorporate a multi-step interaction process as discussed by Henri (see p. 33, this document). With reference to conflicting viewpoints, the higher level of interaction necessary for prolonged debate was not observed in this computer conference. With only a superficial discussion of problematic issues, I suspect that participants were not lead to explore alternative viewpoints, generate a new perspective, nor pass through the other stages of knowledge construction outlined in my original model.

Participants not directly replying to each other also presented viewpoints that conflicted with each other. In the earlier part of the conference, for example, rich posted a comment suggesting that there is no significant difference in achievement levels in K-6 schools due to the integration of computers in the classroom (rich, WebCT: No. 38, Jul. 5, 1999, 16:10). Later in the conference mkb [*sic*] suggested that students in online courses achieved significantly higher grades than in class students (mkb, WebCT: Article No. 134, Jul 23.1999, 01:12). Although posted at a later time in the conference, mkb's comment was not posted as a reply to rich's comment. These two participants, that is, did not directly exchange their viewpoints with each other on line and no debating of the issue was observed. Although exposed to a conflicting

perspective neither participant appeared to reconsider their belief in terms of the alternative viewpoint (Knuth et al., 1993). Consequently, neither of the participants appeared to be dissatisfied with their existing knowledge. Typical in this computer conference, in fact, was that participants who were observed holding conflicting viewpoints did not begin to consider the alternate viewpoint or question their own belief.

Debating conflicting viewpoints could have involved participants either actually disagreeing or simply possessing a willingness to disagree, for the sake of debating the multiple interpretations that can be brought to bear on an issue (Merrill, 1992). Whether presenting a self-chosen view or one presented by playing the "devils advocate," individuals would then have likely been called upon to elaborate, explain, and justify, their position. Through such debate, participants could have been lead into sustained dialogue and engaged in the stages of the knowledge construction process as outlined in my first model. However, in the absence of debate, my first model of knowledge construction was ineffective for determining whether participants in the computer conference that I was investigating had indeed constructed knowledge.

The fact that participants who held conflicting viewpoints did not engage in critical debate suggested that the students either lacked the skills required to enter into a prolonged debate or simply they were not willing to engage in a critical examination of the topic (Henri, 1991). Perhaps, if those participants who disagreed with each other had discussed their ideas through questioning and exploring each other's viewpoints, higher levels of interaction might have been observed and engagement in

further knowledge constructive activity as outlined in my first model might have occurred.

Additionally, in a computer conference where students fail to debate alternative viewpoints, pedagogical intervention may be required. The professor, that is, might assist participants by encouraging them to evaluate alternate understandings by posing probing questions and otherwise facilitating critically dialogue and debate. Under such conditions participants might demonstrate the socio-cognitive constructivist behaviors consistent with those outlined in my first theoretical model of knowledge construction.

Although my first theoretical model of knowledge construction (Appendix E) failed with regards to determining whether participants in this computer conference constructed knowledge, my deductive analysis was useful in that it served to focus my inquiry and provide some boundaries for me to inductively analyze the conference transcripts. Upon failure of my first theoretical model, I was left with a major part my data from the computer conference still uncoded and thereby unexplained. At this point I began to re-examine the transcript data, with no specific behavioral categories or indicators of constructing knowledge in mind. This time I approached the data with an open mind allowing any patterns of interactive behaviors to emerge.

Inductive development of my second model of knowledge construction

In analyzing the computer conference transcripts with no specific indicators of knowledge construction in mind, numerous forms of interaction not accounted for in my first model of knowledge construction were observed. As mentioned, my first

theoretical model (Appendix E) was dependent upon students debating conflicting viewpoints. However, in this computer conference students tended not to disagree with each other or hold conflicting viewpoints, but tended to agree and engage in sharing information and ideas. In this respect, the online interaction consisted of participants contributing input, sharing ideas and responding to questions discussed in class or posted by the professor and other participants. Social interaction was evident in these posting for participants frequently used the names of students when replying to comments and when sharing ideas with the group, participants were either replying to a question posted by the professor, or responding to another student's comment (Henri, 1991).

Although students tended not to debate and argue about issues, they did tend to provide in-depth responses. Such in-depth responding can be seen to reflect socio-cognitive constructivist activity for it is suggested that deep learners integrate new learning into current cognitive framework (Newman et al., 1997). Furthermore, deep thinking is associated with critical thought for according to Schmeck (1983, p. 245) individuals engaged in deep thinking "critically evaluate information, organize it conceptually, and compare and contrast it to previously-held information." In-depth responses then also engage individuals in reflective thinking for the process of organizing ones knowledge structures, requires engagement in reflective thought (Prawat, 1996). The behaviors observed and discussed in this section are those exhibited in in-depth responses arising from sharing of ideas and information online.

Drawing upon personal experiences

A number of comments in the computer conference consisted of students drawing upon their personal experience to express their opinion. Participants, that is, engaged in thinking about how their experience related to the question or topic under discussion and constructed their comments accordingly. In responding, for example, to a question posted by the professor concerning acceptance of the information age, Chesley commented:

> When I graduated from my education program here at Memorial eight years ago, there was absolutely no technological influence or aspect at all in my program. It was not until I had been teaching about four years, that I caught the "fever." Therefore, my own personal acceptance of this valuable asset was quite slow. At this point in time however, I have absolutely no problem with saying that I would be lost without it!! I currently teach on a staff of thirteen and I think that it is safe to say that myself and perhaps three others regularly make use of the technology. I do not feel that all educators have actually accepted the technology and there may be a couple of possible of reasons for this (Chesley, WebCT: No. 27: Jul. 3, 1999, 17:10).

Chesley drew upon his own personal experience concerning the acceptance of technology in education to formulate his response. He then went on to discuss acceptance of the information age with respect to the other teachers on his staff. A deep level of thinking was evident in his comment, for in addition to drawing upon his personal experience, Chesley also engaged in metacognitive activity as demonstrated by his awareness of how he gradually accepted the use of technology in schools.

Metacognition was commonly observed when participants drew upon their personal experience to construct a comment. Drawing upon personal experience then seemed to encourage participants to reflect upon both their ability to contribute to the discussion, as well as to their approach to constructing their comment. Engagement in metacognitive strategies indicated that participants were thinking about their own cognitive states (Resnick, 1989). In responding to a question posted by the instructor, Paul, for example, is quite willing to elaborate on why he feels he lacks the same level of technological knowledge and skills as his peers:

> Having read through all of your postings to date I feel somewhat overwhelmed with your responses. It appears that I may have the least amount of both knowledge and experience with computer use. An explanation as to why rather than an excuse is that the school that I work in has very limited access to the computer lab. The school did not come on line until this past May. Up until this point students used programs installed basically for drill and practice (Paul, WebCT: Article No. 125: Jul. 21, 1999, 21:21).

Participants often thought about how their background knowledge concerning the issue under discussion impacted their ability to contribute to a topic. Metacognitive behavior, that is, was also observed when mkb drew upon personal experience:

> This question is a little difficult for me to answer, namely because I don't have a classroom or students that I would normally teach. I have taught students from grade six to grade twelve in every subject area save French and Home

> Economics. However, the issue of online instruction is the broad umbrella which my research interest do lie and in answering this question, I will try to close that umbrella upon the area that I do know a little about (mkb, WebCT No. 68: Mon, Jul. 12, 1999, 00:45).

In his comment mkb demonstrated an awareness of his ability to comment on a question that was posted by the instructor. He than continued on to discuss his background experience with respect to the topic and ultimately decided to discuss the issue based upon his current understanding.

Overall comments consisting of opinions based upon personal experience were generally indicative of deep thinking conducive to knowledge construction. Susan's comment generated as a response to a question posed by the professor concerning the integration of technology in the classroom, indicated that she engaged in comparative thinking as well as identifying a problem and defining it with supporting examples:

> It has been my experience that technology has not been introduced but been given and people told here go use it. I think there is much confusion around this. Some schools have the privelege of having a computer teacher to facilitate and dispere information to staff and students. While other schools have been just bought programs and those who are interested use it, those who are not, don't use it. There has been little direction provided and I believe it depends on school iniative and priorities of both administation and staff. In my school, one person has been designated (because of personal interest), to be the technology person (Susan, WebCT: No. 31, Jul. 4, 1999, 14:53).

In her comment Susan drew upon her personal experience to support her opinion concerning the integration of technology in the classroom. In comparing how technology has been introduced into different schools, Susan essentially generated examples to support her overall analysis of how computers are being introduced in the school system.

Participants also generally appeared to actively engage in formulating a reply when drawing upon personal experience to respond to an instructor's question. In commenting on the challenges of integrating technology in the classroom Roxanne responded:

> In my experience, there is a hesitation to change "tried and trusted" strategies to include technological advances. This change in methodology requires a willingness to adapt. Yet, the challenge lies in how we can ease this transition? Teachers must reach a comfort level with this new technology if they are to be able to effectively integrate it into their existing methodologies. Thus, inservice training is essential. However, financial contraints limit inservice time (Roxanne, Article No. 63: Jul. 11, 1999, 01:24).

It appears that Roxanne had carefully reflected upon and analyzed her experience in school regarding the integration of technology in the classroom. Her comment indicated that she engaged in idea generation by synthesizing a solution to the problem of technology integration while her point concerning financial constraints indicated that she considered the problem from a variety of viewpoints.

Deep consideration of issues was also apparent in another comment posted by Roxanne:

> In my experience, teachers who are in the latter years of their career seem to be less likely to attempt to use the technology available to them...Maybe, a fear of the unknown? They have developed teaching methods and strategies that they have found to be quite productive, thus "Why fix what isn't broken?"...Maybe a fear of the unknown? Conversely, teachers who have had exposure to the advantageous characteristics of technology use (through recent professional development, university training, inservices, etc.) tend to be more willing to accept new trends and try new strategies...Maybe a constant search for bigger and better things? Yet, the important aspect of this issues is student learning and achievement! We must be cautious not to lose sight of the purpose of our role as teachers (Roxanne, No. 57: Jul. 8, 1999, 10:24).

Here Roxanne interpreted her experience and formulated a conclusion concerning why some teachers might be reluctant to use technology in their classroom. Again she viewed the issue from an alternative viewpoint as indicated when she commented on teachers who are not reluctant to use technology in their classroom and provided some reasons for it. Roxanne also generalized the overall issue by recommending some advice to teachers regarding the role of educators in the classroom.

Drawing upon personal experience to generate a response was also observed when participants replied to comments posted by other members of the computer conference. Like comments resulting from participants replying to a question posted by the professor, comments generated in response to another member's posting frequently contained indication that participants were thinking deeply about the topic

they were discussing. For example in replying to Ann's comment about the role of teachers in the classroom, Chesley replied:

> You are right Ann. Our role is changing from the transmission of knowledge \ to facilitating the acquisition of knowledge. I have never had a problem with saying that I do not know an answer, particularly when it comes in the domain of technology and I often ask students for their help on some things. I have certain students that I like to ask and they do not mind helping. I think this helps to build their confidence (Chesley, WebCT: No. 55, Jul. 8, 1999, 09:43).

In his reply, Chesley agrees with Ann and uses his personal experience as supporting evidence for his argument concerning the changing role of teachers. He also infers how students he teaches have been impacted by the integration of technology in his classroom.

Throughout the computer conference, participants frequently drawing upon their personal experience to identify and define a problem also used their experiences as grounds for synthesizing a solution. While sharing their personal experiences, that is, participants often identified problematic issues related to technology and education and in the process of discussing their experiences generated a means of solving the problem.

> Susan: Your response to question one was on the mark! I guess we all experience this sort of thing in whatever we take on in schools. Some teachers/administrators are all a go and others refuse to participate at all. Some times I question who is better off in this situation. Certainly not the children , but some of these teachers are not the least bit concerned about not being

> involved and more often than not the issue is not discussed by the administration. I feel that for computers or any program for that matter to work the administration should be giving directives to teachers and require some level of involvement (Paul, No. 110: Jul. 17, 1999, 10:49).

Here Paul drew upon his personal experience to agree with Susan's perception of the problem concerning how technology was being integrating in schools. He then offered further elaboration by analyzing how different teachers and administrators deal with the use of technology in their school. Additionally Paul engaged in reflective thinking by questioning who is better off with regards to the use of technology and suggested that it is certainly not the children. Finally, having reflected and elaborated upon on his experiences in schools, Scott synthesized a solution to what both Susan and he perceived as a problem with the integration of technology in the educational system.

The following comment again demonstrates drawing upon one's personal experience to help define a problem and to synthesize a solution to it.

> I believe the biggest challenge in preparing a school for the introduction of computers is ensuring the staff are comfortable with the technology. If staff feel intimidated by the technology, the introduction could become unsuccessful. By providing the necessary training for the teachers and giving them the support that they need success will be on the way. I also believe that expectations need to be laid out for all of the teachers. What kinds of activities are the teachers expected to use the computers for?
>
> I was at Acadia University in 1990 when they introduced the Acadia Advantage, a highly technical program where students were required to

> purchase a laptop for use with their programs. Initially, professors were not very happy with this program. They were given their computers and expected to change courses to meet the new requirements. They were expected to post notes on the web, email assignments, and use the computers for the entire course. Professors, with no computer experience, were not given any training. The program went through a very bumpy beginning (Sarah, WebCT No. 28: Jul. 3, 1999, 18:09).

In generating this comment Sarah had obviously identified similarities between what she experienced at a university level regarding instructor utilization of technology with what had been discussed in the computer conference concerning the integration of technology in the public school system. Having offered a problem by drawing upon her personal experience Sarah then synthesized a solution.

A number of students suggested in the questionnaire that reading the ongoing discussions in the computer conference encouraged them to reflect upon their own teaching experiences. Reflective thinking in the computer conference appeared to have occurred when participants presented their viewpoint in light of their personal teaching experience. In the process of drawing upon their personal experience participants called upon their prior knowledge in order to think about how their own personal experience related to the topic under discussion. Such self-reflective thought can lead to knowledge construction for it often forces individuals to think about information in a new way (Kincheloe, 1993).

Although drawing upon personal experience to generate a response was a typical way of commenting in the computer conference, participants did not limit this

pattern of responding to one form of cognitive activity. The indication that participants considered their personal experience to define problems, synthesize solutions, formulate conclusions, infer, and engage in metacognitive activity (Newman et al., 1997; Ennis, 1986), suggested that they actively engaged in higher order thinking and generated understanding by reflecting upon their personal experience in order to construct ideas for sharing in the conference.

Participants also frequently engaged in asking each other questions concerning their experiences with the use of technology in the school setting. Such questioning appeared to be for the purpose of seeking clarification on an issue and was usually responded to with an elaborate answer constructed from the respondent's personal experience. Scott commented, for example, "Rich this idea of a paperless course is very interesting. It is something that we are just beginning to consider in Bonavista. I'm curious however. Is there apprehension among some of your less technicc1 members of staff, are they afraid they may have to eventually teach their courses in this way" (Scott, WebCt No. 107, Jul 16, 10:11).

Rich responded to Scott by providing an elaborate answer that lead into a discussion of the school climate where he works:

> I don't think there is a level of apprehension about any tech implementations, as so far they have been improvements in one way or another. The introduction of winschool has been great in many ways but also is an inisidious way to download administraivia to the homeroom teacher. There is no pressure to teach paperless courses even within the technology "dept." This speaks a ltle to school climate ... One of teachers wins an award

just about every time he changes his socks, he was once asked while in the states to pick up another award for the science dept. web site (hey ... he brougt me back a T shirt... and it fit!! :)) somebody asked him..."how do you MAKE your teachers do all that work?" Pat looked at him and thought... you just don't get it do you? (rich, WebCT No. 124: Jul. 19, 1999, 23:39).

Chico (self chosen pseudonym) also elaborated on her personal experience to provide an answer when Chesley asked "do you monitor the internet activity of your students in any way? If so, how? If not, Why? (Chesley, WebCT: Article No. 115, Jul. 17, 1999, 15:28).

Chico replied:

Yes, we do monitor students as such in the use of the Internet in the lab. We mainly just observe their activities and if they get into an inappropriate site, they are to back out immediately. Upon speaking to our technology teacher and discussing the WinGuardian or Net Nanny concept, she said that these sometimes block out important information such as information that could be used for high school biology courses. I tend to agree with her on this. I was speaking to another technology teacher last summer and he had some kind of monitoring system set up so he could go back to the server and see the URLs of the sites that have been visited by all the students. I'm not sure of which program it is, but he said that just the mere threat of checking the visited sites was enough for the students to be careful of where the went on the Internet. Hope this helps (WebCT No. 118: Jul. 18, 1999, 12:16).

Although not for the purpose of initiating debate, participants questioning each other, was viewed as a socio-cognitive activity that encouraged knowledge construction. Studies have shown for example, that when individuals provide explanations, learning is enhanced for the one doing the explaining. Answering questions in a group setting involves individuals making their ideas explicit and accessible to both themselves and the group such that understanding emerges as the individual elaborates, evaluates and integrates knowledge in new ways (King, 1990). Furthermore, the participant receiving the elaborate answers is also encouraged to generate meaning for in receiving a question well answered one is likely to connect the new information to one's prior knowledge. Participants questioning each other in the computer conference, then, likely encouraged knowledge to be constructed by both the individual providing the explanation as well as the participant receiving it.

Asking questions seemed to provide a means for participants to gain further insight into how other professionals in their field dealt with the various issues discussed in the computer conference. Insight gained from receiving responses to such questions seemed to provide a means for participants to formulate their own opinion on issues. A number of participants for example suggested in the questionnaire that they found collegues sharing of expertise a very valuable aspect of the computer conference. Participants reading the experiences of others suggested they gained further insight into issues that were discussed. As was frequently indicated in the questionnaire, participants used the knowledge, expertise, and perspectives shared by others, as a bases for constructing their own understanding of the topic. Ann

suggested for example that a valuable aspect of the computer conference was receiving the perspectives of others on various topics, which improved her awareness of the issues facing teachers today. As was indicated then, drawing upon personal experience benefited both the participant sharing their experience as well as those members reading about the experiences of others, for in each situation the participant was encouraged to modify their existing knowledge structure.

Referring to relevant outside information

Another socio-cognitive constructivist behavior commonly exhibited by participants in the computer conference was referring to relevant outside information when discussing a topic. Participants indicated in the questionnaire that conceptual restructuring resulting from seeking outside sources of knowledge to use in building their comments. Most participants, that is, suggested that they were motivated to seek outside information for the purpose of encountering new ideas and gaining a wider view and understanding of the topics covered in the course. Participants also viewed utilizing outside information as a means of furthering their knowledge and assisting them in contributing something that was valid to the discussions.

Relevant outside information consisted primarily of URLs containing information relevant to the topic under discussion and to a lesser extent, quotes from journals and other forms of written text. Participants, that is, often constructed responses by quoting outside sources of knowledge or providing URLs containing information relevant to the topic under discussion. In responding to Scott's comment

about the need for professional development, for example, Chico utilized outside information to formulate her point:

> Hi Scott, Yes, I have been reading alot of articles regarding teachers and the need for professional development. In our school in particular, we have about three or four teachers who pretty much"lead" in regard to technology. Some of the others are using technology but there are others who use it as little as possible because of their unfamiliarity with it and I guess, the fact that they don't see the particular relevance of it. Here are the links to a few articles, if you wish to take alook:
>
> http://cmifves.iserver.net/fromnow/FNOMar93.html
>
> http://www.gt-tv.net/education/k12/staffdev/techin/studentinserv.html
>
> http://www.oise.on.ca/~mfryatt/training/plusfact.htm
>
> http://www.coe.uh.edu/insite/elec_pub/html1995/087.htm
>
> http://www.coe.uh.edu/insite/elec_pub/html1995/0817.htm
>
> http://www.coe.uh.edu/insite/elec_pub/html1995/083.htm
>
> http://www.coe.uh.edu/insite/elec_pub/html1995/0816.htm
>
> I found these articles particularly useful. Hope they are of benefit to you (Chico, WebCT: No. 186: Jul. 30, 1999, 11:21).

It appears that Chico had given her posting some obvious thought. Chico identified additional information as relevant to the topic, and used it as supporting evidence to argue the need for professional development with teachers in her school. In addition to bringing outside information to bear on the topic, Chico also engaged in a number of other cognitive activities. That is, she also utilized her personal experience to hypothesize why teachers are reluctant to use technology.

Similarly, in commenting on an in class discussion concerning a number of issues fundamental to online courses, Cathy also referred to outside information and demonstrated that she gave her posting some reasonable reflective thought.

> There appears to be much dispute and uncertainty as to the role of the technician and that of the teacher. I would argue that in the case of online instruction, the individual responsible must not only be a teacher, but also somewhat of a technician. It is highly unlikely that we will have qualified online instructors if the teachers of today are uncomfortable with new technologies. A 1995 report from the Office of Technology Assessment, Making the Connection, estimated that less than a quarter of teachers had managed to integrate technology in the classroom. (ftp://gandalf.isu.edu/pub/ota/teachers.tech/01readme.txt)
>
> As well, the annual Technology In Education 1998 report from Market Data Retrieval states that while Internetaccess has increased dramatically, just 7% of schools claim that the majority of their teachers are at an Advanced skill level (i.e. able to integrate technology into the classroom) (http://www.schooldata.com). Thus, if online teaching/learning is becoming a major trend in education, it is essential to effectively train these effective but perhaps technology reluctant teachers. To not do so may result in missing out on the opportunity to have very skilled teachers offering online instruction (Cathy, WebCT No. 207: Aug. 1, 1999, 16:47).

It appears that Cathy had considered and reflected upon what was discussed in class and from this cognitive activity she concluded that there is much dispute and

uncertainty about the role of technician and teacher. Cathy drew upon outside information to support her argument and used the outside information to infer a conclusion to explain what is required to effectively develop the online teacher. Additionally she predicted an educational outcome for online instruction when teachers feel uncomfortable with new technology.

Relevant outside information in the form of quoted text was also utilized in generating a comment. Like other comments utilizing outside information, the following one also demonstrates a variety of higher order cognitive behaviors:

> I believe that it is even overly accepted. By this I mean that people (teachers, administrators, and parents) are jumping on the technology (computer) bandwagon, without first knowing why or if we really should be. When this discussion comes up, I am always reminded of a quote from an Atlantic Monthly that I read some years ago:
>
> "In 1922, Thomas Edison predicted that 'the motion picture is destined to revolutionize our educational system andà in a few years it will supplant largely, if not entirely, the use of textbooks.' Twenty-three years later, in 1945, William Levenson, the director of the Cleveland public schools' radio station, claimed that 'the time may come when a portable radio receiver will be as common in the classroom as is the blackboard.' Forty years after that the noted psychologist B.F. Skinner, referring to the first days of his "teaching machines," in the late 1950s and early 1960s, wrote, 'I was soon saying that, with the help of teaching machines and programmed instruction, students could learn twice as much in the same time and with the same effort as in a standard

classroom.'"

> Computers are the teaching machines of the 1990s. And while the President of the United States wants to wire every single classroom in America and the Ontario Minister of Education wants a computer on every desk in the province, I believe it necessary to beg the question "Why?" This is not to say that we shouldn't incorporate computers into our classrooms or that we shouldn't teach our students computer skills. There is no denying the fact that computers will be a part of their lives in their entirety and that they will have to know how to operate a PC to get by in life.
>
> However, does this mean that we need to incorporate computers and technology into our Mathematics, Science and Social Studies lessons? This is the question which teachers must begin to consider as we stand in front of our students. This question basically boils down to two parts. The first "Is the technology available to do what I want to do in my classroom?" The second "Are there strong pedagogical reasons to be using this technology at this time?" As partners in the education process (teachers, administrators, and parents), I fear that we are too consumed by the first question and pay little heed to the second (mkb, WebCT No. 40: Jul. 5, 1999, 18:56).

In this posting mkb quoted an outside source as he drew upon his previous experience to formulate a response. He then used his prior knowledge as the bases for his argument. Mkb than continued on to critically assess what he had concluded were society's reasons for accepting the use of technology in education. Mkb refocused the issue concerning the integration of technology in schools with alternate questions that

suggested educators should consider the availability of appropriate technology and the pedagogical reasons for using it rather than using technology as a teaching machine. Mkb appeared to use questions as rationale for his argument.

The addition of outside information to the computer conference, in the form of URLs can be discussed with regards to "Cognitive Flexibility Theory" (Spiro, Feltovich, Jacobson, & Cousin, 1992, p. 61). Cognitive flexibility theory, a prominent constructivist notion, essentially emphasizes the non-linear presentation of instructional material such that individuals have the opportunity to re-visit the same conceptual material from different points of view. Hypertext consists of computer based text that are read in a nonlinear fashion organized on multiple dimensions such that the same material is capable of being explored in different ways, with different exploration paths (Spiro & Jehang, 1990).

Embedding URLs in conference postings essentially created an interactive environment consisting of hypertext which participants could navigate according to their own personal interest. The interactive environment provided the opportunity for both the participants not only creating the hypertext but those navigating through it as well, to re-conceptualize issues in a non-linear manner. Most participants in this computer conference did indeed indicate in the questionnaire, that their understanding of issues was improved from reading other participants' posting and visiting their links. Participants in the computer conference further indicated that a valuable aspect of their learning was exposure to a variety of viewpoints. Consequently, as a result of navigating through the hypertext, one may suggest that participants gained a better

understanding by re-considered their beliefs in terms of another's idea (Knuth et al.. 1993).

Participants indicated that reading comments, which contained outside information was beneficial to their learning for they suggested in the questionnaire that reading a variety of sources of ideas served as a good prompt for their own thinking. Furthermore, as indicated in the conference postings participants found that reading the many views expressed in the responses both interesting and thought provoking (WebCT No. 42, Jul 5, 1999 23:28). The usefulness of reading outside information was further indicated in the questionnaire by Chico's response, "my learning was enhanced by conversing with other students in the course and visiting their postings and links." Chico's response was typical to that offered by most participants who again generally indicated that they found there learning to be "higher than what they [I] would have gained from traditional classroom discussions" (frank [*sic*]).

Typical of many responses to comments containing attached URLs was Sarah's reply to Sheryl's posting about tools for developing interactive web courses, "I took a look at this site and it is very interesting and I think it will be of some help. Thanks for drawing attention to it" (Sarah,WebCT No. 146: Jul. 25, 1999, 12:59). It appeared then by sharing a variety of idea in the conference, participants were encouraged to connect the new ideas to their existing knowledge structures. Viewing issues from multiple viewpoints provided ample opportunity for participants to construct a more richly integrated and complete cognitive representation of the material (King & Rosenshire, 1993).

Exposing individuals to a variety of perspectives on an issue is a fundamental aspect of a constructivist learning environment. The constructivist view emphasizes that learning arises as individuals attempt to see an issue from different vantage points for in considering a variety of viewpoints individuals are encouraged to modify their cognitive framework (Bednar et al., 1992). In the computer conference investigated for this study participants were provided with many opportunities to access and share a variety of ideas on issues. In addition to perspectives contained in the outside information, the perspectives of participants also served to expose members of the conference to a variety of ideas on an issue. It is likely than that participants were encouraged to restructure their thinking as they considered and reflected upon opinions and ideas presented in comments posted to the conference.

Participants also often engaged in judging the relevancy and/or usefulness of outside information contributed to the computer conference. When utilizing outside information to discuss an issue, for example, frank judged its value by drawing upon her personal experience. For example, in referring to numerous Websites to discuss the best characteristics of online instruction frank commented:

> Sites such as these allow students to actively participate in real activities and encourage them to take a stand for their beliefs. I have found that these sites are extremely effective in keeping students focused and active. My observations reinforce the statements made in The Teaching Web: A Guide to the WWW for all Teachers (http://www.edu.yorku.ca/~rowston/chapter.html).

> Moreover, the web can help us refocus our institutions from teaching to learning, from teacher to student . . .Teachers can encourage students to explore the Web with the goal of having them weigh evidence, judge the authenticity of data, compare different viewpoints on issues, analyze and synthesize diverse sources of information and construct their own understanding of the topic or issue at hand (frank, WebCT: Article No. 72; Jul. 12, 1999, 11:59).

Here frank drew upon her experience with using various Websites in her classroom to judge how effective they were for student learning. Frank then generalized the issue by making a number of conclusive statements concerning the usefulness of the Web for educational purposes.

Both utilizing and reading outside information appeared to encourage knowledge construction among participants. In utilizing outside information in comments, participants incorporated a number of higher order cognitive behaviors, such as drawing on personal experience, summarizing, hypothesizing, generalizing, analyzing and inferring conclusions all of which suggested that critical thinking had occurred (Newman et al., 1997; Henri, 1991) and therefore further indicating that participants thought deeply about issues and engaged in constructing their own understanding of them. In utilizing outside information participants essentially connected concepts discussed in the course with those in the outside material and thereby made connections between various sources of knowledge (King & Rosenshire, 1993). Participants reading other student's postings containing outside sources of ideas also indicated that their understanding of issues improved as a result

of reading linked information presented in the comment. Active learning through constructing understanding then was indicated for both the presenter and reader of outside information.

Elaborating upon other's ideas

Another type of behavior typically exhibited in the computer conference was responding to other participant's postings by building upon their ideas and opinions. Elaborating upon other's ideas and opinions often consisted of participants drawing upon their personal experience as well as bringing outside information to bear on a topic. In the computer conference investigated in this study, more elaborate understandings appeared to result as participants mutually discussed issues and exchanged ideas with other members of the conference (Morttunen, 1992).

When building upon other's responses, participants generally indicated in the early part of their comment that they shared the ideas and opinions of the participant they were responding to. After the responding participant indicated that they shared the same ideas and opinions, they continued on in their response to elaborate upon the ideas and opinions contained in the initial posting. Elaboration tended to incorporate a variety of higher order cognitive behaviors indicative of critical thinking:

> Thanks rich. I agree with you on the need for a technology course in teacher education. I would think that this course would have to be practical and hands-on while not concentrating on theory. Once students have achieved comfort with the technology, then maybe another course could be offered to deal with the integration of technology into the curriculum (Chesley, WebCT:

No. 54: Jul. 8, 1999, 09:39).

Here Chesley stated that he agrees with rich and then continued on to elaborate on rich's idea by generating and predicting what a technology course for teachers should consist of. Furthermore, after discussing with rich the need for a technology course, it seemed that Chesley applied the information to a new situation by generating a program of courses to deal with the integration of technology into the curriculum.

It was also noted that when participants built upon other's ideas and opinions they generally paraphrased them before providing further elaboration. For example. Chesley, agreed with and then paraphrased rich's idea before elaborating upon his comment:

> Good point rich. I tend to think along the same lines. Computers may not be related to higher achievement but it does allow the teacher to present his/her material more professionally. Let us not forget also that most children like working with computers and if they enjoy it, maybe they will apply themselves more (Chesley, WebCT No. 56: Jul. 8, 1999, 09:49).

Participants also replied to questions posted by the professor by building upon other's ideas and opinions. Again, such comments incorporated numerous cognitive behaviors indicative of deep and critical thought. In responding to the professor's question concerning the benefits of online instruction, Chesley quoted another participant and offered further elaboration on that participant's idea.

> In terms of my teaching situation, the usefulness of technology and on-line instruction is perhaps best summarized with a quote from Susan's response to this topic. She states that "on-line learning is the way to bridge the

> geographical restrictions and cultural barriers." I could not have said it any better myself. This is probably the best characteristic from my vantage point. In my particular situation, we are so isolated that the students do not even realize that there is a whole world that awaits them out there. Consequently, technology allows my students and I to access new and current material without having to rely on outdated ancient textbooks that kill the students interest rather than inspire it.
>
> "One of the most essential pedagogical principles of language teaching is one that emphasizes the study of language in a cultural context" (Singhal, 1997, p.4). It brings the second language culture closer to the students and their classroom as well as enhances and facilitates communication in the target language (Chesley, WebCT No. 119: Jul. 18, 1999, 21).

Chesley, who also teaches a second language in a remote community, built upon Susan's idea by relating it to his particular prior experience or knowledge. Chesley also drew upon sources of knowledge outside the regular course content to support his point. Additionally, he discussed the advantages of using technology for second language learning and supported his argument by quoting an outside source and providing explanatory examples of how technology can be advantageous to his students.

Where participants were seen to engage in building upon other participant's postings, the co-construction of ideas resulted. While elaborating upon other comments, students responded to each other's ideas in a collaborative manner as

demonstrated in the following discussion regarding the challenges of preparing schools for the introduction of computers. rich posted:

> The only point that I would like to make is that while our recent graduates (B.Ed) have the opportunity to avail of technology, many still leave this faculty with little or no computer skills. At the recent Tech Ed Special Interest Council AGM a motion was carried that there should be a technology course included in the requirements for any B. Ed. (rich, WebCT: No. 39, Jul. 5, 1999, 16.2).

mkb than relied:

> There was actually one person who completed the B.Ed. (Secondary) when I did (Sep. 97-Aug. 98), who completed every single assignment that he handed in with a pen and loose leaf. He didn't take any of the computer (there were only two anyway) courses and didn't use them at all, even as a word processor (mkb, WebCT: No.45, Jul. 6, 1999, 17:08).

Chesley provides further elaboration on this topic by also replying to rich's posting:

> Thanks Rich. I agree with you on the need for a technology course in teacher education. I would think that this course would have to be practical and hands-on while not concentrating on theory. Once students have achieved comfort with the technology, then maybe another course could be offered to deal with the integration of technology into the curriculum (Chesley, WebCT: No. 54, Jul. 8, 1999, 09:39).

These students appeared to build upon their knowledge through interaction and co-operation with their peers (Hillman 1996). Student responses in the questionnaire concerning their learning within the computer conference supported the notion that

elaborating on each other's comments helped them further and clarify their understanding of topics covered in the course. By elaborating on each other's ideas these students provided each other with on opportunity to expand upon their previous knowledge and to build a more elaborate understanding concerning the integration of technology in the classroom.

As indicated in the questionnaire, participants found reading other's postings helped to further their understanding of topics such that they developed more a complex understanding of issues. Furthermore as participants elaborated upon other members' comments a more complex understanding was seen to evolve. That is, through elaborating upon participants' ideas, collaboratively constructed knowledge emerged. For example Chesley stated:

> James also points out that students can present unique challenges to the introduction of computers into schools in that they need to be taught responsibility in its' use as well as they need to be prepared to cope with the rapid changes in the educational context. I also think that they need to be encouraged to make use of and take advantage of the growing opportunities to employ the technology. They need to be shown the value and practical uses of technology. While this can sound easy, it is often more difficult than it looks. Teachers have to develop and integrate ways that will provide students with this awareness and knowledge (Chesley, WebCT: No. 27, Jul. 3, 1999, 7:10).

By elaborating upon James idea, Chesley helped construct a more complex perspective such that through collaboration these participants seemed to generate a more complete

understanding concerning the challenges that students present to introducing computer in schools.

Elaborating upon other's ideas then indicated that participants were often actively engaged in thinking about what others had contributed to the conference. As a form of conceptual restructuring (King & Rosenshire, 1993) paraphrasing likely encouraged participants to relate the new information contained in the discussion to their own prior knowledge. Furthermore, in the absence of debate, more complex concepts were none the less constructed but through the co-elaboration of ideas. Consequently, it appeared that the co-elaboration of perspectives was a crucial socio-cognitive constructivist behavior exhibited in this computer conference. By sharing perspectives online, a variety of higher order cognitive activities were engaged in by participants, such that they were encouraged to build upon their existing understanding. By considering not only their own personal experiences, but the experiences of others as well as the ideas and opinions expressed in outside relevant information, participants were lead to engage in numerous forms cognitive, metacognitive, and reflective activity indicating that they reformulated their understanding as they constructed understanding for themselves.

Reflective and Metacognitive thinking

As illustrated earlier in this discussion, both reflective and metacognitve thinking were engaged in by participants as they posted comments to the computer conference. Reflective thinking was also apparent in the following comment:

Having had time to reflect upon some of these issues and follow up with some

> reading, I would like to add four new criteria to our class list. It can perhaps be argued that some of my ideas may fall under the auspices of what has already been discussed, however, they do contain components that we have not already examined (frank, WebCT: No. 204, Jul. 31, 1999, 19:59).

Not only did frank take the time to reflect upon her thoughts she also researched the topic before contributing her ideas to the discussion. Another participant, Ann, also indicated that she engaged in reflective thinking when commenting that, "I read through the questions and the first three chapters in the text and decided to mull over a few ideas before sitting down to write up a response" (Ann, WebCT No. 32: Jul. 4, 1999, 21:26).

Reflection and metacognitive thinking were further observed as occurring while participants were composing a response to the conference. Susan, for example, engaged in reflective and metacognitive thought when she commented "as I write this I think that there should be more support and direction from the Department of Education. However, I'm not sure how this could be realistically facilitated" (Susan, WebCT No. 31: Jul. 4, 1999, 14:53).

Both reflection and metacognition seemed to play an important role in cognitive restructuring. Most students indicated in the questionnaire for example, that participating in the computer conference encouraged them to think more deeply and critically about issues covered in the course and the asynchronous communication gave them the chance to reflect on topics and projects. Most participants also indicated that they engaged in metacognitive thinking as their participation in the discussions encouraged them to assess their knowledge (Henri, 1991) by engaging in

questioning their previously held assumptions about issues covered in the course. Through reflective and metacognitive thinking then participants were encouraged to actively process information and in so doing actively re-structure their thinking (Cobb 1996).

Cognitive restructuring

For the most part, cognitive restructuring or the re-organizing of ones thinking was not a behavior directly observed in the computer conference but was inferred from the socio-cognitive constructivist activity engaged in by the learner. The notion of cognitive restructuring resulting from sharing information and ideas online was indicated in the questionnaires when participants suggested that reading other people's postings and visiting their links helped them to gain a better understanding of topics covered in the course. At times, however, instances where participants directly stated that they restructured their thinking as a result of participating in the conference discussions were observed. When responding to the professor's question concerning whether the increase of computers in school makes a difference Ann commented:

> Initially I was going to say yes, the increase in computers has made a difference. But after reading Scott's (I think??Forgive me if I mixed up individual comments) comments I tend to agree with him as well. So I guess my new answer is yes and no!! I believe that an increase in computers within schools will greatly improve computer literacy for students. The more opportunity for exposure and utilization of computers, the more computer literate our students may become (Ann, WebCT No. 32: Jul. 4, 1999, 21:26).

Here Ann had restructured her thinking as a result of reading other participant's postings. She then elaborated upon her new perspective by suggesting a relationship between the opportunity for exposure to computers to computer literacy. Cognitive restructuring was also evident in the following comment:

> The discussion around this topic has been interesting and enlightening for me. There are clearly many ways that teachers can imagine to make use of computer capabilities in the classroom. My own interpretation of the question focuses on the use of the web to deliver all or a significant part of a course (Fred, WebCT No. 122: Jul. 19, 1999, 15:30).

In his comment Fred indicated that he had gained insight into the topic of teaching online by reading the computer conference discussion on this issue. Again a co-elaborated and co-constructed understanding appeared to result as participants co-operatively shared ideas rather then debated opposing viewpoints. Fred, for example, did not question the perspective of the other participants but suggested that by reading the ongoing discussion he furthered his knowledge about how teachers can integrate technology into the classroom.

Having inductively analyzed the conference transcripts in light of the responses to the questionnaire, it appeared that participants in this computer conference constructed knowledge. Based upon constructivist theory, I viewed all thoughtful responses or comments indicating that participants engaged in deep and critical thinking as indication that they engaged in constructivist activity and actively restructured their cognitive framework (Jonassen, 1991).

Intervention by the professor

In this computer conference the professor intervened for the purpose of providing individual students with positive feedback concerning their response to a question or for a response they made to another participant's comment. The professor did not question individual students on their responses and therefore did not engage in probing participants to "expand and build upon their comments" (Mason, 1991). All questions posed by the professor were presented to all participants in the conference. Any individual questioning posed to participants occurred when participants asked each other questions concerning their personal experiences related to the issues being discussed.

Second model of the knowledge construction process

As a result of inductive analysis conducted on the computer conference transcripts it became evident that a more suitable model of the knowledge construction process was required. As mentioned, the dialogue, which occurred in this computer conference, was generally not a form consistent with knowledge building through critical evaluation and debate of conflicting viewpoints. Constructivist activities did not appear to result from prolonged argument or debating opposing viewpoints, but from the co-elaboration of ideas whereby participants appeared to build upon or reconceptualize their existing knowledge structures.

While interpreting my results it became obvious that debating conflicting viewpoints is not the only prerequisite for engaging in constructivist activity. Although conflict can trigger constructivist behaviors, knowledge construction can

also result from processes of co-elaboration and the co-construction of meaning (Brown & Palinscar, 1989). Thoughtful commenting whereby individuals engage in actively processing information as a result of interacting and sharing information with others is indication of constructed understanding. According to the strong constructivist assumptions, that is:

> "everything an individual knows is personally constructed. But directly experienced events is only part of the basis for construction. People also build knowledge structures on the basis of what they are told by others, orally in writing, in pictures, and in gestures. Our daily lives are filled with instances in which we influence each other's constructive processes by providing information, pointing things out to one another, asking question, and arguing with and elaborating on each others' ideas (Resnick 1991 p. 2).

As a result of inductively analyzing the transcript data, I developed a second model of knowledge construction (Appendix G). This second theoretical model was developed based on my discovering a variety of interactive behaviors deriving from co-elaboration and the co-construction of knowledge (Brown et al., 1989). Through my inductive analysis, I noticed that participants frequently engaged in sharing information and ideas by building upon what others had to say. As participants elaborated upon ideas they frequently drew upon their personal experiences as well as referred to outside information to generate their comment. In building upon other's ideas and opinion expressed in the computer conference, participants collaboratively constructed knowledge by jointly building upon concepts articulated in the conference

by both themselves and other members of the discussion (Harasism, 1993; Jennings & Di, 1996). As participants co-elaborated online they engaged in reflective and metacognitive thinking as well as numerous other forms of higher order cognitive activity and actively built knowledge by socially interacting with their peers.

Chapter V

Conclusions and recommendations

Analysis of the transcript and questionnaire data collected from the computer conference investigated in this study revealed that students participating in the computer conference constructed knowledge as a result of socially interacting with their classmates online. It appeared that through co-elaboration, participants co-constructed knowledge by building upon each other's ideas and developing more elaborate understandings of the issued discussed. Participant responses in the questionnaire confirmed this interpretation regarding how students co-constructed understanding while engaged in online dialogue. Participants, for example, generally felt that they had generated ideas and gained more insight as a result of sharing ideas and information with their classmates. Dave suggested, for example, that he found the computer conference provided a non-linear experience that allowed him to synthesize ideas from the readings, class notes and the conference discussions. Similarly rich felt that he had gained a wider view and understanding by building upon what he already knew. In other words, these students suggested that they actively constructed ideas by conversing with their classmates and building upon their prior knowledge.

The results of my study essentially demonstrated that in an environment where students are encouraged to access and share ideas through written communication, (Harasim, 1989) learning founded upon constructivist approaches occurs. As an environment where participants had the opportunity to hold open discussions on issues of mutual interest (Berge & Collins, 1995), the computer conference investigated in

this study appeared to encourage students to become actively involved in generating more complex knowledge structures. As participants shared and built upon ideas presented to the discussions, they were encouraged to access and actively work with information in order to construct comments for sharing with the group. Glen, for example, stated that "the conference often resulted in a search (usually on the net) to expand or support a position." By searching for information to expand or support a position, this student, like most participating in the computer conference, was actually encouraged to access and manipulate information, and in the process, construct a more elaborate cognitive framework (Jonassen et al., 1993).

The integration of computer conferencing for the purpose of encouraging individuals to engage in open dialogue whereby they collaboratively build on ideas and concepts appears to offer a type of learning based upon constructivist principles. In order to determine whether participants learning via computer conferencing engage in knowledge construction, indicators as outlined in my second model of knowledge construction could be looked for in the conference exchanges. Where participants are not seen to engage in such socio-cognitive activity, the professor could act as facilitator by asking questions, and probing for responses in order to encourage students to elaborate their ideas to the group. In such a computer conference where participants observe others asking thought provoking questions, receiving elaborate answers, and constructing their own knowledge structures, higher levels of cognitive functioning conducive to knowledge building could be observed and subsequently modeled.

Additionally, by providing an appropriate level of questioning the professor would be utilizing student's zones of proximal development such that they would be encouraged to develop new more elaborate ways of thinking and viewing an issue. Where zones of proximal development were utilized, more capable students would provide their peers with new information and ways of thinking such that all participants would have the opportunity to create a new means of understanding (Nyikos & Hashimoto, 1997). Furthermore, through appropriate questioning the professor would provide opportunities for members of the conference to observe, experience and internalize the forms of cognition necessary for knowledge construction experienced within a group (Jonassen et al., 1993; Vygotsky 1978;).

Additionally, as a text based environment where discussions are archived by the computer system, computer conference transcripts could provide a means for participants to engage in further metacognitive activity by analyzing the conference transcripts for the cognitive processes they exhibited while discussing issues with their peers. Both the teacher and the participants analyzing the conference transcripts could assist students in thinking about the forms of cognition they selected while contributing to the group. Not only would students become aware of their own thinking but the results of such an analysis could also guide further intervention and support strategies offered by the facilitator (Henri, 1991).

References

Andrusyszyn, M. & Iwasiw C. & Goldenberg, D. (1999). Computer conferencing in graduate nursing education: Perceptions of students and faculty. *Journal of Continuing Education in Nursing,* 30(6), 272-278.

Angeli, C. & Cunningham, D. J. (1998). Bubble dialogue: Tools for supporting literacy and mind. In C.J. Bonk, K.S. King, (Eds.), *Electronic Collaborators: Learner-centered technologies for literacy, apprenticeship, and discourse* (pp. 81-101). Mahweh, NJ: Lawrence Erlbaum Associates, Publishers.

Bauerfeld, H. (1988). Interaction, construction, and knowledge: Alternative perspectives for mathematics education. In D. Grouws, T. Cooney, (Eds.). *Perspectives on research on effective mathematics teaching* (pp. 27-46). Reston, Va: Lawrence Erlbaum Associates.

Bearish, D. J. (1982). New directions in studies of social interaction and cognitive development. In S.C. Felicisima (Ed.), *Social-Cognitive Development in Context* (pp. 199-221). New York: The Guildford Press.

Bednar, A. K & Cunningham, D. & Duffy, T. M. & Perry, T. (1992). Theory into practice: How do we link? In T.M Duffy & D.H. Jonnassen (Eds.), *Constructivism and the technology of instruction: A conversation* (pp. 17-34). Mahweh, NJ: Lawrence Erlbaum Associates, Publishers.

Berge, Z. (1995). Computer-mediated communication and the online classroom in distance Education. [on-line]. Retrieved September, 10, 1996 from the World Wide Web: http://metalab.unc.edu/cmc/mag/1995/apr/berge.html

Berge, Z. & Collins, M. (1995). Computer-mediated scholarly discussion groups. *Computers In Education, 24*(3), 183-189.

Bogdan, R. C. & Bilkin, S. K. (1992). *Qualitative research for education: An introduction to theory and methods.* Toronto: Allyn and Bacon.

Bonk, C. J. & Cunningham, D. J. (1998). Searching for learner-centered, constructivist, and sociocultural components of collaborative educational learning tools. In C. J. Bonk & K. S. King (Eds.), *Electronic Collaborators: Learner-centered technologies for literacy, apprenticeship, and discourse* (pp.25-50). New Jersey: Lawrence Erlbaum Associates, Publishers.

Bonk C. J. & King, K. S. (1998). Introduction to electronic collaborators. In In C. J. Bonk & K. S. King (Eds.), Electronic Collaborators: Learner-centered technologies for literacy, apprenticeship, and discourse (pp. xxv-xxxv). New Jersey: Lawrence Erlbaum Associates, Publishers.

Bonk, C. J. & King, K. S. (1998). Computer conferencing and collaborative writing tools: Starting a dialogue about student dialogue. In C. J. Bonk & K. S. King (Eds.), *Electronic Collaborators: Learner-centered technologies for literacy, apprenticeship, and discourse* (pp. 3-23). New Jersey: Lawrence Erlbaum Associates, Publishers.

Borg, W. R. & Gall, M. (1989). *Educational research: An introduction*. (5th ed.), New York: Longman.

Brown, A. L. & Palinscar, A. S. (1989). Guided, cooperative learning and individual knowledge acquisition, In L. B. Resnick (Ed.), *Knowing, learning and instruction: Essays in honor of Robert Glaser* (pp. 393- 451). Mahweh, NJ: Lawrence Erlbaum Associates Publishers.

Burge, E. J. (1994). Learning in computer conference contexts: The learners' perspective. *Journal of Distance Education, 9*(1), 19-43.

Carr, A. & Jonassen, D, & Litinger, & Marra. (1998). Good ideas to format educational revolution: The role of systemic change in advancing situated learning, constructivism and feminist pedagogy, *Educational Technology, 38*(1), 5-15.

Chandler, D. (1996). Technology or media determinism. [On-line]. Retrieved September 10,1996 from the World Wide Web:http/www.aber.ac.uk/~dgc/tecdet.html#l.

Cobb, P. (1996). Where is the mind? A coordination of sociocultural and cognitive constructivist perspectives. In C. T. Fosnot (Ed.), *Constructivism: Theory, perspectives, and practice* (pp 34-52). New York: Teachers College Press.

Corbin, J. & Strauss, A. (1990). Grounded theory research: Procedures, canons, and evaluative criteria. *Qualitative Sociology, 13* (1),3-23.

Creswell, J. W. (1994). *Research design qualitative & quantitative approaches*. Newbury Park, CA: Sage Publications, Inc

Creswell, J. W. (1998). *Qualitative inquiry and research design*. London: Sage Publications.

Cunningham, D. J. (1992). Assessing constructions and constructing assessments: A Dialogue In T. M. Duffy, & D. H. Jonassen (Eds), *Constructivism and the technology of instruction: A conversation* (pp. 35-44). Mahweh, NJ: Lawrence Erbaum Associates.

Denzin, N. K. (1989). *The research act: A theoretical introduction to sociological methods* (3rd ed.). New York: Mcgraw-Hill.

Dewey, J. (1933). *How we think.* Boston: D.C. Heath and Company.

Dick, W. (1991). An instructional designer's view of constructivism. *Educational Technologist, 31*(5), 41-44.

Duff, T. M. & Jonassen, D. H. (1992). Constructivism: New implications for instructional design. In T. M. Duffy & D. H. Jonnassen (Eds). *Constructivism and the technology of instruction: A conversation* (pp. 1-15). Mahweh, NJ: Lawrence Erlbaum Associates, Publishers.

Ethnograph V5.0. (1998). Qualis Research Associates, Salt Lake City, Utah.

Ennis, R. H. (1986). A taxonomy of critical thinking dispositions and abilities. In J. B. Baron & R. J. Stenberg (Eds.), *Teaching thinking skills* (pp. 9-26). New York: W.H. Freeman and Company.

Fosnot, C. T. (1996). Constructivism: A psychological theory of learning. In C. T. Fosnot (Ed.), *Constructivism: Theory, perspectives, and practice* (pp. 8-33). New York: Teachers College Press.

Garrison, R. D. (1991). Critical thinking and adult education: a conceptual model for developing critical thinking in adults. *International Journal Of Lifelong Education, 10*(4), 287-303.

Garrison, R. D. (1992). Critical thinking and self-directed learning in adult education: An analysis of responsibility and control issues. *Adult Education Quarterly, 42*(3), 136-148.

Garrison, R. D. (1997). Computer conferencing: the post industrial age of distance education. *Open Learning, 12*(3), 3-11.

Glaser, B. G. & Strauss, A. L. (1967). *The discovery of grounded theory: strategies for qualitative research.* New York: Aldine Publishing Company.

Goetz, J. P. & LeCompte, M. D. (1984). *Ethnography and qualitative design in educational research.* Toronto: Academic Press, Inc.

Gore, A. (1994). A transformation of learning: Use of the NII for education and lifelong learning. [On-line]. Retrieved September 10, 1996 from the World Wide Web:gopher:/ittfcat.nist.gov:95/oo/.catitem/Education.

Grabe, M. & Grabe, C. (1996). *Integrating technology for meaningful learning.* Toronto: Houghton Mifflin Company.

Gunawardena, C. N. (1992). Collaborative learning and group dynamics in computer-mediated communication networks. In American Symposium on Research in Distance Education (Ed.), *Distance Education Symposium* (pp. 12-24), University Park: The Pennsylvania State University.

Hannifin, M. J. & Hannifin, K. M. & Land, S. M. & Oliver, K. (1997) Grounded practice and the design of constructivist learning environments. *Educational Technology Research and Development, 45*(3), 101-117.

Harasim, L. (1987). Teaching and learning on-line: Issues in computer-mediated graduate Courses. *Canadian Journal of Educational Education, 16*(2), 117-135.

Harasim, L. (1989). On-line education: A new domain. In R. Mason, A. Kaye (Eds.). *Mindweave communication, computers and distance education* (pp. 55-98), Toronto: Pergamon Press.

Harasim, L. (1990). *Online education: Perspectives on a new environment*. New York: Praeger.

Harasim, L. (1993). Collaborating in cyberspace: Using computer conferences as a group learning environment. *Interactive Learning Environments, 3*(2), 119-130.

Harasim, L. & Hiltz, S. R. & Teles, L. & Turoff, M. (1995). *Learning Networks a field guide to teaching and learning online.* Cambridge Massachusetts: MIT Press.

Henri, F. (1991) Computer conferencing and content analysis, In A. R. Kaye (Ed.), *Collaborative learning through computer conferencing* (pp. 117-136). New York: NATO ASI Series.

Henri, F. (1995). Distance learning and computer-mediated communication: Interactive, Quasi-interactive or monologue, In C. O'Malley (Ed.). *Computer supported collaborative learning* (pp. 145-161). New York: NATO ASI Series.

Hodder, I. (1994). The interpretation of documents and material culture. In N. K. Denzin & Y.S. Lincoln (Eds.), *Handbook of qualitative research* (pp. 393-402). Newbury Park, CA: Sage Publications Inc.

Hillman, D. C. A. (1996). *Improved coding and data management for discourse analysis: A case study in face-to-face and computer-mediated classroom interaction.* Unpublished doctoral dissertation, University of Cambridge, Cambridge.

Huberman, A. M. & Miles, M. B. (1994). Data management and analysis methods. In N. K. Denzin & Y. S. Lincoln (Eds.), *Handbook of qualitative research* (pp. 428-444). Newbury Park, CA: Sage Publications Inc.

Jennings, C. M. & Di, X. (1996). Collaborative learning and thinking: The Vygotsky approach. In L. Dixon-Krauss (Ed.), *Vygotsky in the classroom* (pp. 77-91). New York: Longman Publishers.

Jonassen, D. (1991). Evaluating constructivist learning. *Educational Technology, (*31), 28-33.

Jonassen, D. & Mayers, T. & McAleese, R. (1993). A manifesto for a constructivist approach to uses of technology in higher education. In T. Duffy & J. Lowyck & D. H. Jonnassen (Eds.), *Designing environments for constructivist learning* (pp. 231-247). New York: Springer-Verlag.

Jones B. F. & Knuth, R. A. & Duffy, T. M., (1993). Components of learning environments for professional development. In In T. Duffy, J. Lowyck, D. H. Jonnassen (Eds.), *Designing environments for constructivist learning* (pp. 124-137). New York: Springer-Verlag.

Kaye, A. R. (1991). Learning together apart. In A. R. Kaye (Ed.), *Collaborative learning through computer conferencing* (pp. 1). New York: NATO ASI Series.

Kearsley, G. & Lynch, W. & Wizer, D. (1995). The Effectiveness and impact of online learning in graduate education, *Educational Technology*, 35(6), 37-42.

Kincheloe, J. L. (1993). *Teachers As Researchers: Qualitative inquiry as a path to empowerment.* New York: The Falmer Press.

King, A. (1990). Enhancing peer interaction and learning in the classroom through reciprocal questioning, *American Educational Research Journal, 27*(4), 665-687.

King, A, & Rosenshire, B. (1993). Effects of guided cooperative questioning on children's knowledge construction, *Journal of Experimental Education, 61*(2), 127 - 148.

Kling, R. (1996). *Computerization and controversy: Value conflict and social choice.* (2nd Ed). San Diego: Academic Press.

Knuth, R.A. & Cunningham, DJ (1993). Tools for constructivism, In T. Duffy, J. & Lowyck & D. H. Jonnassen (Eds.), *Designing environments for constructivist le*arning (pp. 163-188). New York: Springer-Verlag.

Lincoln, Y. S. & Guba, E. G. (1985). *Naturalistic inquiry.* Beverly Hills: Sage Publications.

Mason, R. (1991). Evaluation methodologies for computer conferencing applications. In R. Kaye (Ed.), *Collaborative learning through computer conferencing* (pp. 105-116). New York: NATO ASI Series.

Mertens, D.M. (1998). *Research methods in education and psychology: Integrating diversity with quantitative & qualitative approaches.* London: Sage Publications, Inc.

Merrill, D. M. (1992). Constructivism and instructional design. In T. H. Duffy & D. H. Jonassen, (Eds.), *Constructivism and the technology of instruction: A Conversation* (pp. 99-114). Mahweh, NJ: Lawrence Erlbaum Associates.

McIsaac, M. S.& Blocher, J. M. & Mahes, V. & Vraasidas, C. (1999). Student and teacher perceptions of interaction in online computer-mediated communication. *Educational Media International*, 36(2), 121-131.

Missimer, C. (1994). Why two heads are better than one: Philosophical and pedagogical implications of a social view of critical thinking. In K. S. Walters (Ed.), *Re-thinking reason: New perspectives in critical thinking* (pp. 119-133). New York: Albany State University.

Morttunen, M. (1992). Commenting on written arguments as a part of argumentation skills - comparison between students engaged in traditional Vs on-line study. *Scandinavian Journal of Educational Research, 36*(4), 209-302.

Morse, J.M. (1998). Designing funded qualitative research. In N. K. Denzin & Y. S. Lincoln (Eds.), *Strategies of qualitative inquiry* (pp. 56-85). London: Sage Publications.

Mowrer, D. E. (1996). A content analysis of student/instructor communication via computer conferencing. *Higher Education, 32,* 217-241.

Newman, D. R & Johnson, C. & Webb, B. & Cochrane, C. (1997). Evaluating the quality of learning in computer supported co-operative learning. *Journal of the American Society For Information Science, 48*(6), 484-495.

Nyikos, M. & Hashimoto, R. (1997). Constructivist theory applied to collaborative learning in teacher education: In search of zpd. *The Modern Language Journal, 81*(4), 506-517.

O'Malley, C. (1992). Designing computer systems to support peer learning. *European Journal of Psychology of Education,* 7(4), 339-352.

Owston, R. D. (1997). The world wide Web: A technology to enhance teaching and learning? *Educational Researcher, 26*(2), 27-33.

Patton, M. Q. (1990). *Qualitative evaluation and research methods.* Newbury Park: Sage Publications.

Paulsen, M. F. (1995). Moderating educational computer conferences. [On-line]. Retrieved May 2, 2000 from the World Wide Web: http:www.emoderators.com/moderators.morten.html

Pearson, J. (1991). Electronic networking in intial teacher education. Is a virtual faculty of education possible? *Computers & Education*, 32(3), 221-238.

Perkins, D. N. (1992). What constructivism demands of the learner, In T. H. Duffy & D. Jonassen (Eds.), *Constructivism and the technology of instruction: A conversation* (pp.161-165). Mahweh, NJ: Lawrence Erlbaum Associates.

Piaget, J. (1970). *Genetic epistemology.* New York: Columbia University Press.

Piaget, J. (1977). *Equilibration of cognitive structures.* New York: Viking.

Prawat, R. S. (1992). Teachers' beliefs about teaching and learning: A constructivist Perspective, *American Journal of Education,* 100, 354 - 395.

Prawat, R. S. (1996). Constructivism, modern and postmodern, *Educational Psychologist, 31*(3/4), 515-225.

Quellmaiz, E. S. (1987). Developing reasoning skills. In J. B. Baaron & R. J. Sternberg (Eds.), *Teaching Thinking Skills* (pp. 86- 105). New York: W.H. Freeman and Company.

Resnick, L. B. (1989). Introduction. In L. B. Resnick (ed.), *Knowing, learning, and instruction: Essays in honor of Robert Glaser* (pp. 1-22). Mahweh, NJ: Lawrence Erlbaum Assoc.

Resnick, L. B. (1991). Shared Cognition: Thinking as Social Practice. In L. B. Resnick & J. Levine & S. D. Teasley (Eds.), *Perspectives on socially shared cognition* (pp. 1-20). Washington, DC: American Psychological Association,

Rogoff, B. (1990). *Apprenticeship in thinking: Cognitive development in social context.* Oxford: Oxford University Press.

Schmeck, R. R. (1983). Learning styles of college students. In R. Dillon & R.R. Schmeck (Eds.), Individual difference in cognition (pp. 233-279). Vol I. Toronto: Academic Press.

Schroeder, E. E. & Zarinnia, E. A. (1999). Argumentation online: The use of computer conferencing. Whitewater, WI: National Centre for Research on Teacher Education. (ERIC Document Reproduction Services No. 4332310).

Simich-Dudgeon, C. (1999). Interpersonal involvement strategies in online textual conversation: A case study of a learning community. Indiana: National Centre for Research on Teacher Education. (ERIC Document Reproduction Services No. 435169).

Spiro, R. J. & Feltovich, P. J. & Jacobson, M. J. & Cousin, R. L. (1992). Cognitive flexibility, constructivism and hypertext: Random access instruction for advanced knowledge acquisition in ill-structured domains. In T. H. Duffy & D. H. Jonassen (Eds.), *Constructivism and the Technology of Instruction: A Conversation* (pp. 57-75). Mahweh, NJ: Lawrence Erlbaum Associates. Publishers.

Spiro J. S. & Jehang, J. C. (1990). Cognitive flexibility and hypertext: Theory and technology for nonlinear and multidimensional traversal of complex subject matter. In D. Nix R. Spiro (Ed.), *Cognition, education, multimedia* (pp. 163-205). Mahweh, NJ: Lawrence Erlbaum Associates Publishers.

Spivey, N. N. (1995). Written discourse: A constructivist perspective. In L. P. Steffe & J. Gale (Ed.), *Constructivism in education* (pp. 313-329). Mahweh, NJ: Lawrence Erlbaum Associates Publishers

Sproull, L. & Keisler, S. (1991). *Connections: New ways of working in the networked organization.* Cambridge: MT Press

Stainback, S. & Stainback, W. (1988). *Understanding & conducting qualitative research.* Iowa: Kendall Hunt Publishing Company.

Strauss A. & Corbin, J. (1998). Grounded theory methodology. In N. K. Denzin & Y. S. Lincoln, (Eds.), *Strategies of qualitative Research* (pp. 158-183). London: Sage Publications.

Sugar, W. A. & Bonk, C. J. (1998). Student role play in the world forum: Analysis of an arctic adventure learning apprenticeship. In C. J. Bonk & K. S. King (Eds.), *ElectronicCollaborators: Learner- centered technologies for literacy, apprenticeship, and Discourse* (pp. 131-155). Mahweh, NJ: Lawrence Erlbaum Associates Publishers.

Tuckey, C. J. (1993). Computer Conferencing and the electronic white board in the united kingdom: A comparative analysis. *American Journal of Distance Education,* 7(2), 58-72.

Turoff, A. D. & Hiltz, K. A. & Hiltz, J. D. & Turoff, M. O. (1993) *The network nation: Human communication via computers.* Cambridge, Massachusetts: The MIT Press.

Vaverek, K. A. & Saunders, C. (1994). Computerspeak: Message content and perceived appropriateness in an educational setting. *Journal of Educational Technology Systems, 22*(2), 123 - 139.

von Glasersfeld, E. (1989). Constructivism in education. In T. Husen & N. Postlewaite (Eds.), *International Encyclopedia of Education,* (pp.162-163). Oxford, England: Pergamon Press.

von Glasersfeld, E. (1995). Sensory experience, abstraction, and teaching. In L. P. Steffe & J. Gale (Ed.), *Constructivism in education* (pp. 369-383). Mahweh, NJ: Lawrence Erlbaum Associates Publishers.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes.* (M. Cole, V. John-Steiner & S. Scribner & E. Souberman, Trans.). Cambridge: Harvard University Press.

Wallis, C. (1995). The learning revolution, *Time, 145,* 49-51.

Ward, P. & Davis, K. (1996). Empowering students in the information age. [On-line]. Retrieved September 10, 1996 from the World Wide Web: hhtp:/www.ncsa.edu/SDG/IT94/Proceedings/Educ/ward/ward.html

Warschauer, M. (1997). Computer-mediated collaborative learning: Theory and practice. *The Modern Language Journal, 81*(4), 470-481.

Webb, N. M. (1989). Peer interaction and learning in small groups. *International Journal of Educational Research, 13*(2), 21-39.

Wertsch, J. V. (1985). *Vygotsky and the Social Formation of Mind.* Cambridge: Harvard University Press.

Wiesenberg, F. & Hutton, S. (1996). Teaching a graduate program using computer-mediated conferencing software. *Journal of Distance Education , 11(*1), 83-100.

Wittrock,. M. C. (1974). Learning as a generative process. *Educational Psychologist, 11*(2), 87-95.

Wood, T. (1995). From alternative epistemologies to practice in education: Rethinking what it means to teach and learn. In L. P. Steffe & J. Gale (Eds.), *Constructivism in education* (pp. 331-339). Mahweh, NJ: Lawrence Erlbaum Associates Publishers.

Zhu, E. (1998). Learning and mentoring : Electronic discussion in a distance-learning Course. In C. J. Bonk & K. S. King (Eds.), *Electronic Collaborators: Learner-centered technologies for literacy, apprenticeship, and discourse* (pp. 233-259). Mahweh, NJ: Lawrence Erlbaum Associates Publishers.

Appendix A

Henri's (1991) general framework

Dimension	Definition	Indicators
Participative	Compilation of the number of messages or statements transmitted by one person or group	Number of messages Number of statements
Social	Statement or part of statement not related to formal content of subject matter	Self-introduction Verbal support I'm feeling great
Interactive	Chain of connected messages	"In response to Celine" "As we said earlier"
Cognitive	Statement exhibiting knowledge and skills related to the learning process	Asking questions Making inferences Formulating hypothesis
Metacognitive	Statement related to general knowledge and skills and showing awareness, self-control, and self regulation of learning	'I understand...." 'I wonder...."

Appendix B

Newman et al's., (1997) paired indicators of critical vs uncritical thinking for content analysis

R± Relevance
R+ relevant statements
R– irrelevant statements, diversions
I± Importance
I+ Important points/issues
I– unimportant, trivial points/issues
N± Novelty. New info, ideas, solutions
NP+ New problem-related information
NP– Repeating what has been said
NI+ New ideas for discussion
NI– False or trivial leads
NS+ New solutions to problems
NS– Accepting first offered solution
NQ– Squashing, putting down new ideas
NQ+ Welcoming new ideas
NL+ learner (student) brings new things in
NL– dragged in by tutor
O± Bringing outside knowledge/experience to bear on problem
OE+ Drawing on personal experience
OC+ Refer to course material
OM+ Use relevant outside material
OK+ Evidence of using previous knowledge
OP+ Course related problems brought in. E.g. students identify problems from lectures and texts
OQ+ Welcoming outside knowledge
OQ– Squashing attempts to bring in outside knowledge
O– Sticking to prejudice or assumptions
A± Ambiguities: clarified or confused
AC+ Clear, unambiguous statements
AC– Confused statements
A+ Discuss ambiguities to clear them up
A– Continue to ignore ambiguities
L± Linking ideas, interpretation
L+ Linking facts, ideas and notions
L+ Generating new data from information collected
L– Repeating information without making inferences or offering an interpretation.
L– Stating that one shares the ideas or opinions stated, without taking these further or adding any personal comments.
J± Justification
JP+ Providing proof or examples
JS+ Justifying solutions or judgements
JS+ Setting out advantages and disadvantages of situation or solution
JP– Irrelevant or obscuring questions or examples
JS– Offering judgements or solutions without explanations or justification
JS– Offering several solutions without suggesting which is the most appropriate.
C± Critical assessment
C+ Critical assessment/evaluation of own or others contributions
C– Uncritical acceptance or unreasoned rejection
CT+ Tutor prompts for critical evaluation
CT– Tutor uncritically accepts
P± Practical utility (grounding)
P+ relate possible solutions to familiar situations
P+ discuss practical utility of new ideas
P– discuss in a vacuum (treat as if on Mars)
P– suggest impractical solutions
W± Width of understanding (complete picture)
W– Narrow discussion. E.g. address bits or fragments of situation, suggest glib, partial, interventions
W+ Widen discussion. E.g. problem within a larger perspective, intervention strategies within a wider framework

Appendix C

Henri's (1991) cognitive model

Reasoning skills	Definitions	Indicators
Elementary clarification	Observing or studying a problem identifying its elements, and observing their linkages in order to come to a basic understanding	Identifying relevant elements Reformulating the problem Asking a relevant questions Identifying previously stated hypothesis
In-depth clarification	Analysing and understanding a problem to come to an understanding which sheds light on the values, beliefs, and assumption which underlie the statement of the problem	Defining the terms Identifying assumptions Establishing referential criteria Seeking out specialized information
Inference	Induction and deduction, admitting or proposing an idea on the basis of its link with propositions already admitted as true	Drawing conclusions Making generalizations Formulating a proposition which proceeds from the previous statement
Judgement	Making decisions, statements, appreciations, evaluations and criticism Sizing up	Judging the relevance of solutions Making value judgements Judging inference
Strategies	Proposing co-ordinated actions for the application of a solution, or following through on a choice or a decision	Deciding on the action to be taken Proposing one or more solutions Interacting with those concerned

Appendix D

Stages and skills of the Critical Thinking Process developed by Newman et al., (1997) by corresponding Garrison's critical thinking stages with Henri's critical reasoning skills

Garrison's CT stages	Henri's critical reasoning skills
1. Problem identification a triggering event arouses interest in a problem e.g aroused interest, triggered a desire to understand, aware of issues	**Elementary clarification** Observing or studying a problem, identifying its elements, observing their linkages e.g. identifying relevant elements, reformulation the problem, asking a relevant question, identifying previously stated hypothesis
2.Problem definition define boundaries, ends and means e.g. clarified subject, identified personal experience	**In-depth clarification** Analyzing a problem to understand its underlying values, beliefs and assumptions e.g. defining the terms, identifying assumptions, establishing referential criteria, seeking out specialized information
3 Problem exploration ability to see to heart if problem based on deep understanding of situation e.g explore new ideas, develop new solutions, understand issues, disentangle ideas	**Inference** Admitting proposing an idea based on links to admittedly true propositions e.g. drawing conclusions, making generalizations, formulation a proposition which proceeds from previous statements
4 Problem applicability evaluation of alternate solutions and new ideas e.g. critical assessment, judge solutions, critically evaluate, assess practical knowledge	**Judgement** Making decisions, evaluations and criticism e.g, judging the relevance of solutions, value judgements, judging inferences
5 Problem integration acting upon understanding to validate knowledge e.g. previous knowledge, test solutions, apply ideas, relating to other course tasks	**Strategies** for application of solution following on choice or decision e.g. deciding on the actions to be taken, proposing one or more solutions, interaction with those concerned

Appendix E
(model 1)
Skanes's socio-cognitive indicators of knowledge construction

Socio-cognitive indicators of knowledge construction
Dissatisfaction with existing knowledge question personal and/or conflicting understanding, experience cognitive conflict
Explore alternate viewpoints analyze conflicting viewpoint, note discrepancies in alternate viewpoints, compare alternate viewpoints to personally held position, note similarities and differences in alternate and personal viewpoints
Generate perspective question personal perspective in light of alternate viewpoints, draw upon outside information to justify developing personal viewpoint, suggest plausible relationships between alternate viewpoints, suggest new perspective that will resolve cognitive conflict
****Metacognitive strategies*** assess procedures used for establishing current/new perspective, question the implications of new perspective, predict implications of personal or alternative viewpoints
Cognitive restructuring reformulate perspective in terms of alternate viewpoints, share new perspective with others, refer to new perspective with reference to previous understanding, apply new ideas to a practical situation

*Metacognition also includes reflective activity performed as dialogue with oneself for the purpose of assessing the quality of the theories used, judgements and decisions made, as well as the skills and processes used to arrive at those decisions (Jonassen et al., 1993).

** This model incorporates concepts from both Garisson's (1991, 1992) theory of critical thinking as well as Piaget's (1977) theory of knowledge construction.

Appendix F

Garrison's (1991) theory/phases of critical thinking

1. ***Problem Identification:***
   recognition of personal dissonance or a problematic issue

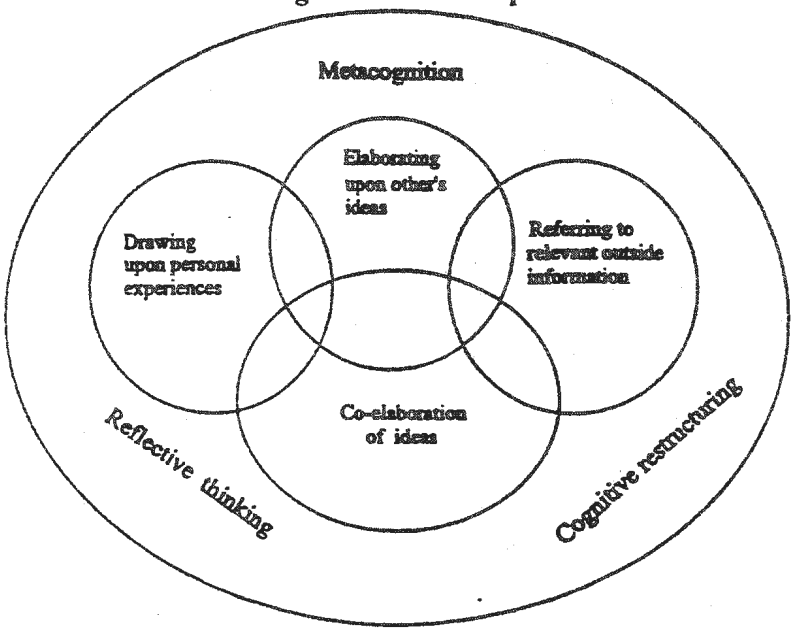
2. ***Problem definition:***
   redefine the issue, clarify the elements of the problem, analyze the conflicting viewpoint, question assumptions (collaboratively), questioning to gain a better understanding of the problem

3. ***Problem exploration:***
   explore alternative ideas to resolve the issue, elaborate on the issue to explain the original problem, understand the issue

4. ***Problem Applicability:***
   critically analyze alternative ideas, judge solutions, search for personal meaning and new perspective/understanding of the issue, assess practical knowledge

5. ***Problem integration :***
   integrate new perspective, act upon understanding to verify knowledge, share understanding with others, apply ideas, relate to other course tasks, relate to previous understanding

Appendix G
Skanes's model 2 of the knowledge construction process



Description of socio-cognitive indicators of knowledge construction

Drawing upon personal experiences (Newman et al. 1997)
-defining a problem based upon personal experience
-using personal experiences as supporting evidence for other's ideas
-comparing one's experience to other's
-synthesizing solutions by drawing upon personal experience
-questioning others about their personal experience
-providing elaborate answers regarding personal experience
-justifying opinions with personal experience
-utilizing personal experience to generalize an issue
-inferring conclusions based upon personal experience
-utilizing personal experience to generate examples
-judging the relevancy/usefulness of information with reference to personal experience

Elaborating upon other's ideas
-relating one's previous experience to other's ideas
-supporting other's ideas with reference to outside information
-paraphrasing other's ideas
-applying co-elaborated ideas to new situation

Referring to relevant outside information (Newman et al. 1997)
-relating outside information to personal experience
-supporting other's ideas with outside information
-supporting one's ideas with outside information
-generalizing issues by referring to outside information
-judging the relevancy/usefulness of outside information
-synthesizing solutions with reference to outside information

Co-elaboration of ideas
-referring specifically to other's ideas
-elaborating upon other's ideas
-drawing conclusions based upon other's ideas
-synthesizing solutions based upon other's ideas-

Metacogition
-commenting on one's ability to contribute to discussion
-assessing procedures used for establishing one's perspective
-questioning the implication of one's perspective
-questioning one's judgement of relevancy/usefulness of information
-predicting the implications of one's perspective
-describing strategies used in generating a comment

Reflective thinking
-stating one engaged in reflective thinking
-drawing upon personal experiences
-elaborating upon other's ideas
-referring to relevant outside information
-engaging in metacognitive strategies

Cognitive restructuring
-reformulating one's perspective/co-elaborating ideas
-referring to new ideas with reference to prior knowledge
-relating outside information to personal perspective
-applying new/co-elaborated ideas to practical situation

Appendix H
Ethics Review Approval

Memorial
University of Newfoundland

Faculty of Education
Graduate Programmes & Research

June 24, 1999

Ms. Joy Skanes
17 Monkstown Road
St. John's, NF
A1C 3T1

Dear Ms. Skanes:

After reviewing your proposal, the Ethics Review Committee is satisfied that it meets the guidelines of the University and Faculty. We wish you all the best in your work.

Sincerely,

Lisa Hunt
for T. Seifert
Ethics Review Committee

cc: Dr. Hammett

Appendix I
INFORMED CONSENT FORM

for participation in research about the perceived impact of computer conferencing on students' learning.

This is to certify my willingness to participate in a study conducted by Joy Skanes, a graduate student in the Teaching and Learning program at Memorial University of Newfoundland. The study will be conducted for the purpose of fulfilling the requirements of a master's degree and is essentially an investigation of the impact of computer conferencing on students' learning. I understand that the study will run under the supervision of Dr. Roberta Hammett.

I understand that the investigator will examine my postings made to a WebCt computer conference that is part of my regular class activity. I also understand that transcripts from the conference will be the primary source of data for the investigation and that results of the study can be made available to me upon request.

I understand that my participation in the study is completely voluntary and that I may withdraw from the investigation at any time without academic prejudice. As a participant in the investigation I further understand that any and all information collected will be strictly confidential regarding my identity and that I can chose a pseudonym for my data to be published beyond the classroom activity in which it was produced.

I also understand that the study meets the ethical guidelines of the Faculty of Education at Memorial University and of Memorial University itself.

I have been given the opportunity to ask whatever questions I may have had and all such questions and inquires have been answered to my satisfaction. Furthermore, I understand that if I have any questions or concerns I may contact Dr. Bruce Sheppard, the associate dean of graduate programs in research, by phoning him at 737-3402, or by emailing him at bsheppard@morgan.ucs.mun.ca

I understand that a questionnaire will also be administered to participants in this study and by completing and handing in the completed questionnaire I give consent to its use in the study.

I the undersigned agree to participate in the study on the effects of computer conferencing on learning.

Chosen Pseudonym:_____

_____ _____

Date Participant's Signature

Appendix J

Date: _____ Name: _____

Questionnaire

Please circle the most appropriate answer:

1. How much experience did you have using the WWW before this course? None A Little A Lot

2. How much experience did you have using a Bulletin Board System, or Email before this course? None A Little A Lot

3. How much experience did you have using Chatrooms or listservs before this course? None A Little A Lot

Rate on a Scale of 1 to 4 with 1 being *All the time*, 2 being *Usually/much of the time*, 3 being *Some of the time*, 4 being *None of the time*.

1. Technologically I found the conferencing system easy to use. 1. _____

2. I was comfortable contributing my ideas and viewpoints to the computer conference forum. 2. _____

3. The computer conference activity helped me to gain a better understanding of topics covered in class. 3. _____

4. The computer conference activity encouraged me to think more deeply about issues covered in class. 4. _____

5. My participation in the computer conference encouraged me to question previously held assumptions about issues covered in class. 5. _____

6. I often generated a topic for discussion in the computer conference from a thought, experience or idea that I did not have a chance to bring up in class. 6. _____

7. I feel I contributed more to the class discussions in the computer conference than I would have in a regular face to face classroom setting. 7. _____

8. I found that reading other students comments helped to clarify my understanding of topics and issues covered in the course. 8. _____

9. I feel I could use computer conferencing software with my students. 9. _____

10. I'd recommend computer conferencing as a medium in which to learn. 10. _____

Open Ended Questions: Whenever possible, refer to specific postings to the conference in your responses to these questions.

1. What specific aspects of the computer conference activity did you find most and least valuable?

2. What did you gain from reading ongoing discussions on the bulletin board?

3. How would you describe the type of learning you received from your computer conference experience?

4. Do you feel computer conferencing activities encourage new expectations of teaching and learning? If so, how?

5. If any, to what extent did the computer conference activity help you become more aware of the issues covered in the course.

6. Did you have access to a home computer while attending this course? If not, do you feel
this impacted upon your participation in the conference?

Appendix K

Frequency tables for pre-structured questions

Experience	None	A little	A lot
WWW	2	6	5
Email	0	6	7
Chatrooms	7	3	3

Question	All	Usually	Some	None
1.Cc easy to use	5	7	1	
2. Comfortable contributing ideas to the cc	7	5	1	
3. Participation helped me gain better understanding of topics covered in course	4	6	3	
4. Cc encouraged me to think more deeply/critically about issues	5	4	4	
5. Participation encouraged me to question previously held assumptions about issues covered in the course	4	6	2	1
6. Generated a topic that I did not have a chance to bring up in class	1	3	7	2
7. Feel I contributed to class discussion more than in ftf setting	1	2	7	3
8. Reading other comment helped to clarify understanding of issues covered in the course	4	8	1	
9. Feel could use the cc with students	3	2	8	
10. Recommend cc as a medium in which to learn	2	10	1	