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Facilitating the process of knowledge construction among preservice teachers through computer -mediated communications

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FACILITATING THE PROCESS OF KNOWLEDGE CONSTRUCTION AMONG PRESERVICE TEACHERS THROUGH COMPUTER-MEDIATED COMMUNICATIONS

by

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A dissertation submitted in partial fulfillment
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ABSTRACT

Facilitating the Process of Knowledge Construction Among Preservice Teachers Through Computer-Mediated Communications

by

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This study was concerned with the potential for asynchronous computer-mediated communications (CMC) to facilitate the process of knowledge construction among preservice teachers. Using both quantitative and qualitative research methods, this study examined the extent to which the CMC among six groups of preservice teachers was influenced by (a) the structure and focus of CMC, and (b) the interactions among peers. Of particular interest was (a) how these factors influenced the depth in cognitive processing that was displayed throughout the course of the semester, and (b) the patterns of social dialogue and interactions that were involved with the displayed levels in cognitive processing. The findings from this study indicated that the structure and focus

of CMC did influence the overall learning that occurred. These factors, however, did not influence the levels in cognitive processing that developed throughout the course of the semester. Playing a central role in this process were the interactions among peers that facilitated and prompted cognitively in-depth levels of CMC.

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CHAPTER 1

INTRODUCTION

Advancements that continue to be made in telecommunication technologies are providing new opportunities to integrate various computer-mediated communication (CMC) tools into higher education (e.g., Duffy, Dueber, & Hawley, 1998; Goldberg, 1997). As with all instructional strategies, choosing to integrate CMC tools must be guided by a particular theory of learning and development. Scholars have stressed the need to situate CMC within a solid theoretical framework as a means to (a) form a solid foundation for research, (b) contribute toward the conceptual insights concerning the complexities of CMC, and (c) develop pedagogical methods for enhancing the teaching-learning environment (e.g., Keegan, 1993; Quigley, 1990). Keegan (1995) asserted that a theory of CMC is needed to provide a foundation upon which political, financial, social, and educational decisions can be confidently made.

This study explored the use of CMC within a social constructivist theoretical framework. Situated within this framework, CMC are supported as a means to move beyond traditional methods of instruction that emphasize the memorization of factual information and toward instructional methods that facilitate the process of knowledge construction through social interactions and discourse among a community of learners (Bonk & Cunningham, 1998; Casey, 1999). Of particular interest to this study was the potential for CMC to facilitate the process of knowledge construction among a

community of preservice teachers through reflective social discourse. This potential was explored using a mixed methods research design in which quantitative and qualitative measures were employed to analyze the content of the discourse displayed in computer–mediated transcripts. (See Appendices B and C for a definition of terms and a partial review of the literature, respectively.)

Reflective Practices

Reflective practices within the context of teacher education have become a prominent topic throughout the literature (e.g., Grimmett, 1988; Valli, 1992). Zeichner (1992) pointed out how "the term reflection has become a slogan around which teacher educators all over the world have rallied in the name of teacher education reform" (p. 161). Various conceptualizations of this term, however, have resulted in a lack of shared meanings among scholars who write about reflective practices within the context of teacher education (e.g., Calderhead, 1992; Feiman-Nemser, 1990). Reflective practices have been conceptualized as (a) an underlying goal of a teacher education program, (b) a means toward the attainment of that or other goals, and (c) the craft of teaching that is derived from professional experience (e.g., Schon, 1991; Valli, 1992). Emerging from each of these conceptualizations are studies that have examined reflective practices within the context of (a) preservice teacher education, (b) field experiences, and (c) informal and formal professional development. In addition, studies on reflective practices have historically been framed from the perspective of exploring what beginning teachers need to know and how they can be trained (Zeichner, 1992) and the role that research derived knowledge and educational theory has in the process of learning to teach (Grimmett, MacKinnon, Erickson, & Reicken, 1990).

The conceptualization of reflection that formed the basis of this study drew from the larger body of literature on learning to teach in which reflective practices are viewed as a means to facilitate the development of preservice teachers' understandings of teaching and learning (e.g., Carter & Anders, 1996; Loughran & Russell, 1997). Situated within a constructivist framework, this conceptualization highlights the importance of the preconceptions of teaching and learning with which preservice teachers enter into teacher education programs (e.g., Huston & Warner, 2000; Richardson, 1997). McIntyre, Byrd, and Foxx (1995) stated, "Constructivist programs recognize that teachers are primarily persons who enter the program possessing values and beliefs that form the foundation from which they make professional choices" (p. 172). Being reinforced through many years of learning about teaching through an apprenticeship of observation (Lortie, 1975), these preconceptions are often deeply rooted and resistant to change. A primary goal for teacher educators is to transform these preconceptions into objectively grounded and evidentiary conceptions of teaching and learning. Engaging preservice teachers in reflective practices has become a prominent means of facilitating this transformation (Cruickshank, Bainer, & Metcalf, 1999; Huston & Warner, 2000).

Although engaging preservice teachers in reflective practices is widely supported, not a lot is known about how it can be prompted and how it is achieved. While many scholars maintain that strategies such as individual journal writing, class discussions, and conferencing facilitate reflective thinking (e.g., Cruickshank et al., 1999; Knowles & Holt-Reynolds, 1991), minimal evidence exists to support such claims (e.g., Calderhead, 1992; Feiman-Nemser & Buchmann, 1987). Furthermore, while preservice teachers may show evidence of reflective thinking, such illustrations may be only temporary or merely superficial procedural displays (Korthagen, 1988; Ross, Johnson, & Smith, 1992).

Computer-Mediated Communications

Advancements in telecommunication technologies are offering a promising new means to promote reflective practices among preservice teachers. CMC, in particular, are emerging as an innovative, potential means to facilitate reflective thinking through social discourse (e.g., Harasim, Hiltz, Teles, & Turoff, 1996; Kahn, 1997). Lin, Hmelo, Kinzer, and Secules (1999) maintained that CMC facilitate reflective thinking as multiple perspectives and individual reasoning are made explicitly visible. When reasoning and thinking are open for public examination through CMC, students become more motivated to engage in reflective practices.

As a relatively recent innovation in higher education, empirical research that supports the potential for CMC to facilitate reflective practice among preservice teachers is scant. Furthermore, although an increasing number of researchers are beginning to examine this aspect of CMC tools, emerging studies continue to illuminate new avenues of research calling for further examination. For example, Bodzin and Park (1998) examined the dialogue that was generated among preservice teachers within the CMC forum, SciTeach. They reported that SciTeach provided a network of socio-emotional support as well as a means to facilitate critical and reflective thinking among preservice science teachers. Their finding highlighted the need for further studies to examine the following questions: (a) Which topic areas promote the most reflective discourse? (b) How does peer responsiveness affect the depth of the dialogue? and (c) Does interacting within a CMC forum promote reflection on what the students are learning, including teaching approaches and decision-making?

Wu and Lee (1999) investigated the use of their CMC forum, Bulletin Board Systems (BBS) that was specifically designed to facilitate reflective dialogue among preservice

teachers during their student teaching practicum. Based upon observations of the postings made throughout a 4-week period, as well as written feedback concerning the usefulness of the BBS during their teaching practicum, they reported that the BBS encouraged most student teachers to discuss and reflect upon their views about teaching. In an effort to maximize the active participation among all student teachers, they suggested placing a maximum length on the required postings, as well as highlighting the major points made throughout the text. They pointed to the need for future studies to examine the impact that a moderator, as well as an experienced teacher, may have in promoting dialogue and encouraging reflection.

While researchers continue to illuminate further avenues of research that are needed if the potential for CMC to foster reflective practices is to be realized, these researchers have been elusive in their conceptualization of reflective thinking. Harrington and Hathaway (1994) have been among the few scholars who have predicated their research involving the learning that occurs among preservice teachers within the context of a CMC context on an explicit conceptualization of reflective practices. They specifically examined the potential of their CMC forum, Dialogical Community Exercise (DCE), to facilitate what they referred to as critical reflection on fundamental pedagogical issues among preservice teachers. Drawing from learning theories on adult development, critical reflection was operationalized as:

> (a) recognizing limitations in socio-cultural, epistemic, and psychological assumptions; (b) acknowledging and including multiple perspectives; (c) considering the moral and ethical consequences of choices; and (d) clarifying reasoning processes when making and evaluating decisions (p. 544).

Harrington and Hathaway found that, although the use of CMC elicited taken-for-granted assumptions about teaching and learning, few preservice teachers explicitly recognized them as such. The ability to recognize and clarify these implicit and often unfounded assumptions about teaching and learning that were generated through the use of CMC co-varied with developmental levels. Based upon their findings, they encouraged further studies to examine the role that different students play in facilitating the professional and cognitive development of their peers.

Complementing the recommendations made by Harrington and Hathaway, Hara, Bonk, and Angeli (2000) raised concerns over a lack of research that examined the cognitive processes that underlie student participation in computer-mediated discussions. They addressed this paucity of research as they examined the extent of social, cognitive, and metacognitive commenting that took place among preservice teachers within a structured computer-mediated discussion component of an Educational Psychology course. Using Henri's (1992) model of content analysis of CMC, they found that structured online collaborative learning activities provided students with the time needed to "reflect on course content and make in-depth cognitive and social contributions" (p. 140). They also found, however, that students limited their participation efforts to the course requirement of one posting per week. Based on this finding, they contended, "There clearly is a pressing need to develop pedagogy that motivates students to electronically participate in class discussions beyond standard course requirements" (p. 141). Furthermore, they suggested that "cognitively deeper discussions might be obtained with asynchronous tools that embed such features as issue-based forums and debates, alternative views of argument structure, and options for comment labeling" (p. 148).

Rationale for the Proposed Study

Reflective practices in preservice teacher education have been conceptualized as a means of guiding preservice teachers as they construct their knowledge of teaching and learning. Although this conceptualization is widely supported among many scholars, little is known about how it can be promoted and how it is achieved. The use of CMC tools offer a potential means to facilitate reflective practices through social discourse, as well as develop a better understanding of how it is achieved. As a relatively recent innovation in higher education however, the research in this area is limited. Extensive studies are clearly needed if the potential for CMCs to facilitate the process of knowledge construction through reflective practices is to be fully realized.

This study examined how knowledge is constructed among preservice teachers through reflective social discourse within a computer-mediated discussion context. This study contributed toward the recommendations made by Harrington and Hathaway (1994) as well as Hara et al. (2000). As Harrington and Hathaway's (1994) study revealed, although CMCs have the potential to elicit taken-for-granted assumptions about teaching and learning, students do not necessarily recognize them as such. This study examined the factors that prompt students to recognize these assumptions. Drawing from Hara et al.'s (2000) recommendation to facilitate cognitively deeper discussions through the use of specifically developed forums, this study examined the patterns of cognitive processes within each of the following computer-mediated discussion forums: (a) practicum experiences, (b) experiences in the methods classroom, and (c) course readings. By examining these facets of computer-mediated dialogue, this study contributed toward a better understanding of the potential for CMC tools to facilitate the

process of knowledge construction among preservice teachers through reflective practices.

Questions that guided this study were:

1. Would the type of cognitive processing vary throughout the semester, independent of discussion forums and teaching teams?

2. Would the type of cognitive processing that develops within each of the six teams of preservice teachers vary among each of the three different discussion forums?

3. Would participating in the different types of discussion forums have an impact on students' cognitive processing?

4. Would participating in the different teams of preservice teachers have an impact on students' cognitive processing?

5. What patterns of interactions and social dialogue are displayed within those groups and/or discussion forums that demonstrate an in-depth level of cognitive processing?

CHAPTER 2

METHOD

Research Perspective

Social Discourse

The social constructivist framework embedded within the context of this study acknowledged the fact that knowledge is constructed through reflective social discourse among a community of learners. Savory and Duffy (1996) asserted that "knowledge evolves through social negotiation and through the evaluation of the viability of individual understandings" (p. 136). Learning processes that are grounded in talk can stimulate higher order thinking skills by providing a context for explanation, justification, and reason (Duffy & Cunningham, 1996; Oliver, Omari, & Herrington, 1997). According to Jonassen, Campbell, Collins, Davidson, and Haag (1995), "learning is necessarily a social dialogical process in which communities of practitioners socially negotiate the meaning of phenomena" (p. 9).

Content Analysis

With the capability to trace, record, and display social discourse, CMC tools provide an ideal context for developing a better understanding of how this discourse guides the process of knowledge construction. This inherent capability for CMC tools to archive student dialogue lend themselves particularly well to the content analysis of the social discourse that is displayed in computer-mediated transcripts.

Mason (1991) advocated the use of content analysis as a means of examining the quality of learning that takes place within an on-line learning environment. She contended that by breaking down educational goals such as collaborative learning, critical thinking, or deep understanding of course material into examples of written work that represent these characteristics, it is possible to analyze the content of CMC and draw conclusions about the educational value of particular on-line activities. Mason emphasized the need "for evaluators to take up the challenge of content analysis both as a key to increasing the professionalism of the field and as the essence of the educational value of the activity" (p. 242).

Henri (1992) has developed an analytical framework for the content analysis of CMC. Within this model, Henri identified the following five dimensions: (a) participative, (b) social, (c) interactive, (d) cognitive, and (e) metacognitive. The first three dimensions of this model have received the greatest amount of attention. Falling within the first dimension are those evaluations that simply examine the numbers and lengths of messages. The social dimension examines the surface-level types of personal commenting that take place within a CMC forum. Responses and commentaries are measured within the interactive dimension, examining how specific events or statements lead to particular responses.

The cognitive and metacognitive dimensions of Henri's framework seemed to be closely tied to the notion of reflective thinking as it has been conceptualized for this study. Harrington and Hathaway (1994) implicitly made this connection in their conceptualization of critical reflection that formed the basis for their previously discussed study. Hara et al. (2000) explicitly drew from the cognitive and metacognitive dimensions of Henri's framework as they examined the extent of cognitive and metacognitive

commenting that took place among preservice teachers within a structured CMC forum component in an Educational Psychology course.

An analysis of the cognitive and metacognitive dimensions of CMC may have shed light on the quality and type of reflective thinking that takes place within a CMC forum. Examining these dimensions in isolation, however, would not have shed light on how preservice teachers construct their knowledge of teaching and learning through reflective social discourse. As inherently embedded factors in the social constructivist perspective that underpinned this study, the social and interactive dimensions of Henri's framework could not be overlooked. Of primary interest to this study was how the social and interactive dimensions of CMC influenced the level of cognitive processing that was demonstrated through reflective social discourse.

Participants and Setting

The participants in this study included 32 preservice teachers who were enrolled in a science teaching methods course in an urban university in the Southwest. The class was held for 16 weeks in a traditional teaching methods classroom. WebCT was used to develop an CMC forum that supplemented the learning that occurred within this traditional setting. Specifically, WebCT's bulletin board feature was used as a medium for small group discussions, explicitly within three different discussion forums. As an integral component of this science methods course, WebCT participation accounted for 20% of student final grades. While students may have accessed WebCT through their home or school systems, access was ultimately ensured by the availability of WebCT throughout the university's libraries and computer labs.

Discussion groups were formed during the first week of the semester by randomly grouping the 32 students into six teaching teams (5-6 students per team). Each teaching team used the WebCT bulletin board as a medium for small group discussions throughout the course of the semester. Forming the basis of the discussions that took place within each teaching team were the following three discussion forums: (a) Readings, (b) Methods, and (c) Practicum. The structure and focus of each of these forums is described in the section that follows.

Procedure

The instructional strategy that Hara et al. (2000) referred to as the starter/wrapper technique was used to guide the discussions within the Readings forum. Each student signed up during the first class meeting to assume the role of the starter and wrapper at least two times each throughout the semester. The starter initiated the discussion within their teaching team for one particular week by posing questions related to course readings. The wrapper summarized the discussion on the readings for that week. The starter was to read the material for their assigned week in advance. They attempted to initiate discussion based upon what they considered to be the key points, issues, and questions. At the end of the week, the wrapper attempted to summarize key contributions, highlighting overlapping ideas, problematic issues, student disagreements, and future directions to be explored.

Unlike the Readings forum, the structure of the Methods forum and Practicum forum was open-ended. Remaining within their teaching team, each student was required to reflect on their class and practicum experiences by posting a minimum of one reflective summary to each of the two forums, every two weeks. Students were encouraged at the

beginning of the course to draw from previous discussions, additional experiences, and course readings as they reflected on these experiences.

Framework for Analysis

Data Sources

The data sources used for this study were the transcripts that were generated within each team as they participated in each of the three discussion forums throughout the course of the semester. Qualitative measures were first used to identify the cognitive, social, and interactive dimensions of the dialogue displayed within these transcripts. The specific unit of analysis was a discussion posting that was defined as any contribution by a participant regardless of its length. Postings that contained two ideas were counted as two separate units. The specific manner in which this dialogue was coded is explained in the section that follows.

Coding Procedures

The coding procedures that were used for this study were modified and adapted from Henri's (1992) analytical model for the content analysis of computer-mediated dialogue. Drawing from the cognitive dimension on this framework, the computer-mediated transcripts were coded using the following four categories: (a) clarification, (b) judgment, (c) extension, and (d) application. Henri extended this framework to identify the type of information processing, surface or in-depth, within each category of cognitive skills. Indicators of surface level processing included: (a) repeating what has been said, (b) statements of agreement, (c) judgments without justification, and (d) asking irrelevant questions. Factors that indicated in-depth processing included: (a) offering new elements of information, (b) discussing the advantages and disadvantages of a situation, (c) making

judgments that are supported by examples and justification, and (d) connecting facts and ideas.

This distinction that Henri drew between surface and in-depth processing paralleled the conceptualization of reflective thinking as it has been operationalized by several researchers (e.g., Harrington & Hathaway, 1994; Hatton & Smith, 1995). In particular, what Henri depicted as dialogue demonstrating different types of in-depth information processing, has been operationalized as different levels of reflective thinking. For the purpose of this study, a framework was developed in which Henri's indicators of in-depth processing were used to identify reflective thinking with respect to cognitive process skills. That is, the categories within Henri's framework were modified to reflect a hierarchical progression toward higher levels of cognitive processing. These levels of cognitive processing, together with a description and example of each, are depicted in a framework found in Appendix D.

Social messages were defined by Henri (1992) as a "statement or part of a statement not related to formal content of subject matter" (p. 126). Hara et al. (2000) examined this dimension of Henri's framework with respect to the following social cues: (a) a self-introduction, (b) expression of feeling, (c) greeting, (d) closure, and (e) compliments to others. These social cues were used as indicators to identify social dialogue postings. In particular, postings that clearly displayed any one, or combination of these social cues were categorized as social dialogue.

The extent of interactivity displayed in the dialogue that was generated throughout the course of the semester was examined using the following three categories offered by Henri (1992): (a) communication of information, (b) a first response to this information, and (c) a second answer related to the first. The extent of interactivity that unfolded

throughout the course of the semester called for the fourth category, a third response related to the first, to be added to this model. These categories were used to indicate the level of interactivity at which each posting entered into a discussion.

The coding procedures that were used to identify each of these three dimensions of computer-mediated dialogue were validated through interrater reliability. Duplicate copies of the postings that were exchanged during four specific weeks of the semester were independently coded by three different raters. The interrater reliability for the social and interactive dimensions were 90 and 85 percent, respectively, and 75 percent for the cognitive dimension. All discrepancies were discussed until 100 percent agreement was reached.

Data Analysis

Cognitive Dimension

The cognitive, social, and interactive dimensions of the dialogue displayed on the coded transcripts were analyzed using both quantitative and qualitative measures. Quantitative measures were first used to examine the levels of cognitive processing that were identified in the computer-mediated transcripts. Specifically, a profile analysis approach, as described by Tabachnick and Fidell (1996), was used to determine if the level of cognitive processing that developed throughout a 16-week semester statistically significantly varied among the six teams of preservice teachers as they participated in each of the three different discussion forums.

In accordance with the profile analysis approach described by Tabachnick and Fidell, the numeric representations of the coded transcripts generated through the preliminary content analysis procedures were used to analyze the main effects and interactions among

the three different discussion forums and six different teaching teams that developed throughout the semester. The interactions examined the type of cognitive processing that developed within each of the six teams of preservice teachers as they participated in three different discussion forums throughout the semester (i.e., the parallelism). The main effects examined the following patterns: (a) the type of cognitive processing displayed in the CMC that developed throughout the semester within each of the three discussion forums, independent of teaching teams, (b) the type of cognitive processing displayed in the CMC that developed throughout the semester within each of the six different teaching teams, independent of discussion forums, and (c) the type of cognitive processing displayed in the CMC that developed throughout the semester, independent of discussion forums and teaching teams (i.e., the flatness). A graphic overview of this analysis is provided in Appendix E.

Since this analysis involved more than two levels of possible statistically significant effects, it was necessary to perform a contrast analysis to determine the specific source of any variation that was revealed. Tabachnick and Fidell pointed out how deciding among the numerous contrast procedures to use is dependent upon the context of the specific research study. Based upon their recommendation with regard to profile analysis procedures, Scheffe's contrast analysis was most appropriate for this study.

Social and Interactive Dimensions

While a profile analysis provided a numerical depiction of the factors that were involved with the cognitive processing displayed in the computer-mediated dialogue, it did not depict the dynamics involved with these factors as they influenced the process of knowledge construction. An adapted model of what Tashakkori and Teddlie (1998) described as a QUAN-QUAL sequential analysis was used to provide this additional

insight. Tashakkori and Teddlie explained that the objective of this model is to identify specific components of a construct (subconstructs) through the analysis of quantitative data, then "expand (emphasis mine) upon the information that is available regarding these subconstructs" (p. 135) using qualitative procedures. For the purpose of this study, any statistically significant variation in the cognitive processing displayed in the computer-mediated dialogue (as revealed by the profile analysis procedures) were qualitatively examined using Miles and Huberman's (1994) effect matrices, against the backdrop of Henri's (1992) social and interactive dimensions of the computer-mediated dialogue.

Miles and Huberman's (1994) effects matrices was used to analyze the social cues and interactions that were displayed in the coded transcripts. This method of data analysis was particularly appropriate for this study in that it allowed for categories to be established a priori. The categories established for this study were (a) discussion forums, (b) teaching teams, and (c) 3-week interval periods. Each of these categories were further divided into the following subcategories: (a) each of the three discussion forums, (b) each of the 6 teaching teams, and (c) five 3-week interval periods.

The number of social dialogue postings identified were numerically recorded and categorized within a 3-dimensional matrices that corresponded to a particular subcategory within each of the three categories. The mapped-out patterns of interactions were similarly categorized within these 3-dimensional matrices. This organizational scheme was used to identify any meaningful patterns within and among these categories. Ultimately, the emergent patterns in social cues and interactions were juxtaposed against any patterns that were identified through the quantitative profile analysis of the levels of cognitive processes that was displayed in the computer-mediated transcripts. A graphic overview of this analysis is provided in Appendix F.

CHAPTER 3

RESULTS

A total of 1,145 postings were exchanged among the 32 students who were enrolled in the 16-week semester course Methods for Teaching Elementary School Science. Among the 1,145 postings, 877 were coded according to the level of cognitive processing that was made explicitly visible (classification, judgment, extension, or application). The 268 postings omitted from this analysis were those that were simply questions about assignments, project due dates, and absenteeism. The written dialogue of 416 of the 877 postings included social greetings, expression of feelings, and/or compliments to others. These postings were categorized with respect to the contexts in which it was exchanged (teaching teams, discussion forums, and semester intervals). All 877 postings were coded according to the manner in which it contributed toward an interactive dialogue. These coded transcripts and categories were analyzed using both quantitative and qualitative measures. The results of each of these analyses are discussed in the sections that follow. An overview of the number of postings that were exchanged within each of the six teams of preservice teachers and each of the three discussion forums is provided in Table 1.

Cognitive Processing

A profile analysis was performed on the 877 postings that were coded according to the type of cognitive processing that was made explicitly visible. Cognitive processing

was measured on a scale of 1 through 4, with 1 = clarification, 2 = judgment, 3 = extension, and 4 = application. The profiles of the cognitive processing means displayed in the written dialogue exchanged within each of the six teams of preservice teachers as they participated in three different discussion forums throughout four 3-week intervals are displayed in Table 2.

SPSS MANOVA was used for the primary analysis of cognitive processing patterns. Reflecting a multivariate approach of repeated measures ANOVA, measures of cognitive processing at each of the four 3-week intervals throughout the course of the semester were treated as a set of four dependent variables. The variation in the cognitive processing that was displayed throughout these four 3-week intervals was found to be a statistically significant deviation from flatness, $F(3, 873) = 7.98$, $p < .001$. With partial eta squared (η^2) = .027, however, the practical significance was not substantial. When examined as a function of both (a) teaching team, and (b) discussion forum, the patterns of cognitive processing displayed throughout the course of the semester indicated a statistically significant deviation from parallelism, $F(30, 805) = 1.803$, $p = .006$. With partial $\eta^2 = .063$, this deviation was also of practical significance. That is, these two variables did play a role in the deviation in cognitive processing that was displayed throughout the course of the semester.

Development over Time

Pairwise comparisons of the marginal means in each of the four 3-week intervals were used to analyze the statistically significant deviation from flatness. With alpha set at .0125 to achieve an experiment-wise $\alpha = .05$, interval I was found to statistically significantly vary from interval III ($p < .001$). While no statistically significant difference was found in the remaining pairwise comparisons, a graphic illustration of each of these

means (see Figure 1) depicts an increase in cognitive processing throughout intervals I, II, and III, followed by a decrease during the final 3-week interval (2.04, 2.29, 2.54, and 2.45, respectively).

Interactions

Teaching Teams and Discussion Forums

A doubly multivariate design was used to analyze the effects of (a) teaching team, and (b) discussion forums on the cognitive processing that was displayed throughout the course of the semester. Multivariate analysis revealed a statistically significant difference among the six teams of preservice teachers in the combined cognitive processing means from each of the four 3-week intervals, $F(15, 805) = 1.803$, $p < .001$, $\eta^2 = .054$. No statistically significant effect was found, however, between each of the three discussion forums in the combined means of the cognitive processing within each the four 3-week intervals, $F(6, 805) = 1.085$, $p = .370$.

Teaching Teams over Time

Two-way ANOVA procedures were used to examine the statistically significant difference in the cognitive processing means between each of the six teams of preservice teachers in each of the four 3-week semester intervals. Confidence limits were calculated around the combined mean of the profiles for the six teams of preservice teachers in each of the four 3-week intervals. To achieve an experiment-wise error at 5%, the cognitive processing mean of each teaching team was evaluated within a 99.8% confidence interval ($\alpha = .002$).

As displayed in Table 3, the mean of one or more teaching teams fell outside of these limits in each of the four intervals. With a mean of 1.38 and 1.44 in cognitive processing displayed during interval I and II respectively, Team 5 was the only team with a mean

that was reliably lower than the combined mean in each of the four 3-week intervals. With a mean of 2.90 and 2.65 respectively, the cognitive processing displayed by Team 1 and Team 6 was reliably higher than the combined mean during interval II (mean = 2.29). The mean in cognitive processing displayed by Team 1 and Team 6 (2.89 and 3.02 respectively) continued to be reliably higher than that of the combined mean during interval III. During interval IV, only the cognitive processing displayed in the postings by Team 6 (mean = 3.08) was found to be reliably higher than that of the combined mean for this final interval (mean = 2.45).

The statistically significant effect that teaching team had on the cognitive processing that developed throughout the course of the semester was further examined by plotting the means of each of the six teams of preservice teachers for each of the four 3-week semester intervals. An analysis of these plots revealed both ordinal and disordinal interactions among the six teams of preservice teachers throughout the course of the semester. These interactions are graphically illustrated in Figure 2.

Discussion Forums

With no statistically significant difference found among the three discussion forums in the combined means of cognitive processing that unfolded throughout the course of the semester, further analysis of their interactions throughout each of the four 3-week semester intervals was not warranted. However, in light of the unique structure and focus of each of these three forums, the extent to which cognitive processing was facilitated within each, in-and-of themselves, was examined. Using one-way ANOVA procedures, differences in the cognitive processing means of each of the three discussion forums was found to be statistically significant, $F(2, 872) = 9.312$, $p < .001$. With $\eta^2 = .021$, however, the practical significance of this difference was minimal. Scheffe's post hoc comparison

procedures indicated that the cognitive processing displayed within the Practicum discussion forum was statistically significantly lower than that displayed within both (a) the Readings discussion forum ($p < .005$), and (b) the Methods discussion forum ($p < .001$) (see Table 4).

Social Dialogue

The 416 postings that were coded as social dialogue were examined with respect to (a) each of the six teams of preservice teachers, (b) each of the three discussion forums, and (c) each of the four semester intervals in which they were exchanged. The results of this analysis are numerically depicted in the effects matrices displayed in Table 5 and Table 6.

Teaching Team

An examination of Table 5 highlights the substantial difference in the extent of social dialogue that was involved in the CMC that took place within each of the six teams of preservice teachers. The greatest difference, in particular, was found between Team 5 and Team 6. Among the 165 postings that were exchanged within Team 6, 105 postings included social dialogue. In contrast to Team 6, social dialogue was included in only 14 out of the 97 postings that were exchanged within Team 5.

Discussion Forum

Examining the extent to which social dialogue was included in the postings exchanged in each of the three discussion forums highlighted a more subtle difference than that found between each of the six teams of preservice teachers. The greatest amount of social dialogue was involved in the discussions that took place within the Practicum forum. Among the 336 postings that were exchanged in this forum, 206 postings included

social dialogue. In contrast to the Practicum forum, only 88 out of the 310 postings that were exchanged within the Readings forum included social dialogue. Out of the 231 postings that were exchanged within the Methods forum, 122 postings displayed social dialogue (see Table 6).

Semester Interval

A final pattern highlighted in both Table 5 and Table 6 was the steady increase in the extent of social dialogue involved in each of the postings that were exchanged throughout the course of the semester. During the first 3-week interval of the semester, social dialogue was included in 27% of the postings that were exchanged (64 postings). The extent of social dialogue increased to 48% during the second interval, followed by 58% of the postings exchanged during the third semester interval (127 and 137, respectively). During the last interval of the semester, interval IV, social dialogue was displayed in 59% of the 88 postings that were exchanged.

Interactive Dialogue

To explore the extent of interactivity involved in the discussions that took place within each of the six teams of preservice teachers, the 877 postings were categorized according to the level of interactivity at which it entered into a particular discussion (i.e., first communication of information {COI}, first response {R1}, second response {R2}, and third response {R3}). Through the analysis of the coded transcripts, the 877 discussion postings were found to contribute toward a total of 119 different discussions (indicated by the number of COI postings). Each of these discussions were categorized with regard to both (a) discussion forum, and (b) teaching team. The extent of interactivity that was involved in each of these discussions is numerically depicted in

Table 7 and Table 8, respectively. These two tables depict this facet of the written dialogue via the number of postings at each of the particular levels of interactivity that were involved in the discussions that took place within each team and discussion forum.

Discussion Forums

Readings Forum

As indicated by the number of COI postings shown in Table 7, the greatest number of discussions within each team took place within the Readings forum. This finding was expected in light of the starter/wrapper discussion format in which one student in each team was assigned two weeks within the semester in which they were responsible for generating a discussion based upon assigned readings. While the greatest number of discussions were generated within this forum, it is interesting to note that the level of interactivity involved in each of these discussions was the lowest among the three discussion forums. In particular, while the 58 COI postings (representing the 58 different discussions) lead to 196 R1 postings, only 52 postings continued to build on these discussion with a second response (i.e., R2 postings), and only 5 of these 52 postings were built upon with a third response (i.e., R3 postings).

Continuing to examine this numerical depiction within the context of the starter/wrapper format that drove the discussions within this forum, it is important to note that the 58 COI postings were questions posted by the assigned starter for a particular week, within each team (i.e., starter postings). Of the 196 R1 postings, 190 were reflective of the starter/wrapper format in which those students who were not assigned the role of starter nor wrapper for a particular week were required to respond to the question(s) posed by the starter. Of the 52 R2 postings, 48 were postings in which the

assigned wrapper for a particular week summarized the discussions that were generated within their particular team.

Methods/Practicum Forums

Unlike the dialogue within the Readings forum in which the extent of interactivity seemed to be predominantly guided by the structured starter/wrapper format, the extent of interactive dialogue that was generated within the Methods and Practicum forums was not guided by a pre-specified format. While each student was required to initiate and/or contribute to discussions by posting a minimum of one reflective summary to each of these two forums, every two weeks, the manner is which each discussion developed was dependent upon the extent and direction of the efforts and contributions made within each team.

As Table 7 illustrates, 28 different discussions developed within the Methods forum, while 33 developed within the Practicum forum. Comparisons in the number of postings at each of the levels of interactivity (with respect to the total number of postings) revealed similarities in the structure of the discussions that took place within each of these two discussion forums, specifically within each of the individual teams. Table 8 highlights the nature of this similarity as each of the levels of interactivity are broken down within each team, across each discussion forum. For example, the discussion postings within Team 6 contributed to five different discussions in the Methods forum and six different discussions within the Practicum forum. Within the Methods forum, the five COI postings elicited 22 R1 postings, 24 R2 postings, and 11 R3 postings. Similarly, in the Practicum forum, the six COI postings prompted 19 R1 postings, 23 R2, and 7 R3 postings. Such similarities suggested that the level of interactivity involved in the

different discussions that took place within each individual team was not reflective of the forum in which it was generated.

Teaching Teams

Examining the levels of interactivity with respect to each team of preservice teachers highlights the contrast between (a) the explicitly structured Readings forum and (b) the open-ended structure of the Methods and Practicum forum. In particular, while the extent of interactivity that was displayed within the Readings forum was relatively similar across each of the six teams (see Table 8), this was not the case for the Methods and Practicum forums. While the number of COI postings shown in Table 8 indicates that there was not a notable difference in the amount of discussions that each team engaged in within each of the Methods and Practicum forums, (average of 5 COI postings), the number of R1, R2, and R3 postings highlights the difference in the level of interactivity within the discussions that took place within each of the six teams. For example, the members of Team 1 generated five different discussions in the Methods forum throughout the course of the semester. A high level of interactivity is indicated by the number of R1, R2, and R3 postings that were involved in each of these discussions (21 R1 postings, 11 R2 postings, and 8 R3 postings).

Contrasting this level of interactivity were the discussions that took place within Team 5 (within the Methods forum). With only 21 postings in this forum, discussions were generated by four COI postings that prompted 13 R1 postings. Only three of these 13 postings elicited an additional R2 response. Such contrasts suggested that the discussions that took place within these two forums were shaped by the dynamics within each of the particular teams of preservice teachers.

Cognitive Processing, Social Dialogue, and Interactivity

Of particular interest to this study was the role that computer-mediated social dialogue and interactivity had in the process of knowledge construction among preservice teachers. To examine this relationship, the patterns in social dialogue and interactivity were juxtaposed numerically and descriptively against the patterns in cognitive processing that were identified in the profile analysis of each of the six teams of preservice teachers. For ease of interpretation, numerical findings are displayed in two separate tables. Table 9 displays these patterns against the backdrop of the six teams of preservice teachers. Table 10 juxtaposes patterns in cognitive process, social dialogue, and interactivity within each of the three discussion forums.

Social Dialogue: Teaching Teams

The comparisons illustrated in Table 9 fail to depict any strong relationship between cognitive processing and social dialogue. At best, these findings suggested that social dialogue tended to be more prevalent within those teams that displayed a high level of cognitive processing. Team 5 and Team 6 particularly suggested such a pattern as the extent of social dialogue that these two teams displayed was congruent with the levels of cognitive processing that were demonstrated. That is, Team 6 exhibited the greatest extent of social dialogue, as well as a notably high level of cognitive processing, throughout the course of the semester. In contrast to Team 6, Team 5 exhibited a notably low level of both (a) cognitive processing and (b) social dialogue throughout the course of the semester.

Team 6

To shed further light on the nature of the relationship between cognitive processing and social dialogue, the dynamics that were displayed in the written dialogue exchanged

within Team 6 were examined in greater detail. The following excerpt illustrates the nature of the socializing that became intertwined throughout the dialogue within this team, as one member, Derek, used sarcasm to encourage greater participation among his teammates. Pseudonyms were used to refer to all participants.

> (Derek) Where's the love for K.C., girls? Can't you see she is a distraught individual going through some difficult times right now?... searching hopelessly for the uncomprehensible, seemingly unreachable meaning of life... embarking on an inquiry-based journey to understand and make meaning of the world around us... to unveil the very secrets of science which we too desire to have revealed to us... hence driving us all to become overachievers in our science methods course and perplex even [instructor]beyond the point of reason.

While this sense of sarcasm became embedded in the discussions that took place throughout intervals II, III, and IV, it did not seem to play a role in facilitating the high level of cognitive processing that continued to be displayed within this team. Forming the basis of this conclusion was the level of cognitive processing and social dialogue displayed by one member of this team, Lindsey. In contrast to the high level of cognitive processing displayed by each of the other members of this team, Lindsey continued to display a notably low level of cognitive processing. Adding to this contrast was her lack of involvement in the social dynamics of this team. In the following dialogue, this lack of involvement was explicitly recognized by Derek as he used sarcasm to address an earlier posting in which Lindsey claimed to be actively involved in the team discussions:

> (Derek) Sure you do (to Lindsey). You just keep telling yourself that and maybe you will start believing it soon. Actually, I think I almost believed you for a minute myself... well, not really. C'mon, if you want us to believe that you are actually reading all of the profound postings we are straining ourselves to produce, you must do so by RESPONDING to them. But don't just respond, respond with LOVE and let us know you care. Once again, LOVE is the key team 6! Can you all feel the love yet?

In spite of such frequent encouragements, Lindsey continued to contribute only toward the formal content matter that was being addressed, displaying a low level of cognitive processing. These findings seem to indicate that the social dialogue did not prompt nor facilitate higher levels of thinking within this team. Rather, these findings suggest that peers who exhibited high levels of cognitive processing were merely more apt to engage in social dialogue.

Team 5

Examining the written dialogue exchanged within Team 5 supports the conclusion drawn from Team 6. In particular, the written dialogue exchanged within this team supports the suggestion that students displaying higher levels of cognitive processing are more apt to engage in social dialogue. In contrast to Team 6, the cognitive processing displayed in the written dialogue exchanged within Team 5 was notably lower than that displayed in each of the other teams. Congruent with this contrast, the social dialogue exchanged within Team 5 was minimal. Thus, parallel to the nature of the relationship between cognitive processing and social dialogue reflected in the dynamics of Team 6,

the low level of cognitive processing displayed within Team 5 would suggest that the members of this team were not apt to engage in an extensive amount of social dialogue.

Team 1, Team 3, and Team 4

Examining the social dialogue within Team 1, Team 3, and Team 4 with respect to the levels of cognitive processing that was displayed continues to support the pattern suggested in the profiles of Team 5 and Team 6. Team 1, for instance, clearly exemplifies this pattern as levels in both (a) cognitive processing and (b) social dialogue were slightly less than Team 6, yet notably higher than each of the other four teams. Sharing overall means of 2.19, both Team 3 and Team 4 displayed modest levels in cognitive processing. Consistent with the relationship between cognitive processing patterns and social dialogue exemplified by Team 5 and Team 6, the postings exchanged within each of these teams displayed only a modest level of social dialogue (see Table 9).

Team 2

As Table 9 further reveals, Team 2 was the only team in which the levels of cognitive processing and social dialogue clearly deviated from the pattern depicted by each of the other teams. While this team displayed a steady increase in the extent of social dialogue across Interval I, Interval II, and Interval III, the level of cognitive processing steadily decreased. Possible factors contributing toward this deviation will be addressed in the concluding discussion of this study.

Social Dialogue: Discussion Forums

Practicum Forum

Comparisons in cognitive processing and social dialogue within the context of each of the three discussion forums continued to highlight the minimal role that social dialogue played in the process of knowledge construction. Examining these two factors within the

Practicum forum, for instance, reveals that while the greatest extent of social dialogue was involved in the discussions that took place within this forum, the level of cognitive processing displayed was notably lower than each of the other two forums (see Table 10). Exemplifying the nature of the discussions that took place within this forum is the following dialogue that was prompted by one student, Sandy, as she expressed her feelings regarding an evaluation she received from her supervisor:

> (Sandy) This is one of the few lessons where I felt like I actually was useful and gave them information they would remember. I got the worst evaluation marks of the semester on the one lesson I was most pleased with. My supervisor's remarks were that that I should use another method for giving the students the information and I didn't involve them enough to find out what they knew. My defense, which I will not tell her, is that I wanted to give them some background knowledge for the simulation and I didn't want that to take all day....I realize I am venting but I was fired up about that assessment and it dawned on me that I was basically being penalized with all 5's and 4's because of my lesson format and she didn't even see the whole thing.
>
> (Reid –responding to Sandy) I totally feel like you too Sandy! I am so bushed with my practicum. I have done a whole lot of lessons. I don't think I can do any more this semester. My supervisor saw one of my lessons. It was a redo of a lesson I did in another class. It was the one I was most proud of. He hated it.. The lesson in his eyes

showed him that I am not ready for student teaching. HE TOLD ME! He said by the way I do things, I will sink as a student teacher.

(Janelle –responding to Sandy) I'm really sorry to hear about that Sandy. I have found that we Practicum students often have to take things with a grain of salt and try not to take things personally. And your 4's and 5's are extremely subjective. The comments count most! You are a good person and will be an excellent teacher!

(Lori –responding to Sandy) All I can say is that we're almost done with this semester and then we're on to the big stuff which makes me nervous in a way, but on the other hand I'm so excited b/c I know I only need to make it through one more semester for now... See everyone in two weeks.

As depicted in these excerpts, the social dialogue that permeated this forum primarily involved exchanges of social-emotional support among team members as they shared their practicum teaching experiences.

Methods Forum

The extent of social dialogue involved in the discussions that took place within the Methods forum was less than that of the Practicum forum (relative to the total number of postings in each forum). As discussed earlier, however, the dialogue within this forum displayed the highest level of cognitive processing. The difference in cognitive processing levels continued to be highlighted in the nature of the social dialogue that was involved in the discussions that took place within this forum. The following excerpts

illustrate this distinction as two members of Team 4 express their appreciation toward the insight that was gained from another team member:

> (Ann) Tory, I want to thank you for the very insightful things you had to say last week on WebCT. I feel I have been raised by the whole get by attitude. I do not want to become a get by teacher. I want to be able to push my students to learn no matter what grade they are in. I get very defensive when it comes to learning science because I feel like I am asked to perform so many operations that I have no clue how to do. I guess the more practice and exposure I have will be a great help. I thank you, Tory, for your enthusiasm and encouragement not to stop at second best.

> (Shannon) I was also in the same spot as Ann, completing the assignment or experiment to get it done. I can see us adjusting as we did to those experiments the other week and had to think of a way to measure in our cylinders that did not have small measurements. We were so stuck on our previous ways of learning, it took us a while to figure out that we could fill up our cylinder with water at a larger amount and count one up from there. We have to be able to think more openly, without getting stuck on the technicalities, and shy away from the way we were taught in order to teach the students meaningful things about science.

As illustrated in these excerpts, the social dialogue in this discussion forum seemed to act as a springboard for higher learning, rather than a forum for social-emotional support, as was evidenced with the Practicum forum.

Interactive Dialogue: Teaching Team

Intertwined within the relationship between cognitive processing and social dialogue was the extent of interactivity involved with each of the different discussions that were generated throughout the course of the semester. As highlighted previously, the written dialogue exchanged within Team 1 displayed the greatest extent of interactivity, while the least amount of interactivity was displayed within Team 5 (see Table 8). Examining this facet of CMC against the backdrop of the cognitive processing that was displayed among all teams provided little insight toward the role that interactivity among peers may have on cognitive processing. When examined within the context of the dynamics that were displayed within Team 1, however, the level of interactivity was found to play a notable role in the process of knowledge construction.

The extent to which knowledge was constructed in Team 1 is illustrated in the following dialogue that was exchanged between Emily and Ashley during the third week of interval IV:

> (Emily) Hi Team 1, I know from this class, it has been a challenge for me to get to the point where I am now. At first I was completely lost when it came to this inquiry-based teaching, but thanks to [instructor] she has been patient with us on helping us learn this type of teaching. Obviously, we found out there is another way to think. [Instructor] has opened a new eye for me when it comes time to finding out your own answers and looking elsewhere instead of the teacher. Sometimes I

think it is important for students to memorize things, but I also think it is important for students to be able to find their own answers, and know how to find their own answers. For example, I believe students should memorize most of their math facts, like multiplication, addition, but then if we are doing an assignment on the moon, the students should be able to find the answers amongst themselves.

(Ashley) Hi team one. I agree with you Emily. At the beginning I was wondering when we will ever learn something. But as the semester is coming to an end I can really see how I will remember this stuff that we learned in this class rather than just information that is drilled into our heads and we are tested on it. I feel that it is good that [instructor] has broadened our horizons. We are all a bit more well rounded as teachers after taking this class. Teaching in inquiry-based ways requires you to be open and let the students learn and explore what interests them and what they want to find out. By doing this, students get more involved and the information that they learn is much more meaningful. Thank you [instructor] for helping us all learn another way to teach and handle our classroom in an effective way.

The manner in which the interactivity among the members of Team 1 facilitated this process of knowledge construction is illustrated in the following discussion that was prompted by Ashley during the second week of interval I, as she expressed her opinions concerning inquiry-based teaching and learning:

(Ashley) I feel that learning about inquiry method and all this stuff is

not what I agree with. I mean at least to a certain extent. I feel that at younger grades they should be taught directly. I thought that direct instruction can be good sometimes. I'm not sure. I don't mean to sound so negative or anything, but I don't see what I am getting out of this inquiry chapters. I know that it is a different way of teaching, but what if I want direct instruction with a little inquiry? I don't know but I will still learn it and do what we have to do. I just wanted to voice my opinion.

(Emily) Hi Ashley, Sorry I didn't respond to this stuff, I am still trying to figure everything out. At first I was confused about the whole inquiry based classroom, but I think I am starting to figure that all out. I think it would be hard to teach elementary students in an inquiry-based classroom and let them think for themselves. There is a point when there can be half direct instruction, and half inquiry based, but that still leaves too much stuff for the students. I even have trouble now when a teacher says just go head, do it. It seems maybe our lives are based on someone telling you how to exactly do it, and now I believe that is where this inquiry based classroom comes from. Many people don't know how to think for themselves or even be creative with their work. Now the inquiry based classroom comes in and tries to help students with a different way of thinking.

(Katherine) Hi! Emily, yes, we all have trouble with the inquiry type

> teaching method because we have never had any experience with it. I think that the main lesson that our science method's class is trying to convey to us, is that we need to start teaching students to ask questions at a very young age so they will be ready. The problem being, we haven't been taught that way. It's hard to teach something when you haven't had that experience. It's up to us to change. Change has to come from someplace. Otherwise, well, discoveries won't be made and our world really needs new discoveries and answers to questions that may improve our environment, our health, and perhaps better relationships with the rest of the world.

Highlighted in this dialogue is the manner in which the interactivity among these students acted as a scaffold toward higher levels of thinking. As Ashley expressed her opinions concerning inquiry-based teaching and learning, her poorly developed understanding and low levels of thought processing was made explicitly visible. Displaying cognitive processing at a slightly higher level, Emily's response provided a stepping-stone for Ashley to develop a better understanding of this topic. Displaying a notably high level of cognitive processing throughout the course of the semester, Katherine (implicitly) took on the role of an informal mentor as she guided both Emily and Ashley toward higher levels of cognitive processing.

Interactive Dialogue: Discussion Forums

While the dynamics of Team 1 suggested that the process of knowledge construction was facilitated by interactive dialogue, examining the role that this factor played within the context of the discussion forums reveals mixed findings. Within both the Methods and Practicum forums, similar levels of interactivity were displayed in the written dialogue

(see Table 8). The levels of cognitive processing displayed within each of these forums, however, differed considerably (see Table 10). As discussed earlier, while the discussions that took place within the Methods forum displayed notably high levels in cognitive processing, the cognitive processing displayed in the discussions that took place within the Practicum forum was notably low.

Examining the findings presented in Table 10 in greater detail brings the various facets of these analyses full circle, as the interconnectedness between the factors that were examined is exemplified. Illustrating the nature of this interconnectedness is the juxtaposition of (a) the levels of interactivity and (b) the extent of social dialogue that was displayed in both the Methods and Practicum forums. Of particular importance is that while the social dialogue that was exchanged within the Practicum forum consisted predominantly of social-emotional support, the social dialogue that was exchanged within the Methods forum acted as a springboard toward new ideas and better understandings.

Extending this juxtaposition to the cognitive processing that was displayed within these two forums exemplifies the nature of the relationship between the level of interactivity and the process of knowledge construction. Mirroring the nature of the relationship between social dialogue and cognitive processing, the interactions that were displayed in the Practicum forum were driven by exchanges of social emotional support, thus, not prompting higher levels of cognitive processing. The interactive dialogue that was displayed within the Methods forum was driven by various aspects of teaching and learning. Thus, unlike the context of the Practicum forum, students' levels of understanding were made explicitly visible – a factor that clearly may have prompted higher levels of thinking and cognitive growth as interactions among peers provided a scaffold toward new understandings.

CHAPTER 4

DISCUSSION

This study was concerned with the potential for CMC tools to facilitate the process of knowledge construction among preservice teachers through reflective social discourse. CMC tools offer a promising new means to facilitate this process as individual reasoning and multiple perspectives are made explicitly visible. Through the quantitative and qualitative examination of the computer-mediated dialogue that was exchanged throughout the course of the semester, this study was able to identify and explore the various factors that contributed toward the knowledge that preservice teachers constructed.

The resultant findings will be discussed by returning to the questions that guided this study. These questions will be addressed in an increasingly overlapping manner, as the insight that was gleaned from one acted to inform another. The theoretical and practical implications of these findings will then be discussed, followed by suggestions for further research. First, however, the limitations of this study are addressed.

Limitations

The main limitations of this study lie in how cognitive processes were defined and interpreted. Understanding how people learn is an inherently complex and multifaceted area of study. For the purpose of this investigation, cognitive processing was interpreted

as a developmental progression through discrete modes of reasoning. While this perspective was drawn from experts in the field, it clearly oversimplifies a dynamically complex process that is not yet fully understood.

Along these same lines, embedded within this perspective was the conceptualization of reflective practices. As thoroughly discussed in the review of the literature, reflective practices have been conceptualized in many different ways. For the purpose of this study, the conceptualization of reflective practices was intertwined within the interpretation of cognitive processing. That is, reflective thinking was conceptualized as a hierarchical progression leading to more advanced levels of cognitive processing. While this conceptualization is shared among a number of researchers, it represents only one among many possible interpretations.

An additional limitation of this study was the assumption that students' written dialogue provided an accurate gauge of cognitive processing levels. While reliability was established with regard to the manner in which this dialogue was coded, the meaning that was drawn from these coded transcripts was based upon the assumption that this dialogue reflected cognitive processing abilities. Extraneous factors such as comfort level, experience, and accessibility are a few among many other factors that may have impacted the level of cognitive processing that was displayed in a student's written dialogue. While considering these limitations, the questions that guided this study are now discussed.

Would the Type of Cognitive Processing Vary throughout the Semester, Independent of Discussion Forums and Teaching Teams?

The cognitive processing that was displayed in the written dialogue of the 877 postings that were examined did vary throughout the course of the semester. This

variation in cognitive processing suggests that students began to think about teaching and learning in a more cognitively complex manner throughout the first 12 weeks of the semester. During the last interval of the semester, however, cognitive processing levels were found to decrease. Examining the written dialogue exchanged within this last interval strongly suggests that this decline was merely indicative of the increasingly relaxed manner in which students contributed toward discussions as the semester was winding-down. Thus, the process of knowledge construction seems to have been facilitated throughout the course of the semester as students engaged in computer-mediated dialogue.

Following Clark's (1994) line of reasoning, although these findings indicated that the process of knowledge construction seems to have been facilitated as students engaged in computer-mediated dialogue, this was not inherent in the use of this instructional medium. This instructional medium merely provided a pedagogical context that had the potential to facilitate this process. Questions concerning the various facets of this pedagogical context are addressed in the sections that follow.

Would the Type of Cognitive Processing that Develops within the Six Teams of Preservice Teachers throughout the Course of the Semester Vary among Each of the Three Discussion Forums?

A fundamental driving force shaping the pedagogical context was the three different discussion forums in which each of the six teams of preservice teachers participated. The written dialogue that was exchanged within each of these discussion forums did display varying levels in cognitive processing. Of particular importance, however, was that this variation was not congruent with each of the six teams of preservice teachers, throughout

each of the four semester intervals. The nature of this disparity highlights two overlapping salient points: (a) the pattern in cognitive processing that developed within each team of preservice teachers over the course of the semester was not influenced by the structure of each of the three different discussion forums; however, (b) the structure of each forum did influence the overall learning that occurred. Given this, the discussion that follows elaborates on the overall learning that took place within the context of each of the three different discussion forums, from lowest to highest level demonstrated.

Would Participating in the Different Types of Discussion Forums Have an Impact on Students' Cognitive Processing?

Practicum Forum

As evidenced by the low level in cognitive processing displayed in the written dialogue within this forum, the context of the Practicum forum did not lend itself toward the process of knowledge construction. The discussions within this forum were predominantly exchanges of social-emotional support rather than exchanges in new ideas and understandings.

While the cognitive processing that was demonstrated in these discussions was considerably low, the number of postings students made was greater than each of the other two forums. Additionally, as explicitly stated by a number of students in their postings throughout the course of the semester, nearly all students appreciated this forum as it gave them the opportunity to share their teaching experiences with their peers. Thus, exemplifying the conclusions drawn from a number of studies concerned with the social dimension of CMC (e.g., Bodzin & Park, 1997; Casey, 1994; Merseth, 1991), preservice teachers did find computer-mediated discussion forums to be a valuable resource when

used as a medium for social-emotional support among peers with shared teaching experiences.

Embedded within the social-emotional dialogue that was exchanged within this forum were the many assumptions that students held about various aspects of teaching. For instance, as students discussed a specific lesson that was taught in their practicum classroom, assumptions of what good teaching is were often made apparent. Unfortunately, although assumptions were often made explicitly visible in the written dialogue that was exchanged, they would seldom be clarified. Confirming the findings from Harrington and Hathaway's (1994) study, although the discussions within this forum generated a rich source of assumptions about teaching, few students recognized them as such, even when questioned by their peers. As a fundamental concern in preservice teacher education, this issue will be addressed in greater detail as it relates to the implications that it has for further research.

Readings Forum

The written dialogue exchanged within the Readings forum displayed higher levels in cognitive processing than the dialogue within the Practicum forum. Clearly contributing toward this higher level in thinking was the focus of the discussions within this forum. The discussions that took place within the Readings forum were explicitly structured to generate meaningful dialogue concerning the issues/ideas addressed in the assigned readings. The assigned starter for each week was responsible for posting 2-3 questions that would generate in-depth discussions concerning what they thought to be among the most relevant issues/concepts addressed in the readings. Thus, unlike the Practicum forum, this forum did not elicit discussions based merely upon shared experiences but rather ideas and understandings concerning various topics of teaching and learning.

While the explicit focus of the discussions within this forum prompted higher levels of cognitive processing, the structure of these discussions did not lend itself entirely well toward the process of knowledge construction. The primary drawback of this structure was that it did not prompt students to exchange written dialogue that was highly interactive. Supporting the findings from Hara et al.'s (2000) study, this structure impeded interactive dialogue as students limited their participation to the requirement of one posting per week, responding to the weekly starter questions. As a result, this forum did not generate discussions in which students were prompted to defend assumptions, exchange ideas, or negotiate new understandings.

It is important to note, that although students' limited participation did not foster discussions that were highly interactive, students did not merely contribute to this forum as if in a vacuum, responding to the questions posed by the starter in an isolated context. While the first posting was (understandably) a direct response to the questions posed by the starter, the postings that followed would often build on the ideas presented in the previous postings. Students who were among the last in their team to respond to the weekly starter question would often begin by stating that they agree with an earlier response, that was then rephrased and expanded upon with additional details or new insights.

It was also interesting to find that few responses clearly suggested that students were taking advantage of this medium to lurk. That is, students seldom seemed to deliberately rely on the responses posted by their peers to develop their own response. While lurking has been well cited (e.g., Hatton & Smith, 1995; Mason, 1991) as one of the disadvantages inherent to this instructional medium, this study found very little evidence of its occurrence. To the contrary, students who were among the last to post a response to

a starter question often explicitly expressed frustration as they were challenged to contribute insights that were not already posted by their peers. Thus, in light of the extent and manner in which students recognized the ideas presented by their peers, this forum did provide a means for knowledge to be constructed. However, given the limited participation and lack of interactivity, this structure was not particularly conducive toward developing the habits-of-the-mind that this medium was intended to foster – those that are needed to become a reflective practitioner.

Methods Forum

As evidenced by the consistently high levels of cognitive processing displayed in the written dialogue that was exchanged, the context of the Methods forum lent itself particularly well toward facilitating the process of knowledge construction. Like the Readings forum, a key factor in prompting higher-order cognitive processing was the focus of the dialogue – learning to teach. Rather than providing an explicitly structured format for student participation, however, students were simply required to reflect on their experiences in the classroom component of this course, approximately every two weeks.

As expected, the focus of this forum was initially problematic for many students. It was clear that students were not accustomed to thinking about learning to teach. To stimulate this line of thinking, students were initially asked to use this forum to discuss their opinions regarding the activities that were taking place in the classroom component of this course. Interestingly, students were eager to share an array of opinions which, in turn, provided a springboard for an array of discussions concerning learning to teach. For example, as one team expressed concerns that they were not given a "box of science lessons", it became apparent that this group of students perceived this to be a key

component of the teaching process. Throughout the course of the semester, the dialogue exchanged within this group of students progressed toward a more fully developed understanding of the complexities of learning to teach.

Although a number of undeveloped and often misconceived perceptions of learning to teach were elicited in this initial dialogue, discussions within this forum did not lead all students toward improved understandings and insights into the complexities of teaching. Clearly, the learning that was demonstrated within this forum was facilitated, as well as impeded, by a myriad of factors. The discussion that follows provides further insight into possible factors that were involved with this process as they are addressed with respect to (a) the low levels in cognitive processing that were displayed by Team 2 and Team 5, and (b) the more cognitively complex levels of thinking that were demonstrated by Team 1 and Team 6.

Would Participating in the Different Teams of Preservice Teachers Have an Impact on Students' Cognitive Processing?

As evidenced by the variation in the cognitive processing displayed in the written dialogue exchanged within each of the six teams of preservice teachers, the dynamics within each team played a critical role in the knowledge that was constructed throughout the course of the semester. The discussion that follows focuses on those teams that provided unique insight toward impeding and facilitating factors that were involved with the process of knowledge construction. This discussion begins by returning to the deviating pattern in cognitive processing that was displayed within Team 2. The dynamics that seemed to contribute toward the low levels in cognitive processing that were demonstrated by Team 5 throughout the course of the semester are then elaborated

upon. Finally, providing further insight toward the role that social dialogue and peer interactions have in the process of knowledge construction, the high levels of cognitive processing that were displayed in the discussions that took place within both Team 1 and Team 6 are discussed within the context of the social and interactive dimensions of CMC.

Low Cognitive Processing Levels

Team 2

The written dialogue that was exchanged within Team 2 during the first interval of the semester demonstrated cognitive processing at an expected moderate level. The students within this team were often recognizing alternative perspectives in conjunction with supporting assertions that were being made about teaching and learning. Interestingly, however, this displayed level of cognitive processing deviated from the predominantly increasing trend that was displayed by each of the other teams as it declined throughout the second and third intervals of the semester. Among the myriad of factors that may have contributed toward this decline in cognitive processing were the dispositions toward the teaching profession that permeated the written dialogue posted by two students within this team, Leanne and Shelly.

Unlike the other four members of Team 2, Leanne and Shelly had considerable experience teaching in a private school setting and through long-term substitute teaching assignments. With this experience, these two students readily gained the respect of their peers. Unfortunately, however, the influence that this respect had on this team was less than ideal.

While Leanne and Shelly did have considerable teaching experience, they did not share this experience in a manner that fostered new understandings to be constructed and negotiated within this team. Rather, their written dialogue seemed to inhibit the process

of knowledge construction as they shared various challenges involved with teaching in a highly unconstructive manner that was not questioned nor further examined. The following dialogue illustrates the negative impact that these two students seemed to have on the overall learning that was demonstrated within this team as they expressed their opinions toward the teaching and learning opportunities that new technologies offer:

> (Leanne) I know tech really does have some wonderful things to improve teaching, but it is pointless to even talk about. If you were so lucky as to have computers, not to mention Internet access, using it in the classroom is just one big headache.
>
> (Talia) Leanne, if I was so lucky, why would it be so difficult to use? I have heard this before, I am just interested in your experiences.
>
> (Shelly) Talia, I know you were asking Leanne, but let me tell you what I have learned from shop talk at all the schools I have subbed at- 1st, internet access is so slow that there is not enough class time for students to access basic information. Even if they could, I guess the district has filtered out a ton of science related material since the content includes body parts, drugs, and stuff like that ya know (-:, and I guess ECS's just create one glitch after another...
>
> (Sharon) Wow! That is so disappointing. I wonder if that is just in those schools or even just this district!? I hope so!!!

(Cory) Thanks for the reality check you two!

Throughout the course of the semester, Leanne and Shelly continued to dominate the discussions within this team. As evidenced by the decline in cognitive processing throughout the course of the semester, these two students did not stimulate discussions that called for in-depth levels of thinking. Rather than fostering new knowledge to be constructed and negotiated among peers, the dynamics within this team shaped a context in which less than ideal knowledge was dispensed and seldom questioned.

Team 5

The written dialogue that was exchanged within Team 5 was of particular interest in that the cognitive processing that was displayed was notably lower than that which was displayed by each of the other teams throughout the first three intervals of the semester (with the exception of Team 2). Among the several factors that may have contributed toward the notably low levels in cognitive processing were the seemingly narrow grade-driven dispositions that were displayed by three of the five students within this team, Kayla, Julie, and Natalie.

This grade-driven disposition was made explicit during the first classroom meeting of this course as one student, Kayla, asked several detailed questions pertaining to the expected quantity and quality of the postings that were to be made to each of the discussion forums. She concluded her questioning with the assertion that she needed to know precisely what needed to be done to earn an A in this course.

This disposition immediately permeated the written dialogue that was exchanged between Kayla, Julie, and Natalie. Specifically, these three students contributed toward team discussions in a very regimented manner that was bounded by their efforts to earn an A. Paradoxically, given the low level of cognitive processing that was made evident in

their written dialogue, these students did not demonstrate the capacity to accurately understand the type of thinking that their discussions were intended to foster. That is, these students seemed to be functioning at a cognitive level that interpreted learning outcomes in terms of discrete skills or concepts rather than the thinking processes leading toward such objectively defined goals. In this way, this disposition seemed to perpetuate low levels of cognitive processing.

As evidenced by the steady increase in cognitive processing within Team 5, it is important to note that this disposition did seem to give way toward more complex levels of thinking as the semester progressed. Contributing toward this growth was the written dialogue of the other two members of this team, Iliana and Lindsey. Unlike Kayla, Julie, and Natalie, Iliana and Lindsey demonstrated a more intellectually-oriented disposition toward their participation in the computer-mediated discussions. Particularly, these two students did not participate in a manner that seemed to be bound to a particular question or topic; rather, in a conversational manner, they brought up questions and uncertainties concerning various aspects of teaching and learning. As the semester progressed, the dispositions modeled by Iliana and Lindsey seemed to guide the discussions in a more meaningful direction. That is, in contrast to Team 2, the patterns in cognitive processing suggested that students were progressing toward higher levels of thinking as they continued to engage in computer-mediated discussions throughout the course of the semester.

High Cognitive Processing Levels

The in-depth levels of cognitive processing that were displayed in the dialogue exchanged within Team 1 and Team 6 illustrated the potential for CMC tools to facilitate the process of knowledge construction among small groups of preservice teachers. Of

particular interest were the dynamics within these two teams as they each provided unique insights toward the patterns in social dialogue and peer interactions that were involved with the processes of knowledge construction. Specifically, the dynamics within Team 6 provided unique insight toward the extent and manner in which social dialogue was involved with the displayed depth in cognitive processing, while Team 1 highlighted the extent and manner in which peer interactions contributed toward the process of knowledge construction.

What Patterns of Interactions and Social Dialogue Were Displayed Within those Groups and/or Discussion Forums that Demonstrated an In-depth Level of Cognitive Processing?

Teaching Teams

Social Dialogue

Throughout the course of the semester computer-mediated discussions became increasingly less formal as students' displayed a steady increase in social dialogue. Notably congruent to this trend were the patterns in cognitive processing that unfolded across the four semester intervals. That is, as students displayed increasingly higher levels in cognitive processing, the written dialogue that was exchanged became increasingly more social.

Interestingly, Team 6 exemplified this trend as the discussions that took place within this team not only displayed notably high levels in cognitive processing but also the greatest extent of social dialogue. This was of particular interest in that it conflicted with the assumptions to which Hara et al. (2000) alluded concerning the relationship between social dialogue and cognitive processing. In particular, these researchers discussed social

dialogue as a trade-off with higher levels of cognitive processing, implying that it was an impediment toward learning. Juxtaposing the extent of social dialogue with the levels of cognitive processing that were displayed within Team 6, as well as the overall trend displayed by each of the other teams throughout the course of the semester, clearly contradicts this assumption. That is, the social dialogue did not impede the levels in cognitive processing that were displayed.

It is important to note that this congruency between cognitive processing and social dialogue was not indicative of a causal relationship. That is, social dialogue did not foster higher levels of cognitive processing, nor did higher levels of cognitive processing necessarily facilitate social dialogue. Rather, the findings from this study seemed to merely indicate that the capacity to process information at a more complex level allowed for students to be more social in their discussions. That is, parallel to the dynamics within a classroom setting, these students were simply capable of multitasking.

Interactivity

The dynamics displayed in the written dialogue exchanged within Team 1 illustrated the extent and manner in which peer interactions can facilitate the process of knowledge construction via CMC. Of particular importance, the interactions within this team were reflective of the informal peer mentoring and scaffolding that seemed to lead toward the demonstrated higher levels of thinking. More specifically, as the written dialogue that was exchanged within this team displayed levels of thinking that spanned from low to highly complex levels of cognitive processing, the computer-mediated discussions seemed to provide a scaffold toward higher levels of learning.

While the highly interactive discussions that took place within this team seemed to facilitate the higher levels of cognitive processing that were demonstrated, the extent and

nature of this interactivity was fueled by a myriad of factors. Foundational to these factors was the notably high level of cognitive processing that was demonstrated by one student within this team, Katherine. In particular, the progression toward higher levels of learning seemed to be prompted by Katherine as she modeled in-depth levels of cognitive processing in her written dialogue throughout the course of the semester. Overlapping with the in-depth levels of cognitive processing that was displayed, Katherine prompted highly interactive discussions as she took on the role of an informal mentor, guiding her peers toward more complex levels of thinking.

It is important to note that while the high levels of cognitive processing that were displayed by Katherine provided a scaffold for higher levels of learning, only two students within Team 1, Emily and Ashley, showed evidence of this. The written dialogue exchanged by the other two students within this team showed little evidence of progressing toward higher levels of thinking. Clearly, a myriad of factors may have contributed toward the discrepancy in the learning that was demonstrated by these four students. For instance, further examination of the dialogue that was exchanged within this team suggests that the capacity to think about one's own thinking may have contributed toward the higher levels of learning that were demonstrated. This dimension of cognitive processing was particularly highlighted by Emily and Ashley as they often made their thinking explicitly visible in their written dialogue. Unlike the written dialogue of those students who continued to display low levels of thinking throughout the semester, Emily and Ashley seemed to be more aware of the limitations in their own thinking with statements such as "I don't know, that's just what I think", "Maybe it is just me, but I don't understand the purpose of this", and "I'm just not used to this".

The extent and manner in which this cognitive awareness was involved with the levels of thinking that were displayed by the students within this team goes beyond the scope of this study. As this clearly may have substantial implications toward facilitating the process of knowledge construction via this instructional medium, this dimension of cognitive processing is further addressed with respect to the implications that it has for future research.

Discussion Forums

The extent and manner in which Team 1 and Team 6 depicted social dialogue and interactivity to be involved with the process of knowledge construction is further exemplified by examining these two dimensions of CMC within the context of the learning that was demonstrated in each of the three discussion forums. In particular, examining the discussions that took place within the Practicum forum exemplifies the seemingly meager role that social dialogue played in the cognitive processing that was demonstrated within Team 6. Supporting the conclusions drawn from Team 1, the discussions within the Methods forum exemplify the importance of peer interactions as a facilitating factor involved with the process of knowledge construction via CMC. Each of these dimensions of CMC is now depicted within the context of these two discussion forums.

Social Dialogue

In contrast to the patterns in social dialogue that unfolded within each team, social dialogue was more prevalent within the forum that demonstrated the lowest levels in cognitive processing – the Practicum forum. Continuing along this same line, however, comparisons between social dialogue and cognitive processing failed to follow a similar pattern. In particular, while discussions within the Readings forum were least social,

students demonstrated only moderate levels of cognitive processing. Within the Methods forum, discussions were moderately social, yet students demonstrated cognitive processing at notably high levels. Thus, exemplifying the conclusions drawn earlier, social dialogue did not seem to impede or facilitate students' demonstrated ability to process information at a cognitively in-depth level.

Interactivity

Contributing toward the high levels in cognitive processing that were displayed within the Methods forum was the level of interactivity that often led students toward more fully developed understandings of teaching and learning. A fundamental factor enabling highly interactive discussions within this forum was the open-ended structure that guided student participation. In contrast to the explicit structure of the Readings forum that seemed to inhibit highly interactive discussions as they merely replied to weekly questions that were posted, students did not limit their participation in this forum to course requirements, nor did they participate as if in a vacuum. The open-ended structure of this forum facilitated highly interactive discussions as students shared and questioned ideas concerning teaching and learning.

Overlapping with the structure of this discussion forum, the focus of the discussions within the Methods forum was also of particular importance. Comparisons between the Methods and Practicum forums exemplified this importance as the discussions within each were equally interactive, yet at opposite extremes with respect to the levels of cognitive processing. As this clearly suggests, facilitating the process of knowledge construction via CMC called for discussions to be less structured with respect to the extent and manner for participation. However, for meaningful learning to occur discussions should be guided by specific topics/issues concerning teaching and learning.

Conclusions

Practical Implications

The findings from this study highlighted the extent and manner in which CMC tools can facilitate the process of knowledge construction among preservice teachers. As computer-mediated discussion forums provide a means for preservice teachers to share teaching experiences among their peers, the written dialogue that is exchanged provide teacher educators with a valuable resource that can be used to enhance preservice teacher education. For instance, the transcripts that are generated among preservice teachers as they participate in computer-mediated discussions provide a useful tool for teacher educators to gauge students' levels of cognitive processing. This, in turn, can be particularly useful in structuring small groups for computer-mediated discussions in which students functioning at a high cognitive and metacognitive level of development prompt higher levels of cognitive processing within a small group of their peers.

From a more pragmatic view, computer-mediated discussion forums provide a means to engage students in meaningful learning activities outside of the structured class time. While the structured starter/wrapper format did not lend itself particularly well toward highly interactive discussions, it did provide a means for knowledge to be constructed in a collaborative manner. Strategies in which all students within a small group have a unique responsibility would perhaps stimulate greater levels of interactivity. Forming learning communities where students defend a particular position or develop an argument involving complex issues or topics within a small group of peers is one among a number of strategies that could be used.

It is important to note that recognizing the extent and manner in which CMC can enhance preservice teacher education calls for time and commitment on the part of

teacher educators. As this study highlighted, teacher educators may often need to prompt preservice teachers to engage in meaningful CMC that foster intended learning outcomes. Furthermore, assessing individual learning that is demonstrated via this medium calls for teacher educators to read, and often respond to, each posting that students contribute toward computer-mediated discussions. From each of these perspectives, it is clear that teacher educators must be willing and able to invest additional time and efforts toward their role in the preparation of preservice teachers if the potential that CMC tools have to offer teacher education is to be recognized.

Suggestions for Future Research

The computer-mediated transcripts that are generated via CMC tools not only provide teacher educators with a valuable resource to enhance the learning within the context of their own classroom, but also provide researchers with an ideal resource to analyze the factors involved with preservice teacher development. In conjunction with gaining a better understanding of preservice teacher development, insight into how this development can be fostered via CMC tools is gained. While a growing number of researchers are beginning to provide this needed insight, there clearly are a myriad of areas that have yet to be examined.

Foundational to these unexamined areas is the capacity for this medium to elicit taken-for-granted assumptions about teaching and learning. Recognizing taken-for-granted assumptions about teaching and learning is a central component involved with facilitating the process of knowledge construction among preservice teachers. The findings from this study exemplified the fact that while CMC tools do lend themselves well toward eliciting the assumptions and preconceptions with which preservice teachers enter into teacher education programs, these are deeply rooted and resistant to change.

Further research is clearly needed to understand how this medium can be used to transform these assumptions into an objectively grounded and evidentiary knowledge base of teaching.

As this study exemplified, students' levels of cognitive development are a central factor involved in shaping the knowledge that is constructed within computer-mediated discussion groups. Further studies, however, are needed if this understanding is to be used to maximize the potential of CMC tools. For instance, this study suggested that metacognitive dispositions play an important role in students' demonstrated ability to develop more advanced understandings of teaching and learning through peer scaffolding. Given this, to what extent can CMC tools be used to foster such dispositions? Perhaps examining this epistemological dimension within the context of a graduate level course in teacher education would provide a valuable perspective toward this dimension, particularly as metacognitive thought processing may be demonstrated as the norm rather than the exception among students.

Finally, as evidenced by the dynamics within Team 5, although this instructional medium can stimulate the development of a disposition that fosters more cognitively complex modes of learning, this does not unfold simply in a manner that can be readily and fully recognized within a 16-week semester course. Additional studies, therefore, are needed that examine the impact of computer-mediated discussions beyond the immediate context in which it is used. Specific questions that might be raised include: (a) At what stage in teacher preparation programs do most students recognize learning and thinking that was fostered via this instructional medium (if at all)? (b) Are there commonalities among student experiences that fostered this recognition? (c) Ultimately, to what extent

do CMC tools foster the development of the habits of the mind needed to become a reflective practitioner?

Final Considerations

While new technologies continue to provide numerous opportunities to enhance learning and teaching, recognizing this potential is clearly dependent on the pedagogical and theoretical bases of its use. Recognizing the potential that CMC technologies offer preservice teacher education calls for instructors and researchers to recognize this instructional medium within a social constructivist framework. As CMC technologies continue to merge with social constructivist models of teaching and learning, preservice teacher education programs will help prepare students to become reflective practitioners.

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APPENDIX A

TABLES AND FIGURES

Table 1

Number of Postings Exchanged within (a) Six Teams of Preservice Teachers, and (b) Three Discussion Forums.

	Discussion Forums			
Team	Readings	Methods	Practicum	Total
1	62	44	72	178
2	65	40	59	164
3	44	33	68	145
4	53	32	43	128
5	38	20	39	97
6	48	62	55	165
Total	310	231	336	877

Table 2

Profiles of Cognitive Processing Means Displayed in the CMC within (a) Six Teams of Preservice Teachers, and (b) Three Discussion Forums across Four 3-Week Intervals

Team	Forum	Intervals I	II	III	IV	M
1	R	2.41	3.35	2.71	3.50	2.89
	M	2.60	3.13	3.12	2.43	2.84
	P	1.81	2.23	2.87	2.30	2.28
	M [a]	2.18	2.73	2.89	2.54	2.63 [b]
2	R	2.31	1.85	2.00	2.25	2.09
	M	2.38	2.35	1.88	1.50	2.23
	P	2.19	1.73	1.83	2.00	1.95
	M [a]	2.29	2.02	1.92	2.07	2.07 [b]
3	R	1.95	2.41	3.00	3.38	2.45
	M	2.25	2.00	2.89	1.67	2.25
	P	1.42	2.10	1.91	1.90	1.81
	M [a]	1.85	2.22	2.52	2.33	2.19 [b]
4	R	2.24	2.11	2.25	1.80	2.11
	M	2.00	2.50	2.64	2.25	2.42
	P	2.06	1.88	2.40	2.38	2.13
	M [a]	2.14	2.07	2.44	2.12	2.19 [b]
5	R	1.63	1.63	2.90	3.50	2.16
	M	1.00	1.00	1.60	2.00	1.45
	P	1.50	1.64	2.11	2.29	1.82
	M [a]	1.48	1.44	2.33	2.60	1.88 [b]
6	R	1.92	2.68	2.38	2.75	2.43
	M	2.83	2.72	3.85	3.67	3.27
	P	2.14	2.56	2.11	2.83	2.41
	M [a]	2.29	2.65	3.02	3.08	2.76 [b]
						2.29 [d]
	M [c]	2.04	2.29	2.53	2.45	

Note. R = Readings forum; M = Methods forum; P = Practicum forum

M [a] = M of team within each of the four separate intervals; M [b] = Overall M of each team; M [c] = M of each interval; M [d] = Overall M of teams across intervals

Table 3

Comparisons in Cognitive Processing Profile Means of Each Teaching Team Across Each of the Four 3-Week Intervals

	Intervals				
	I	II	III	IV	
Team					M^a
1	2.18	2.90*	2.89*	2.54	2.63
2	2.29	2.02	1.92	2.07	2.07
3	1.85	2.22	2.52	2.33	2.19
4	2.14	2.07	2.44	2.12	2.19
5	1.38*	1.44*	2.33	2.60	1.88
6	2.17	2.65*	3.02*	3.08*	2.73
M^b	2.04	2.29	2.53	2.45	

Note. M^a = Mean of each team across intervals; M^b = Mean of each interval over teams

*p<.002

Table 4

Results of Scheffe's Post Hoc Comparisons of Cognitive Processing Levels Displayed in Each Discussion Forum

	M	Readings	Method	Practicum
Readings	2.37	-	.09	.28*
Methods	2.46	.09	-	.37**
Practicum	2.09	.28*	.37**	-
Overall M	2.29			

Note. M = Mean level of cognitive processing displayed within each discussion forum.

*p <.005; **p < .001

Table 5

Comparisons in the Extent of Social Dialogue Exchanged Within Each Teaching Team, Across Four Semester Intervals

	Intervals				Total	
Team	I	II	III	IV	SD	%
1	14	29	27	25	95	53%
2	11	24	32	15	82	50%
3	11	21	26	7	65	45%
4	9	15	20	11	55	43%
5	1	4	4	5	14	14%
6	18	34	28	25	105	64%
Total	64	127	137	88	416	47%

Note. Values indicate number of postings with social dialogue.

SD = Total number of social dialogue postings within each team, across four intervals

% SD = Percent of social dialogue postings with respect to total number of postings in each team, across four intervals

Table 6

Comparisons in the Extent of Social Dialogue Exchanged Within Each Discussion Forum, Across Four Semester Intervals

Forum	Intervals				Total	
	I	II	III	IV	SD	%
Reading	15	27	29	17	88	28%
Methods	17	38	37	30	122	53%
Practicum	32	62	71	41	206	61%
Total	64	127	137	88	416	47%

Note. Values indicate number of postings with social dialogue.

SD = Total number of social dialogue postings within each forum, across four intervals

% SD = Percent of social dialogue postings with respect to total number of postings in each forum, across four intervals

Table 7

Extent of Interactive Dialogue Within Each of the Three Discussion Forums

Team	Discussion Forum			Total
	Readings	Methods	Practicum	
	Communication of Information			
1	12	5	5	22
2	12	4	6	22
3	11	5	6	22
4	9	5	5	19
5	8	4	5	17
6	6	5	6	17
Total	58	28	33	119
	1st Response			
1	37	21	24	82
2	40	16	30	86
3	33	15	32	80
4	29	17	21	67
5	22	13	22	57
6	35	22	19	76
Total	196	104	148	448
	2nd Response			
1	12	11	33	56
2	11	13	14	38
3	8	8	5	21
4	7	8	30	45
5	8	3	12	23
6	6	24	23	53
Total	52	67	117	236
	3rd Response			
1	1	8	10	19
2	2	7	9	18
3	1	4	0	5
4	0	1	12	13
5	0	0	0	0
6	1	11	7	19
Total	5	31	38	74

Note. Values indicate number of postings.

Communication of Information represents number of discussions that were generated.

Table 8

Extent of Interactive Dialogue Within Each Teaching Team

Team	Level of Interactivity	Discussion Forum			Total
		Readings	Methods	Practicum	
1	COI	12	5	5	22
	R1	37	21	24	
	R2	12	11	33	
	R3	1	8	10	
2	COI	12	4	6	22
	R1	40	16	30	
	R2	11	13	14	
	R3	2	7	9	
3	COI	11	5	6	22
	R1	33	15	32	
	R2	8	8	5	
	R3	1	4	0	
4	COI	9	5	5	19
	R1	29	17	21	
	R2	7	8	30	
	R3	0	1	12	
5	COI	8	4	5	17
	R1	22	13	22	
	R2	8	3	12	
	R3	0	0	0	
6	COI	6	5	6	17
	R1	35	22	19	
	R2	6	24	23	
	R3	1	11	7	

Note. COI = Communication of Information; R1 = 1st Response; R2 = 2nd Response; R3 = 3rd Response

Values indicate number of postings.

Number of COI postings represent number of different discussions that were generated.

Table 9

Comparisons between Cognitive Processing Profiles, Social Dialogue, and Interactivity among Each of the Six Teams of Preservice Teachers

	Intervals									
	I		II		III		IV		M[a]	Total
	CP	SD	CP	SD	CP	SD	CP	SD	CP	SD
Team										
1	2.18	14	2.90	29	2.89	27	2.54	25	2.63	95
2	2.29	11	2.02	24	1.92	32	2.07	15	2.07	82
3	1.85	11	2.22	21	2.52	26	2.33	7	2.19	65
4	2.14	9	2.07	15	2.44	20	2.12	11	2.19	55
5[d]	1.38	1	1.44	4	2.33	4	2.06	5	1.88	14
6[c]	2.17	18	2.65	34	3.02	28	3.08	25	2.73	105
CP M[b]	2.04		2.29		2.53		2.45		2.29	
SD Total		64		127		137		88		416

Note. CP = Mean level of cognitive processing; SD = Number of social dialogue postings

M[a] = CP mean of each team; M[b] = CP mean of each interval

[c] Team with greatest interactivity displayed in dialogue as per Table 8

[d] Team with least interactivity displayed in dialogue as per Table 8

Table 10

Comparisons Between Cognitive Processing Profiles, Social Dialogue, and Interactivity Among Each of the Three Discussion Forums

	Intervals										
	I		II		III		IV		M[a]	Total	
Forum	CP	SD	CP	SD	CP	SD	CP	SD	CP	SD	%
Reading[c]	2.08	15	2.50	27	2.46	29	2.64	17	2.37	88	28%
Methods[d]	2.22	17	2.36	38	2.97	37	2.06	30	2.46	122	53%
Practicum[d]	1.90	32	2.08	62	2.23	71	2.22	41	2.09	206	61%
CP M[b]	2.04		2.29		2.53		2.45		2.29		
SD Total		64		127		137		88		416	

Note. CP = Cognitive Processing; SD = Social Dialogue

%= Percent of social dialogue postings with respect to number of postings in each forum, across four intervals

M[a] = CP mean of each forum; M[b] = CP mean of each interval

[c] Interactivity reflective of starter/wrapper discussion format as per Table 7

[d] Similar levels of interactivity displayed in dialogue as per Table 7

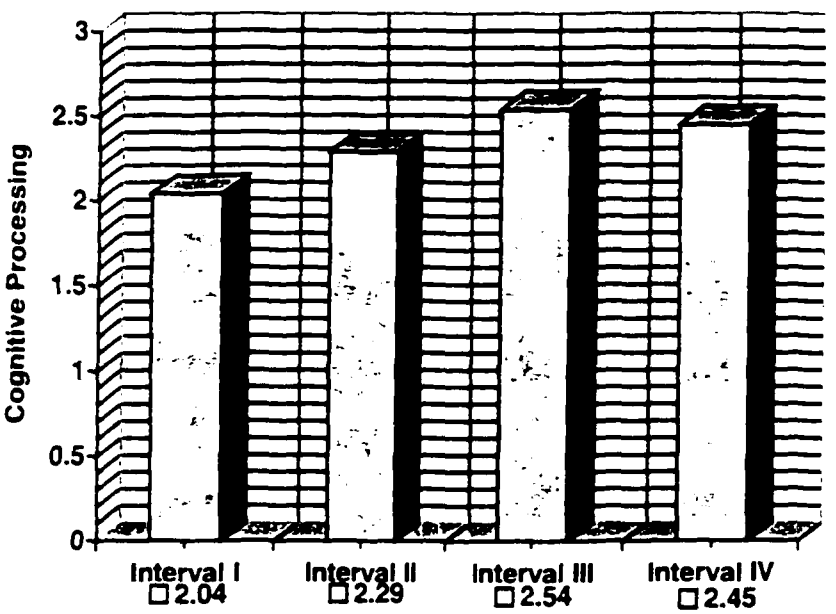
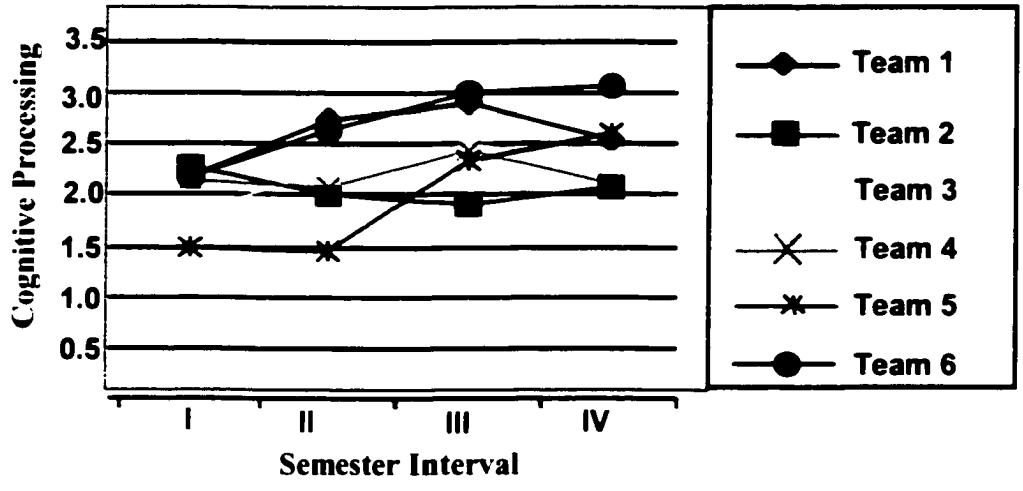


Figure 1. Cognitive processing across intervals.



APPENDIX B

DEFINITION OF TERMS

For the purpose of this proposed study, the following terms are defined:

Asynchronous learning networks. The term asynchronous learning network is used to refer to those courses that use the World Wide Web as a means of accessing learning resources and which use CMC to support teacher-student and student-student communication (Hiltz, 1997). Staley and MacKenzie (2000) further explained that CMC tools such as e-mail, mailing lists, and conferencing underpin ALNs.

Content analysis. Content analysis is a general term used to describe various textual analyses that typically involve comparing, contrasting, and categorizing a set of data (Schwandt, 1997).

Discussion posting. A discussion posting can be defined as any contribution made by a participant in a computer-mediated discussion regardless of its length.

Flatness. Flatness is a term that is used in quantitative profile analysis procedures that addresses the similarities of response to all dependent variables, independent of groups (Tabachnick & Fidell, 1996).

Parallelism. Parallelism is a term used in quantitative profile analysis procedures that addresses the interactions among all independent variables (Tabachnick & Fidell, 1996).

Profile analysis. "Profile analysis is a special application of multivariate analysis variance (MANOVA) in which several DVs (dependent variables) are measured and they are all measured on the same scale" (Tabachnick & Fidell, 1996, p. 441).

Reflection. Reflection is the "disposition and ability to consider education as the result of many social, political, and individual factors accompanied by an understanding of the need to base subsequent action on careful analysis of the results of such inquiry" (Clift, Houston, & McCarthy, 1992, p.127).

Reflective social discourse. Reflective social discourse is a type of scaffolding in which community-based discourse is used to provide multiple perspectives and feedback as a means of facilitating the process of knowledge construction (Lin et al., 1999).

Social constructivism. Social constructivism is a synthesis of a constructivist and socio-cultural theoretical perspective. Building on the constructivist view that knowledge is actively constructed and reconstructed as the learner interprets their experiences based on prior understandings (von Glasserfeld, 1987), the socio-cultural perspective of constructivism emphasizes that knowledge is constructed through social interaction and collaboration with others (Cobb, 1994)). According to Cobb, "Each of the two perspectives, the social-cultural and the constructivist, tells half of a good story, and each can be used to complement the other" (p. 17).

APPENDIX C

A REVIEW OF THE LITERATURE

For this study this review examined the literature which concerned facilitating knowledge construction among preservice teachers as it related to (a) reflective practices, and (b) computer-mediated communications. The research reviewed in each of these two areas provided the theoretical framework in which this study was situated. As will be evident at the conclusion of this review, the juxtaposition of these two areas suggested the need for the current study.

Reflective Practices

Foundations of Reflection

Among the earliest scholars credited with laying the groundwork of reflective practices has been John Dewey (1933; 1938). Dewey conceptualized reflection as a specialized way of thinking that emerges from doubt and perplexity and leads to purposeful inquiry and problem resolution. Dewey recognized that inferences drawn from past experiences form the basis of future actions. Actions that result in situations that are perplexing, yet meaningful, prompt the deliberate engagement in reflective practices as the learner becomes aware of the inadequacies involved with their existing conceptions.

Building on the seminal work of Dewey, Donald Schon has been among the most prominent scholars credited with renewing the interest in the concept of reflection,

specifically within the context of reflective teaching (Grimmett, MacKinnon, Erickson, & Riecken, 1990; Valli, 1992). Schon (1983) depicted the importance of reflective practices among practicing teachers in his The Reflective Practitioner. According to Schon, practicing teachers reflect in-and on-action. Reflection-in-action occurs while an action is being undertaken. It may be characterized as the craft of teaching that is derived from professional experience (Feiman-Nemser, 1990; Gilson, 1989; Schon, 1983, 1991). Reflection-on-action is the deliberate thinking through of a teaching situation after it occurred, possibly leading to the transformation of beliefs and toward efforts to act similarly or differently in future. According to Schon (1983, 1991), reflection in and on action are two sources of information from which competent teachers draw to generate new knowledge.

Perspectives of Reflection

The work of Donald Schon has prompted a vast array of interests in reflective practices among scholars ranging from cognitive psychologists to critical theorists (Grimmett, 1988; Valli, 1992). Within the context of teacher education, Zeichner (1992) pointed out how "the term reflection has become a slogan around which teacher educators all over the world have rallied in the name of teacher education reform" (p. 161). Within this context, reflective practices have evolved into a multifaceted concept, representing various overlapping conceptualizations that have been crafted to fit within a variety of perspectives on teaching and learning.

Grimmett (1988) illustrated the multifaceted nature of reflective practices as he categorized the various conceptions of reflection according to the ontological perspective of how research-derived knowledge is used in teacher education. Against this backdrop, he depicted the following three categories of reflective practices: (a) the thoughtful

application of research findings or educational theory to practice, (b) the deliberation among competing views of teaching, and (c) the reconstruction of experiences. Situated within the first category are those scholars who perceive teaching as more technical in nature, wherein reflection on research-based knowledge is supported as a means to direct teachers in their practice. Among the scholars placed within the second category of reflective practices are those who view research based knowledge as a source for teachers to draw from as they reflect and deliberate among competing versions of good teaching.

Among those scholars associated with Grimmett's third category of reflective practices are those who have contributed to the body of the literature that draws explicitly on a constructivist view of knowledge. Within this category, research-based knowledge is viewed as one source of information that guides teachers as they reconstruct their understanding of teaching and learning based upon their experiences. Embedded within this category are the following subcategories: (a) new understandings of action situations, (b) new understandings of self-as-teacher, and (c) new understandings of taken-for-granted assumptions about teaching and learning. As he further explained, the first subcategory represents reflection as a means of reconsidering the assumptions that prior understandings of a situation were based and rethinking the possible responses that are available. The second subcategory is based upon the idea that reflection on experiences, including past and present teaching experiences and personal biographies, act to structure and restructure personal and practical knowledge. The third subcategory consists of scholarly works that emphasize reflection as a means of emancipation from the social, political, and taken-for-granted assumptions about teaching and learning.

The multifaceted nature of reflective practices was further illustrated by several scholars in Reflective Teacher Education: Cases and Critiques (Valli, 1992). This

collection of works provided several critiques of reflective practices against the backdrop of seven different case studies of reflective teacher education programs. Each of these case studies illustrated various conceptualizations of reflective practices as the following aspects of each program were discussed: (a) history and pedagogical assumptions, (b) instructional strategies, (c) evaluation procedures, and (d) problems that have been encountered.

Sparks-Langer (1992) provided further insight on the multifaceted nature of reflective practices as she reviewed the various approaches toward understanding teachers' reflective thinking that were taken by each of these seven teacher education programs. Specifically, she proposed that, to a certain extent, each of the seven reflective teacher education programs have drawn from a cognitive, critical, and narrative understanding in their approach to reflective practices. A cognitive approach toward reflective practices was used by Sparks-Langer to describe those programs concerned with how teachers process information and make decisions. Programs concerned with the sociopolitical implications of the experiences, values, and goals of teachers were used to illustrate a critical approach toward reflective practices. The narrative approach was used by Sparks-Langer to describe those programs that emphasized the validity of the inferences that preservice teachers draw from their past and present teaching experiences.

In addition to Sparks-Langer, Zeichner (1992) highlighted the various conceptualizations of reflective practices as he reviewed each of these reflective teacher education programs against the backdrop of the following historically-based traditions of educational reform: (a) social efficiency, (b) academic, (c) developmentalist, and (d) social reconstructionist. As Zeichner explained, the social efficiency tradition of educational reform emphasizes the need to base educational practices on empirical

findings of effective teaching. Within the academic tradition, Zeichner referred to Lee Shulman's (1986; 1987) emphasis on teachers' deliberations on subject matter knowledge and the ability to transform this knowledge to facilitate student understanding. The developmentalist tradition identifies with a constructivist view of learning in which reflective practices are supported as a means of facilitating professional growth as well as fostering the habits of the mind needed to become a reflective practitioner. Within the social reconstructionist tradition, reflective practices are emphasized as a means of focusing teachers' attention on their own practices and the social conditions upon which these practices are situated.

In contrast to the various categorical perspectives of reflection are conceptualizations of reflection as a hierarchical progression leading to more complex forms of reflective practices. Contributing toward this conceptualization has been the work of Van Manen (1977) and Valli (1992). Van Manen conceptualized reflective practices as a hierarchical progression involving the following three levels of reflection: (a) technical reflection, (b) practical reflection, and (c) critical reflection. Van Manen contended that each of these ways of knowing should not be conceptualized in isolation but rather as transitional components progressing toward a higher level of reflectivity.

Expanding on Van Manen's conceptualization of reflection as a hierarchical progression, Valli (1992) offered the following six levels of reflective practices: (a) behavioral, through (b) technical decision making, to (c) reflecting-in-action, (d) deliberative, (e) personalistic, leading to (f) critical. According to Valli, each of these levels can be viewed either as mutually exclusive visions of good teaching or as hierarchical qualities of good teaching. However, supporting Van Manen's contention,

she suggested that these levels are to be viewed as interrelated facets leading toward more complex forms of reflection.

Reflective Pedagogy

Journal Writing

The multifaceted conceptualizations of reflective practices in teacher education has prompted the widespread use of various instructional strategies to facilitate the process of reflection among preservice teachers. Among the numerous strategies recommended to facilitate reflective thinking is journal writing. Journal writing is a recommended instructional tool that prompts preservice teachers to explicitly recognize and examine their beliefs about teaching and learning (Cruickshank, Bainer, & Metcalf, 1999). Feiman-Nemser (1992) explained that journal writing encourages "student teachers to reflect systematically on their own development and their actions in the classroom" (p. 227). Knowles and Holt-Reynolds (1991) contended that journal writing reveals "many of the catalysts and inhibitors in prospective teachers' past and contemporary experiences, and in their thinking about future practices" (p. 108).

Carter (1994) specifically advocated journal-writing activities that focus on what she termed well-remembered events. These writings are explicitly structured into the following three components: (a) detailed description of the event, (b) an analysis of the event, and (c) the implications that the experience and subsequent examination has for teaching. Based on initial research findings (Carter, 1994; Carter & Gonzalez, 1993), Carter suggested that well-remembered events provide a means to understand the cognitive processes involved with learning to teach and how classroom events impact these processes.

Dialogue

Another highly touted strategy to prompt reflection among preservice teachers is through dialogue. Class discussions, as well as individual conferences, provide a means for preservice teachers to reflect on their classroom observations and teaching experiences as they are shared with others. Killian and McIntyre (1988) recommended providing preservice teachers with ample opportunities to talk with their cooperating teachers. Weekly seminars that include students, cooperating teachers, and university faculty offer a means for all of those involved to reflect on teaching and learning within the context of their experiences through conversations (e.g., Applegate & Lasley, 1982; Tabachnick & Zeichner, 1984; Zeichner & Liston, 1987).

Experiences

Laboratory experiences. Laboratory experiences such as microteaching and case studies are supported as a means of facilitating reflective practices as they offer a context that may challenge the preconceptions with which preservice teachers enter into teacher education programs. According to McIntyre, Byrd, and Foxx (1995), laboratory experiences are "designed to encourage prospective teachers to challenge their traditional beliefs about teaching and learning" (p. 180).

Microteaching is a simulated teaching experience in which preservice teachers prepare a segment of a lesson with pre-established objectives and methods that is then taught to their peers. Cruickshank et al. (1999) specifically emphasized microteaching experiences that focus on reflective teaching lessons. These reflective microteaching lessons, in turn, facilitate reflection among preservice teachers as they discuss specific and general concerns about teaching and learning that emerged from the experience.

Case studies were described by Merseth (1995) as a "descriptive research document based on a real-life situation or event" (p. 726). Merseth continued to explain that cases are explicitly developed with the detail and information needed to foster discussions that elicit active analysis and interpretations among students. According to Carter and Anders (1996), the use of cases has increased dramatically in response to the growing emphasis being placed upon the reflective dimensions of teaching practices.

Field experiences. Among the more controversial means of facilitating reflective practices among preservice teachers have been proposals to provide preservice teachers with an increased number of field experiences throughout teacher education programs. While field experiences are supported as a means of providing preservice teachers with an authentic context to prompt and base reflective practices, scholars have recognized that an increase in field experiences alone will not facilitate reflective practices (Calderhead, 1992; Knowles & Cole, 1996; Zeichner & Liston, 1987). Critiques have warned that such experiences in isolation could be detrimental as preservice teachers may emulate and conform to non-exemplary models of traditional teaching practices (Feiman-Nemser & Buchmann, 1987; Knowles & Cole, 1996).

McIntyre et al. (1995) recognized this potential detriment in their discussion of field experiences in teacher education programs. They emphasized that teacher education programs must create field experiences that enable preservice teachers to engage in reflection as they observe and interact with experienced teachers who model reflective practices. Carter and Anders (1996) pointed out that professional development schools seem to be especially suited to overcome this potential detriment as "faculty from both public schools and universities convene to engage in the enterprise of educating new teachers..." (p. 577).

Criticisms of Reflective Practices

Conceptualization of Reflection

As a prominent topic throughout the literature in teacher education, reflective practices have not gone without criticisms. Forming the basis of many of these criticisms are the various conceptions of reflective practices that were previously discussed. This array of conceptualizations prompted Feiman-Nemser's (1990) omission of reflection from her list of the following conceptual orientations: (a) academic, (b) practical, (c) technical, (d) personal, and (c) critical. Feiman-Nemser stated that many programs "explicitly endorse the goal of reflection, even though they embody different conceptual orientations" (p. 221). Thus, Feiman-Nemser contended that reflection is not a conceptual orientation, but rather a generic professional disposition embedded within each of these other legitimate orientations.

Levels of Reflection

Specific hierarchical conceptualizations of reflective practices have also been the focus of many criticisms. Van Manen's (1977) depiction of reflective thinking as a progression through the technical, practical, and critical stages of reflection has been a particular target for such criticisms. While technical reflection is often recognized as an initial step in student teacher development and a precursor to other kinds of reflection (Gore & Zeichner, 1991), minimal evidence exists to support such claims. Furthermore, although critical theory is gaining an increasingly prominent place within teacher education programs (e.g., Adler, 1991; Gore & Zeichner, 1991; Zeichner & Liston, 1987), the extent to which it is emphasized varies among institutions and programs.

Valli's (1992) depiction of the six levels involved with the development of reflective practices has also been the target of such criticisms. The fundamental flaw associated

with her depiction is the placement of Schon's reflection-in-action at level three within her 6-level hierarchy. Hatton and Smith (1994) pointed out that reflection-in-action has been cited to be among the most complex and demanding modes of reflection as it involves multiple types of reflection and perspectives to be applied during an unfolding situation. According to Schon (1983), reflection-in-action develops only through considerable experience.

Cognitive Development

Raising concerns over the developmental process of facilitating reflective thinking, Calderhead (1992) questioned the ability to predict the effect that pedagogical strategies will have on students. He explained that students enter into teacher education programs with various preconceptions about teaching and learning and thus progress towards reflective teaching in different ways. According to Calderhead, preservice teachers will "inevitably learn in diverse ways and take different meanings from the experiences that are offered to them" (p. 143).

Kennedy (1993) raised a similar concern when she referred to the process of reflective thinking as "chaotic and slippery" (p. 3). According to Kennedy, new experiences are often used to confirm rather than disconfirm existing knowledge, thus allowing faulty conclusions to be reached. Highlighting the fine line between rationalization and reflection, she questioned how an individual would be prompted to make a decision based upon prior experience rather than empirical research.

Reflective Pedagogies

Additional criticisms of reflective practices have questioned the potential for specific reflective pedagogies to facilitate the development of reflective teaching. While strategies such as journaling, dialoguing, microteaching, and case studies are commonly viewed as

strategies to facilitate reflective thinking, little evidence exists to support such claims. Furthermore, many scholars are recognizing that while reflective teacher education programs may appear to facilitate the transformation of preservice teachers' conceptions about teaching and learning, these changes may be temporary or superficial (e.g., Clift, Houston, & McCarthy, 1992; Ross, Johnson, & Smith, 1992). Scholars continue to question how reflection can be distinguished from procedural display. As reminded by Korthagen (1988), "students are good at figuring what the teacher educator wants to hear" (cited in Richardson, 1997, p. 113).

Conclusion

As Zeichner (1992) stated, teacher educators have rallied around reflection as a slogan for teacher education reform. However, various conceptualizations of this term have emerged as it is crafted to fit within various contexts of teacher education. As a result, there is a lack of shared agreement among scholars who write about reflective practices. Furthermore, within the context of preservice teacher education, there remains a dearth of empirical evidence that supports the impact of reflective pedagogies such as journaling and dialogue, as well the cognitive processes involved with reflection. Thus, although the concept of reflection continues to be a prominent topic throughout the literature in teacher education and is well-supported as means of preparing preservice teachers to enter into the teaching profession, additional research is clearly needed to develop a better understanding of how reflective practices facilitate the process of knowledge construction among preservice teachers.

One potential means to facilitate the process of knowledge construction through reflective practices seems to be asynchronous computer-mediated communications (CMC) (Lin, Hmelo, Kinzer, & Secules, 1999; Zhu, 1998). Unlike pedagogical methods

such as journaling and dialogue, asynchronous CMC tools offer a potential means to facilitate the process of knowledge construction through reflective social discourse. Reflective social discourse was described by Lin et al. (1999) as a type of scaffolding in which community-based discourse is used to provide multiple perspectives and feedback as a means of facilitating the process of knowledge construction. They pointed out that asynchronous CMC facilitate reflective social discourse as multiple perspectives and individual reasoning are made explicitly visible. They further pointed out that, when reasoning and thinking are open for public examination through asynchronous CMC, students become motivated to place more depth and meaning into their thinking.

As a relatively recent innovation in higher education, studies examining the potential of this instructional medium are limited and disparate. Within the context of preservice teacher education, this paucity of research becomes even greater. The next section will, therefore, begin by examining the use of asynchronous CMC in areas of higher education that are not exclusive to preservice teacher preparation. The focus of this section will become increasingly narrow, however, as I then review the literature that examines the use of asynchronous CMC within the specific context of teacher education. Ultimately, this section of the review will demonstrate the need for the current study as the promising potential that asynchronous CMC have to facilitate the process of knowledge construction through reflective practices is juxtaposed with additional areas of research that need to be explored if this potential is to be realized.

Asynchronous CMC

Asynchronous CMC tools refer to those telecommunication technologies that mediate communications independent of time and location. Advancements that have been made in

telecommunication technologies throughout the past decade have lead to the development and proliferation of asynchronous CMC tools that are more interactive, distributed, and collaborative (Hedberg, Brown, & Arrighi, 1997). Within the context of higher education, these technological advancements are providing new opportunities to foster the process of knowledge construction with text-based computer-conferencing tools that prompt social interaction and collaborative dialogue among a community of learners (e.g., Duffy, Dueber, & Hawley, 1998; Goldberg, 1997). It is from this interactive/collaborative perspective that the use of asynchronous CMC tools will be examined in the section that follows.

Higher Education

Advantages and Disadvantages

Asynchronous CMC are becoming increasingly recognized as an innovative instructional medium that can be used as a supplement as well as an alternative to learning and teaching within the traditional classroom setting. Surrounding the growing interest in the use of this instructional medium are a number of advantages as well as disadvantages that have been cited throughout the literature. According to Wagner (1995), asynchronous CMC offer the following advantages over face-to-face classroom discussions:

> (a) increased participation, (b) meaningful communication, (c) individual feedback, (d) enhanced elaboration and retention, (e) support of learner control and self-regulation, (f) motivation, (g) negotiation of understanding, (h) team building, (i) discovery, (j) exploration, (k) clarification of understanding, and (l) opportunities for closure (p. 37).

Discussions throughout the literature suggest that asynchronous CMC foster improved decision-making and higher level reasoning by removing barriers such as gender and social status that occur in the typical classroom setting (e.g., Althaus, 1997; Kuehn, 1994; Olaniran, Savage, & Sorenson, 1996). Hiltz and Wellman (1997) contended that asynchronous CMC can improve in-depth reflection, development of a topic, and enhance the quality of decision-making by increasing the time available to read messages and formulate responses. Althaus (1997) proposed that students using computer-mediated discussion groups as a supplement for face-to-face discussions both earn higher grades and seem to learn better than students who participate only in face-to-face discussions.

In addition to these advantages, many scholars have noted several disadvantages concerning the use of asynchronous CMC. Included among these disadvantages is the potential for the time and place flexibility of an ALN-based learning context to enable habits of procrastination. Dufner, Hiltz, and Turoff (1994) discussed the potential for the anxiety produced by delays and different participation rates to reduce the quality of decision-making. Harasim (1990) pointed out that members may go along with an initial suggestion, even if they do not agree with it, in order to accelerate the process and meet a deadline. According to Galegher and Kraut (1994), accomplishing a task in a computer-mediated group is perceived to be more time consuming and labor intensive than it would be in a face-to-face context. Hara, Bonk, and Angeli (2000) pointed out, "the removal of time constraints can overload both instructors and students with ceaseless opportunities to learn and work" (p. 116).

Examining the advantages and disadvantages of asynchronous CMC against the backdrop of the traditional classroom setting has elicited criticisms from a growing number of scholars. Forming the basis of these criticisms is the error in assuming that

these advantages and disadvantages are inherent in the medium used. Scholars have warned that telecommunication technologies are merely an instructional medium (Clark, 1994; Kuehn, 1994; Levin, 1999). The advantages and disadvantages of this medium must be examined within a specific pedagogical context that is situated upon a solid theoretical framework.

Theory and Pedagogy

Complementing the theoretical framework that underpinned the current study, Bonk and Cunningham (1998) provided a convincing argument to situate the use and study of asynchronous CMC within a social constructivist framework. This argument was developed by Bonk and Cunningham as they established the theoretical foundation for a collection of works included in Bonk and King's (1998) Electronic collaborators: Learner-centered technologies for literacy, apprenticeship, and discourse. These scholars examined use of asynchronous CMC within each of the following frameworks: (a) learner-centered, (b) constructivist, and (c) social constructivist. Acknowledging that while each of these three frameworks do overlap, they encouraged scholars to situate CMC within a social constructivist framework. They explained that the greatest potential of asynchronous CMC lies within this framework as it promotes the process of knowledge construction through collaboration and negotiations, providing the learner with the opportunity to reflect on alternative perspectives and personal insights.

The pedagogical context of asynchronous CMC was the focus of a series of longitudinal field studies that examined student learning within the Virtual Classroom (e.g., Benbunan-Fich & Hiltz, 1999; Harasim, Hiltz, Teles, & Turoff, 1994; Hiltz, 1994; Hiltz & Wellman, 1994). The Virtual Classroom was a computer-mediated network that consisted of 26 courses that were a part of an undergraduate degree program in

Informational Technology Systems. These courses were offered as a traditional classroom-based course, as well as a computer-mediated course. While these studies examined the learning outcomes of the computer-mediated sections of each of these courses versus that of the traditional classroom, the explicit focus was on the instructional method that each medium employed. Specifically, these studies examined each of these instructional mediums against the backdrop of working individually versus in collaborative learning groups. The results of these studies supported the premise that when students are actively involved in collaborative learning within a computer-mediated forum, the learning outcomes can be equal to, or better, than those of traditional classes. However, when individuals are simply receiving posted material and sending back individual work, the results are poorer than in traditional classrooms. Based on these findings, the researchers involved with these studies continue to emphasize the need to integrate collaborative learning strategies into computer-mediated learning contexts.

While the Virtual Classroom studies demonstrated that collaborative learning strategies promote a high-level of quality learning through CMCs, these studies did not examine the dynamics involved with this process. Collaborative learning and teaching within a computer-mediated context is not an effortless process, but rather a dynamic endeavor that has yet to be fully understood. An integral facet involved with this endeavor is the social interactions that take place via CMC (e.g., Gunawardena, 1995; Olaniran, Savage, & Sorenson, 1996). Recognizing the potential of asynchronous CMC calls for a better understanding of this endeavor.

Social Interactions

Vrasidas and McIsaac (1999) addressed this aspect of asynchronous CMC as they examined the factors that influenced the social interactions within a graduate-level

hybrid-based course in instructional technology. This course was structured around four computer-mediated discussions and four discussions that took place within the traditional classroom setting. An interpretivist approach was used to examine the nature of these interactions from the perspective of both the instructor and the student.

An analysis of the data collected from observations, semi-structured interviews, and computer-mediated transcripts revealed that the four major factors influencing the interaction in this course were (a) structure, (b) class size, (c) feedback provided to the students, and (d) participants' prior experience with CMC. The researchers found that structural components such as required activities led to more interactions and increased dialogue among the participants. Students cited the small class size and lack of instructor and peer feedback as factors that limited the extent of their interactions. Finally, while students with greater experience were more comfortable with the asynchronous CMC and enjoyed posting and reading messages, novice users found it difficult to keep up and often hesitated to post messages. Vrasidas and McIsaac concluded their discussion of these findings by encouraging researchers to employ a discourse analysis approach to examine how ideas of power and control influence interactions within a computer-mediated learning context.

This aspect of asynchronous CMC was examined by McDonald and Gibson (1998) as they explored the extent and intent of the social interactions that guided group development over time in an asynchronous computer-mediated course. Specifically, this study explored these interactions within three groups of eight graduate students. The following five categories were used to code the computer-mediated transcripts that were generated throughout the semester: (a) involvement, (b) control, (c) openness, (d) solidarity, and (e) conflict.

A statistically significant difference in the extent and intent of interpersonal issues indicated that group development in this asynchronous computer-mediated course did not follow a specific pattern. A trend analysis of the proportion of interpersonal segments exchanged over time, however, revealed a statistically significant downward trend among each of the three groups of students, as well as the three groups combined. Based on these findings, the researchers suggested that it is possible to identify and describe predictable patterns of group development within a CMC-based context. The recommendation was made, however, for additional studies to relate the patterns of group development to the type and depth of learning that was taking place. McDonald and Gibson explained that with this understanding educators can improve the design of CMC-based courses to meet desired learning objectives.

Knowledge Construction

Zhu (1998) related the patterns of group development to the type and depth of learning in a study that examined the use of the asynchronous CMC software tool, VAX Notes, in a graduate-level distance-learning seminar on interactive technologies. The purpose of this study was to document patterns of students' computer-mediated discussions and knowledge construction practices. The computer-mediated transcripts that were generated throughout the semester were coded and analyzed in terms of note categories (e.g., comments, questions, scaffolding, and reflections) and participation roles (e.g., contributor, wanderer, seeker, and mentor). Additionally, patterns of interaction were classified as either vertical or horizontal. Vertical interactions were those in which group members concentrated on the responses of more capable peers, rather than constructing their own knowledge. In contrast, in horizontal interactions, group members displayed a strong desire to express their own ideas.

The process of knowledge construction was found to proceed through the following three stages: (a) formulating initial ideas based on weekly reading assignments, (b) development of new ideas through discussions and interactions among peers, and (c) the construction of new perspectives, insights, and understandings through ongoing dialogue. The process in which individuals constructed their own knowledge within these three stages differed, however, according to individual efforts, levels of active involvement, and existing knowledge. According to Zhu, the process of knowledge construction was facilitated through either (a) discussions and interactions with peers, or (b) assimilation of the information provided by peers. Based on these findings, the recommendation was made for additional studies to establish guidelines for incorporating computer-mediated tools into the classrooms. Zhu emphasized the need to examine pedagogical strategies that facilitate the process of knowledge construction within a computer-mediated learning context.

Zhu's emphasis on the process of knowledge construction through asynchronous CMC closely resembles the focus of the current study. Congruent with the premise of the current study, Zhu recognized that although social interactions are an integral facet that merges social constructivist pedagogy with the use of asynchronous CMC tools, this facet must also be connected with student learning. Unlike the context of the current study, however, this connection was drawn by Zhu within the context of a course in instructional technology that was entirely mediated through asynchronous CMC. While this course involved the study of technology within an educational setting, the participants were not predominantly preservice teachers. Accordingly, the asynchronous CMC did not center on pedagogical topics and experiences specific to preservice teacher education – an integral facet examined in the current study. Addressing this facet of

asynchronous CMC necessitates a more narrowed focus on the literature that examined the potential of asynchronous CMC within the specific context of teacher education.

CMC Technologies in Teacher Education

Congruent with other areas throughout higher education, CMC technologies are becoming an increasingly integral facet of many teacher education programs and courses. While the growing array of collaborative and integrative tools may lend themselves well toward the goals of many teacher education programs and courses, scholars must make well-informed decisions concerning the value and purpose of the various CMC tools available. As pointed out by Bonk, Hansen, Grabner-Hagen, Lazar, and Mirabelli (1998) however, a dearth of empirically based studies that compare the growing assortment of CMC tools available has left scholars with minimal guidance in making these decisions. These researchers explained that while scholars have examined the purpose and value of CMC as an alternative to learning and teaching within the traditional classroom setting, studies that examine the purpose and value of CMC against the backdrop of the variety of CMC tools available are scant.

Asynchronous/Synchronous

In an effort to address this dearth of research, Bonk et al. (1998) examined how two groups of preservice teachers resolved electronically-presented case vignettes of teaching situations using the synchronous CMC software tool Connect, and the asynchronous software tool, VAXNotes. The peer interactions and dialogue that were displayed on the computer-mediated transcripts generated throughout the semester by both groups of students using the two different CMC tools were coded using the following categories: (a) content answers, (b) questioning, (c) peer feedback, and (d) off-task behaviors. Additionally, each student completed a questionnaire at the end of the semester that

addressed the usefulness of using the synchronous and asynchronous CMC as a medium to discuss teaching cases.

Students' responses to the questionnaires indicated that although CMC could assist learning, it was less useful than anticipated by the researchers. Several of the students participating in the real-time discussions indicated that they would prefer to discuss teaching cases in a traditional classroom format. Criticisms involving the usefulness of the asynchronous CMC were often based upon the work that it added to their overloaded schedules. In spite of this less than anticipated usefulness, the researchers found that both forms of CMC facilitated student learning. The transcripts revealed that all students reflected on personal experiences as well as class material as they participated in solving the teaching cases. Additionally, the researchers reported that as students within both asynchronous and synchronous discussions carefully and deliberately crafted their comments for their peers to read, they were prompting higher levels of learning as they extended discussions and debates that were at the edges of their peers' zones of proximal development.

While acknowledging the disparity in case formats and time allotment between the two modes of CMC, the researchers continued to discuss the vast differences in the interactions and processes that were used to resolve the teaching vignettes. For instance, students participating in the synchronous discussions posted a greater number of responses than those students participating in the asynchronous discussions. Students participating in the asynchronous discussions, however, were more elaborate and responsive to their peers in their remarks. Continuing to acknowledge the limitations in generalizing their findings to decisions about asynchronous and synchronous CMC tools, the researchers highlighted the fact that while the "length of the session, task format, and

particular tool used were all influential in student-learning outcomes, the teacher had a significant role in guiding the form of dialogue" (p. 309). Based on this assertion, the recommendation was made for instructors to model effective questioning techniques. Additionally, the suggestion was made to assign students specific roles such as devil's advocate, protesters, critics, and optimists to prompt and facilitate student interactions and debate. The researchers concluded by emphasizing the need for future studies to examine how competent students may scaffold the learning of less competent peers and how discourse patterns may vary according to task criteria, instructional tools, and interaction timings.

Peer-to-Group/Individual-to-Individual

Similar to the concerns raised by Bonk et al. (1998), Levin (1999) asserted that the uses of CMC tools have not been sufficiently evaluated. According to Levin, decisions concerning the use of CMC tools are often based upon familiarity and availability, rather than pedagogically sound and empirically-based recommendations. In an effort to address this shortcoming, Levin examined the purpose and content of four different types of asynchronous CMC that were exchanged among 35 preservice teachers throughout 3 of 4 semesters in an undergraduate teacher education program. Of primary interest was how different types of asynchronous CMC facilitated reflective thinking. Comparisons were made between the asynchronous CMC that were mediated with the computer conferencing software tool, TopClass, to the asynchronous CMC mediated through email messages. The preservice teachers involved in this study were expected to communicate every few weeks about their field experiences through email with (a) their peers, (b) a teacher candidate in another state, and (c) their instructor. During the third semester of the program, preservice teachers were given the option to participate in the computer-

mediated, threaded discussion group using the asynchronous CMC software tool, TopClass, in lieu of regular journal writing assignments.

Using a constant comparative method of data analysis, Levin reported that the major purposes of the asynchronous CMC included opportunities for personal reflection, sharing teaching activities, and offering support. Among the four types of communication, peer-to-group discussions using TopClass fostered the most discussions that prompted reflective thinking. Following Clark's (1994) line of reasoning, however, Levin emphasized that the medium is not the method. The asynchronous CMC tools were only a delivery system. With this limitation acknowledged, Levin pointed out that these findings may have merely indicated that the 11 students who chose to participate in the TopClass discussions in lieu of regular journal assignments had a natural disposition toward reflective thinking. Levin further suggested that the content and purpose of these messages were likely influenced by the unstructured nature of the e-mail exchanges.

Peer-to-Group Asynchronous CMC

The purpose and value that prompted the use of asynchronous CMC for the current study were consistent with the findings of these two investigations. CMC that are elaborate, interactive, and reflective are essential facets involved with the process of knowledge construction through social reflective discourse and, thus, of primary consideration for the current study. As these investigations demonstrated, telecommunication technologies that mediate peer-to-group discussions via asynchronous CMC seem to offer the greatest potential to foster these attributes of learning. As the remainder of this review becomes increasingly focused on this instructional medium within the context of teacher education, it will become apparent that the questions and

concerns posed by these researchers directly informed the questions that drove the current study.

CMC Tools in Teacher Education

Parallel to the rapid proliferation of asynchronous CMC tools has been the rapid emergence of various terms used to refer to telecommunication technologies that mediate peer-to-group discussions via asynchronous CMC. Included among these terms are (a) electronic computer-conferencing systems, (b) electronic bulletin boards, (c) computer-supported collaborative learning tools, and (d) asynchronous learning networks (Hedberg, Brown, & Arrighi, 1997; Kahn, 1997). Among each of these terms, an ALN seems to be most commonly used throughout the literature. Thus, while each of these terms may accurately depict the manner in which asynchronous CMC tools were used throughout this study, the remainder of this review will use the term asynchronous learning networks.

The growing interest in the potential that asynchronous CMC have to offer teacher education continues to be demonstrated through the rapid proliferation of CMC-based learning forums. The Harvard Beginning Teacher Computer Network (BTCN), for example, is a CMC forum that was developed to provide beginning teachers with a forum to discuss topics related to their teaching experiences (Merseth, 1991). TeacherNet is an CMC forum that was developed by Jean Casey (1994) to facilitate the integration of technology use among preservice teachers throughout their student teaching experiences. The ALN, SciTeach, offered preservice teachers a medium to share ideas and reflections on the implementation of technology as well as other instructional pedagogies (Bodzin & Park, 1997). The electronic Bulletin Board System (BBS) is CMC forum that was designed to facilitate reflective dialogue between preservice teachers during their student teaching practicum (Wu & Lee, 1999).

Potential Benefits

Studies have revealed a variety of social and emotional benefits derived from participation in these CMC-based forums. In a study of the nature and type of support delivered to 39 of the beginning teachers who participated in the BTCN, Merseth (1991) found that this forum provided beginning teachers with personal, emotional, and technical support through asynchronous CMC. The following benefits were reported by the six student teachers and six master teachers participating in Casey's (1994) examination of TeacherNet: (a) increased feeling of rapport with and support from the university supervisor, (b) decreased feelings of isolation, and (c) increased self-esteem due to mastering technology. According to Bodzin and Park (1997), participating in SciTeach provided preservice teachers with a network of socio-emotional support. The use of the electronic BBS provided an "instrument for the emotional support of student teachers during their teaching practicum" (Wu & Lee, 1999, p. 246).

The potential for CMC forums to foster reflective thinking among preservice teachers was also highlighted by these researchers. According to Casey (1994), TeacherNet provided students with increased time to reflect on what they were learning. Bodzin and Park (1997) asserted that the SciTeach forum enabled preservice teachers to become "critical and reflective about issues of pedagogical knowledge and practice"(p. 7). Wu and Lee (1999) reported that interactions with peers via the BBS promoted preservice teachers to reflect on their views about teaching.

Integral Factors to be Considered

Continuing to follow with Clark's (1994) line of reasoning, it is important to note that the medium is not the instructional method. The potential benefits that CMC tools have to offer teacher education are not inherent in them. While this instructional medium

facilitates asynchronous CMCs, this tool can be used to structure the learning context in a variety of ways. For instance, while Harvard's BCTN and Casey's TeacherNet were open-structured CMC forum in which participation was voluntary, the preservice teachers involved with the SciTeach program were required to post a minimum of three messages each week. Additionally, SciTeach was structured into the following discussion forums: (a) teaching science content, (b) incorporating instructional technology into the curriculum, (c) general pedagogy, and (d) general concerns about their teaching experiences. While participation in the electronic BBS was also a requisite, requiring student teachers to post a minimum of one message each week, the topic of these postings was not explicitly defined beyond reflections on student teaching experiences. Furthermore, while master teachers and university supervisors were encouraged to participate in both TeacherNet and SciTeach, the electronic BBS was designed to encourage open dialogue by explicitly limiting participation to student teachers.

The structure of the pedagogical context is an integral facet that is intertwined between (a) the promising potential that CMC tools have to offer teacher education, and (b) the myriad of questions that have yet to be answered if this potential is to be realized. Bodzin and Park (1997), for example, found that although participation in SciTeach facilitated critical and reflective thinking, perceptions and attitudes toward experiences with the SciTeach forum varied greatly among the participants in this study. These findings suggest the need for additional studies to examine the potential factors that contribute toward the variance in perceptions and attitudes of participating in computer-mediated discussion forums. In addition, Bodzin and Park highlighted the following questions that call for further examination: (a) Which topic areas promote the most reflective discourse? (b) How does peer responsiveness affect the depth of the dialogue?

And (c) Does interacting via CMCs promote reflection on what the students are learning, including teaching approaches and decision-making?

While most of the student teachers involved in Wu and Lee's (1999) examination of the electronic BBS reported that they appreciated the use of this medium to facilitate the growth of their teaching experiences, other student teachers failed to actively participate in these discussions. The researchers suggested that active participation might have been impeded by the length of time that was needed to read and respond to elaborate postings. Based on this concern, the suggestion was made to place a maximum length on the required postings as well as highlighting the major points made throughout the text. The additional recommendation was made for researchers to examine the impact that a moderator, as well as an experienced teacher, may have in promoting dialogue and encouraging reflection.

Foundational to the consideration of the pedagogical context are the pedagogical goals that this instructional medium is intended to foster. Congruent with the growing emphasis on reflective practices throughout teacher education programs, reflection seems to be an underlying goal embedded in the use of CMC tools. Few scholars, however, have clearly depicted this concept as an explicit goal for student learning. Furthermore, continuing to parallel discussions throughout the literature on reflective practices in teacher education, scholars are often elusive on the conceptualization of reflection.

Reflective Practices

Harrington and Hathaway (1994) have been among the few scholars who have predicated their research involving the learning that occurs among preservice teachers within CMC-based context on an explicit conceptualization of reflective practices. They specifically examined the potential of their computer-mediated discussion forum,

Dialogical Community Exercise (DCE), to facilitate what they referred to as critical reflection on fundamental pedagogical issues among preservice teachers. Drawing from learning theories on adult development, critical reflection was operationalized as:

> (a) recognizing limitations in socio-cultural, epistemic, and psychological assumptions; (b) acknowledging and including multiple perspectives; (c) considering the moral and ethical consequences of choices; and (d) clarifying reasoning processes when making and evaluating decisions (p. 544).

Harrington and Hathaway found that although the use of a CMC forum elicited taken-for-granted assumptions about teaching and learning, few preservice teachers explicitly recognized them as such. The ability to recognize and clarify these implicit and often unfounded assumptions about teaching and learning that were generated via CMCs co-varied with developmental levels. Based upon their findings, they encouraged additional studies to examine the role that different students play in facilitating the professional and cognitive development of their peers.

The recommendations made by Harrington and Hathaway call for researchers to examine the potential for CMC tools to facilitate reflective practices from a cognitive perspective. This perspective was used by Hara et al. (2000) in a study that examined the cognitive processes that underlie student participation in computer-mediated discussions. Specifically, this study examined the extent of the social, cognitive, and metacognitive CMCs that took place among a group of preservice teachers enrolled in an Educational Psychology course that combined face-to-face meetings and computer-mediated discussions. Using Henri's (1992) model for the content analysis of CMC, they found that structured online collaborative learning activities provided students with the time needed

to "reflect on course content and make in-depth cognitive and social contributions" (p. 140).

Although students were processing information at a high cognitive level, Hara et al. (2000) found that students limited their participation efforts to the course requirement of one posting per week. Based on this finding, they contended, "There clearly is a pressing need to develop pedagogy that motivates students to electronically participate in class discussions beyond standard course requirements" (p. 141). Furthermore, they suggested that "cognitively deeper discussions might be obtained with asynchronous tools that embed such features as issue-based forums and debates, alternative views of argument structure, and options for comment labeling" (p. 148).

The findings and recommendations presented by the researchers involved in these two studies formed the basis of the current study. As Harrington and Hathaway's (1994) study revealed, although CMC tools have the potential to elicit taken-for-granted assumptions about teaching and learning, students do not necessarily recognize them as such. The current study examined the factors that prompted students to recognize these assumptions. Of primary interest were the patterns of cognitive processing displayed among peers and how these patterns developed throughout the course of the semester. Drawing from Hara et al.'s (2000) recommendation to facilitate cognitively deeper discussions through the use of specifically developed forums, this study examined the patterns of cognitive processes within each of the following computer-mediated discussion forums: (a) practicum experiences, (b) experiences in the methods classroom, and (c) course readings.

By examining these facets of asynchronous CMC, this study contributed toward developing the understanding needed to maximize the potential for this instructional

medium to facilitate the process of knowledge construction among preservice teachers through reflective practices. The questions that guided this study were:

1. Would the level of cognitive processing vary throughout the semester, independent of discussion forums and teaching teams?

2. Would the level of cognitive processing that develops within each team of preservice teachers vary among different discussion forums?

3. Would participating in the different types of discussion forums have an impact on students' cognitive processing?

4. Would participating in the different teams of preservice teachers have an impact on students' cognitive processing?

5. What patterns of interactions and social dialogue were displayed within those groups and/or discussion forums that demonstrated an in-depth level of cognitive processing?

APPENDIX D

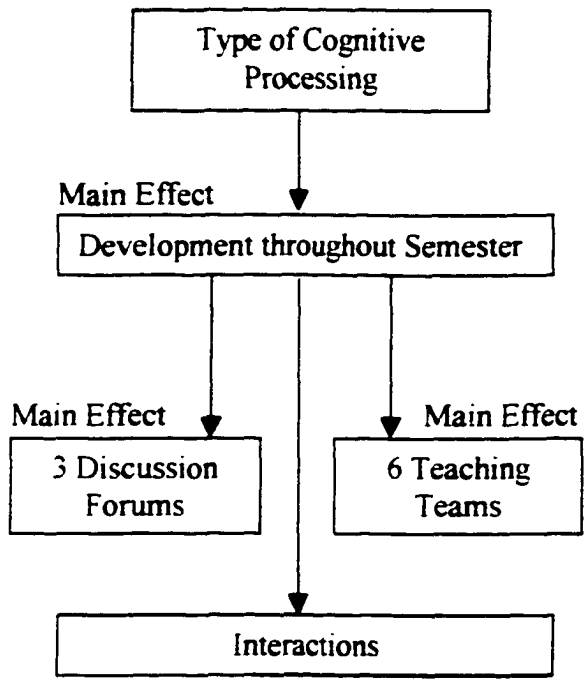
CONTENT ANALYSIS FRAMEWORK

<table>
<tr><th></th><th><u>Readings</u>
Inquiry Teaching/Learning</th><th><u>Methods</u>
Learning to Teach</th><th><u>Practicum</u>
Experiences in Teaching</th></tr>
<tr><td rowspan="2">Clarification</td><td>• Responds to question</td><td>• Discusses process of learning to teach in concrete/layperson terms</td><td>• Describes what is taking place in practicum classroom</td></tr>
<tr><td colspan="3"><u>Example:</u> Inquiry based assessment involves in-depth reasoning and concept application. It checks to see what each student understands and what can be done with current knowledge. It works to help students generate questions, develop explanations, design investigations, and use data as evidence for their explanations. On the other hand, more conventional assessments ask students to identify facts, concepts, or definitions. The conventional ways are extremely broad, shallow in depth of reasoning, and too narrow in measuring outcomes.</td></tr>
<tr><td rowspan="2">Judgment</td><td>• States & supports opinions/perceptions on topic of readings</td><td>• States & supports opinions/perceptions of learning experiences in methods classroom</td><td>• States & supports opinions/perceptions on what is taking place in practicum</td></tr>
<tr><td colspan="3"><u>Example:</u> About one month into my practicum, I was still very discouraged about the noisiness of the class, and in the lack of interest of the students. There did not seem to be many management strategies in place, and there were many times when the teacher told the class she would do something, such as end a quiz at a certain time, and then she did not do it. Students were allowed to wonder the room during transitions, call out answers ,mimic the teacher, talk to each other, and other behaviors which I would not allow.</td></tr>
<tr><td rowspan="2">Extension</td><td>• Makes connections between readings and/or practicum/methods experiences</td><td>• Makes connections between readings and/or practicum/methods experiences
• Recognizes complexities involved with learning to teach</td><td>• Makes connections between readings and/or practicum/methods experiences
• Recognizes complexities involved with teaching</td></tr>
<tr><td colspan="3"><u>Example:</u> However, I'm having some problems with behavioral management. It's funny how strategies that you learn about in class or in textbooks sound so good until you apply them in real life situations!!! I do believe it is a matter of trial and error to discover the strategies that work best for you and your class.</td></tr>
<tr><td rowspan="2">Application</td><td>• Examines readings within the context of social/political and personal limitations</td><td>• Examines complexities of learning to teach within the context of social/political and personal limitations</td><td>• Examines personal & societal limitations
• Examines multiple views/options of learning and teaching</td></tr>
<tr><td colspan="3"><u>Example:</u> .. but science is taught more of like a health lesson than science. I know that health is a type of science and the CEF requirements are many so it's probably easier to put the two together, but I think there is so much more out there that needs to be dealt with. Somehow I know that I will bring more of what I consider science to be asking questions about nature, etc. into my classroom.</td></tr>
</table>

APPENDIX E

MAIN EFFECTS AND INTERACTIONS EXAMINED

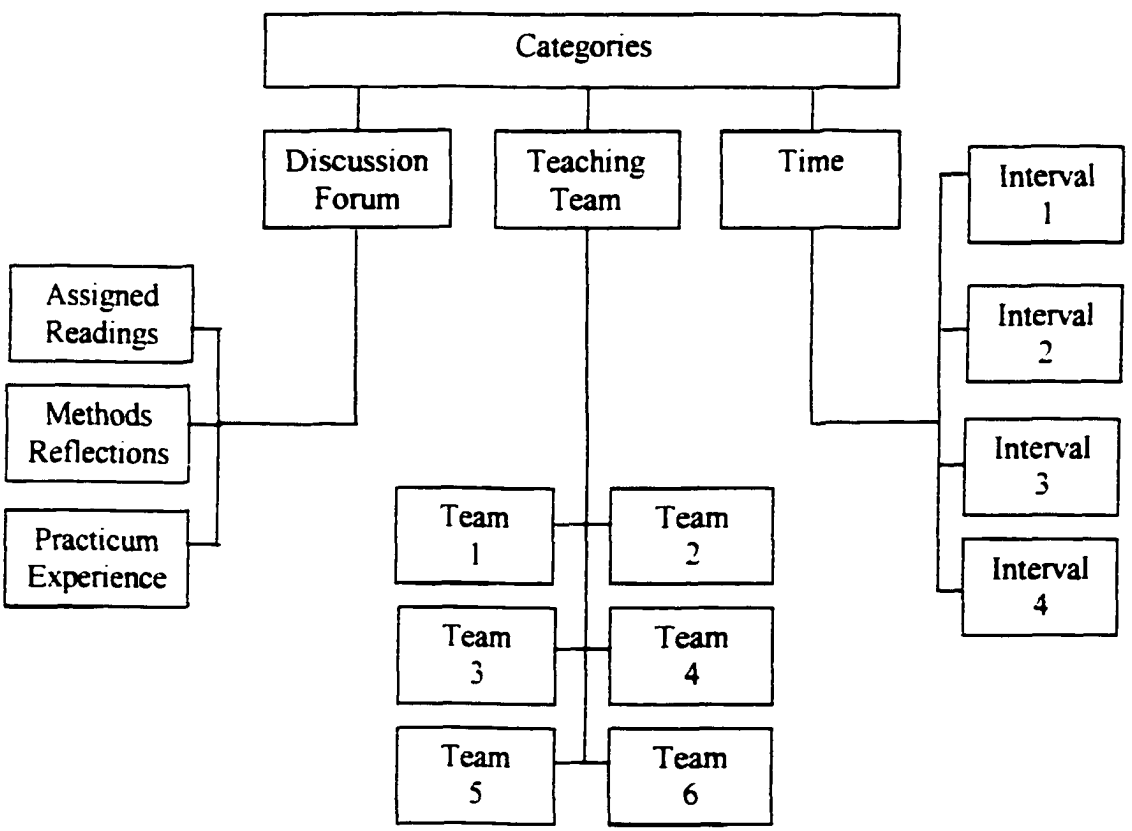
THROUGH PROFILE ANALYSIS PROCEDURES



APPENDIX F

CATEGORIES AND SUBCATEGORIES EXAMINED

THROUGH EFFECTS MATRICES



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