GROUP PROCESSES SUPPORTING THE DEVELOPMENT OF PROGRESSIVE DISCOURSE IN ONLINE GRADUATE COURSES

by

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Abstract

This design-based research study investigates the development of progressive discourse among participants (n=15, n=17, n=20) in three online graduate course contexts. Progressive discourse is a kind of discourse for inquiry in which participants share, question, and revise their ideas to deepen understanding and build knowledge. Although progressive discourse is central to knowledge building pedagogy, it is not known whether it is possible to detect its emergence in the patterns of participation in asynchronous conferencing environments or what kinds of instructional scaffolding are most effective to support its development. This study offers a unique perspective by characterizing episodes of discourse where participants honor the commitments for progressive discourse and by refining designs of peer and software-based scaffolding for progressive discourse.

Results showed that measures such as note count, replies, and thread sizes can determine some qualities of online discourse but do not shed light on the development of progressive discourse. Thus an in-depth analysis of discourse for groups was developed to trace the interdependent individual contributions to the group discourse. Peer scaffolding that made norms for progressive discourse explicit was introduced to encourage participants to engage in sustained student-centered discourse for inquiry. Findings show that this intervention was most effective at the beginning of a course for newer online learners and newer graduate students, and least effective for students who were practicing K-12 teachers. A significant barrier to fostering
progressive discourse is the tendency for teachers to reject these norms and revert to belief-mode thinking and devotional discourse typical of traditional schooling. Additionally, findings suggest that software-based scaffolding (as found in Knowledge Forum’s scaffold support feature) is a promising avenue for future design innovations to encourage progressive discourse.

Although the results of this study are only suggestive, the findings do illustrate ways in which graduate students can uphold the commitments to move beyond expressions of socio-affective connection and opinion to discuss ideas in ways that lead to more useful explanations. The implications for these results for analyzing the quality of online discourse and the designs of instructional scaffolding in online learning environments are discussed.
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Verification Standards and Procedures ................................................................. 66
Iterations 2 and 3 ....................................................................................................... 66
Review of Findings from Iteration 1 ......................................................................... 68
Iteration 2: Fall 2004 Course .................................................................................... 69
  Intervention Activities for Iteration 2 ...................................................................... 69
  Participants in Iteration 2 ....................................................................................... 71
  Data Sources for Iteration 2 ................................................................................... 72
  Data Analysis in Iteration 2 Informing Design Changes for Iteration 3 ................. 73
Iteration 3: Winter 2005 Course .............................................................................. 76
  Intervention Activities for Iteration 2 ...................................................................... 76
  Participants in Iteration 3 ....................................................................................... 77
  Data Sources for Iteration 3 ................................................................................... 79
Analysis of the Discourse ....................................................................................... 79
  Manifest Content Analysis .................................................................................... 81
  Latent Analysis ...................................................................................................... 82
  Intercoder Reliability ............................................................................................ 86

Chapter Five: Results and Discussion for Iterations 2 and 3 ................................. 89
  1. Detecting the Emergence of Progressive Discourse Through the Analysis of Online Participation Patterns ............................................................... 89
     Results of Analytic Toolkit Analysis ................................................................... 89
     1a. Extent to which Students Build on to and Reference Other Students’ Notes to Advance Their Understanding and Build Knowledge ................... 90
     1b. Extent to Which Students Collaborate to Co- Author Notes ......................... 92
     1c. Extent to Which Students Exhibit Independence From the Instructor .......... 93
     1d. Extent to Which Students Engage in Discourse Versus Completion of a Task 97
     Results of Latent Analysis 1: Qualitative Coding of the Topic of Students’ Notes .... 97
     Results of Latent Analysis 2: Quantitative Coding of Ideas in Students’ Notes .... 101
  2. How the Discourse for Inquiry (DFI) Card Intervention Affected Student Discourse .................................................................................. 104
     2a. Extent to Which Students Perceived the DFI Cards to be Useful ................... 105
     Course 2 Student Self-Reports on DFI Cards in Learning Journals ................. 106
     Course 3 Student Self-Reports in Weblogs and Questionnaires on DFI Cards .... 110
     2b. How the DFI Cards Changed (or did not Change) the Students’ Discourse ... 115
  3. How the Knowledge Forum (KF) Scaffolds Affected Student Discourse ........... 124
     3a. Extent to Which Students Used the Scaffolds .............................................. 125
     Results from Analysis Mapping Bereiter’s (2002b) Commitments for Progressive Discourse to KF Scaffold Use ......................................................... 127
     3b. Extent to Which Students Perceived the KF Scaffolds to be Useful .......... 130
     Course 2 Student Self-Reports in Learning Journals on KF Scaffolds .......... 131
     Course 3 Student Self-Reports in Weblogs and Questionnaires on KF Scaffolds .... 138
     3c. How KF Scaffolds Change (or do not Change) Student Discourse ............. 142

Chapter Six: Conclusions And Implications ............................................................ 153
  Summary ............................................................................................................... 153
  Implications for Analyzing the Quality of the Discourse ..................................... 155
  Implications for Designs of Instructional Scaffolding .......................................... 156
TABLES
Table 1 Correspondence Across Stages of Cognition in 3 Models as Presented by Schrire (2006) ................................................................. 21
Table 2 Feedback Scaffolds Used in Iteration 1, Summer 2004 ................................................................. 37
Table 3 Participant Demographics for Iteration 1 ............................................................................ 39
Table 4 Overview of Patterns of Participation of Iteration 1 Students in KF .............................................. 42
Table 5 Participation in Selected Course 1 Knowledge Forum Views ...................................................... 43
Table 6 Distribution of Iteration 1 Notes Coding to Phases of the Practical Inquiry Model ........... 43
Table 7 Knowledge Forum Scaffold Use in Iteration 1, Summer 2004 .................................................. 47
Table 8 Comparisons of Psychological Experiment Methods and Design-Based Research Methods ................................................................................................................. 63
Table 9 Summary of Design Changes to Scaffold Progressive Discourse Across Three Graduate Courses ........................................................................................................................................... 68
Table 10 Knowledge Forum Scaffolds and Scaffold Supports Used in Iteration 2 ...................... 71
Table 11 Participant Demographics for Iteration 2 ............................................................................ 72
Table 12 Participant Demographics for Iteration 3 ............................................................................ 78
Table 13 Mapping Bereiter’s (2002) Progressive Discourse Commitments to Data Collection and Analysis .................................................................................................................................. 80
Table 14 Coding Scheme for Content Analysis of Student Discourse in two Online Graduate Courses ......................................................................................................................... 84
Table 15 Overview of Student Participation in Knowledge Forum in Two Online Graduate Courses ...................................................................................................................................... 90
Table 16 Frequencies of Different Build-On Tree Sizes in Knowledge Forum in two Online Courses ................................................................................................................................. 91
Table 17 Frequencies of References Created in Knowledge Forum in two Online Courses .... 92
Table 18 Frequencies of Co-Authored Student Notes in two Online Courses ............................... 92
Table 19 Description and Frequencies of Topic Categories of Students’ Notes .............................. 98
Table 20 Distribution of Student Responses to the DFI Cards Items in Course 3 Post-Course Questionnaire ........................................................................................................................................... 113
Table 21 Frequencies of Knowledge Forum Scaffolds Used in two Online Graduate Courses 125
Table 22 Distribution of Student Responses to KF Scaffold Items in Course 3 Post-Course Questionnaire ...................................................................................................................................... 141
FIGURES

Figure 1. Four axes of relevant intellectual traditions in Wenger’s (1998) social theory of learning. ................................................................. 11
Figure 2. Discussion thread on the topic of professional development from Iteration 1, Week 6. ................................................................. 48
Figure 3. Epistemological stances among design-based researchers adapted from Dede (2004). 64
Figure 4. Idea advancement scaffolds in Knowledge Forum used in Iteration 3. 77
Figure 5. Visualization of Course 2, Week 3 discussion view activity. 94
Figure 6. Visualization of Course 2, Week 3 discussion build-on activity. 95
Figure 7. Visualization of Course 2, Week 2 discussion view activity. 96
Figure 8. Relative proportion of categories of idea units in Course 2 and Course 3. 102
Figure 9. Types of Knowledge Forum scaffolds used by students in Course 2. 126
Figure 10. Types of Knowledge Forum scaffolds used by students in Course 3. 127
Figure 11. New note window in Knowledge Forum (version 4.5.3). 135

APPENDICES

Appendix A: Participant Informed Consent Document ................................................................. 177
Appendix B: Instructor Informed Consent Letter ............................................................................ 179
Appendix C: Online Questionnaire for Iteration 1 ........................................................................ 181
Appendix D: Pre-Intervention Interview Questions for Iteration 1 .............................................. 183
Appendix E: Post-Intervention Interview Questions for Iteration 1 ........................................... 184
Appendix F: Discourse for Inquiry Cards for Iteration 2 ............................................................ 185
Appendix G: Discourse for Inquiry Cards for Iteration 3 ............................................................ 188
Appendix H: Coding Scheme for Content Analysis of Discourse Used by Zhang, Scardamalia, Lamon, Messina, & Reeve (2007) ................................................................. 190
Appendix I: Coding Scheme for Content Analysis of Discourse Used by Muukkonen, Lakkala, & Hakkarainen (2005) ...................................................................................... 192
Dedication

For my father, Yasuyoshi Fujita, who always encouraged my curiosity and persistence
Chapter One: Introduction

This dissertation reports the findings of a design-based research study exploring ways to foster and characterize progressive discourse in three online graduate course contexts. Progressive discourse is the process through which participants share, question, and revise their ideas to develop “a new understanding that everyone involved agrees is superior to their own previous understanding” (Bereiter, 1994, p. 6). Through such sustained discourse for inquiry, online graduate students may not only deepen their learning of key course concepts but also begin to participate legitimately in practices that are important for their enculturation into the educational research community. In master’s level education courses, however, many students are practicing teachers who find it difficult to engage in such reflective, collaborative group discourse. This problem is not a challenge unique to online contexts, but understanding how these students can interact productively online so that progressive discourse can emerge is particularly important given the affordances and constraints of the computer-mediated communication medium.

To this end, this thesis offers a unique perspective by investigating whether it is possible to see the emergence of progressive discourse in the patterns of online participation in asynchronous computer conferencing environments, and by refining designs of instructional scaffolding to foster the development of progressive discourse. In computer-mediated communication (CMC) transcripts, it may be possible to analyze ways in which participants appear to honor the commitments for progressive discourse “to improve the quality, coherence, and utility of their ideas” in order to deepen their understanding and build knowledge (Scardamalia, 2002). Existing behavioral and content analyses are useful for answering questions about patterns of participation and quality of discourse online, but to make claims about progressive discourse, it is necessary to examine in depth what is happening in between individual notes and how a group of students are interpreting a particular classroom discussion activity. This study went beyond reductive content analyses to develop an analysis of discourse for groups to capture the interactions that unfolded among a group of students in situ over two thirteen-week graduate educational technology courses delivered using web Knowledge Forum. This analysis provided insight on how to harness the socio-cognitive and technological dynamics that drive student discourse towards knowledge building, or alternatively, present barriers to knowledge building.
Background

Improving the quality of learning in and design of online learning environments has become important as these contexts proliferate as supplements to (Dede, 2000; Duffy, Dueber, & Hawley, 1998) and as alternatives to (Allen & Seaman, 2006; Hiltz & Wellman, 1997; Rovai, 2002) traditional face-to-face classrooms. The written nature of the asynchronous computer-mediated communication (CMC) medium may confer benefits of greater reflection (Andrusyszyn & Davie, 1997) and reasoning (Applebee, 1984).

Following Vygotsky (1986), distributed reasoning through the vehicle of collaborative discourse is the primary mechanism for learning (Chinn & Anderson, 2000; Hmelo-Silver, 2003). In face-to-face discourse, students are able to internalize ideas and externalize their argumentative reasoning. Thus, they expose their ideas to contrasting views, which facilitates progressive improvement of ideas through collaborative and explanatory discourse. This may be possible because words are accompanied by audio-visual cues that temper critical feedback.

Unfortunately, CMC is a lean medium for social presence (Gunawardena & Zittle, 1997; Short, Williams, & Christie, 1976). Social presence is crucial to perceptions of cooperation and trust necessary to build a learning community (Palloff & Pratt, 1999; Preece, 2000). CMC’s paucity of social presence makes creating an online course community conducive to developing progressive discourse less spontaneous and more difficult. Attending to and supporting cohesive factors in learning communities, notably function, identity, discursive participation, and shared values (Woodruff, 1999) should improve students’ knowledge building in online learning environments.

Creating an online community of inquiry that engages in sustained critical discourse is a major challenge in higher education (Garrison, Anderson, & Archer, 2001; Rourke & Kanuka, 2007). Researchers disagree as to whether asynchronous threaded CMC environments can support higher-order goals for discourse (e.g., Bullen, 1998; Hewitt, 2001). The medium may encourage students to share and compare ideas, rather than to engage in systematic and sustained critical discourse for inquiry (Garrison et al., 2001; Kanuka & Anderson, 1998). Indeed, without considerable direction from the instructor, online discussions show low levels of participation and lack continuity (Guzdial, 1997; Hewitt & Scardamalia, 1998; Scardamalia, 2002). Research on facilitation (e.g., Berge, 1995; Davie, 1989) has addressed many aspects of social interaction from an instructor’s perspective; however, I focus on group processes that emerge among
students, as they accept greater responsibility to self-regulate their online discourse with each other. Studies have shown that peer feedback can enhance the quality of discourse that takes place to reinforce learning and deepen understanding online (Ertmer et al., 2007; Han & Hill, 2006).

**Educational Implications**

This research has educational implications in the fields of online graduate education, teacher professional development, and knowledge building in computer-supported collaborative learning environments.

First, critical discourse is “a hallmark for higher education” (Garrison et al., 2001) and understanding the mechanisms through which students learn through discourse in online learning environments using asynchronous, text-based CMC is crucial (Wallace, 2003). However, many barriers to fostering critical discourse exist. Common practices that students follow in threaded discussion to process a large number of notes may impede progress (Hewitt, 2001, 2005). Worse, students can have competing orientations to the function of online discussion (Rourke & Kanuka, 2007). Han and Hill (2006) have suggested that analyzing in depth how different strategies are employed in multiple graduate education contexts and how they affect the discussion would extend understanding of how discourse supports the learning process online. My dissertation attempts to address this challenge in the context of growing opportunities for online graduate courses and degree programs (Pethokoukis, 2002; Tallent-Runnels, Thomas, Ahern, Shaw, & Xiaming, 2006).

Second, this study contributes to research on online teacher professional development (e.g., Blanton, Moorman, & Trathen, 1998; Dede, 2006; Wallace, 2003). Contemporary teacher education programs expect teachers to become professionals who not only understand how students learn, can teach subject-specific content to diverse students, manage the classroom, and assess student performance, but can also use new technologies effectively (Darling-Hammond & Bransford, 2005). While situated opportunities for apprenticeship and mentorship by more experienced teachers is commendable, an emerging trend in online teacher education is to fuse the culture between teachers and educational researchers by bringing teachers to the cutting edge of knowledge in their field for induction into that community (Bereiter, 2002b; Laferrière, Lamon, & Chan, 2006). The current research refined designs of interventions to support
in-service teachers in their efforts to move beyond serial monologues (Pawan, Paulus, Yalcin, & Chang, 2003).

Finally, this study attempts to address a question that remains in knowledge building theory: how to characterize the complex interactions between individual and group understanding in online discussion environments (Lee, Chan, & van Aalst, 2006). Through a knowledge-building lens, this thesis project attempted to capture and describe what progressive discourse looks like as it unfolds in situ among in-service teachers in online graduate education courses delivered using Knowledge Forum. Doing so may help educators to improve practice by understanding when deep student learning of content knowledge is occurring online and how to foster collaborative discussions that involve constructive peer feedback.

Knowledge Forum, an extension of CSILE software, is a software environment specifically designed to support knowledge building. It has been continually designed, tested and improved to enable students of all ages to read, reflect and write at length, before publicly sharing ideas (Scardamalia, 2004; Scardamalia & Bereiter, 1996). As Scardamalia (2003) explained,

The basic units in Knowledge Forum are ideas, represented as Notes. The basic workspace for developing, sharing, organizing, and creating a multiple representations of ideas is a View. (p. 24).

It affords special features like scaffolds, annotations, “rise above” or summary note capacities, and lateral linking between notes in different topic views. These features embody many of the principles for knowledge building and discussion-based constructivist learning. I aim to complement the technological design considerations of online courses with practical social designs (Bielaczyc, 2006; Scardamalia, 2000) that promote group processes supporting the development of progressive discourse.

**Theoretical Framework**

This section is organized into two main sections, with further subsections in each. The first section discusses the important role of discourse, particularly progressive discourse, in mediating deep learning through social interactions situated in learning communities. In the second section I outline similarities and differences between three constructs of learning
communities that are relevant to the current study of progressive discourse among students in the context of online courses in higher education using asynchronous computer-mediated communication. Finally, I conclude the introduction with a summary and pose my research question.

**Discourse**

Instructional research in the West first shifted away from objectivism and behavioral accounts such as Thorndike’s (1906) to individual cognitive perspectives that promote a Piagetian psychology of constructivism (Palincsar, 1998). More recently, learning theorists have moved from Piaget’s emphasis on individual thinkers and their isolated minds to theories based on Vygotsky (1978) that emphasize the social, situated and distributed nature of cognition and meaning (Barab & Duffy, 2000). Many social constructivist principles are traceable to Vygotsky who emphasized the importance of language in social interactions and externally-mediated action that come to be internalized in the thoughts of individuals (Pea, 1993). Vygotsky’s ideas, along with those of activity theorists such as Leontiev (1981) form the basis for studies of cognition in everyday activity (Lave, 1988), situated cognition (J. S. Brown, Collins, & Duguid, 1989) and situated learning (Lave & Wenger, 1991) perspectives.

Since the term “situated cognition” might imply that there is a type of cognition that is not situated, Greeno (1995) proposed an alternative term, “situativity.” Greeno (1998) contended that the situative perspective subsumes cognitive and behaviorist perspectives, and that the main distinguishing feature of the situative perspective is its theoretical focus on interactive systems that are larger than the behavior and cognitive processes of an individual agent. Thus, the growth of conceptual understanding through discourse is as significant as acquisition of basic skills from the view of situativity. Likewise, contemporary expansions of activity theory (Engeström, 1987, 2001; Engeström, Miettinen, & Punamäki, 1999) highlight a systemic unit of analysis for characterization of goal-directed activity.

Research suggests that students can improve their ideas through the forms of discourse they use (Brett, 2002; Pontecorvo, 1993; L. B. Resnick, Salmon, Zeitz, Wathenm, & Holowchak, 1993; Woodruff & Brett, 1999). Forms of discourse become internalized as forms of thought following Vygotsky since functions first occur on the social level, in interaction with others, then on the individual level, inside the student. Once internalized, the student engages in what Mead (1934) called a “conversation with the generalized other.” Students internally and vicariously
attempt to respond to imagined responses of others to their ideas and arguments (L. B. Resnick et al., 1993). Thus, understanding of ideas and coherence of arguments are strengthened by considering them from other perspectives.

Moreover, argument is a fundamentally social process of collaborative reasoning in which productive peer interactions are key (Kuhn, 1991; Moshman, 1998). Vygotsky (1978) noted, “Piaget and others have shown that reasoning occurs in a children’s group as an argument intended to prove one’s own point of view before it occurs as an internal activity…” (p. 89). This suggests that examining forms of discourse and structuring group discourse for collaborative student relationships are fundamental to learning.

Classroom discourse is typically one-sided, following a pattern of teacher question, student response, and teacher evaluation of the response (Applebee, Langer, Nystrand, & Gamoran, 2003; Cazden, 1988; Sinclair & Coulthard, 1975). In contrast, discussion-based approaches to developing understanding encourages peer interaction: as a catalyst for collaboration; for the enactment of complementary problem-solving roles; relationship with an audience; and as exploratory talk (Cazden, 1988). In addition to cognitive benefits, Cazden points to the value of collaborations both as expressions of pro-social attitudes and as a multiplier of resources for the participants. Unfortunately, this also creates problems for those who are left out.

Tannen (2003) asserts that contemporary Western academic discourse is characterized by agonism, or ritualized adversity. She claims that framing academic discourse as a metaphorical battle leads to negative consequences, including the exclusion or marginalization of those lacking a taste for contentiousness, especially when there is widespread assumption that critical dialogue is synonymous with negative critique. According to Tannen, “much more might be learned if we think of theory not as static structures to be demolished or falsified, but a set of understandings to be questioned and shaped” (p. 1666). Thus, she recommends open expression and mutual respect to hone ideas and correct mistakes without fear of stigmatization or agonistic attack, characteristics shared by progressive discourse.

In the field of education, there is an even greater challenge for classroom or academic discourse. Research on teachers’ discursive interactions in general shows a lack of direct advice or criticism (Ellis, 1993; Kling & Courtright, 2003; Little, 1985, 1990). In the culture of teaching, a teacher’s classroom practice is much more closely tied to his or her identity as a
person; in contrast, in the culture of science, a researcher accepts critical discourse as a natural part of inquiry (Cochran-Smith and Lytle; as cited in Barab, MaKinster, & Scheckler, 2003). However, in a knowledge-based society, “people need to be able to move freely between scientific and other modes of thought, according to the situation and their purposes” (Bereiter, Scardamalia, Cassells, & Hewitt, 1997, p. 329). Progressive discourse might be crucial for scientific modes of thought, but it is challenging in online contexts since teachers face greater risk of being misinterpreted from lower levels of social presence. To promote greater critical engagement and a sense of group identity among teachers with such constraints, Kling and Courtright suggest that offline and online mechanisms conducive to forging greater trust may be required. Therefore, greater attention to group processes may enable progressive discourse to emerge in online courses.

**Progressive Discourse**

Bereiter (1994; 2002b) suggests that we structure student discourse for progress. Progress, not objectivity, is the essential claim of science that forms the conceptual basis of progressive discourse. It is discourse involving what Popper (1963/2002) calls “conjectures and refutations.” Rather than verifying a theory against an “objective” standpoint, Popper asserted that scientists should falsify a theory and give rise to a new theory that transcends contradictions to the original theory. This is what demarcates the scientific community from other communities for Popper. Progressive discourse is also progressive in the sense that Lakatos (1970) described “research programmes,” in which the “discourse advances by trying to deal with puzzling facts in ways that lead to more powerful explanations” (Scardamalia & Bereiter, 1993, p. 38). The latter view also emphasizes a commitment to improve promising ideas at the core of a research programme rather than simply abandoning them in light of conflicting evidence. Therefore, the aim of progressive discourse is idea improvement, to advance the state of the knowledge (Scardamalia & Bereiter, 2006).

While norms for quality, quantity, relevance and manner (Grice, 1975) may apply to all kinds of discourse, what distinguishes progressive discourse from other kinds of discourse are a set of commitments that amount to devotion to progress in knowledge and understanding over time (Bereiter, 1994, 2002b; Bereiter et al., 1997; Scardamalia & Bereiter, 2006). The number of commitments for progressive discourse varies in different publications. In *Education and Mind in the Knowledge Age*, Bereiter (2002b) identifies the following six commitments:
1. a focus on ideas as conceptual artifacts
2. improvability as a positive attribute of conceptual artifacts;
3. common understanding given priority over agreement;
4. commitment to expand the factual base;
5. selective criticism based on knowledge-advancement goals; and
6. non-sectarianisms (pp. 87-88)

Bereiter states that these commitments represent what it means to engage in knowledge-building discourse. For teachers who might be averse to critical and collaborative discourse, honoring these commitments for progressive discourse in online graduate education courses is challenging. The few empirical studies on progressive discourse that have been conducted tend to examine the epistemic nature of students’ written comments in elementary science classrooms (Bereiter et al., 1997; Hakkarainen & Palonen, 2003) Other studies on knowledge building discourse with adult learners have studied how certain knowledge building principles are operationalized in professional settings (e.g., Russell, 2002). None of these studies focus on group processes necessary for progressive discourse to emerge in a formal online education learning community. Perhaps a greater attention to shared goals in a social contract may assist teachers in such a community negotiate shared goals for progressive discourse.

Social Contract

The concept of social contracts can be traced back to Plato’s older contemporary, the sophist Lycophron, and it is discussed by Plato in both Gorgas and the Republic (Flew, 1979). Other philosophers, including Hobbes, Locke, Rousseau, and more recently, Rawls, have advocated the idea of social contracts as a way to establish mutually beneficial principle of justice in a well-organized society. For the purposes of this study, I will not expound upon their philosophical arguments. Rather, I use the term social contract to refer to a negotiated agreement between members in a learning community to work collaboratively toward shared goals that mutually benefit them. Thus, social contracts differ from learning contracts, which usually negotiate agreements between teachers and individual students in academic courses or programs (G. Anderson & Boud, 1996; Brockett & Hiemstra, 1985; Knowles, 1986). Researchers (Burge, 1994; McGrath, 1990) have pointed to the use of social contracts as a way to improve peer
interactions in online courses. A social contract might be able to establish more quickly productive norms for discourse and collaboration online.

Design research is inherently interventionist and carried out in close collaboration with designers and practitioners (Bereiter, 2002a). In my study, the social contract intervention will be designed as a separate view or folder in the course database, and is based on classroom activities developed by the instructors, called “Discourse for Inquiry” (Woodruff & Brett, 1999). The original intervention involved an initial activity (30 minute audio-taped introduction and group discussion) aimed at helping students manage group discourse. Later, the researcher went through ideas and techniques for managing discourse summarized on a set of cards given to each group member.

I adapted these activities for the online environment in consultation with the course instructors, coordinated them with course objectives, and facilitated their implementation. First, participants were introduced to the notion of a social contract, or the deliberate creation of social norms online (McGrath, 1990) in an effort to improve discursive and collaborative interactions. Second, participants’ learning objectives, strategies and resources, outcomes and assessment criteria were negotiated in Knowledge Forum similar to a learning contract, usually used to negotiate agreements between instructors and individual students (G. Anderson & Boud, 1996; Knowles, 1986). This highlighted shared goals among students. Third, I created “scaffolds” or headings to be used to organize online contributions to assist participants manage problem finding, solving, and group discourse. These scaffolds were intended to serve a similar purpose in Knowledge Forum to the set of cards in the face-to-face Discourse for Inquiry activity by highlighting commitments to respect, honesty, frankness and objectivity (Howard & Barton, 1992), as well as the four Bereiter (1994) pointed to for progressive discourse. Finally, guidelines for supportive, descriptive, and non-judgmental feedback following Block (1981) were provided to assist participants who may be teachers who find giving feedback to colleagues particularly difficult.

Discourse and Community

Various learning community models emphasize discourse as a way to produce meaning. Such interaction is important for “socially constructed meanings from the participants’ perspectives” (Vrasidas & McIssac, 1999, p. 22). In this section, I present characteristics of three models, Wenger’s (1998) communities of practice, Scardamalia and Bereiter’s (2003) knowledge
building communities, and Garrison, Anderson, & Archer’s (2000) community of inquiry, and discuss similarities and differences between them.

**Communities of Practice**

Lave and Wenger (1991) introduced the notion of “community of practice” in their situated learning theory of legitimate peripheral participation, which characterizes learning as a process wherein new members enter communities of practice. Over time, newcomers proceed along a centripetal path from legitimate peripheral to full participation. While the concept served a purpose in their theory, it did not address the “unequal relations of power” (p. 42) needed to truly understand the production of meaning and identities in a community of practice as it is historically realized. This earlier conceptualization of community of practice thus emphasized naturalistic observation of a community rather than designing for community.

Wenger’s (1998) later conception of communities of practice is a social learning theory which also views learning as a process in which members participate in the practices of communities to produce meaning and construct identities in relation to these communities. In this view, knowledge is conceived as “a matter of competence with respect to valued enterprises” (p. 4). Thus, knowledge refers to expertise that community members develop over time as they participate in preserving valuable ideas and in creating new ones. In terms of fashioning identity, Wenger expands the concept of legitimate peripheral participation by transforming unidirectional apprenticeship, in which more experienced members mentor less experienced members, to a matrix of dynamic dualities, which I refer to as axes here for ease of explanation. Wenger conceptualizes the dialectical relationship between participation and identity along one axis. He intersects it with a second axis that relates the social structure of the community and situated experience. The third and fourth axes intersect the first two, to addresses issues of power as it relates to meaning, as well as those of subjectivity as it relates to collectivity (See Figure 1):

Thus, the communities of practice perspective is replete with explicit “language, tools, documents, images, symbols, well-defined roles, specified criteria, codified procedures, regulations, and contracts” as they relate to “implicit relations, tacit conventions, subtle cues, untold rules of thumb, recognizable intuitions, specific perceptions, well-tuned sensitivities, embodied understandings, underlying assumptions, and shared world views” (Wenger, 1998, p. 47). Therefore, it offers a lens with which to view the multifaceted social practices that support the development of progressive discourse and community among students in an online database.
However, by nature, online course communities have a beginning, middle, and an end. Thus online course communities might be more accurately seen as a learner’s community (Henri & Pudelko, 2003), a practice field (Barab & Duffy, 2000), or a bounded course community (B. G. Wilson, Ludwig-Hardman, Thornam, & Dunlap, 2004) rather than a perennial community of practice. In a learner’s community the teacher determines the strength of the social bond and gatherings’ intentionality unlike in a true community of practice, where these emerge out of the participants’ activity. Nonetheless, central to both of these learning contexts is the opportunity for students to engage actively in negotiating meanings through practice (Barab & Duffy, 2000). One approach might be to observe, in interviews, discourse in the database, and participation patterns, how agreeing to a social contract affects students’ attention to group processes and engagement in community practices. Another approach might be to see how the community refines its practices to incorporate supplementary media (e.g., synchronous chat and KF scaffold supports), and whether this increases the entry of peripheral, especially at risk, members into the community.

![Image: Four axes of relevant intellectual traditions in Wenger’s (1998) social theory of learning.](image)

*Figure 1.* Four axes of relevant intellectual traditions in Wenger’s (1998) social theory of learning.

**Knowledge Building Communities**

A knowledge building community is one that engages in
the production and continual improvement of ideas of value to a community, through means that increase the likelihood that what the community accomplishes will be greater than the sum of individual contributions and part of broader cultural efforts (Scardamalia & Bereiter, 2003, p. 1370)

From this view, being able to advance knowledge is not a social process exclusive to experts, but rather one in which students can and should engage if they are to progress along a “developmental trajectory” from childhood inquisitiveness to mature, disciplined creativity. Knowledge building communities differ from the other learning community models discussed here by focusing on collective knowledge creation rather than collaborative learning. Yet the by-product of knowledge building is learning, just as a research team would learn from logically and deliberately identifying problems of understanding and advancing their ideas. Thus, knowledge building communities are deeply constructivist in the sense that the learner is asked to accept the logical and social method of inquiry using language (Dewey, 1997). Its members participate in focused and sustained deliberative discourse that marks it as a community of inquiry (T. Anderson, Rourke, Garrison, & Archer, 2001).

Knowledge Forum is a software environment specially designed to support knowledge building. Like its precursor CSILE (Computer Supported Intentional Learning Environments), the design of Knowledge Forum is based on “the deep underlying similarity of the socio-cultural and cognitive processes of knowledge acquisition and knowledge creation” (Scardamalia, 2003, p. 24). Available in both client and web browser versions, the technological features of Knowledge Forum are continually designed, tested and improved to embody the twelve principles that distinguish the work of knowledge building communities (Scardamalia, 2004; Scardamalia & Bereiter, 1996). This provides community members with progressively refined computer-supported collaborative learning environments in which to read, reflect and write at length, before publicly sharing ideas. Questioning helps members evaluate their understanding and constitute goals for further inquiry (Scardamalia & Bereiter, 1992). To be able to engage in such discourse, members must accept higher levels of epistemic agency as individual members (Scardamalia & Bereiter, 1991) and “collective cognitive responsibility” as a whole community (Scardamalia, 2000, 2002).

Moreover, in knowledge building communities, the overt focus is on improving ideas, rather than collaborative learning activities, such as in “communities of learners” (A. L. Brown
& Campione, 1990, 1994). In knowledge building, ideas are considered as “conceptual artifacts,” and knowledge work is defined as “work that creates or adds value to conceptual artifacts” (Bereiter, 2002b, p. 69). Broadly, they are cultural artifacts, as in communities of practice. Of these, some cultural artifacts are abstract rather than concrete. Conceptual artifacts are abstract cultural artifacts that “can be distinguished by the logical relations that exists between them” (Bereiter, 2002b, p. 76). In knowledge building communities, members engage in discursive practices to improve the quality, coherence, and utility of abstract concepts such as theories. Ideas therefore have a “thinglike or artifactual” nature, and serve “design” goals rather than “truth” goals (Bereiter & Scardamalia, 2006). This puts knowledge building in diametrical contrast to traditional school work, but aligns it with current educational reforms for preparing students for a future in a knowledge-based economy (Drucker, 1994).

In this study, knowledge building provides a socio-cognitive conceptual framework to examine the effect of social contracts on students’ progressive discourse activity in an online database, as gauged by analyses of the patterns of participation, self-report data, and group discourse in the database. This view highlights the complex social-cognitive and technological dynamics that can be harnessed to allow progressive discourse to emerge online and either drive the discourse opportunistically towards knowledge building, or present a barrier to knowledge building.

Community of Inquiry

Garrison, Anderson and Archer’s (2000) community of inquiry model is based, like knowledge building communities, on Dewey’s (1997) foundational concept of practical inquiry. Both of these models were conceived for text-based computer conferencing contexts. However, the community of inquiry model was designed for, and is most often applied in, higher education contexts. Thus, this model shares its basic structure of inquiry with other critical thinking models such as Duffy, Dueber & Hawley’s (1998).

In the community of inquiry model, learning occurs as the result of the interaction of three core elements: cognitive presence, social presence, and teaching presence. Cognitive presence is defined as “the extent to which learners are able to construct and confirm meaning through sustained reflection and discourse in a critical community of inquiry” (Garrison et al., 2000; 2001, p. 11). This involves how learners systematically progress in thinking over time through the phases of a Practical Inquiry Model. Social presence is defined as “the ability of
participants to project themselves socially and affectively” (Rourke, Anderson, Garrison, & Archer, 2001a, p. 50) into the community. This refers to how students present themselves to others as “real people.” Teaching presence is defined as “the design, facilitation, and direction of cognitive and social processes for the purpose of realizing personally meaningful and educationally worthwhile learning outcomes” (T. Anderson et al., 2001, p. 5). This points to the teacher’s responsibility to structure student discourse and facilitate it for optimal learning outcomes.

Furthermore, the community of inquiry model delivers a content analysis scheme to characterize indicators of cognitive, social and teaching presence. The use of the Practical Inquiry model to measure cognitive presence will be discussed in the Literature Review and Iteration 1 chapters. The community of inquiry model could be a useful one to analyze the student discourse in the databases.

In summary, Wenger’s (1998) community of practice, Scardamalia and Bereiter’s (2003) knowledge building, and Garrison, Anderson and Archer’s (2000) community of inquiry are three learning community models that emphasize discourse and offer different lenses through which to explore group processes that support the development of progressive discourse in an online database.

**Research Question**

To date there are widely accepted models for teaching in online learning communities (e.g., Palloff & Pratt, 1999; Preece, 2000; Salmon, 2000). For example, Salmon’s (2000) five-stage model for “e-moderating” describes the progression of students as they move through the beginning stages of access and motivation, to online socialization, information exchange, and knowledge construction and ultimately to development. This model highlights the importance of instructor’s role in the earlier stages of building an online learning community. A pitfall of computer-mediated communication is that it will not in itself create social interaction (Kreijns, Kirschner, & Jochems, 2003; Preece, 2000). Once a sense of community is established, the instructor shifts the locus of control to the students, who are then able to engage in active learning and collaboration (Palloff & Pratt, 1999). However, the difference in the approach to fostering progressive discourse being advanced in this study is the focus on higher order goals. Whereas “knowledge construction” is synonymous with constructivist learning in these models,
progressive discourse as the vehicle for “knowledge building” goes beyond learning to recognize the importance of creating new knowledge:

Learning is an internal, observable process that results in changes of belief, attitude, or skill. Knowledge building, by contrast, results in the creation or modification of public knowledge—knowledge that lives ‘in the world’ and is available to be worked on and used by other people (Scardamalia & Bereiter, 2003).

Thus, while many online learning studies have examined social interaction and collaboration, less is known about how instructors may move students to the next step and foster progressive discourse for knowledge building online. The purpose of this dissertation is to investigate what kinds of instructional interventions foster the emergence of progressive discourse. Specifically, the research question guiding this study is, “How can online progressive discourse be fostered among students in semester-long online graduate courses?”
Chapter Two: Literature Review

This chapter outlines relevant research in the areas of online education, knowledge building pedagogy, and design innovations for supporting progressive discourse. For each area, the studies will be related to the research question.

Introduction

In recent years, enrollments in online courses and programs in higher education have been growing substantially. During the fall 2004 term, 2.3 million higher education students were taking at least one online course in the United States; one year later, during the Fall 2005 term, this figure increased to nearly 3.2 million students (Allen & Seaman, 2006). The population of online students, like the overall higher education body, is comprised largely of undergraduates, but the proportion of graduate students is slightly higher online. This may be because in the knowledge society, the restructured job market necessitates life-long learning and professional development (Drucker, 1994). Accordingly, 200 schools now offer online graduate degree programs (Pethokoukis, 2002; Tallent-Runnels et al., 2006).

The primary mode of online course delivery at nearly 90% of U.S. higher education institutions is asynchronous computer-mediated communication (CMC) (Greene, 2005). Asynchronous CMC uses web-based computer conferencing technology (e.g., Knowledge Forum, Blackboard, First Class, WebCT, etc.) to connect distributed participants in text-based communication. Like distance education, CMC frees students from time and place constraints; like face-to-face instruction, CMC affords interactivity (Kaye, 1989). When cognitive, social, and teaching elements are present in computer conferencing, critical thinking and higher order learning may occur (Garrison et al., 2001). However, a significant challenge remains in encouraging students to move beyond information giving, exploring of ideas, and social interchange (Gunawardena, Lowe, & Anderson, 1997; Kanuka & Anderson, 1998).

Ideally, CMC is used to create “the kind of learning community that can arise in a good graduate seminar” (Hiltz, 1998). Through “weaving” or meta-communication of ideas in online discourse, students would be able to participate in high-quality, collaborative learning (Feenberg, 1989; Kaye, 1989). Curtis and Lawson found similarities and differences between the collaborative behaviors as described by Johnson & Johnson (1996) and their online context. One notable difference they observed between face-to-face and online collaborative learning is the lack of “challenge and explain” cycles anticipated in promotive interactions. They postulated that
online students did not risk engaging in more critical discourse since they did not know each other at the beginning of the course and did not meet face-to-face. Furthermore, the absence of good synchronous interaction support tools made group interactions very time consuming.

Researchers in various disciplines including communications, distance education, and educational technology have studied issues of interactivity and learning in asynchronous CMC environments. More recently, the developing computer-supported collaborative learning (CSCL) research community has turned its attention from studying face-to-face settings in which the computer is one element of a collaborative learning environment to also studying exclusively online teaching and learning contexts (Wallace, 2003). CSCL studies place an emphasis on examining how participants use technology tools to communicate, as well as exploring the effectiveness of innovations to support the needs of local learners (e.g., Lipponen, Rahikainen, Lallimo, & Hakkarainen, 2003; Orrill, 2002).

Concurrently, CSCL research has built on the theoretical foundations of the field to understand the processes of the social knowledge construction in both face-to-face and online CMC environments (Orrill, Hannafin, & Glazer, 2003). Sociocultural learning theories emphasize analysis of discourse in order to understand learning, and stress the importance of tools in mediating knowledge construction (Cole & Engeström, 1993; Hmelo-Silver, 2003; Palincsar, 1998; Pea, 1993). From this perspective, instructional interventions focus on redistributing the responsibility for generating questions and evaluating explanations to place a greater emphasis on student-centered discourse compared to traditional classrooms (Greeno, Collins, & Resnick, 1996).

Promisingly, CSCL research suggests that specially-designed computer tools like CSILE/Knowledge Forum can support student-centered discourse to improve learning and enhance knowledge building in classroom settings (Scardamalia & Bereiter, 1994; Scardamalia, Bereiter, & Lamon, 1994). Researchers question, however, whether technology tools alone can mediate online discourse aimed at higher-order goals (e.g., Hewitt, 2001; Lai & Law, 2006). Online discussions typically feature a minimal number of turns (Guzdial & Carroll, 2002). They involve low levels of participation and lack continuity without considerable direction from the instructor (Guzdial, 1997; Hewitt & Scardamalia, 1998). Moreover, patterns of online engagement or disengagement are established quickly, are persistent, and show stability and robustness over time (Brett, 2002). These patterns may be seen even among “expert” learners.
like graduate students, who rarely engage in convergent processes (synthesizing or summarizing ideas) in threaded discussion (Hewitt, 2001). Indeed, content analysis studies have shown that students’ online discourse mostly consists of sharing of information and exploration, rather than negotiation of meaning and integration to co-construct knowledge (e.g., Gunawardena et al., 1997; Kanuka & Anderson, 1998).

While content analysis is useful for answering certain kinds of research questions, it is a reductive analysis (Stahl, 2002). Mixed methods may be required to obtain understanding of the multi-faceted phenomena of collaborative knowledge construction (Hmelo-Silver, 2003). Documenting the complex interplay between individual and collaborative processes of knowledge construction is critical not only in CSCL research (Hmelo-Silver, 2003) but it is also a major challenge for knowledge building research (Lee et al., 2006). Progressive discourse is a focal point in knowledge building communities. Yet, it is not known whether it is possible to see the emergence of progressive discourse in patterns of online participation in asynchronous computer conferencing environments, or what kinds of scaffolding are most effective for supporting its development. Understanding the mechanisms through which students learn in online course discussions will advance knowledge in the field of online learning and teaching (Wallace, 2003).

This chapter will review three areas of education research relevant for the current study. First are studies in which social knowledge construction is the framework for evaluating the quality of online learning, as this is a crucial part of the theoretical framework guiding the current study. The second is how the knowledge building (Scardamalia & Bereiter, 2003) approach to teaching and learning online has been researched, since this is the pedagogical approach used in the courses studied. The third is the use of design innovations to support progressive discourse in online graduate teacher education courses, since that is the particular focus of this investigation.

Relevant Online Education Studies

Online education researchers have investigated interaction and learning from various perspectives. In this section, recent studies using a variety of approaches to analyzing discourse and understanding learning in and design of online graduate education course environments will be discussed.
The most prevalent approach to studying online interaction is to identify recurrent patterns in participation and to analyze the content of individual notes for evidence of learning and knowledge construction. For example, Pawan, Paulus, Yalcin, & Chang et al. (2003) employed the oft-used Garrison et al.’s (2001) Practical Inquiry Model as a framework to analyze qualitatively the patterns of engagement and interaction in three online graduate education courses. Participants (n=13, n=11, n=12) were inservice teachers enrolled in a language teacher education program in the Faculty of Education at a large, Midwestern U.S. university.

Pertinent to the current study, Pawan et al. (2003) found that students participated in a one-way pattern of interaction or in “serial monologues” (Henri, 1991). These findings are in line with those of Curtis and Lawson (2001), who reported that online students refer to comments of others (one-way interaction), but do not “challenge and explain” comments of others in collaborative argument/counter-argument (two-way interaction). Serial monologues may serve to externalize students’ ideas, but it is through dialogue that students use others’ comments to understand their own thinking and, in some cases, to transform their understanding (Bakhtin, 1981; Blanton et al., 1998). Since the goal of progressive discourse is shared understanding, it is important for students to be aware their own online practices and participate in a two-way pattern of interaction or in dialogues.

In terms of content, Pawan et al. (2003) reported that the most common level of student discourse was Phase 2 Exploration. Consistent with previous studies (e.g., Garrison et al., 2001), little Phase 3 Integration (11%), and no Phase 4 Resolution level discourse were found. This suggests that little progressive discourse is occurring online, since arguably, the indicators for Integration (e.g., connecting ideas, creating solutions, etc.), and Resolution (e.g., testing solutions) may also serve as indicators for progressive discourse. Participants in Pawan et. al.’s study contributed mostly commentaries: “Personal narratives, descriptions, and facts not used to defend, justify, or develop the participants positions or that of others” (Pawan et al. 2003, p. 127). While information exchange can enrich online discussion, progressive discourse requires the use of evidence to support conclusions and to substantiate contradictions of previous ideas in order to to improve ideas and advance the community’s knowledge.

In a similar vein, Schrire (2006) investigated the process of knowledge building in three graduate asynchronous computer conference courses in educational technology at an American
university. Participants were students enrolled in doctoral-level online courses in computing technology in education at an American university. Using a qualitative case study method (Merriam, 2001; Yin, 1984) Schrire selected two courses or cases (n=12, n=22) for maximal variation (Huberman & Miles, 1994). She not only analyzed the patterns of interaction and the content of student discourse across the cases, but also went beyond quantitative content analysis to examine the quality of the relationship between the two analyses.

First, Schrire (2006) identified two distinctive patterns of interaction: 1) instructor-centered, in which most of the student messages showed explicit or implicit interaction with the instructor’s message; and 2) synergistic, in which many of the messages showed explicit or implicit interaction to the other participants’ messages in the thread. These patterns are consistent with those reported by previous researchers (Hara, Bonk, & Angeli, 2000; Lipponen et al., 2003). Of particular interest to the thesis study reported here is the latter, synergistic pattern that diverts from traditional pedagogical pattern of classroom discourse—Initiation, Response, Feedback (IRF) (Sinclair & Coulthard, 1975). The synergistic pattern also suggests a dialogical, “exploratory talk” pattern more accurately described as Initiation, Discussion, Response, Feedback (IDRF) (Wegerif, 1996).

Second, Schrire (2006) analyzed the cognitive content of messages in terms of three models: Garrison, Anderson, & Archer’s (2001) Practical Inquiry Model, Bloom’s Taxonomy (Bloom, Engelhart, Furst, Hill, & Krathwohl, 1956), and the SOLO Taxonomy (Biggs & Collis, 1982). Although these models have different emphases (the Bloom and SOLO Taxonomies emphasize individual cognition; the Practical Inquiry model emphasizes socially-distributed cognition), Schrire holds that there are general correspondences across the stages specified in the models (see table 1).

As Schrire (2006) defines the development of critical thinking in computer conferencing as a collaborative knowledge-building process of practical inquiry, she “chunks” the indicators from the other two models along the phases of the Practical Inquiry Model (Garrison et al. 2001). Schrire reorganizes Garrison et al.’s indicators and adds an additional phase, Suspension, to indicate the lack of progression in the process of practical inquiry. The Suspension category does not have a direct correspondence in the other models, but is relevant to the current
study on progressive discourse. Unfortunately, Schrire does not report the distribution of the discourse found in the Suspension phase.

Third, Schrire’s (2006) related the students’ pattern of interaction with the phase of critical thinking in the Practical Inquiry Model. The synergistic interaction pattern was found to be associated with a trend towards greater Integration (level 3) and Resolution (level 4) than the instructor-centered pattern. Further, discourse analyses showed that synergistic threads had a larger proportion of explicit interaction relative to implicit interaction, while the instructor-centered threads featured an inverse relationship. Synergistic threads also displayed a relative balance among the three move types (initiate, response, and follow-up), whereas instructor-centered threads displayed a clear predominance of response moves. Schrire’s research thus focused on characteristics of productive online discourse patterns, content of notes, and the relationship between these two measures.

Another study took a very different approach to understand patterns of online discourse, and investigated why and how discussion threads do not progress but rather become inactive and “die” (Hewitt, 2005). Using a computer simulation of certain common practices that students may follow in computer conferences, Hewitt revealed that the widespread routine of focusing on unread notes in computer conferences could hasten the death of some threads and reduce the likelihood of reactivating inactive threads. Hewitt (2005) identifies a number of problems with this “single-pass routine”:
1. students may not be aware that important discussions have stopped growing and neglect them;
2. students may not engage in synthesis and summarizing operations;
3. student may drift off topic; and
4. students may neglect difficult issues or questions to advance knowledge progressively, and favor easy and familiar topics to satisfy participation requirements.

It is recommended that instructors constrain the number of online discussions and draw students’ attention to important discussions that are faltering to reduce the likelihood that threads will die accidentally. Additionally, Hewitt highlights the need to create new cultures of computer conferencing, ones that purposely centers on progressive knowledge building.

Other researchers have also examined barriers to critical discourse, which is closely related to progressive discourse in online graduate course contexts. Using a more traditional qualitative case study method, Rourke and Kanuka (2007) conducted several in-depth interviews with five participants. Three insights emerged from their data:

1. students did not orient to the conference as a forum for critical discourse, and worse, had competing orientations;
2. students perceived critiques as personal attacks; and
3. students realized early on that critical discourse was a bothersome means to obtain their participation marks (Rourke & Kanuka, 2007).

They conclude that certain practices, such as well-structured learning activities that clearly define participant roles, and assessment methods that reflect the time and effort that engaging in critical discourse takes, may ease these difficulties.

In sum, the online education studies reviewed in this section investigated prevailing patterns in participation and analyzed the content of individual notes for evidence of learning and knowledge construction. Findings indicate that students tend to participate in one-way, monologic interactions and primarily contribute personal commentaries online. When students interact in a more synergistic pattern, the quality of their notes improves. Yet, the common practices that students follow in computer conferences limit opportunities for this more dialogic
interaction. To support the development of progressive discourse, therefore, it may be helpful to orient students explicitly to the purpose of the conference as a forum for knowledge building, and work towards developing assessment methods that accord value to collaborative and explanatory discourse as the vehicle to learn deeply online.

**Relevant Knowledge Building Studies**

Turning to relevant studies using knowledge building pedagogy, this section outlines elements central to knowledge building pedagogy, highlighting the role of progressive knowledge-building discourse, and summarizes relevant findings from existing studies using various versions of CSILE/Knowledge Forum. For a more thorough review of the history of knowledge building theory, pedagogy, and technology, see Scardamalia and Bereiter (2006) and Orrill et al. (2003).

Knowledge building is a radical attempt to refashion traditional educational practice, which has focused intensely on individual students and the contents of their minds (Bereiter, 2002b; Scardamalia & Bereiter, 2006). Knowledge building pedagogy is:

> Based on the premise that authentic creative knowledge work can take place in school classrooms—knowledge work that does not merely emulate the work of mature scholars or designers, but that substantively advances the state of knowledge in the classroom community and situates it within the larger societal knowledge building effort. (Scardamalia & Bereiter, 2006, p. 98)

As in real-world knowledge creating organizations, individuals in knowledge-building classrooms are recognized for the contributions they make to the organization’s or the community’s knowledge. Thus, knowledge building speaks to the contemporary emphasis in educational reform efforts to prepare students for creative work and innovation in the knowledge economy (Bereiter & Scardamalia, 2003).

For online graduate education, the knowledge-building approach may encourage students to begin seeing the Internet as not only an information resource and communication system, but a way to connect their own learning community’s efforts with the larger academic community’s efforts to advance disciplinary knowledge. Traditionally, graduate students work on projects with experienced researchers to be inducted into the community of practice of researchers (J. S. Brown et al., 1989; Lave & Wenger, 1991). In contrast, non-traditional students who take online
courses and degree programs—practicing teachers, medical professionals, instructional designers, corporate trainers, professors, etc.—pursue graduate study part-time and at a distance from campus. These students have limited opportunities to engage in research practices compared to their on-campus peers. They also voice correspondingly different goals for enrollment and research than traditional graduate students who are enculturated into the academic community via the apprenticeship model (Fujita & Freeman, 2006). Their goals, in fact, tend to be professional goals rather than the academic one embracing the role of a researcher contributing to the advancement of knowledge in their field (Freeman, 2008).

Bereiter (2002b) suggests that for education to become a modern profession it must be able to generate knowledge through a culture that bridges teaching and research. An important consideration in preparing teachers to become education researchers is to help them negotiate the cultural difference between the world-views of the teacher and researcher (Labaree, 2003). Many graduate students in faculties of education come from teaching with very little research preparation in their bachelor of education programs (Donald, 2002). Elements that support the development of online graduate students in becoming education researchers include opportunities to discuss ideas, assignments, and exchange information with faculty and peers in online course contexts (Fujita & Freeman, 2006). Often, however, they are not exposed to diverse epistemological perspectives in their graduate programs (Pallas, 2001). Historically, formal education has emphasized “belief mode” concerns with truth and warranted belief over “design mode” concerns with usefulness and pragmatism (Bereiter & Scardamalia, 2006). This makes it especially challenging for graduate students to work in design mode to make a contribution to knowledge in the field. Ideally, they are able to contribute to the kind of “usable knowledge” that impacts educational practice (Lagemann & Shulman, 1999). To support these students, then, it may be helpful to draw their attention to the distinction between working creatively with knowledge and working creatively on tasks that use knowledge. One way to facilitate this epistemological development may be through engaging in progressive discourse, which involves working towards a shared vision of possibilities without recourse to pre-existing beliefs.

There are a few empirical studies on progressive discourse. These explore the epistemic nature of written notes contributed to CSILE databases in elementary science classrooms and suggest that, regardless of prior knowledge of the subject matter or mastery of research
procedure, even young students can carry on progressive discourse. For example, Bereiter, Scardamalia, Cassells, and Hewitt (1997) describe one CSILE discussion that took place over three months among 17 sixth-grade students in a public middle school in the United States. A design innovation called a “discussion note,” an extended note with entries made by different students appearing one after another in chronological order (Scardamalia, Bereiter, Hewitt, & Webb, 1996), was utilized. In this extended note, students were co-authors of the note, but individual contributions were labeled according to the thinking type (e.g., I need to understand, New Information). These labels clarified how individual students had contributed to advancing the community knowledge.

Focusing on a sub-discussion of 179 entries, which was initiated by a student using the “I need to understand” label and titled “About Growing,” the researchers present examples of student contributions that illustrate commitments to progressive discourse and that move from expression to understanding. In so doing, they conclude that even young students can honor discourse commitments and engage in progressive explanations of scientific phenomena. Bereiter et al. (1997) caution, however, that this kind of inquiry-based classroom discourse is not easy to achieve. They acknowledge the considerable thought and effort of the teacher’s role in creating a culture that is oriented towards collaborative knowledge building and modeling the processes and attitudes that make it happen.

In another study, Hakkarainen and Palonen (2003) investigated gender effects in patterns of participation in two grade 5/6 classes using CSILE. These researchers first classified the content of individual notes into categories of communicative ideas. They then examined the intensity of direct interaction between members of each learning community using social network analysis (Scott, 1991; Wasserman & Faust, 1995). They indicated that in a successful knowledge-building classroom, explanatory discourse prevailed over discussion of research questions and factual information, and that progressive inquiry took place. Further, relevant to the current study, they found a positive relationship between the mean proportion of explicated comments and critical comments. This suggests that critical comments are more likely to be explicated than other kinds of comments. In terms of evenness of participation, they found that all students in a knowledge-building classroom, regardless of gender, participated evenly towards improving ideas instead of assimilating pre-existing knowledge. To bring about this process, however, these researchers conclude that it is essential to build a supportive “social
“infrastructure” (Bielaczyc, 2001, 2006; Lipponen et al., 2003), or a culture of collaborative knowledge building around the technological infrastructure.

In the higher education setting, Oshima and Oshima (2002) compared the qualities of discourse by experts (graduate students) and novices (undergraduate students) in face-to-face cognitive science and educational technology courses using WebCSILE. As expected, they reported experts engaged in significantly more progressive discourse than novices. Oshima and Oshima (2002) identified two main differences between the discourse of experts versus novices:

1. that novices did not develop control and learning strategies for knowledge advancement; and
2. that the novices’ motivations for learning were not necessarily oriented to knowledge building goals.

In a related study, Oshima and Oshima (1999) reported that providing instructional scaffolding for scientific argumentation did not lead students to progressive discourse. Instead, the argument framework led the students to be task goal-oriented. They proposed that revisions to the scaffolding model and articulate the progressive discourse process, to discuss with students why this kind of discourse is valuable for knowledge advancement, and to increase students’ motivation by involving them as participants in the design of activities.

Encouragingly, the studies above suggest that engaging in progressive discourse can lead to knowledge building over time. Unfortunately, these studies have limited applicability to the current study. The participants in the first two studies (Bereiter et al., 1997; Hakkarainen & Palonen, 2003) are elementary science students, who may be engaging in inquiry-based classroom discourse largely on academic interest alone (Woodruff & Brett, 1999). The participants in the third and fourth studies (Oshima & Oshima, 1999, 2002) more closely resemble the participants in the present study, but it too examined progressive discourse that developed in a primarily face-to-face course with computer supports, rather than exclusively online course contexts. In this dissertation research, the participants are non-traditional students who are enrolled part-time in online graduate in-service teacher education courses for professional development and to a lesser extent, for induction into the academy as education researchers (Fujita & Freeman, 2006). Thus these graduate students’ goals are not necessarily oriented to knowledge building. In sum, both the literature and personal observation indicate that
students may not be aware of the particular control and learning strategies that are needed to support progressive discourse in exclusively online graduate education settings.

One recent study did analyze how collaborative knowledge building interactions unfold in an online master’s-level course using CoDE (Constructivist, Distributed learning Environment) (Puntambekar, 2006). Participants were 24 graduate students in an in-service teacher education course on learning theories. CoDE is an integrated learning environment designed to promote deep learning by solving real-world problems. Like Knowledge Forum used in this dissertation study, CoDE combines cognitive tools for individual reflection (reflective notebooks) as well as collaborative online discussion (WebBoard). Although the pedagogical approach in Puntambekar’s study is a more structured problem solving one (e.g., Barrows, 1985; Barrows & Kelson, 1995), the study is included in this section on relevant knowledge building studies because it focuses on documenting and understanding how individual and collaborative learning activities interact and develop over time in the online graduate course context similar to the present study.

Puntambekar (2006) focused her investigation along three dimensions:

1. divergence of ideas;
2. collaborative knowledge building; and
3. individual knowledge construction.

The first two dimensions are most relevant for studying progressive discourse. Qualitative analysis of WebBoard discussions showed that only a very low percentage of the total number of student responses on each problem presented a divergent perspective, or a response that provided a novel interpretation of a problem or the application of theory to a problem. Further, scoring student responses using a five-point rubric for shared understanding, defined as the incorporation of relevant aspects of comments made by others in the group, showed no consistent pattern of trends in shared understanding among student responses for seven problems. However, on the last problem, which had the highest scores, students did use relevant theoretical constructs to justify their responses with appropriate theories and course material. Puntambekar’s (2006) findings lend support to the view that the collective object of
progressive discourse, in which divergent perspectives are explored and shared understanding is the goal, occurs neither frequently nor consistently among online graduate students in education.

From the relevant knowledge building studies reviewed in this section, it is evident that progressive discourse happens rarely and therefore little is known about the character of emergent progressive discourse in the online graduate education level or how to assess it at the group level. As the students in this context are becoming graduate student researchers and reflective practitioners, it is particularly important to understand how they develop deep understanding of the subject matter in their courses. Thus, this study employs social and technological design innovations to support students towards progressive knowledge-building discourse. The following section will describe relevant design innovation studies.

**Relevant Design Innovation Studies**

The third type of online education research relevant for this work is the literature on instructional scaffolding. Instructional scaffolding in this study is conceptualized as assisting learning with minimal support, gradually fading the assistance, and increasing responsibility of the learner her/himself (e.g., Edelson, Gordin, & Pea, 1999; Scardamalia & Bereiter, 1994). Elsewhere, instructional scaffolding has also been referred to as design innovations (e.g., Woodruff & Nirula, 2005).

To help students take a more advanced, progressive approach to online discussion, this dissertation study explored design innovations to foster:

1. Peer scaffolding to establish norms of scientific discourse for inquiry, and
2. Technology-based scaffolding via sentence openers to promote epistemic fluency using Knowledge Forum scaffolds.

Related studies are discussed in the sub-sections below.

**Peer Scaffolding: Discourse for Inquiry Norms**

Balancing collegiality and collaboration in teacher education is not a problem unique to online learning. Research on teachers’ discursive interactions shows a general lack of direct advice or criticism (Ellis, 1993; Kling & Courtright, 2003). This may be because in the culture of teaching, a teacher’s classroom practice is much more closely tied to his or her identity as a
person, whereas in the culture of science, a researcher accepts critical discussion as a natural part of inquiry (Barab, MaKinster, & Scheckler, 2003; Cochran-Smith & Lytle, 1999).

In science, public discourse is primarily seen as a way of sharing knowledge and subjecting ideas to criticism as it is carried through academic publications and presentations (Scardamalia & Bereiter, 1993; 2006). Sociological accounts portray scientists arguing with scientists in other laboratories as they compete for publications and grants (e.g., Latour & Woolgar, 1986). However, more recent empirical studies of scientific discourse in laboratories (e.g., Dunbar, 1995) have revealed that scientists within a research team also practice collaborative and explanatory kinds of discourse. Accordingly, Woodruff and Meyer (1997) hold that collaborative intra-group discourse and critical inter-group discourse serve complementary functions in knowledge building. They suggest that collaborative, explanatory discourse can develop conceptual understanding, and argument or debate can help strengthen coherence of the proposed theories.

Scardamalia and Bereiter (2006) admit that practitioners of a discipline need to be proficient in both forms of discourse, although they stress that collaborative, explanatory discourse is more relevant for learning (Coleman, Brown, & Rivkin, 1997). Coleman et al. (1997) report that explanations are more helpful than summaries for problem solving, but they did not examine the interplay of explanation and argumentation.

On one hand, argument and explanation serve different purposes: an argument offers justification whereas an explanation offers understanding (Govier, 1992; Nussbaum & Sinatra, 2003). Explanations also assume a fact, situation, or event that exists, and address why or how it came into existence. In contrast, arguments question whether the fact, situation, or event truly exists. The value of explanation for progressive discourse, which is aimed at mutual understanding, is clear. Unfortunately, goals for discourse are less clear online (Oshima & Oshima, 2002) so instructional interventions may be needed to keep the students’ focus on explanations in online discourse.

On the other hand, goal orientations for online discourse are complicated by views that assert the inextricably related nature of explanation and critical discussion or argumentation (e.g., Walton, 1998; Walton & Krabbe, 1995). These views also acknowledge the close relationship between problem solving and argumentation. These wider views form the philosophical basis of the work by CSCL scholars on argumentation research. These researchers
recognize both explanation and argumentation as vehicles for understanding and knowledge construction (e.g., Andriessen, Baker, & Suthers, 2003; de Vries, Lund, & Baker, 2002). Therefore, the relationship between explanation and argument is a complex one that is open for further investigation.

For the current study, the goal for students to work towards progressive discourse was made explicit in a set of cards called “Discourse for Inquiry” (DFI) adapted from Woodruff and Brett (1999) for students to refer to as they worked online. These cards outlined strategies and self-questions aimed at helping to manage group structure and discourse.

In the original study, grade 5/6 students and initial teacher education students first discussed how their group functioned. Then, the researcher explicated a set of cards containing strategies and self-questions to promote the development of productive norms and discourse structures. In so doing, she highlighted aspects that pertained to particular group needs. Finally, each group tried out some of the strategies in response to short excerpts from journal articles and other content related to their work.

In the current study, online graduate education students were asked to read through the DFI cards as part of their course readings during the first week of discussion. The researcher reminded the students of the course theme of progressive discourse, then drew the students’ attention to the commitments for progressive discourse on the Managing Problem Solving card: mutual understanding, empirical testability, openness, expansion (Bereiter, 1994, 2002b; Bereiter et al., 1997). This card emphasized problem solving through collaborative, explanatory discourse. Another card called Managing Group Process included ways to voice disagreement and counterargument for inquiry rather than persuasion.

**Software-Based Scaffolding: Knowledge Forum and Scaffolds**

Many advanced technologies for fostering inquiry-based learning and knowledge building have been developed. Also referred to as “note starters” (Nussbaum, Hartley, Sinatra, Reynolds, & Bendixen, 2004), or “sentence openers” (Kreijns et al., 2003; Scardamalia & Bereiter, 1991; Soller, 2001), scaffolds can structure online discussions to favor certain forms of interaction, particularly those that are task-focused (i.e. problem solving) and concentrate on reflective activities like evaluation, explanation, and giving reasons (Baker & Lund, 1997).

Scardamalia and Bereiter (1991) pioneered the research on the use of scaffolds in online discussion. According to their work on “procedural facilitation” (Bereiter & Scardamalia, 1987),
scaffolds support higher-level processes during composition when needed, rather than producing conformity to routines of how a process should be carried out. Knowledge Forum comes equipped with scaffolds of two different thinking types: Theory Building and Opinion. Students insert *scaffolds supports* while writing notes to help focus their goals for online discussion. For example, *My Theory* signals conjecture and *I need to understand* flags a problem needing explanation. *Opinion* and *Different opinion* share alternate perspectives in argument. Custom-designed scaffolds can also be added.

Previous research with K-12 students has found that work in CSILE resulted in the generation of higher-level questions, more elaborated explanations, and deepening of conceptual understanding (Scardamalia, Bereiter, & Lamon, 1994). As it was not clear whether these results were caused by scaffolds or other system attributes, more recent research attempted to delineate the effect of scaffolds. Nussbaum et al. (2002) found a significant positive main effect of note starters on the frequency of disagreement or counterargument assumed to result in higher quality of online discussion. They also obtained results suggesting that note starters are most useful for students who are less open to ideas or assertive, and who are not overly anxious. Zhang, Scardamalia, Lamon, Messina, and Reeve (2007) reported a strong relationship between the presence of extensive writing and reading, and a number of quantitative indicators of participation including use of scaffolds with knowledge building, as measured by independent analyses of the note content for levels of knowledge advancement. System attribute studies further suggested that using sentence openers may be sufficient for automating assessment of collaborative group interaction, and recommends further research on sentence openers to identify characteristic sequences of student interaction that yield productive learning opportunities (Soller, 2001).

In light of the reviewed literature, the current study employed two instructional interventions, DFI cards and Knowledge Forum scaffolds, to support the emergence of a progressive discourse among students in two online graduate in-service teacher education courses using Knowledge Forum. Instances of this collaborative, explanatory kind of discourse for furthering understanding were identified and characterized using both summary and sequential analyses. I wanted to understand what instantiations of progressive discourse looked like as they unfolded so that educators could recognize when it occurs. Existing research has focused on assessments of participation patterns and content of individual written notes. I
proposed to extend this work by employing instructional interventions to create conditions conducive to the emergence of progressive online discourse, and to enable the assessment of group rather than individual discourse.
Chapter Three: Iteration 1

The first iteration of this design-based research study consisted of testing instruments and procedures in a mixed-mode summer 2004 course. This chapter will review selected findings and discuss how they informed the design of Iterations 2 and 3 conducted in fully online fall 2004 and winter 2005 session courses.

Ethical Considerations

Bogdan and Biklen (1998) claim that two issues dominate traditional guidelines for ethical conduct of research involving human subjects: informed consent and the protection of subjects from harm. These guidelines insure that subjects enter research projects voluntarily, understanding the nature of the study and the dangers and obligations that are involved; and that subjects are not exposed to risks that are greater than the gains they might derive.

Ethics approval for this dissertation study was first secured through the University of Toronto’s Office of the Vice President, Research in May 2004 and renewed each year (Protocol Reference #22683). The informed consent form (see APPENDIX A) notified students that their decision to participate or not to participate would not influence their grades. In requesting permission to access online contributions, results of an online questionnaire, and interview responses, participants were assured that no negative consequences would result if they decline to have any or all of the data requested. Further, participants were reminded that data would be used anonymously to ensure privacy and confidentiality. In addition, participants were able to withdraw from the study at any time and without providing a reason.

Although this is an intervention study, the activities involved were coordinated with course objectives and similar to those encountered in regular online course participation. Thus, they could be considered enrichment activities that allow participants to manage problem finding, problem solving, and group process more effectively online. The purpose of the study revealed that the study does not engage in deception (Creswell, 1998). Besides being unethical and morally wrong, deception makes participants suspicious and distrustful of researchers (Borg & Gall, 1989). I thus presented participants with a general, rather than specific, information about the study (Creswell, 1998; Hammersley & Atkinson, 1995). Finally, participants were offered a short summary of the research results, which Bogdan and Biklen (1998) recommend over a lengthy report.
Iteration 1: Summer 2004 Course

Iteration 1 involved a six-week, graduate educational technology course in the Faculty of Education at a large, research-intensive Canadian university during the 2004 summer intersession (May 4 – June 10). This course provided an overview of the various uses of computer applications for educational purposes. The class met face-to-face twice a week, on Tuesday and Thursday evenings. Typically, the first two hours of each class took place in a seminar room where pairs of students led discussions on course readings; for the last hour, the class moved to a computer lab where each student had an opportunity to demonstrate an emerging or compelling educational technology to their classmates. On a couple of occasions, the class also took advantage of an audio- and video-conferencing room equipped with voice-over internet protocol to meet virtually with authors of course readings at other institutions, including the Massachusetts Institute of Technology and the University of Michigan.

Following icebreaker activities on the first day of class, the instructor reviewed and explained the syllabus in class. Then, he oriented the students to the web-based Knowledge Forum online discussion database in the lab. Knowledge Forum is a sophisticated computer-supported collaborative learning environment that differs from typical course conferencing systems by having features such as scaffolds, annotations, “rise-above” or summary note capacities, and allows lateral linking of references to be created between topic “views” or folders (Scardamalia, 2004).

The syllabus explicitly stated that the purpose of the online discussion environment was to extend face-to-face class discussions and to help each other build knowledge and deepen understanding through collaborative discourse:

Students are expected to participate in Knowledge Forum discussions as an extension of the class. This involves contributing notes, reading notes, and commenting on notes in the database. In a collaborative manner, students are expected to participate, and assist others, in the process of building their knowledge and deepening their understandings.

Participation on Knowledge Forum accounted for 20% of the students’ grade. In addition, equal weights were apportioned to online discussion facilitation (20%), in-class discussion
facilitation (20%), and computer lab software demonstration (20%). This grade distribution bestowed value upon the online participation and discussion facilitation, since together they were worth as much as the final paper (40%).

On the second day, the instructor introduced me, the researcher, to the students. Henceforth I was able to observe the class and participate in the Knowledge Forum database. This allowed me to develop rapport with the students, which was helpful for recruitment for the study. As well, ongoing involvement in the class activities enabled the instructor and I to tailor the intervention activities to the specific needs of these learners.

**Methods in Iteration 1: Summer 2004 Course**

Design research is inherently interventionist and involves a close collaboration between design researchers and teachers (Bereiter, 2002a). As the design researcher in this dissertation study, I collaborated closely with two experienced faculty members who taught graduate educational technology courses using web Knowledge Forum. One of the instructors taught the summer 2004 course that forms Iteration 1; the other instructor taught both the fall 2004 and winter 2005 courses that form Iteration 2 and Iteration 3. The instructors and I collaboratively adapted intervention activities that were originally designed to help preservice teachers and grade 5/6 students engage in face-to-face group “Discourse for Inquiry” (Woodruff & Brett, 1999).

**Intervention Activities**

In Woodruff and Brett’s (1999) original activity, the two participant groups separately took part in an initial training program to promote “Discourse for Inquiry” (DFI). This consisted of a 30-minute audio taped introduction followed by a tripartite group discussion around a set of cards. The DFI cards contained strategies and self-questions to help students manage group structure and discussion. First, each group discussed how they felt their group functioned and what they needed to do to improve it. Second, the researcher explained the cards in more detail and pointed to aspects appropriate to each group’s particular needs. This second step emphasized two key issues:

1. that inquiry discourse requires a commitment to a particular set of values, namely *respect, honesty, frankness, and objectivity*; and
2. the goal of the group was to work together towards advancing each other’s understanding by focusing ideas.
Finally, each group tried out some of the suggestions in response to short excerpts from journal articles or other content related to their classroom work.

In the current study, Woodruff and Brett’s (1999) intervention activities were adapted to support online graduate education students, rather than face-to-face student teachers and elementary school students. Similar to the original study, the aim of this study was for students to engage in progressive discourse for inquiry in response to journal articles related to course work (educational technology). The design innovations were refined over three iterations of this dissertation. In this section, I describe two activities that the first instructor and I introduced in Iteration 1 involving learning goals and Knowledge Forum scaffolds.

**Learning goals activity.** This activity asked students to state their personal learning goals publicly in a separate Knowledge Forum view or folder. A goal orientation towards learning rather than task completion encourages students to deepen personal knowledge, and over time, to develop expertise (Bereiter & Scardamalia, 1993). For student-centered learning through discourse in group settings, being able to set and follow through on shared learning goals is critical (Woodruff & Brett, 1999). Thus the purpose of the learning goals activity was to draw attention to shared learning goals, if any, in order to establish norms for progressive discourse and support collaborative dialogue to attain these goals for mutual benefit.

In week 1, the instructor introduced the notion of publicly declaring personal learning goals in class and asked the students to contribute their goals in a Knowledge Forum view especially created for this purpose. Later, in week 3, I summarized the participants’ learning goals in a note highlighting commonalities. In so doing, we hoped that students would begin to consider the course community’s activity in Knowledge Forum as one directed at the object of progressive discourse and the outcome to deepen shared understanding.

**Scaffold activity.** This activity encouraged students to incorporate Knowledge Forum’s scaffolds into their online contributions. The available scaffolds included the existing Theory Building and Opinion scaffolds, as well as custom-designed scaffolds that I designed called Feedback (see Table 2). The scaffolds were to be used while composing notes in Knowledge Forum similar to how the original DFI cards were to be used while composing thoughts in face-to-face group discussion. Scaffolds provide metacognitive prompts to keep the students’ focus on ideas and can assist the students in writing constructive comments to each other in Knowledge
Forum (Scardamalia & Bereiter, 1991). Thus we expected that the quality of student notes with scaffolds to be higher than the quality of student notes without scaffolds.

Table 2

*Feedback Scaffolds Used in Iteration 1, Summer 2004*

<table>
<thead>
<tr>
<th>Scaffold support</th>
<th>Description of how scaffold may be used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description of situation</td>
<td>to describe current situation accurately and advance understanding</td>
</tr>
<tr>
<td>Proposed change</td>
<td>to evaluate the proposal for change—is it a practical one?</td>
</tr>
<tr>
<td>How could we test X…</td>
<td>to test ideas against “received fact,” existing cognitive schema, personal experience, empirical data collected, contradictory testimony in the literature, etc.</td>
</tr>
<tr>
<td>This argument fits with…</td>
<td>to analyze ideas and integrate them</td>
</tr>
<tr>
<td>Consequences</td>
<td>to expand the basis for discussion</td>
</tr>
</tbody>
</table>

After summarizing the participants’ personal learning goals, I posted another note in the Learning Goals view. This note outlined strategies and self-questions to support discourse for inquiry, and urged students to try using the available scaffolds. In the computer lab, I drew the students’ attention to this note, reiterated the importance of working collaboratively towards shared goals, and asked students for their cooperation in trying to use scaffolds to structure their online interaction in more progressive ways.

**Participants**

Participants were 15 students (13 female, 9 male) in a six-week graduate educational technology course in the Faculty of Education. A cross-listed course, it was open to initial teacher education (B.Ed.) students in combined programs leading to a master’s degree. Participants ranged in age from early 20s to mid-50s. Nine were full-time students in academic (M.A., M.T.) degree programs; five were part-time students in professional degree (M.Ed.) programs. Participants were either in the first or second year of their programs of study. One participant was a visiting scholar auditing the course.
**Data Sources**

Data sources for Iteration 1 include online questionnaire responses to questions on demographic background, computer skills, and experience with collaboration; audio taped and transcribed pre- and post-intervention interviews; and student discourse in Knowledge Forum.

**Results and Discussion**

This section outlines selected findings from Iteration 1 conducted in summer 2004: participants’ demographic background; analyses of the online discourse; and a case study of Kate\(^1\), examining interview data on the participant who showed the most change in Iteration 1. This section concludes with implications of the summer 2004 findings for Iterations 2 and 3 conducted in Fall 2004 and Winter 2005.

**Demographic Background**

All 15 participants provided responses to a 13-item online questionnaire soliciting information on their demographic background, computer skills, and previous collaborative experiences towards the beginning of the course. Selected demographics are shown in Table 3. The results of the questionnaire indicated that overall, Iteration 1 participants were new online learners with little previous online course experiences. Specifically, ten respondents (67%) reported not having taken any previous online graduate education courses. Of the five respondents who had taken online courses before, none had taken more than three online courses.

In terms of computer skills, most of the participants (79%) rated their computer skills as average. Similarly, the majority of the participants (80%) had some previous collaboration experience. However, the participants’ collaboration experiences related to use of computer or Internet communication technologies (ICTs) was limited. These were largely confined to prior course assignments including using Knowledge Forum (13%), work on group website development projects (13%), and participation in synchronous chats (7%).

\(^1\) All participants in this dissertation were assigned pseudonyms in an effort to assure their privacy and confidentiality.
Table 3

Participant Demographics for Iteration 1

<table>
<thead>
<tr>
<th>Name</th>
<th>Gender</th>
<th>Age</th>
<th>Degree</th>
<th>Reg</th>
<th>Occupation</th>
<th>Residence</th>
<th>Familiar with KF</th>
<th>Online Grad Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alycia</td>
<td>F</td>
<td>&lt;25</td>
<td>M.A.</td>
<td>F/T</td>
<td>Graduate Student, Teacher Candidate</td>
<td>Toronto, ON</td>
<td>Yes</td>
<td>2</td>
</tr>
<tr>
<td>Adele</td>
<td>F</td>
<td>26 - 35</td>
<td>M.Ed.</td>
<td>P/T</td>
<td>Postsecondary Instructor</td>
<td>Toronto, ON</td>
<td>No</td>
<td>0</td>
</tr>
<tr>
<td>Dylan</td>
<td>M</td>
<td>36 - 45</td>
<td>M.Ed.</td>
<td>P/T</td>
<td>Elementary Teacher</td>
<td>Toronto, ON</td>
<td>No</td>
<td>0</td>
</tr>
<tr>
<td>Fiona</td>
<td>F</td>
<td>26 - 35</td>
<td>M.A.</td>
<td>F/T</td>
<td>Graduate Student</td>
<td>Toronto, ON</td>
<td>Yes</td>
<td>0</td>
</tr>
<tr>
<td>Kate</td>
<td>F</td>
<td>&lt;25</td>
<td>M.A.</td>
<td>F/T</td>
<td>Graduate Student, Teacher Candidate</td>
<td>Toronto, ON</td>
<td>Yes</td>
<td>0</td>
</tr>
<tr>
<td>Madeline</td>
<td>F</td>
<td>26 - 35</td>
<td>M.A.</td>
<td>F/T</td>
<td>Graduate Student, Teacher Candidate</td>
<td>Toronto, ON</td>
<td>Yes</td>
<td>0</td>
</tr>
<tr>
<td>Mark</td>
<td>M</td>
<td>46 - 55</td>
<td>M.Ed.</td>
<td>P/T</td>
<td>Secondary Teacher</td>
<td>Toronto, ON</td>
<td>No</td>
<td>0</td>
</tr>
<tr>
<td>Michelle</td>
<td>F</td>
<td>26 - 35</td>
<td>M.A.</td>
<td>F/T</td>
<td>Graduate Student, Teacher Candidate</td>
<td>Toronto, ON</td>
<td>Yes</td>
<td>3</td>
</tr>
<tr>
<td>Mona</td>
<td>F</td>
<td>26 - 35</td>
<td>M.A.</td>
<td>P/T</td>
<td>Social Worker</td>
<td>Toronto, ON</td>
<td>No</td>
<td>0</td>
</tr>
<tr>
<td>Natalie</td>
<td>F</td>
<td>&lt;25</td>
<td>M.A.</td>
<td>F/T</td>
<td>Graduate Student, Teacher Candidate</td>
<td>Toronto, ON</td>
<td>Yes</td>
<td>0</td>
</tr>
<tr>
<td>Rachel</td>
<td>F</td>
<td>&lt;25</td>
<td>M.T.</td>
<td>F/T</td>
<td>Graduate Student, Teacher Candidate</td>
<td>Toronto, ON</td>
<td>No</td>
<td>0</td>
</tr>
<tr>
<td>Sandra</td>
<td>F</td>
<td>26 - 35</td>
<td>M.Ed.</td>
<td>P/T</td>
<td>Elementary Teacher</td>
<td>Toronto, ON</td>
<td>No</td>
<td>0</td>
</tr>
<tr>
<td>Sharon</td>
<td>F</td>
<td>26 - 35</td>
<td>M.A.</td>
<td>P/T</td>
<td>Elementary Teacher</td>
<td>Toronto, ON</td>
<td>Yes</td>
<td>2</td>
</tr>
<tr>
<td>Suzanne</td>
<td>F</td>
<td>26 - 35</td>
<td>M.A.</td>
<td>F/T</td>
<td>Graduate Student, Teacher Candidate</td>
<td>Toronto, ON</td>
<td>No</td>
<td>0</td>
</tr>
<tr>
<td>Zara</td>
<td>F</td>
<td>46 - 55</td>
<td>Visiting Scholar</td>
<td>F/T</td>
<td>Postsecondary Instructor</td>
<td>Toronto, ON</td>
<td>No</td>
<td>0</td>
</tr>
</tbody>
</table>

For example, Natalie described her initial, brief experiences with Knowledge Forum in another course:

The only form of collaboration that I’ve done using computers or online learning is using Knowledge Forum. This is the place where instead of just communicating by posting messages for each other, we are actually trying to build on one
another’s ideas to deepen our understandings of a specific topic. The first time I used KF, it was unusual and I was just using it as a tool for posting my own thoughts without really collaborating to develop ideas. It does take a little bit of practice and getting used to in order to work well. (Natalie, Iteration 1)

Only two participants (13%) described being members design teams using ICTs in their professional capacity:

I am involved in developing educational programmes for health care professionals as part of my job. We are in a stage to incorporate an on-line component into it. I am reading a lot of books and magazines for this matter (Mona, Iteration 1).

Have joined a program of designing online course software of college English (Zara, Iteration 1).

As Iteration 1 participants are new online learners who were just beginning to develop online practices in academic and work contexts, they were in a unique position to learn practices that promote progressive discourse in these online learning environments.

*Analyses of Student Discourse*

This section presents findings from quantitative and qualitative analyses of student discourse conducted in Iteration 1. The findings are organized along the following research questions:

1. What are the patterns of participation of students in Knowledge Forum (KF)?
2. What are the students’ personal learning goals?
3. What is the students’ use of scaffolds in KF?
4. How do the personal learning goals and use of scaffolds affect student discourse in KF?
Q1. What are the Patterns of Participation of Students in KF?

Built into Knowledge Forum is the Analytic Toolkit (Burtis, 2002), which computes summary statistics including how many notes are in each database, how many notes an author has created, what percentage of notes have been read, and what features has been used. Relevant to the current study, previous researchers have reported findings correlating these quantitative indicators of participation to portfolio scores and conceptual understanding (e.g., Chan & van Aalst, 2003). In another recent study, a strong relationship between extensive writing, reading and use of features such as build-on notes, rise-above notes (summaries and higher-order syntheses), referencing, and scaffold use with knowledge building was identified (Zhang, Scardamalia, Lamon, Messina, & Reeve, 2007). Accordingly, the Analytic Toolkit was used to examine patterns of participation in 13 views for Iteration 1 (see Table 4).

As Table 4 shows, the mean number of notes contributed per student was 26.5. Though there was considerable variation in the levels of note creation (range 9 to 54), on average, students wrote two notes per view over 13 views. The mean percentage of notes read per student was 58%. Again, there was a wide range in reading levels, from a low of 12% to a high of 100%. Interview data for at least two participants with low reading levels indicated that accessing Knowledge Forum on their primary computer was difficult, as a result of security measures at work (firewall) or a lack of Internet access at home.

In total, students in Iteration 1 in contributed nearly all of the notes in 13 views over a six-week period (397 of 426; 93%). The instructor and researcher notes were omitted in the Analytic Toolkit calculations partly because it only comprised a very small proportion of the database discussion (29; 6.8%). In part, the low instructor contributions resulted from the instructional intent to simply remove impediments to progressive discourse rather than overtly directing the discourse, following research showing that instructor-centered discussions are associated with more monologic patterns of interaction (Hara et al., 2000; Lipponen et al., 2003; Schrrie, 2006) that do not divert from traditional classroom discourse (IRF) patterns (Cazden, 1988; Sinclair & Coulthard, 1975).
Table 4

*Overview of Patterns of Participation of Iteration 1 Students in KF*

<table>
<thead>
<tr>
<th>Participant</th>
<th># Notes Created</th>
<th># Notes Linked</th>
<th>% of Notes Read</th>
<th># of Revisions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adele</td>
<td>36</td>
<td>67</td>
<td>83</td>
<td>0</td>
</tr>
<tr>
<td>Alycia</td>
<td>54</td>
<td>83</td>
<td>82</td>
<td>10</td>
</tr>
<tr>
<td>Dylan</td>
<td>24</td>
<td>79</td>
<td>66</td>
<td>18</td>
</tr>
<tr>
<td>Fiona</td>
<td>42</td>
<td>76</td>
<td>100</td>
<td>11</td>
</tr>
<tr>
<td>Kate</td>
<td>25</td>
<td>92</td>
<td>74</td>
<td>17</td>
</tr>
<tr>
<td>Madeline</td>
<td>22</td>
<td>82</td>
<td>56</td>
<td>5</td>
</tr>
<tr>
<td>Mark</td>
<td>28</td>
<td>79</td>
<td>56</td>
<td>1</td>
</tr>
<tr>
<td>Michelle</td>
<td>28</td>
<td>79</td>
<td>73</td>
<td>31</td>
</tr>
<tr>
<td>Mona</td>
<td>14</td>
<td>57</td>
<td>12</td>
<td>3</td>
</tr>
<tr>
<td>Natalie</td>
<td>27</td>
<td>89</td>
<td>43</td>
<td>4</td>
</tr>
<tr>
<td>Rachel</td>
<td>19</td>
<td>79</td>
<td>73</td>
<td>0</td>
</tr>
<tr>
<td>Sandra</td>
<td>12</td>
<td>50</td>
<td>19</td>
<td>0</td>
</tr>
<tr>
<td>Sharon</td>
<td>44</td>
<td>84</td>
<td>77</td>
<td>41</td>
</tr>
<tr>
<td>Suzanne</td>
<td>13</td>
<td>54</td>
<td>31</td>
<td>0</td>
</tr>
<tr>
<td>Zara</td>
<td>9</td>
<td>78</td>
<td>22</td>
<td>0</td>
</tr>
<tr>
<td><em>M</em></td>
<td>26.5</td>
<td>75.1</td>
<td>57.8</td>
<td>9.4</td>
</tr>
<tr>
<td><em>Mdhn</em></td>
<td>25</td>
<td>79</td>
<td>66</td>
<td>4</td>
</tr>
<tr>
<td><em>SD</em></td>
<td>12.5</td>
<td>12.1</td>
<td>25.8</td>
<td>12.1</td>
</tr>
</tbody>
</table>

To explore characteristics of progressive discourse, I selected two discussion views from towards the end of the course that contained episodes of discourse that appeared progressive for content analysis (see Table 5).

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2 *Note.* Kate was the participant who showed the most change in participation in Iteration 1 and was selected for case study presented in a later section.
Table 5

*Participation in Selected Course 1 Knowledge Forum Views*

<table>
<thead>
<tr>
<th>View</th>
<th># Students Participating in View</th>
<th># Discussion Leader Notes</th>
<th># Student Notes</th>
<th># Instructor/Researcher Notes</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week 5 Thursday, CSCL and Knowledge Construction</td>
<td>13 of 15</td>
<td>11 (26.2%)</td>
<td>27 (64.3%)</td>
<td>4 (9.5%)</td>
<td>42 (100%)</td>
</tr>
<tr>
<td>Week 6 Thursday, CSCL Discourse and Social Influences</td>
<td>12 of 15</td>
<td>9 (20.5%)</td>
<td>31 (70.5%)</td>
<td>4 (9.0%)</td>
<td>44 (100%)</td>
</tr>
</tbody>
</table>

As Table 5 shows in both views most of the class participated in peer-led discussion. Slightly more discussion leader notes versus regular student notes were found in Week 6 than Week 5, but both of the views focus on peer-peer discourse.

Next, employing Garrison, Anderson, & Archer’s (2001) oft-used cognitive presence coding scheme for Practical Inquiry I coded each note at the message level. When a note contained indicators for more than one phase, it was coded at the highest level (see Table 6):

Table 6

*Distribution of Iteration 1 Notes Coding to Phases of the Practical Inquiry Model*

<table>
<thead>
<tr>
<th>View</th>
<th>Phase 1 Trigger</th>
<th>Phase 2 Exploration</th>
<th>Phase 3 Integration</th>
<th>Phase 4 Resolution</th>
<th>Off-Task</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week 5 Thursday</td>
<td>4 (7.9%)</td>
<td>17 (44.7%)</td>
<td>11 (28.9%)</td>
<td>4 (10.5%)</td>
<td>3 (7.9%)</td>
<td>38 (100%)</td>
</tr>
<tr>
<td>Week 6 Thursday</td>
<td>6 (15%)</td>
<td>13 (32.5%)</td>
<td>14 (35%)</td>
<td>3 (7.5%)</td>
<td>4 (10%)</td>
<td>40 (100%)</td>
</tr>
</tbody>
</table>

The most common level of student discourse for week 5 was Phase 2 *Exploration*. This suggests that the findings here are consistent with previous research that suggests students rarely move beyond information sharing (Garrison et al., 2001; Pawan et al., 2003). Interestingly, the
second most common level of student discourse for both weeks 5 and 6 was Phase 3 Integration (Week 5, 10.5% Week 6, 35%), which was slightly more prevalent than Exploration during Week 6 (32.5%). While the proportion of Integration found in the current study is higher than the 13% found by Garrison et al. (2001) and 11% Pawan et al. (2003) using the same coding scheme, it is possibly in line with the 32% reported by Meyer (2003).

Very little Phase 4 Resolution was found in either week 5 (10.5%) or week 6 (7.5%) views. The current study’s finding for Resolution is higher than the 4% that Garrison et al. (2001) found. Pawan et al. (2003) did not find any Phase 4 in their data. In contrast, Meyer (2003) reported a much higher proportion of 19.8% coding to Phase 4 in her study. Meyer’s (2003) sample consisted of doctoral students who are “expert” students who would likely have engaged in more progressive discourse (Oshima & Oshima, 1999, 2002). This might account for the greater Integration and Resolution levels of discourse found in Meyer’s study. In this dissertation study, the participants are master’s students possibly more similar to those in Pawan’s study. However, in this study the participants received peer and software-based scaffolding to engage in progressive discourse for inquiry whereas Pawan’s did not.

Further research is needed to clarify why so few participant notes coded to Phase 4 in Iteration 1. A likely explanation is that it is a challenge to ask graduate students to test solutions in a semester long course, let alone a six-week interim session course like Iteration 1. In these brief course contexts, the Knowledge Forum environment functions more as a practice field (Barab & Duffy, 2000) or a bounded learning community (B. G. Wilson et al., 2004). Enabling participants to interact over a longer period of time with connections to a broader research community might encourage them to engage in progressive discourse that involves the testing of ideas as in Phase 4 contributions.

In summary, the most salient finding from content analysis is that views containing student discourse that appear progressive contain proportionately more notes that code to higher levels of Garrison et al.’s (2001) practical inquiry model, particularly Phase 3 Integration. In these views, students focus on connecting ideas and creating solutions. Elsewhere, researchers have used other terms, for example “convergent processes,” to refer to similar summarizing and synthesizing processes (Hewitt, 2001). There are a number of limitations with the content analysis in first iteration. First, no intercoder reliability was calculated for this preliminary study. Another limitation is that analyzing the content of individual student notes does not capture how
progressive discourse develops over time. Discussions did not proceed linearly through phases 1 to 4, and often stalled at phase 3 *Integration*. Often, students interjected *Phase 2 Exploration* notes containing personal commentaries that enlivened peer interactions but did not advance shared understanding (see also Pawan et al. 2003). The threaded discussion software interface in the Knowledge Forum did not make progress immediately apparent, and students did not take advantage of features like rise-above notes or candidate for publication to highlight advances made by the group. In part, the lack of use of these features reflected a lack of instructor emphasis as there were many other technical features students were required to adjust to, and thus these, more sophisticated ones, were not focused upon.

**Q2. What are the Students’ Personal Learning Goals?**

Analysis of students’ personal learning goals revealed, contrary to expectations, that students actually held dissimilar goals. First, while the majority of participants (79%) had self-identified themselves as having average computer skills, gaining technological competence remained a goal for a third of the participants. For example Suzanne stated,

> In taking this computer course, my hope was to become more comfortable on a daily basis, in and outside of the classroom. As it is, I am very dependent on others when problems arise (as they often do) to fix my computer. In addition to that, I would like to become knowledgeable in the computer lingo so that, even if I do require help (usually over the phone) I can follow along without feeling and seeming completely inept. (Suzanne, Iteration 1)

Second, students varied in terms of depth of understanding of educational technology that they hoped to develop by taking the course. For about one third, simply gaining familiarity with different technologies was a goal. For a second third of the participants, a goal was to delve a little deeper to evaluate critically different technologies to use in their teaching practice. Most relevant for the current study are the final third of participants stated that in addition to these goals, understanding in-depth how to use technology effectively to enhance the quality of their pupils’ learning was also goal for them. These students suggested that they wanted to use technology in situated ways that moved beyond *transmission* models and more towards *participation* models of learning (Sfard, 1998):
Many of the computer programs I have come across as a second language learner and teacher have sought only to reinforce language learning by rote memorization. I feel that computers have the potential to greatly enhance language learning and should not only be used as grammar drill tools. Reading comprehension, writing, speaking and listening comprehension are the four main skills of language learning, and I believe that computers can aid in the development of these skills. Becoming familiar with effective language-learning software, as well as evaluating computer programs are my learning goals for this and future courses. (Alycia, Iteration 1)

In the entry above, Alycia articulates understanding not only of how students learn and how to teach subject-specific content matter, but also how technology may be used effectively in the classroom. In this iteration, participants who had goals for deep understanding of the course content (how to use technology to enhance their pupils’ learning) also appeared to play key roles in instantiations of progressive discourse. This is consistent with previous research noting that students’ goal orientations for exploratory discourse and progressive discourse are crucial to quality online discourse (Nussbaum, 2005; Oshima & Oshima, 2002). These participants were also more likely to practice “convergent processes”—to summarize and synthesize the state of the discussion (Hewitt, 2001, 2005). As well, these students tended to ask more questions to encourage peer interaction, consistent with Lai and Law’s (2006) findings.

In terms of shared goals, responses in interviews support the view that most students (78%) were unclear as to why shared goals would be helpful to their own learning. This view was prevalent even among students who had goals for deep personal understanding. One likely explanation is that students were relatively inexperienced online learners who did not yet understand how environments like Knowledge Forum enhance learning through collaborative knowledge building. Another explanation is that it may be more useful to focus on the shared value underlying the different personal goals. In degrees, whether it was to gain comfort with technology, to learn different technologies, to evaluate technologies, or to understand how to enhance pupils’ learning with technologies, all participants showed a commitment to teacher learning and ongoing professional development—to become better teachers using technology.
Q3. What is the Students’ Use of Scaffolds in KF?

About half of the participants (53%) incorporated at least one type of scaffold in writing their notes (see Table 7). For the students who used KF scaffolds in composing their notes, the scaffolds were described in the post-interviews as being helpful for reading and writing. For reading, a few students suggested that scaffolds “break up long notes and increases clarity—it was easier to pick up the more important notes” and that they made long notes “more motivating to read.” For writing, some students noted that scaffold supports “didn’t fit with what I wanted to say” or that it was “hard to find one that applies” during composition. Only one student stated that scaffolds “fit with my own argument in writing.”

Table 7

Knowledge Forum Scaffold Use in Iteration 1, Summer 2004

<table>
<thead>
<tr>
<th>Student</th>
<th>Scaffold</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Theory Building</td>
</tr>
<tr>
<td>Adele</td>
<td>0</td>
</tr>
<tr>
<td>Alycia</td>
<td>11</td>
</tr>
<tr>
<td>Dylan</td>
<td>0</td>
</tr>
<tr>
<td>Fiona</td>
<td>2</td>
</tr>
<tr>
<td>Kate</td>
<td>9</td>
</tr>
<tr>
<td>Madeline</td>
<td>3</td>
</tr>
<tr>
<td>Mark</td>
<td>0</td>
</tr>
<tr>
<td>Michelle</td>
<td>5</td>
</tr>
<tr>
<td>Mona</td>
<td>1</td>
</tr>
<tr>
<td>Natalie</td>
<td>6</td>
</tr>
<tr>
<td>Rachel</td>
<td>0</td>
</tr>
<tr>
<td>Sandra</td>
<td>0</td>
</tr>
<tr>
<td>Sharon</td>
<td>1</td>
</tr>
<tr>
<td>Suzanne</td>
<td>0</td>
</tr>
<tr>
<td>Zara</td>
<td>0</td>
</tr>
</tbody>
</table>

Total | 38 | 35 | 3 | 76 |
To understand what scaffolds did fit with what the students’ wrote, the distribution of the scaffolds were examined. This showed that students almost always used the existing Theory Building (50%) and Opinion (46%) scaffolds rather than the customized Feedback (4%) scaffolds. In fact, only one participant who also used the most number of scaffolds, Kate, tried using the Feedback scaffolds. While Theory Building and Opinion scaffolds may be sufficient to support knowledge building and argumentation for inquiry, I was interested in involving the participants in refining the design of the scaffolds supports for progressive discourse (Woodruff & Nirula, 2005). Scaffolds seemed to have a positive effect the participation and discourse of students who incorporated them into their notes, as illustrated in an episode of student discourse in the next section.

**Q4. How do the Learning Goals and KF Scaffold use Affect Student Discourse in KF?**

To understand how the two instructional interventions to scaffold progressive discourse affected student discourse in Knowledge Forum, I present a thread of discourse that I would consider progressive discourse, because it clearly identified a problem of understanding and tried to solve it through collaboration. The student discussion leaders, Alycia and Zara, did not post any guiding questions for this view. Instead, Fiona initiated a discussion on professional development involving about half of the class in a note entitled, “Three levels of professional development” (see Figure 2).

---

1. **Three levels of professional development** edit by Fiona [2004, June 06]
2. **Professional Development** edit by Alycia [2004, June 06] (Sub-thread 1)
3. **Technical Competency // Pre Service Teacher Training** edit by Mark [2004, June 07] (Sub-thread 2)
   - **Pre-service training** edit by Alycia [2004, June 07]
   - **pre-service/admin** edit by Adele [2004, June 07]
4. **I agree, but the order of importance for the three levels should be addressed** edit by Kate [2004, June 07]
   (Sub-thread 3)
5. **The reason** edit by Alycia [2004, June 07]
6. **Pedagogy is key** edit by Fiona [2004, June 07]
7. **Thanks! Another question...** edit by Kate [2004, June 08]
   - **students and pedagogy** edit by Madeline [2004, June 08]
8. **Merge being explicit and marketing?** edit by Rachel [2004, June 08]
   - **It should be explicit** edit by Alycia [2004, June 08]
9. **Help students understand pedagogy** edit by Fiona [2004, June 08]
10. **Web Technology and World 2** edit by Dylan [2004, June 08]
11. **public knowledge, open source** edit by Researches [2004, June 08]
12. **Children are Naturals** edit by Dylan [2004, June 08]
13. **Interesting points! Children are naturals...** edit by Kate [2004, June 08]

*Figure 2.* Discussion thread on the topic of professional development from Iteration 1, Week 6.
This episode of progressive discourse illustrates multiple actions taken by six students over three days in Iteration 1, week 6. Fiona opens the discussion by expressing a view that professional development (PD) for technology infusion should consider teacher knowledge not only the technological level, but also at the pedagogical and affective levels. Three sub-threads develop as participants build on to Fiona’s note. In the first sub-thread, Alycia acknowledges and agrees with Fiona acting in her discussion leader role. In the second sub-thread, Mark is contemplating what mandating technical competencies in preservice teacher education programs would have on the educational system. In the third sub-thread, Kate is speculating the relative order of importance of the three levels of professional development. For the current analysis, I focus on how Fiona’s initial ideas on PD progress, with attention to the students’ personal learning goals and use of KF scaffold tools. Note that KF scaffolds are indicated in italics in the transcript.

Day 1
1 Fiona

Just to build on the topic of professional development, I think teachers not only need be trained at the technical level, but also should be informed at the pedagogical level. That is, they should know how to integrate technology into their curriculum. The third level is the affective level. Teachers need to be comfortable with technology and have a positive attitude toward it. They should be motivated to use it in classrooms because they find it useful, rather than being pressured into it because of administrative decisions or parent preference.

Day 2
2 Kate

I agree with your three levels of professional development that you discussed as important for teachers. Although I agree with the three levels, I feel that some may be more important than others.

Elaboration After our last class (last Thurs.) I can truly see the importance of teachers understanding the pedagogical theory behind the use of particular technologies before they implement them. Although knowing how to use them and feeling good about them may be important, I think, especially for
online knowledge building communities, it is even MORE important to know the pedagogical reasoning behind it. For instance, if teacher did not understand importance of children exploring ideas in WORLD 3 knowledge (public knowledge) then they may not be as motivated or passionate about using Knowledge Forum in their classroom despite knowing how it works.

Maybe the same can be said for Fishman’s KNOW³. If teachers did not understand that this system is meant for teachers to share their classroom practice that have worked for them and to help “leverage community knowledge” and not just be a showcase where teachers try to “show-off” their best practices in a competitive manner. By discussing the online video practices and asking questions in order to discover “why” these practices are good or not, teachers can become knowledge builders about their own profession!

3 Alycia  
*Putting our knowledge together* Thanks for your comments. I agree with you that teachers should be well aware of the reasoning behind videos and their intention should be to share their knowledge and expertise with others.

*I need to understand* You [Kate] mention the importance of the order of the three levels of PD that Fiona addresses. So how would you place the three levels in order?

4 Fiona  
Hi Kate, Thanks for pushing our understanding on different layers of professional development (PD). I also believe that pedagogical training on technology is the most important element in PD. Teachers need to know how to integrate technology into the curriculum and how to use technology to make their instruction more effective.

I just came across an article that argues for three key issues in PD. They are

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³ Students were reading a manuscript version of Fishman, Marx, Blumenfeld, Krajcik, & Soloway (2004)
establishing comfort level with technology, understanding the pedagogical use of the technology, and developing the ability to critically evaluate technology. I guess the affective and technical levels of PD I mentioned in an earlier note [hyperlink to day 1 note entitled Three levels of professional development] can fall into the first category.

Day 3 5 Kate

Thanks for the helpful comments and mentioning the article related to the topic we’re discussing (pedagogy and PD). I feel that it is so important for teachers and even students to understand the reasons why they are using the technology and how it will help them if used properly in the classroom.

I need to understand Do you feel it is equally important for students to learn about the pedagogy behind technology such as KF or is it more important for the teacher to understand the theory behind it and how to implement it? Maybe as long as the teacher understands how technology such as KF is important for building community knowledge and helping the children develop stronger inquiry, evaluation skills, etc. the students will fall into the swing of things naturally without having to be explicitly taught the pedagogy behind KF. Any thoughts?

6 Madeline Opinion If both teachers and students understood how different technologies contributed to learning they would be more effective.

Elaboration Kate, you bring up an interesting point. I think that students should understand the pedagogy behind any technology that they use. Kids often feel like they are learning things that are irrelevant to them (“I’m never going to use this in the real world!”) but if the reasons are explained to them then they can become active and willing participants in their own learning.

I don’t know about you guys but I remember being in school and having different computer software available to use but it was always treated as a
reward because it was seen as a “game” opposed to a learning tool. Textbooks and the like were the real stuff of learning but playing a game that simulated the pioneers’ journey across the prairies or whatever, it was “fun.” The students didn’t take it seriously because of the teachers’ attitude towards it.

7 Rachel I’m standing torn between 1) making the pedagogy explicit to the students so that they understand what and why they are learning what they are and 2) Madeline’s point of computers as “fun” and not “learning”

Are students interested in certain computer software/games over other ones because games aren’t considered “learning”? Teaching is partially about marketing the material to students in a way that is motivational. Maybe the upper-hand teachers have of using computers as a teaching tool is that students don’t think of it as “learning,” instead they consider it as fun and games. What does everyone else think?

8 Dylan Kate, I think you bring up a very important point in regards to World 3 contributions by teaching professionals towards a collective knowledge base. This pedagogical approach is definitely not the norm and really requires a turn around in thinking amongst educators. In my teaching practice, I develop 90% of my instructional material (all online) disseminated in class whether it is handouts, tutorials, visualizations, projects, etc. The prevailing attitude amongst many professionals seems to be very guarded of their intellectual property. Only recently did I shift from this position to an “open source” mentality as I now accept the notion that my ideas and work are going to be distributed, used by others and possibly improved. I think web technology has shattered the idea of knowledge being available only through gatekeepers such as teachers, professors, technicians, subject matter experts, etc.

9 Researcher Dylan, Kate and others, I think making knowledge public and having an
“open source” mentality is great. To build on to the intellectual property issue, I think some people are worried about copyright, too. Still, I can’t see it being so bad if people cite the work on the web, authors of notes, etc.

Re: Teaching pedagogy behind KF. Kate, I agree, I think it is important for the teacher to understand the theory, but the students don’t necessarily have to understand World 1, 2, 3, etc. The teacher might model and redirect the children at first, but over time, I think children would do it more naturally. Anyone disagree?

10 Dylan I agree with you [Researcher] that children will follow the modeling provided by the teacher and other kids. As we have discussed here and in class, children thrive in social learning environments and will naturally want to share and work with others. They may not be conscious of the World 3 knowledge and it is probably not important for them to understand this metaphor. It is not until later in school as children become older and as the educational institutions dictate, systemic competitiveness sets in. Knowledge building is a democratic and collective process that really steps outside the ways schools encourage learning as a gateway to individual success.

11 Kate Putting our knowledge together Based on everyone’s contributions to my question regarding whether students should be informed about the pedagogy behind KF etc., I agree that it may not be important to explicitly teach children about the abstract concepts of World 3, 2, 1, knowledge, but instead to explain the importance of sharing information and improving the group’s knowledge as a whole. As Dylan mentioned, children are naturals and will pick up on the importance of sharing information, ideas, and inquiries with others after experiencing it with scaffolding at first and then more independently with time (hopefully anyway).

In this transcript, a group of six students contribute to developing a rich understanding of PD and technology infusion in the K-12 context. These students honor the progressive discourse
commitment to work towards mutual understanding and to expand the factual base. They use the asynchronous KF environment and course materials. The group’s goal is to engage in progressive discourse on the topic of PD and technology infusion. Rather than advancing existing sub-threads, Kate begins a new sub-thread Kate builds onto the Fiona’s note. Kate agrees with the three levels that Fiona proposes, but speculates if some levels mentioned are more important than others.

Using the “Elaboration” scaffold, Kate considers Fiona’s ideas on the three levels of PD and to emphasize the importance of the pedagogical level. Kate incorporates ideas from course readings that showcase theory-building research on integrating particular technologies to support teaching and learning (Fishman et al., 2004; Scardamalia et al., 1994).

During the same day, Alycia thanks Kate and consolidates their shared understandings by using the “Putting our knowledge together” scaffold. Further, Alycia prompts Kate to articulate the order of importance among the three levels of PD suggested by Fiona.

Fiona also thanks Kate and corroborates the group’s shared understanding that pedagogy is the most important element in PD for making instruction more effective. Like Kate, Fiona cites research to back this argument. In addition, Fiona grants Alycia’s request for ordering the importance among the three levels of PD. Fiona surmises that both affective and technical levels of PD can be categorized under “comfort level with technology,” which is less important than understanding the pedagogy or developing the ability to evaluate critically the use of particular technologies.

Next morning (Day 3), Kate thanks Fiona for her helpful contribution. Kate then uses the “I need to understand” scaffold to inquire more deeply about the relationship between pedagogy, technology, and student learning. Kate wonders if it is more important for the teacher to understand the pedagogy than it is for the student. However, Kate also shows openness to other participants’ views, and ends by asking encouraging feedback from peers with a closing question, “Any thoughts?”

This invitation elicits responses from three other students: Madeline, Rachel, and Dylan. Rachel and Madeline share interesting personal narratives and opinions, but they do not advance the group’s understanding of the importance of the pupil understanding pedagogy underlying technologies infused into instruction. Their contributions do, however, highlight the importance of motivation and engagement in teaching for student learning. Thus Rachel and Madeline’s
contributions may be seen to be examples of teachers’ “devotional discourse” instead of discourse for inquiry (Woodruff & Brett, 1999). Their notes also bring to light how technology is not used often for instruction or integrated into classroom teaching practice (Becker & Riel, 2000; Cuban, Kirkpatrick, & Peck, 2001).

Dylan return to Kate’s first note to elaborate on the notion of World 3 or public knowledge. Dylan points out that the knowledge-building pedagogy is a radical approach, one that requires educators to change their thinking. Dylan relates these ideas to the shift in his own teaching practice embracing an “open source” mentality concurrent with the growth of ICTs.

At this point, I interjected in the group’s discussion. I strengthened the link between Kate and Dylan’s attempts to advance Fiona’s ideas about PD. Specifically, I affirmed that making knowledge public and having an open-source mentality was positive direction for education. Then, challenged Kate’s idea that students need to understand pedagogy underlying educational technology in order to experience meaningful learning experiences. This was because Madeline, Rachel, Alycia, and Fiona were concurrently sharing divergent perspectives about whether to make pedagogy explicit to students or not, rather than engaging in convergent processes (see Figure 2). At the same time, I attempted to avoid directing the students to accept my view and invited them to continue unpacking these ideas.

Dylan assents, but he connects these ideas back to prior discussions in Knowledge Forum and in class. Dylan attests that children “will naturally want to share and work with others.” He explains that it is only later that “systemic competitiveness” sets in as a result of schooling that focuses on individual learning achievement. Dylan may be drawing on his own experiences, which include being a parent to a young child and being a post-secondary instructor.

To conclude this episode of progressive discourse, Kate uses the “Putting our knowledge together” scaffold to synthesize the group’s understanding based on responses to her question. She re-capitulates that it may not be necessary to teach children about abstract pedagogical concepts explicitly for them to experience the benefits of computer-supported collaborative learning (CSCL) environments, provided that adequate scaffolding is provided initially, then faded over time.

This episode is progressive in the sense that students each contributed to advancing this group’s understanding of PD. First, a student identified the kind of skills, beliefs, and knowledge needed to support technology integration “levels” involved in professional development efforts.
to. Then, another student encouraged peers to organize the levels in order of importance. One student drew attention to the importance of pedagogy, referencing innovative pedagogical approaches that CSCL environments can support. A second student concurred, and referenced research to finally considering applications to teaching with technology to foster learning in K-12 classrooms. This extended the range of issues related to understanding the problem and expanded the base of facts that they accept or do not deny. Virtually all of the six participants in this group voiced personal learning goals for deeply understanding how to infuse technology effectively to enhance the quality of their pupils’ learning. Half of the group incorporated scaffolds into their notes. Students who used scaffolds were able to elaborate their own ideas and source-based ideas. Particularly effective were the “Putting our knowledge together” and “I need to understand” scaffold supports. These helped students converge different perspectives and explore questions that were unresolved through dialogue.

**Case Study: Kate**

In this final section, I characterize Kate, a participant who showed the most change in participation in Iteration 1. A full-time student under 25 years old, Kate was in the second year of a combined preservice program leading to a master’s degree. She identified her computer skills as average, but did have previous online course experience from taking undergraduate distance education courses using WebCT. She also described prior experiences with Knowledge Forum in a five-week science unit taught by the same instructor.

During Iteration 1, Kate noticeably deepened her level of engagement in the database. Kate’s increases in reading and writing levels resemble the patterns of online engagement for the emergent learners noted in another study of online discourse patterns (Brett, 2002, 2004). However, this deepening engagement is not discernable from the number of notes created in the ANALYTIC TOOLKIT overview of patterns of participation displayed in (Table 4) because overall, Kate wrote only an average number of notes. Analyzing the views post-intervention, however, shows that Kate wrote more notes—three to five notes per week—and above the mean of 2 notes per week. Combined with Kate’s overall high levels of reading (fifth highest), highest percentage of linked notes, and highest use of scaffolds in the course, the quantitative indicators of participation for Kate suggest that she is actively contributing to Knowledge Building in the course database.
Analysis of Kate’s personal learning goals reveals an orientation towards deep understanding of how to use technology to develop pupils’ learning:

First, I am hoping to gain a better understanding of software that I could use in my own classroom. The only real software programs that I have been exposed to for use in the classroom are word processing, power point, and e-mail. Although these are useful tools, I would like to learn about programs that provide students with more of a tool to help them explore and construct their own knowledge. Second, I would like to learn about software that could be used to help remediate or accommodate children with learning difficulties. Finally, I would like to learn how to be more critical when it comes to choosing the right computer software (and hardware) for my classroom. (Kate, Learning Goals View, Iteration 1)

Kate identifies desktop software programs with which she is familiar, but indicates a desire to learn about educational technology that supports active, constructivist learning for her students. As well, Kate conveys an interest in accommodating students’ individual differences and to become more critical in selecting technology to infuse into her classroom.

In the post-interview, Kate reported that did not find learning goal activity particularly helpful for her learning. She stated reading over shared goals “didn’t really drive my learning” in the course, mostly because she had forgotten about them. Kate speculated that the activity would be more successful if students were reminded to monitor and evaluate their goals throughout the course:

Maybe if I had been reminded…maybe to go back and maybe everyone should update their learning goals or if they have actually reaching their goals. Then I would have…um looked at it more and concentrated on them more? But I kind of lost track of it. (Kate, Post-Interview, Iteration 1)
Kate’s reflections on the learning goals activity suggests that students require more metacognitive support to keep the focus on shared goals, particularly in order to engage in progressive discourse.

In comparison, Kate said in the post-interview that she liked using scaffolds and found them useful. She thought that scaffolds organized the writing in notes, and preferred to read notes with them:

When I open up somebody’s comment or somebody’s posting and it’s just like huge, and there’s nothing breaking it up, and it sort of doesn’t motivate me to read. God, it’s so much to read. But when it’s broken up, it structures it more, even for my own thinking. I’m like, ok, it’s their “Understanding” now, it’s “New Information.” I just find it helpful. (Kate, Post-Interview, Iteration 1)

Kate’s attitude towards scaffolds and Knowledge Forum in general was not always so positive. When Kate’s used Knowledge Forum in a previous course, the scaffolds were “already in place,” but was “too lazy to find out how to use them.” Kate confided, “I really couldn’t stand Knowledge Forum. I know that sounds harsh, but a lot of people in my class were like, ‘Oh, this is annoying, what are we doing?’” In the current study, however, Kate started using scaffolds following the step-by-step instructions in the note I posted in the Learning Goals view in the database. Kate recalled the Instructor and I encouraging students to try using the scaffolds to structure online interactions for progressive discourse.

As expected, the Instructor had a large influence on how Kate provided feedback to classmates online:

During our discussions in class you know, just saying how critical sometimes he is, like kind of taking…not critical but looking at it being a devil’s advocate sort of, and: “People have good points, that great, but…” So sometimes I follow that lead online. (Kate, Post-Intervention Interview, Iteration 1)

Thus, Kate stated that she “always kind of have a critical eye” online. She described first reading through a thread of discussion to see what people have said. Then, if there was missing
information or something that she didn’t understand, she wrote a build-on note and tried to relate to what somebody had said.

Kate said that she actually enjoyed Knowledge Forum discussions by the end of Iteration 1, disclosing that she “really felt the change.” At the beginning, Kate was going through the motions by reading the articles and posting notes to fulfill participation expectations for the course grade. Kate revealed that she “really got into it” after her software demonstration in the computer lab with Palm Pilot handheld technology in week 4, and her discussion leadership in week 5. For the Palm Pilot demonstration, Kate ran a simulation activity based on the Prisoner’s Dilemma (Axelrod, 2006; Poundstone, 1992). For the discussion, Kate collaborated with Mona to lead a discussion on a chapter on knowledge building pedagogy and technology (Scardamalia et al., 1994). Kate showed a particular interest in Popper’s (1972) philosophy of the three worlds of knowledge that underlies knowledge building, which may have helped Kate understand the purpose of collaborative online discussions:

I could understand how you need to get the information out there and let people comment and criticize, evaluate other people’s information in order to build because it’s hard when it’s just yourself and you have books and you’re reading books and you contemplate them in your own mind. It doesn’t go as far as it could go when you’re with a group of other people…

Kate is referring to public knowledge (conceptualized as world 3 by Popper) rather than the content of individual minds (which he refers to as world 1) when she refers to putting “information out there” for others to improve through progressive discourse. Her recognition of the value of social interaction and collaboration in deepening individual learning is evident.
Summary and Implications for Iterations 2 and 3

This chapter reviewed selected findings from the first iteration of a design-based research study to inform the design of the second and third iterations. I first examined the demographics of Iteration 1 participants using an online questionnaire. Overall, it was found that most of the participants were new online learners with little or no previous online graduate course experiences. There were younger, full-time, on-campus graduate students enrolled in academic master’s degree programs compared to the slightly older, part-time graduate students enrolled in professional degree programs anticipated for the later iterations. Most had average computer skills and limited experiences using computers or ICTs to collaborate in academic or professional contexts.

Next, I presented findings from analyses of discourse conducted along four research questions. The first research question explored patterns of participation of students in Knowledge Forum. Quantitative indicators calculated using the Analytic Toolkit indicated that there was considerable range in reading and writing activity over the 13 selected views in Knowledge Forum. However, in the two views from towards the end of the course that I selected for qualitative analysis revealed that nearly all of the participants contributed to peer-led discussion. Further, the most common levels of student discourse coded using Garrison et al.’s practical inquiry model in these views were Phase 2 Exploration and Phase 3 Integration. The most salient finding from the content analysis is that student discourse that seems progressive possibly contains proportionately more notes that code to higher levels of practical inquiry. Nonetheless, only a small number of notes in Iteration 1 coded to the highest level, that of Phase 4 Resolution.

Research question 2 examined the content of student notes and interview transcripts to understand what the students’ personal learning goals were, and how they perceived the first intervention activity drawing attention to shared goals to be achieved through the vehicle of progressive discourse. It was found that students actually held dissimilar goals that were not necessarily aimed at depth of understanding or knowledge building. Students were unclear as to how shared goals for collaboration were helpful to their own learning. Not unexpectedly, the culture of collaboration and progressive problem solving was not one that was familiar to them.

Research question 3 investigated the students’ use of scaffolds in Knowledge Forum (KF). About half of the participants incorporated KF scaffolds into their notes. Students suggested that scaffolds can be helpful for reading and writing, but a number also noted that the
available scaffolds did not fit with what they wanted to say. The customized scaffold designed for Iteration 1 was used the least of the different types of scaffolds.

Research question 4 characterized an instantiation of what I considered an example of progressive discourse. The episode showcased a group of six students working together through progressive discourse to deepen their shared understanding of PD, technology, and pedagogy. This analysis highlighted the importance of the context in which the discourse unfolds. The tight timelines for discussion between the face-to-face meetings in Iteration 1 made it challenging for students to interact progressively. Yet, participants who stated goals to understand deeply how to use technology to enhance the quality of their pupils’ learning engaged in convergent processes that monitored and evaluated the progress of the group’s discussion. These students also effectively used certain KF scaffold supports. For example the “I need to understand” scaffold was used to identify questions or that arose from inquiry; the “Putting our knowledge together” scaffold was employed to integrate different perspectives into a shared understanding.

In the final results and discussion section, a case study of Kate, the participant who demonstrated the most improvement in participation was discussed. Kate’s change in attitude towards collaborative knowledge building in Knowledge Forum was remarkable. Kate’s views on the two intervention activities are in line with the overall findings. Studying Kate as a case, however, was particularly helpful in shedding light on how the design of the interventions could be improved.

For instance, Kate’s post-course interview responses suggested that a reading on knowledge building pedagogy might help students understand the purpose of collaborative discussions. Thus reading selections to orient students to progressive discourse were introduced at the beginning of the course for Iteration 2. Also, most students, including Kate, were unclear on the usefulness of working towards shared goals. To promote group processes that support progressive discourse, DFI cards making explicit progressive discourse norms were provided from the beginning of Iteration 2. Another change from Iteration 1 to the later iterations involves the types of KF scaffolds available. Kate found scaffolds to be very helpful for her learning and they seemed to have a positive impact on the way she gave feedback to her classmates. Because students used the Feedback scaffolds the least, only the Theory Building and Opinion scaffolds were made available at the beginning of Iteration 2. The instructor and I hoped that students would participate in designing scaffolds for progressive discourse that they might actually use.
Chapter Four: Iterations 2 and 3

This chapter begins with a brief review of the literature on the design-based research methodology used in this thesis project. Then, a description of the intervention activities used in Iteration 2 to support progressive discourse is presented. This is followed by a description of the participants, data collected and results of analyses in Iteration 2 that informed the changes made to the intervention in Iteration 3. Finally, the chapter ends with a discussion of the methods that were used to analyze the students’ discourse at different levels.

Design-Based Research

Responding to major changes in the focus of learning theory from the study of individual behavior and cognition to larger interactive systems, Ann Brown (1992) and Alan Collins (1992) introduced the term “design experiments” to label a new methodology for carrying out studies of educational interventions (Collins, Joseph, & Bielaczyc, 2004). Design experiments are iterative, situated and theory-based attempts to understand and improve educational processes (A. L. Brown, 1992; Cobb, Confrey, diSessa, Lehrer, & Schauble, 2003; Collins, 1992, 1999; diSessa & Cobb, 2004; Edelson, 2002).

More recently, design research has been described as an emerging paradigm that treats design as a strategy for developing and refining theories (Edelson, 2002). The Design-Based Research Collective (2003) defines it as “an emerging paradigm for the study of learning in context through the systematic design and study of instructional strategies and tools” (p. 5). Following Hoadley (2002), I will use the term “design-based research” rather than “design experiments” or “design research” to avoid mistaken identification with experimental design, with studies of designers, or with trial teaching methods.

In the literature review section that follows, I outline in brief the characteristics of design-based research, note advantages and challenges, and clarify verification standards and procedures.

Characteristics of Design-Based Research

Design-based research developed in response to the limitations in existing traditional psychological experimental research. Thus, Collins (1999) identified seven major differences between methods of traditional psychological experiments and design experiments (see Table 7):
Table 8

Comparisons of Psychological Experiment Methods and Design-Based Research Methods

<table>
<thead>
<tr>
<th>Category</th>
<th>Psychological Experiments</th>
<th>Design-Based Research</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research setting</td>
<td>Laboratory</td>
<td>Messy, real-life situations e.g., classroom, workplace, home</td>
</tr>
<tr>
<td>Types of variables</td>
<td>Single dependent variable</td>
<td>Multiple dependent variables including climate, outcome, and system variables</td>
</tr>
<tr>
<td>Research focus</td>
<td>Identify a few independent and dependent variables and hold all other variables constant</td>
<td>Characterize the situation, identify all variables affecting dependent variables of interest, much of which is not now a priori</td>
</tr>
<tr>
<td>Procedures used</td>
<td>Fixed procedures that are carefully documented to enable replication</td>
<td>Flexible design revision; start with planned procedures and materials that are not completely defined and are revised according to their success in practice</td>
</tr>
<tr>
<td>Amount of social interaction</td>
<td>Studies isolated the learner from interaction with other learners and—usually—a teacher or expert</td>
<td>Studies complex social interactions with learners sharing ideas, distracting each other, and so on</td>
</tr>
<tr>
<td>Characterize the findings</td>
<td>Testing hypotheses</td>
<td>Developing a qualitative and quantitative profile by looking at different aspects of the design in practice</td>
</tr>
<tr>
<td>Research lens</td>
<td>Involves the researcher/experimenter only</td>
<td>Involves participants in order to bring their different expertise into producing and analyzing the design</td>
</tr>
</tbody>
</table>

Note. Adapted from Collins (1999) and Barab and Squire (2004)

1 Climate variables (e.g., collaboration among learners) can be studied by observation, interviews, and surveys; outcome variables (e.g., learning of content, transfer) can be studied by giving pre- and post-tests or evaluating products and performances; and system variables (e.g., dissemination, sustainability) can be studied by follow-up to observations, surveys, interviews and longitudinal studies
Clearly, design-based research and traditional psychological experiments differ on paradigmatic issues such as ontology, epistemology, methodology and axiology. Design-based researchers assume a participative reality instead of positing that the knower has an independent existence from the subject (Barab & Kirschner, 2001). Design-based researchers’ epistemological stances also vary along a continuum (see Figure 3):

![Figure 3. Epistemological stances among design-based researchers adapted from Dede (2004).](image)

Dede (2004) notes that some researchers (e.g., diSessa & Cobb, 2004) are on the objectivist end of the epistemological continuum, but suggests that most are in the middle, with cognitivists closer to the objectivist stance and the situated learning theorists on the subjectivist side.

In terms of methodology, design-based researchers typically use mixed methods to describe the complex phenomena over time. For example, traditional pre- and posttest data may be combined with a few in-depth analyses of some students (A. L. Brown, 1992). Additionally, values play a large role in interpreting results. Bereiter (2002b) argues that design-based research is not defined by its methods, but the goals for sustained innovation of education. Likewise, diSessa and Cobb (2004) suggest that the goal of design-based research should be ontological innovations. Finally, design-based research shares philosophical characteristics of pragmatism with mixed-method research (Tashakkori & Teddlie, 1998, 2003), but differs in that one of its goals is to advance theory (Barab & Squire, 2004; Cobb et al., 2003; diSessa & Cobb, 2004).

**Advantages of Design-Based Research**

Design-based research addresses needs

1. for investigating theoretical questions about the nature of learning in context;
2. for approaches to the study of learning phenomena in the real world rather than the laboratory;
3. to go beyond narrow measures of learning; and
4. to derive research findings from formative evaluation (Collins et al., 2004).

Design-based research may superficially resemble formative evaluation methodologies, but it is distinguished from the latter by going beyond improving the value of the particular designed artifact, to developing evidence-based theoretical knowledge about learning (Barab & Squire, 2004). It also speaks directly to the improvement of activities, materials and curricula in practice (Edelson, 2002).

**Challenges of Design-Based Research**

While Collins et al. (2004) assert that design-based research is a powerful tool for studying learning, they concede challenges such as:

1. difficulties arising from the complexity of real-world situations and their resistance to experimental control;
2. large amounts of data arising from a need to combine ethnographic and quantitative analysis; and
3. comparing across designs.

Similarly, Dede (2004) recognizes that design-based research is an important addition to the repertoire of educational researchers, and constructively suggests that it:

1. make less ambitious claims at this early stage in its evolution;
2. make more careful delineation of its limited role in the spectrum of experimental methods;
3. evolve collective standards for what constitutes quality; and
4. focus the design-based community’s efforts on issues of concern to practitioners and policymakers.

Of these concerns, the collective standard for trustworthiness, or “the quality of an investigation that makes it noteworthy to audiences,” (Schwandt, 1997) will be discussed next.
Verification Standards and Procedures

The design-based research community recognizes the need for collective standards for quality (Barab & Kirschner, 2001; Barab & Squire, 2004; The Design-Based Research Collective, 2003). The Design-based Research Collective (2003) states:

Objectivity, reliability, and validity are all necessary to make design-based research a scientifically sound enterprise, but these qualities are managed in noticeably different ways than in controlled experimentation (e.g., Barab & Kirshner, 2001). (p. 7).

This statement points to the use of alternative criteria to ensure trustworthiness in design-based research, instead of narrow traditional criteria for validity and reliability.

Barab and Squire (2004) propose design-based researchers follow Schoenfeld’s (1992) standards for novel methods. Schoenfeld suggested that researchers specify the scope and limitation of a method, describe circumstances in which it can profitably used, and treat issues of reliability and validity in a broader sense than the statistical sense. Thus, Barab and Squire (2004) recommend criteria for trustworthiness and credibility akin to reliability and validity, and usefulness, analogous to generalizability or external validity. These criteria resemble credibility, transferability, dependability, and confirmability used in qualitative research (Guba, 1981; Lincoln & Guba, 1985).

Iterations 2 and 3

This section outlines the design iterations of two thirteen-week online graduate education courses during two consecutive terms in the 2004-2005 school year. The different instructor than the one in Iteration 1 taught both courses exclusively online using web-based Knowledge Forum (version 4.5.3), without any face-to-face meetings.

The instructor typically organized the weekly course discussions in Knowledge Forum database into separate views or folders. There were separate views for Class Biographies, Course Café, Course Administration, Course Assignments, and Practice (to practice technological features of Knowledge Forum). This was to keep off-task posts to a minimum in the course discussion views, enable online students to get to know each other, and to deal with procedural or technical questions elsewhere.
Participation in the course discussion views including discussion leadership accounted for 20% of the students’ grade for both courses. The instructor did not specify a minimum number of contributions per week, but from the beginning of the course made explicit the expectations for students to engage in progressive discourse for deepening understanding.

Each week, the instructor introduced the topic of discussion using a QuickTime “Movie of the week.” She clarified any difficult concepts from the preceding week and offered reassurance to students who were encountering difficult concepts for the first time, or were struggling to keep up with the volume of notes contributed by their peers. Besides Knowledge Forum, the instructor also encouraged students to use Macromedia Breeze, a sophisticated web-based conferencing environment that allowed them to connect synchronously with peers using text, audio, video, whiteboard, and presentation tools.

I participated in the two courses both as the design researcher collaborating with the instructor and as a teaching assistant interacting in online discussions with students. As a design researcher, my epistemological stance is in the middle, leaning to the situated learning side of the continuum. Thus, I used a predominantly qualitative mixed-method research design for this exploratory study. The goals for the study were twofold: to improve first hand the quality of online graduate education in these particular contexts, and to contribute, hopefully, to the theoretical understanding of how students learn deeply and build knowledge through online progressive discourse over time.

Table 9 provides an overview of the changes made across all three design iterations of this dissertation study. In the following sections I outline

1. the intervention activities introduced;
2. the data collected;
3. the data analyzed to assess which interventions were working;
4. the results of the analysis step that were used to plan the next intervention.
Table 9

Summary of Design Changes to Scaffold Progressive Discourse Across Three Graduate Courses

<table>
<thead>
<tr>
<th>Modification</th>
<th>Iteration 1</th>
<th>Iteration 2</th>
<th>Iteration 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Introduction to Computer Applications</td>
<td>Educational Applications of Computer-Mediated Communication</td>
<td>Constructive Learning and Design of Online Learning Environments</td>
</tr>
<tr>
<td>Discourse for Inquiry Cards</td>
<td>Suggestions in class and KF to work towards shared goals</td>
<td>Managing Problem Solving</td>
<td>Managing Problem Solving</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Managing Group Process</td>
<td>Managing Group Process</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Managing Meetings</td>
<td></td>
</tr>
</tbody>
</table>

**Review of Findings from Iteration 1**

In Iteration 1, the intervention activities involved asking the students to state their personal learning goals publicly in a separate Knowledge Forum view to highlight shared goals and to incorporate KF scaffolds into their notes to improve the quality of their online contributions.

An online questionnaire was used to collect participant demographics. Pre- and post-intervention interviews were collected to investigate student perceptions of their participation in Knowledge Forum and usefulness of the interventions for their own learning. Transcripts of student discourse in the database were collected to understand what progressive discourse might look like in an introductory graduate educational technology course.

Analysis of post-intervention interview responses found that most students (78%) were unclear about the usefulness of shared goals for their own learning. The finding that the culture of collaboration was unfamiliar to the students is not surprising, since schooling has traditionally

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4 On the back of the Managing Problem Solving card was the Managing Problem Finding card (see APPENDIX F).
emphasized individual learning rather than collective knowledge building. In response, the instructor and I added a reading on knowledge building pedagogy to orient students to the purpose of collaborative discussions at the beginning of Iteration 2. We also decided to provide a set of DFI cards at the beginning of the second course to emphasize the working norms of progressive discourse for collaboration and inquiry rather than persuasion. We believed that doing so might assist students learn to discuss in order to better advance understanding.

Analyses of interviews and the students’ discourse in Iteration 1 both pointed to the use of KF scaffolds as a promising way to support students’ learning and improve contributions to group discourse. About half of the Iteration 1 students had tried using scaffolds and reported their usefulness for reading and writing notes. However, they noted that the available scaffolds were not designed to support what they wanted to express. Because students in Iteration 1 used the Feedback scaffolds that the researcher designed the least, only the Theory Building and Opinion scaffolds that come with Knowledge Forum were made available to students at the beginning of Iteration 2.

**Iteration 2: Fall 2004 Course**

Iteration 2 involved a fall 2004 (September 13 – December 13) course surveying educational applications of computer-mediated communication (CMC). This course explored applications and issues of teaching and learning in the online environment related to all levels of education. For the first two weeks, the instructor led the course discussion in Knowledge Forum; thereafter, a pair of students led discussions on the course readings.

In addition to participation in Knowledge Forum (20%, including discussion leadership), students were also responsible for a pre- and post-course assignments on conceptions of collaborative discourse (5% each); an online learning journal that took the form of a single note in Knowledge Forum that students added to weekly starting in week 3 (20%, self-assessed); a group assignment on a relevant educational application issue in CMC (15%); and a final assignment (35%).

**Intervention Activities for Iteration 2**

**Reading.** In the first week of the course, to introduce the course theme of progressive discourse, the students read a chapter by Bereiter (2002b) that presented rationales for engaging in progressive discourse for knowledge building. This reading was a more theoretically
challenging one than the other course readings, which helped set high expectations for online discussion.

**Discourse for Inquiry (DFI) cards.** As discussed in the last chapter, the DFI cards were adapted from classroom materials originally developed by Woodruff and Brett (1999) to help elementary students and preservice education students take a more advanced approach to face-to-face collaborative discussion. These activities were adapted with the aim to help online graduate students engage in progressive discourse by modeling thinking processes and discourse structures that could be possible in the online Knowledge Forum environment.

In Iteration 2, three DFI cards were available as a portable document file (.pdf) in the database for students to download, print out, and refer to as they worked online (see Appendix F). There were three cards: Managing Problem Solving outlined commitments to progressive discourse (Bereiter, 2002b); Managing Group Discourse suggested guidelines for voicing a supporting view or an opposing view; and Managing Meetings provided two strategies to help students with dealing with anxiety.

**Knowledge Forum scaffolds.** Scaffolds are sentence openers built-in to Knowledge Forum that appear as yellow brackets around relevant segments of text. In Iteration 2, only the Theory Building and Opinion scaffolds were available at the beginning of the course. Later, in week 9, two students designed the Idea Improvement scaffolds as part of their discussion leadership (see Table 10). The Idea Improvement scaffolds emphasize the socio-cognitive dynamics of “improvable ideas,” one of the twelve knowledge building principles (Scardamalia, 2002) relevant to supporting progressive discourse.
Table 10

*Knowledge Forum Scaffolds and Scaffold Supports Used in Iteration 2*

<table>
<thead>
<tr>
<th>Scaffolds</th>
<th>Theory Building</th>
<th>Opinion</th>
<th>IDEA IMPROVEMENT (All caps in original)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Scaffold Supports</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>My Theory</td>
<td>Opinion</td>
<td></td>
<td>IDEA</td>
</tr>
<tr>
<td>I need to understand</td>
<td>Different opinion</td>
<td></td>
<td>IDEA ADVANCEMENT</td>
</tr>
<tr>
<td>New information</td>
<td>Reason</td>
<td></td>
<td>WHAT DO WE NEED THIS IDEA FOR</td>
</tr>
<tr>
<td>This theory cannot explain</td>
<td>Elaboration</td>
<td></td>
<td>PROBLEM/QUESTION</td>
</tr>
<tr>
<td>A better theory</td>
<td>Evidence</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Putting our knowledge together</td>
<td>Example</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Conclusion</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Participants in Iteration 2*

Participants in Iteration 2 were 17 students (12 females, 5 males) in an online graduate course surveying educational applications of computer-mediated communications (see Table 11). The participants ranged in age from mid-20s to mid-40s. Five were students in academic programs (4 M.A., 1 Ph.D.); 12 were students in professional programs (9 M.Ed., 3 Ed.D.).
<table>
<thead>
<tr>
<th>Name</th>
<th>Gender</th>
<th>Age</th>
<th>Degree</th>
<th>Reg</th>
<th>Occupation</th>
<th>Residence</th>
<th>Familiar with KF</th>
<th>Previous Online Courses</th>
</tr>
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<tbody>
<tr>
<td>Adam</td>
<td>M</td>
<td>26 - 35</td>
<td>M.A.</td>
<td>P/T</td>
<td>Graduate Student Secondary Teacher</td>
<td>Toronto, ON</td>
<td>Yes</td>
<td>5</td>
</tr>
<tr>
<td>Anne</td>
<td>F</td>
<td>M.Ed.</td>
<td>P/T</td>
<td></td>
<td>Secondary Teacher</td>
<td>Newmarket, ON</td>
<td>No</td>
<td>0</td>
</tr>
<tr>
<td>Belinda</td>
<td>F</td>
<td>36 - 45</td>
<td>M.Ed.</td>
<td>P/T</td>
<td>Postsecondary Instructor</td>
<td>Kelowna, BC</td>
<td>Yes</td>
<td>5</td>
</tr>
<tr>
<td>Chloe</td>
<td>F</td>
<td>36 - 45</td>
<td>M.Ed.</td>
<td>P/T</td>
<td>Software Trainer</td>
<td>Toronto, ON</td>
<td>Yes</td>
<td>4</td>
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<tr>
<td>Christine</td>
<td>F</td>
<td>26 - 35</td>
<td>M.A.</td>
<td>P/T</td>
<td>Postsecondary Instructor</td>
<td>Taiwan</td>
<td>Yes</td>
<td>5</td>
</tr>
<tr>
<td>Dylan</td>
<td>M</td>
<td>36 - 45</td>
<td>M.Ed.</td>
<td>P/T</td>
<td>Graduate Student</td>
<td>Toronto, ON</td>
<td>Yes</td>
<td>0</td>
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<tr>
<td>Evelyn</td>
<td>F</td>
<td>&lt;25</td>
<td>M.Ed.</td>
<td>F/T</td>
<td>Student Elementary School Principal</td>
<td>Toronto, ON</td>
<td>Yes</td>
<td>0</td>
</tr>
<tr>
<td>Gail</td>
<td>F</td>
<td>36 - 45</td>
<td>Ed.D.</td>
<td>P/T</td>
<td>Secondary Teacher</td>
<td>Simcoe County, ON</td>
<td>Yes</td>
<td>3</td>
</tr>
<tr>
<td>Ian</td>
<td>M</td>
<td>26 - 35</td>
<td>M.Ed.</td>
<td>P/T</td>
<td>Elementary Teacher</td>
<td>Toronto, ON</td>
<td>Yes</td>
<td>0</td>
</tr>
<tr>
<td>Jeff</td>
<td>M</td>
<td>26 - 35</td>
<td>M.Ed.</td>
<td>P/T</td>
<td>Teacher Educational Technology Consultant</td>
<td>Toronto, ON</td>
<td>Yes</td>
<td>3</td>
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<td>Kelly</td>
<td>F</td>
<td>26 - 35</td>
<td>M.Ed.</td>
<td>P/T</td>
<td>Postsecondary Instructor</td>
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<td>Laurel</td>
<td>F</td>
<td>26 - 35</td>
<td>Ed.D.</td>
<td>P/T</td>
<td>Educational Technology Consultant</td>
<td>Markham, ON</td>
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<td>Maria</td>
<td>F</td>
<td>MA</td>
<td>F/T</td>
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<td>Postsecondary Instructor</td>
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<td>Megan</td>
<td>F</td>
<td>36 - 45</td>
<td>Ph.D.</td>
<td>F/T</td>
<td>Postsecondary Instructor</td>
<td>Millbrook, ON</td>
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<td>Sharon</td>
<td>F</td>
<td>26 - 35</td>
<td>M.A.</td>
<td>P/T</td>
<td>Teacher Information &amp; Planning Analyst</td>
<td>Toronto, ON</td>
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<tr>
<td>Paul</td>
<td>M</td>
<td>36 - 45</td>
<td>Ed.D.</td>
<td>F/T</td>
<td>Educational Technology Consultant</td>
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<td>Yvonne</td>
<td>F</td>
<td>36 - 45</td>
<td>M.Ed.</td>
<td>P/T</td>
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</table>

**Data Sources for Iteration 2**

Four types of data were collected for Iteration 2: online questionnaire responses, pre- and post-course assignments, learning journals, and student discourse in Knowledge Forum. As in Iteration 1, an online questionnaire was used to collect participant demographics.
The pre- and post-course assignment and learning journal data replaced the pre-and post-intervention interview data collected in Iteration 1. Both were a part of the instructor’s teaching repertoire that I sought to preserve in collecting data for this study. The instructor and I collaborated on the design of the assignments and questions asked in the journals to obtain data similar to that collected using interviews in Iteration 1. Pre- and post-course assignments in Iteration 2 took the form of notes containing an attachment in the Course Assignments view. These provided some insight into the students’ incoming and outgoing conceptions of collaborative discourse. The learning journals in Iteration 2 took the form of a note in the database to which students added weekly from weeks 2-13 during the course. These journals were also available to the whole class. For a more thorough discussion on the learning journals, see Brett Forrester, & Fujita (in press).

Transcripts of student discourse in Knowledge Forum were collected to understand what progressive discourse might look like in an online graduate course in educational technology.

**Data Analysis in Iteration 2 Informing Design Changes for Iteration 3**

**Reading.** The reading selection “Knowledge Outside the Mind,” chapter three from Bereiter (2002b), presented theoretical and empirical approaches to the course theme of progressive discourse in Course 2, week 1. It contained complex philosophical ideas such as Popper’s (1972) three worlds—the physical world (World 1), the subjective or mental world (World 2), and the world of ideas (World 3) — that were largely unfamiliar to students. The Instructor assured the students that we would be working together towards understanding these difficult ideas in class discussions throughout the course.

However, analysis of students’ learning journal entries found that for 41% of the students, the reading was difficult and anxiety-provoking, especially when they faced with the steep learning curve of the course technology. For example, Megan said of week 1:

> It has been a somewhat frustrating week. I had difficulty with the Bereiter reading - not something that I am used to. I found it somewhat disconcerting because I was having difficulty with the concepts and making connections. Why? Was it poorly written? It didn't seem so. Was it out of context? Perhaps. Maybe I needed more background. Was it of value? Somewhat. I got the most value out of reading everyone else's interpretations of this article. It certainly helped bring things to
light, but most of it is still in the dark. I had and continue to have technical problems. For some reason, KF is not showing up on my computer at home. I didn't have any trouble in the summer taking two courses on KF. (Megan, Ed.D. student, Course 2, week 1)

Later, in week 9, Megan writes that she understands the importance of engaging in high-level academic discussions as a part of graduate study, and states that she is now able to understand the reading better:

I understand we are grad students and we need to go deeper in our discussions - and I think we have to a certain degree. In comparing the two courses that I am taking, the depth of knowledge in this course goes far deeper than in the other, so to that end, it has been successful. Perhaps I'm missing the bigger picture of the course? I know I reread part of the Bereiter reading last night and found that I am much more able to understand what he was talking about - not like in week 1 when I was totally lost. So, success. (Megan, Ed.D. student, Course 2, week 9)

In the transcript from Week 13 discussions, where students were asked to evaluate the course, 18% of students in Iteration 2 mentioned that the reading was too “abstract” and difficult to understand at the beginning of the course. Megan suggested keeping the same reading but moving it to later in the course. Another student, Adam, the only one who was familiar with the reading from before and had greatly enjoyed it in week 1, proposed that a different chapter (chapter 11, “Can Education become a Modern Profession?”) from Bereiter (2002b) might be more accessible to other students. The third student, Ian, recommended a video “clarification in the beginning of the course on the philosophy of Knowledge Building and whether it is a prevalent school of thought or a local initiative.” Based on the learning journal and transcript data from Iteration 2, the instructor and I agreed that a more accessible reading should be used to introduce the course theme of progressive discourse for Iteration 3.

**DFI cards.** The Results and Discussions chapter will discuss in depth findings for DFI cards and KF scaffolds from Iteration 2. Here, I focus on results from analysis of the students’
learning journal entries in Course 2, week 4 that were used to plan the DFI card intervention in Iteration 3.

While all 17 students in Iteration 2 responded to the question, “To what extent do you use the DFI cards in interacting with classmates? If you don’t use them, what is your reasoning?” the responses from two students who said they did not use the cards are particularly informative. Whereas Adam, an advanced M.A. student whose interests lay in knowledge building, suggested that the DFI cards were already “ingrained” or well established in his online practices, Laurel, an Ed.D. student who had extensive online learning experience, stated that she had become “ingrained” with bad habits. She suggested that she would benefit most from the Managing Problem Solving card that highlighted six commitments to progressive discourse:

1. a focus on ideas as conceptual artifacts;
2. improvability as a positive attribute of conceptual artifact;
3. common understanding given priority over agreement;
4. commitment to expand the factual base;
5. selective criticism based on knowledge-advancement goals; and
6. non-sectarianism (pp. 87-88).

This suggested that the Managing Problem Solving card would be most relevant to establishing good habits for progressive discourse. Based on these responses, instructor and I reduced the number of DFI cards for Iteration 3 to two: the Managing Problem Solving card and the Managing Group Discourse card. We omitted the Managing Meetings card in Iteration 3 because this card seemed to be more therapeutic than academic.

**KF scaffolds.** Inspiring the changes to the KF scaffold intervention from Iteration 2 to Iteration 3 are results from analysis of the students’ learning journals. In Course 2, week 10, students were asked to reflect on the question, “Have you tried using the scaffold supports? What do you find helpful or not helpful in reading and writing notes with them?”

One negative perception that Iteration 2 repeatedly voiced regarding scaffolds was the constraint that KF scaffolds imposed on creative thinking. Scaffolds were designed to support for progressive discourse and knowledge building rather than the more personal communication that creates and sustains interpersonal relationships. Students like Belinda wondered whether
scaffolds were too structured to permit relationship building. In addition, because students tended to see ideas as strongly connected to the individual who contributed them, they did not like Idea Improvement scaffold supports that openly criticized another student’s ideas.

To address these concerns, the instructor and I made some changes to the Idea Improvement scaffolds for Iteration 3 and renamed them to Idea Advancement scaffolds. For example the scaffold, WHAT DO WE NEED THIS IDEA FOR? could be interpreted in multiple ways. Its negative interpretation was deemed ill suited for creating a culture of psychological safety needed for improvable ideas. We thus softened the wording of the support to How this idea could be advanced.

**Iteration 3: Winter 2005 Course**

Iteration 3 involved the winter 2005 (January 3 – April 4) term examining the theory and research that inform constructivist learning and the design of online learning environments. Taking a historical approach, this course introduced concepts such as situated cognition and distributed cognition. Educational applications that have developed out of these ideas, like problem-based learning, collaborative learning, and knowledge building were subsequently explored with regards to how such concepts can inform and enhance the design of online environments and methods of teaching.

In addition to participation in Knowledge Forum, students were responsible for pre- and post-course assignments on their theories of learning (6% each); an online learning journal that took the form of a weblog to which students added weekly starting in week 3 (23%, self-assessed); three annotated online resources (10%); and a final essay assignment (35%).

**Intervention Activities for Iteration 2**

**Reading.** To introduce the course theme of progressive discourse in this more theoretical course, students read an article by Wilson, Ludwig-Hardman, Thornam, & Dunlap (2004). This selection offered students a more accessible foray to progressive discourse than Bereiter (2002b) and situated it as a crucial activity for online engagement in learning communities.

**DFI Cards.** As a result of analyses of learning journals in Iteration 2, Iteration 3 used only two cards: the Managing Problem Solving and Managing Group Discourse cards (see Appendix G). The Managing Meetings card, which students perceived was not particularly helpful for online progressive discourse was removed.
**Knowledge Forum scaffolds.** For Iteration 3, the course instructor and I worked together to refine the Idea Improvement scaffolds from Iteration 2. Our modifications addressed concerns that students voiced about the Idea Improvement scaffolds in Iteration 2. We also reintroduced three of the Feedback scaffold supports from Iteration 1 based on analyses of the student discourse transcripts, which will be discussed in more depth at the end of this chapter. We believed that How could we test X might encourage students to meet the empirical testability commitment; This idea fits with… could help students analyze ideas and integrate them; and Consequences might assist students in fulfilling the expansion commitment.

The Idea Advancement scaffolds are displayed to the left of the content window within a new note window in Knowledge Forum (see Figure 4):

![Scaffold](image)

*Figure 4. Idea advancement scaffolds in Knowledge Forum used in Iteration 3.*

**Participants in Iteration 3**

Participants in Iteration 3 were 20 students (15 females, 5 males) in an online graduate course examining the theory and research that inform constructivist learning and design of online learning environments (see Table 12). The participants ranged in age from mid-20s to mid-50s. Three were students in academic programs (2 M.A., 1 Ph.D.); 17 were students in professional programs (13 M.Ed., 4 Ed.D.).
Table 12

Participant Demographics for Iteration 3

<table>
<thead>
<tr>
<th>Name</th>
<th>Gender</th>
<th>Age</th>
<th>Degree</th>
<th>Reg</th>
<th>Occupation</th>
<th>Residence</th>
<th>Familiar with KF</th>
<th>Previous Online Courses</th>
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<tr>
<td>Andrea</td>
<td>F</td>
<td>26 - 35</td>
<td>M.Ed.</td>
<td>P/T</td>
<td>Elementary Teacher</td>
<td>Shanghai, China</td>
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<td>April</td>
<td>F</td>
<td>26 - 35</td>
<td>M.Ed.</td>
<td>P/T</td>
<td>Elementary Teacher</td>
<td>Toronto, ON</td>
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<tr>
<td>Brian</td>
<td>M</td>
<td>36 - 45</td>
<td>M.Ed.</td>
<td>P/T</td>
<td>Corporate Trainer Software</td>
<td>Victoria, BC</td>
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<tr>
<td>Chloe</td>
<td>F</td>
<td>36 - 45</td>
<td>M.Ed.</td>
<td>P/T</td>
<td>Trainer Physical Education Teacher</td>
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<td>Dale</td>
<td>M</td>
<td>26 - 35</td>
<td>M.Ed.</td>
<td>P/T</td>
<td>Secondary Teacher</td>
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<td>Dana</td>
<td>F</td>
<td>26 - 35</td>
<td>M.Ed.</td>
<td>P/T</td>
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<tr>
<td>Donna</td>
<td>F</td>
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<tr>
<td>Drew</td>
<td>M</td>
<td>26 - 35</td>
<td>M.Ed.</td>
<td>P/T</td>
<td>English Teacher Elementary School Principal</td>
<td>Kuwait</td>
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<tr>
<td>Gail</td>
<td>F</td>
<td>36 - 45</td>
<td>Ed.D.</td>
<td>P/T</td>
<td>Postsecondary Instructor</td>
<td>Simcoe County, ON</td>
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<tr>
<td>Gillian</td>
<td>F</td>
<td>36 - 45</td>
<td>Ed.D.</td>
<td>P/T</td>
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<td>Gordon</td>
<td>M</td>
<td>26 - 35</td>
<td>M.Ed.</td>
<td>P/T</td>
<td>Teacher Educational Technology Consultant</td>
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<td>Hanna</td>
<td>F</td>
<td>26 - 35</td>
<td>M.Ed.</td>
<td>P/T</td>
<td>Consultant Health Research</td>
<td>Ottawa, ON</td>
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<tr>
<td>Jane</td>
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<td>P/T</td>
<td>Medical Doctor</td>
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<td>Jen</td>
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<td>Leah</td>
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<td>P/T</td>
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<tr>
<td>Paul</td>
<td>M</td>
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<td>Sabine</td>
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<td>26 - 35</td>
<td>M.A.</td>
<td>P/T</td>
<td>Nursing Program Manager</td>
<td>Cambridge, ON</td>
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<td>Sue</td>
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Note that four participants—Chloe, Gail, Paul, and Sharon—were students in both Iteration 2 and Iteration 3. Therefore, in total there were 33 participants in the online course iterations, with 24 females and 9 males.

**Data Sources for Iteration 3**

As in Iteration 2, four types of data were collected for Iteration 3: online questionnaire responses, pre- and post-course assignments, learning journals/weblogs, and student discourse in Knowledge Forum. An online questionnaire was used to collect participant demographics. The pre- and post-course assignments in Iteration 3 took the form of notes containing an attachment in the Course Assignments view. These provided some insight into the students’ incoming and outgoing theories of learning and knowledge. The learning journals in Iteration 3 took the form of a note in the database to which students added weekly during weeks 2-5 during the course. Starting in week 6, the learning journals were transferred to weblogs that were made publicly available as part of another research project (Freeman, 2008). The instructor and I collaborated on the design of questions, which encouraged students to reflect regularly on the course content and their discussion participation for each week.

**Analysis of the Discourse**

To understand how online progressive discourse can be fostered among students in semester-long online graduate courses, it is necessary to assess the quality of progressive discourse in a particular CMC transcript. Taking a principled approach, I mapped Bereiter’s (2002) six commitments to progressive discourse to data collection and analysis in Iterations 2 and 3 (see Table 13).

Table 13 shows the six commitments, the possible indicators in the group discourse if students upheld each commitment, and what kind of student discourse data was collected and analyzed for each. The commitments might be considered cognitive responsibilities that individuals uphold rather than characteristics of discourse that are easily observable in the transcripts. Thus, I analyzed both manifest and latent content in the transcripts. By “manifest,” I refer to “content that resides on the surface of communication and is therefore observable” (Garrison & Anderson, 2003, p. 140). By “latent,” I refer to content that “involves the imputation of meaning, ‘the reading in’ of content, the inference that the behavior has function(s) either by intent or effect” (Bales, as cited in Garrison & Anderson, 2003).
**Table 13**

*Mapping Bereiter’s (2002) Progressive Discourse Commitments to Data Collection and Analysis*

<table>
<thead>
<tr>
<th>Bereiter’s (2002) Progressive Discourse Commitments</th>
<th>Possible Indicators in Group Discourse</th>
<th>Data Collected and Analyzed</th>
</tr>
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<tbody>
<tr>
<td><strong>Focus on ideas as conceptual artifacts</strong></td>
<td>Students begin to treat ideas as things that one can relate to, use, manipulate, judge in various ways, and have feelings about separately from personal relevance</td>
<td>Manifest: Discourse data analyzed in terms of KF Scaffold use (<em>My Theory, IDEA, Current statement of idea</em>)</td>
</tr>
<tr>
<td></td>
<td>There are logical and explanatory relationships between ideas e.g., implication, derivation, contradiction, alternative explanation, generalization, limitation</td>
<td>Latent: Discourse data analyzed in terms of the topic a note contains (Analysis 1)</td>
</tr>
<tr>
<td></td>
<td>Students are focused on discussion of ideas, not completion of a project, report, exhibit, or presentation</td>
<td></td>
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<tr>
<td><strong>Improvability as a positive attribute of conceptual artifacts</strong></td>
<td>Students engage in design mode activity in which concern for truth and warrant become incidental to pragmatic concerns:</td>
<td>Manifest: Discourse data analyzed in terms of KF scaffold use (<em>A better theory, Different opinion, WHAT DO WE NEED THIS IDEA FOR, Current statement of idea, How idea could be advanced, How idea is useful</em>)</td>
</tr>
<tr>
<td></td>
<td>What is this idea (concept, design, plan, problem statement, theory, interpretation) good for?</td>
<td></td>
</tr>
<tr>
<td></td>
<td>What does it do and fail to do?</td>
<td>Latent: Discourse data analyzed at group level (Analysis 3)</td>
</tr>
<tr>
<td></td>
<td>How could it be improved?</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Students formulate conceptual artifacts vulnerable to criticism and disconfirmation</td>
<td></td>
</tr>
<tr>
<td><strong>Common understanding</strong></td>
<td>Students work together (i.e. collaborate) towards understanding, not controversy as in a debate</td>
<td>Manifest: Discourse data analyzed in terms of build-ons, references, and co-authored notes (Analytic Toolkit analysis); KF scaffold use (Co-occurrence of <em>I need to understand</em> and <em>My Theory, Putting our knowledge together</em>)</td>
</tr>
<tr>
<td></td>
<td>Students conjecture and ask questions to explore ideas</td>
<td>Latent: Discourse data analyzed in terms of explanations contained within a note (Analysis 2)</td>
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<td></td>
<td>Students provide explanations instead of arguments</td>
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<td></td>
<td>Students feel safe to reveal ignorance or lack of knowledge</td>
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<tr>
<td><strong>Expand the factual base</strong></td>
<td>Students contribute new facts to those they accept or do not deny</td>
<td>Manifest: Discourse data analyzed in terms of KF scaffold use (<em>New Information</em>)</td>
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<tr>
<td></td>
<td>Students extend the range of issues related to</td>
<td></td>
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<tr>
<td>Empirical testability</td>
<td>Students frame questions and propositions in ways that enable evidence to be brought to bear on them</td>
<td>Manifest: Discourse data analyzed in terms of KF scaffold use (<em>This theory cannot explain, How can we test X?</em>)</td>
</tr>
<tr>
<td>-----------------------</td>
<td>-------------------------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td>Students voluntarily make their position vulnerable</td>
<td>Latent: Discourse data analyzed at group level (Analysis 3)</td>
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<tr>
<td></td>
<td>Students test their explanations against “received fact,” existing cognitive schema, personal experience, empirical data, contradictory testimony in literature, etc.</td>
<td></td>
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<tr>
<td>Openness/Non-sectarianism</td>
<td>Students remain open to dialogue, to dissent, to challenge, to new ideas, from outside as well as inside the group</td>
<td>Manifest: Discourse data analyzed in terms of KF scaffold use (<em>My Theory, A better theory, different opinion, IDEA ADVANCEMENT, How idea could be advanced were used to challenge ideas</em>)</td>
</tr>
<tr>
<td></td>
<td>Students modify original ideas in response to criticism</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Students do not dismiss ideas prematurely even if they disagree with them</td>
<td>Latent: Discourse data analyzed at group level (Analysis 3)</td>
</tr>
</tbody>
</table>

**Manifest Content Analysis**

The manifest content analysis in this dissertation observed the patterns of participation in the student discourse data, especially students’ use of features in Knowledge Forum such scaffolds, co-authored notes, build-ons, and hyperlinked references.

**KF scaffold use analysis.** The advantage of this analysis is that scaffolds are readily observable in transcripts as yellow brackets around segments of text in Knowledge Forum notes. However, the vulnerability in this analysis is that it assumes that scaffolds accurately reflect the discourse processes in the text. To address this problem, 56 segments of student discourse containing a scaffold support⁵ were randomly selected from the sample to check to see if a neutral observer can predict the scaffolds that students used in the database. Then, the scaffold support that the participants actually used were omitted from the text and another graduate student was asked to guess correctly the appropriate scaffold based on the discourse processes reflected in the text. Finally, percentage agreement was calculated to ensure objectivity.

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⁵ Scaffold supports bracketed or preceded segments of text, setting it apart from the rest of the note.
Analytic toolkit analysis. The Analytic Toolkit (Burtis, 2002) provided not only an overview of the students’ participation in the weekly course discussion views, but also computed numbers of co-authored notes, build-ons notes, and hyperlinked references that students contributed. The use of these features may indicate that students are meeting the common understanding commitment by collaboration, building on and referencing other students’ notes to advance their understanding and to build knowledge.

Latent Analysis

The latent analysis in this dissertation involved three separate analyses on a reduced subset of student discourse data collected in Iterations 2 and 3. The subset consisted of 407 student notes posted to four weekly discussion views in Knowledge Forum. One view from the beginning and one view from the end of the two online graduate courses were selected because they were the most likely to reveal any changes in the student discourse during each course.

Latent Analysis 1: Qualitative coding of the topic of students’ notes. The purpose of this analysis was to identify the topic of students’ notes to cluster together notes that refer to a common topic. From a knowledge building perspective, a topic might be considered the “problem of understanding” that students progressively solve through discussion. Following Bereiter (2002b), if students honor the commitment to focus on ideas as conceptual artifacts, they should discuss a concept, design, plan, problem statement, theory, or interpretation rather than topics relating to the completion of a task or material artifact (e.g., a project, report, exhibit, or presentation).

I exported the text of student notes out of Knowledge Forum into rich text files (.rtf) and imported them into NVivo 7.0 to code. I read each note several times in the context of the discussion thread in which the student posted the note. Using constant comparison (Merriam, 1998; Strauss & Corbin, 1998), I coded each note to an emergent topic or topics that it addressed. As I worked through the student discourse data, subcategories were created as I found more possibilities under each topic category. Sometimes, students addressed more than one topic within a note, so notes were coded to two or more topics.

To ensure the “trustworthiness” (Barab & Squire, 2004; Lincoln & Guba, 1985) of the findings from these analyses, I asked another doctoral student external to the study to serve as an auditor to examine my data and coding for verification (Creswell & Miller, 2000; Miller, 1997).
An auditor thus assessed the product and process to assess that the findings from this analysis were supported by the data.

**Latent Analysis 2: Quantitative coding of ideas in students’ notes.** The aim of this analysis was to examine what kinds of ideas students’ notes contained. For example, if students meet the commitment to work towards common understanding, one would expect to see students posing explanatory questions and providing explanations or theories. Similarly, if students fulfill the commitment to expand the factual base, one would expect to see facts that they accept or do not deny.

I thus analyzed the same subset of student note data, but at a finer granularity in NVivo. I segmented each note into idea units. According to Budd, Thorp, & Donohew (1969), an idea unit “conveys a single item of information extracted from a segment of content” (p. 34). Budd, Thorp, and Donohew do not distinguish between idea units and idea units. Idea units can be “a sentence (or sentence-compound), usually a summary or an abstracted sentence” (Berelson, 1952, p. 138). Because researchers have expressed concern about the subjective nature of idea units (e.g. Rourke, Anderson, Garrison, & Archer, 2001b), I calculated intercoder reliability for segmentation as well as coding following a recommendation by Strijbos, Martens, Prins, & Jochems’ (2006). The intercoder process will be discussed in the last section of this chapter.

To code the idea unit segments, I adapted a coding scheme developed by Zhang, Scardamalia, Lamon, Messina, & Reeve (2007) (see APPENDIX H) and Muukkonen, Lakkala, and Hakkarainen (2005) (see APPENDIX I). These schemes embody knowledge building and progressive inquiry frameworks consistent with this study. Adaptations addressed complex knowledge and reflective practice at the graduate level. I removed the “correctness of ideas” category, a 4-point scale for measuring misconceptions in Zhang et al. (2007) more suited for studying elementary school science; I added the “metacognitive comments” category following Muukkonen et al. (2005), as research suggests that graduate students employ metacognitive control and learning strategies for progressive discourse (Oshima & Oshima, 1999). From the data, I added the emergent categories “socio-affective connection” and “technological issues” (See Table 14). This analysis may show how students uphold the common understanding commitment by determining proportions of discourse that contains explanations. As well, it may reveal how students fulfill the commitment to expand the factual base.
<table>
<thead>
<tr>
<th>Category</th>
<th>Subcategory and defining features</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problem</td>
<td>(PF) Factual: explicit questions that can be answered by providing factual information</td>
<td>“phylogenetic” and “ontogenetic” - looked up in Webster's but still not sure, does it mean from the beginning of life (evolution) to the end?</td>
</tr>
<tr>
<td></td>
<td>(PE) Explanatory: explicit questions that can only be satisfactorily answered by elaborating on why, how, what-if, and some types of what</td>
<td><em>I need to understand</em> Why do Lave &amp; Wenger continually discuss the importance of authentic learning environments, while ignoring the topic of schools?</td>
</tr>
<tr>
<td>Own ideas</td>
<td>(OU) Unelaborated: Students’ own ideas and thoughts</td>
<td><em>Opinion</em> Technology can be an awesome resource in the class so that students can engage in activities that were otherwise not possible</td>
</tr>
<tr>
<td></td>
<td>(OE) Elaborated: Students’ own explanations for problem being investigated, or generalizations of their experiences</td>
<td>So far, in my experience I have never seen a truly &quot;authentic&quot; teaching environment. This is partially because teaching takes place in an artificial environment. I think that &quot;simulated&quot; teaching might be a better description of what is occurring in classrooms today.</td>
</tr>
<tr>
<td>Source-based ideas</td>
<td>(SU) Unelaborated: ideas that reference a specific theory or model, or to results from research without explicitly mentioning source.</td>
<td><em>Phylogenetic</em> - pertaining to 1) the evolutionary development of any species of plant or animal or 2) the historical development of a tribe or racial group. <em>Ontogenetic</em> - pertaining to the course of development of an individual organism</td>
</tr>
<tr>
<td></td>
<td>(SE) Elaborated: explanations that contain explicit reference to an article, book, or other study material on which the student based the explanation.</td>
<td><em>My theory</em> If we take &quot;on-line learning&quot; to be &quot;a community of practice&quot; in Lave &amp; Wenger terms and the members are us, the students, then as we take more and more online courses we gradually start to become core members of the community. As core members we learn the ins and outs of online learning such as jumping into the discussion early (wish I had of done that this week), html code, scaffolding etc.</td>
</tr>
<tr>
<td>Reference</td>
<td>(RS) Self</td>
<td>First, one might wish to check <em>2 Our Famous Favourite Quotations</em> [own note]</td>
</tr>
<tr>
<td></td>
<td>(RP) Peer</td>
<td>I was drawn to the following section in BB's note ¹ Trying to understand: WHAT DO WE NEED THIS IDEA FOR Or is the emphasis on improvability of our understandings whether they are stated as ideas or opinions?</td>
</tr>
<tr>
<td></td>
<td>(RI) Instructor</td>
<td>In Instructor’s note she theorizes that &quot;people might feel their work is less valued if it wasn't chosen for publication.&quot;</td>
</tr>
</tbody>
</table>
We were discussing assessment recently with a group of teachers and it was suggested that in addition to a rubric that teachers provide examples of work associated with each section of a rubric. We were discussing assessment recently with a group of teachers and it was suggested that in addition to a rubric that teachers provide examples of work associated with each section of a rubric.

<table>
<thead>
<tr>
<th>Metacognitive comments</th>
<th>Monitoring or evaluating one’s own learning process or understanding; explicit expression of generalization from one’s own experience; monitoring or evaluating advancement of the discourse; functionality of the software; explicit expression of generalization from group’s experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>I think you might have summed up what I was thinking and the discussion in these two threads (listed in order)</td>
<td></td>
</tr>
<tr>
<td>1. How much and when?</td>
<td></td>
</tr>
<tr>
<td>2. non-authentic learning</td>
<td></td>
</tr>
<tr>
<td>3. is situated thinking authentic?</td>
<td></td>
</tr>
<tr>
<td>4. learning to learn</td>
<td></td>
</tr>
<tr>
<td>5. Good Question!</td>
<td></td>
</tr>
<tr>
<td>6. an authentic classroom</td>
<td></td>
</tr>
<tr>
<td>7. Shades of authenticity</td>
<td></td>
</tr>
<tr>
<td>8. situated vs. authentic</td>
<td></td>
</tr>
<tr>
<td>9. Context and context relatedness?</td>
<td></td>
</tr>
<tr>
<td>10. &quot;Authentic&quot; and Meaningfulness</td>
<td></td>
</tr>
<tr>
<td>11. 3 types?</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Socio-Affective Connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>(SAC) Expressions of shared interest, similar experience, emotional response, etc.</td>
</tr>
<tr>
<td>Hi Kelly,</td>
</tr>
<tr>
<td>I taught music for years (JK-8) and still have a couple of piano students. Its nice to have another connection with you. :)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Technological Issues</th>
</tr>
</thead>
<tbody>
<tr>
<td>(TI) Directions, questions, and comments about technology-related issues</td>
</tr>
<tr>
<td>1. If you don’t already have one, set up an OISENET account.</td>
</tr>
<tr>
<td>2. Download and install First Class to your computer. Go to: <a href="http://fcis.oise.utoronto.ca/">http://fcis.oise.utoronto.ca/</a> and select OISENET software download</td>
</tr>
</tbody>
</table>

**Latent Analysis 3: In-depth analysis of discourse for groups of students.** The aim of this analysis was to go beyond reductive content analysis and analyze in depth episodes of group discourse to understand what is happening between individual notes and how students interpret a particular course discussion activity. This was because latent analyses 1 and 2 can tell us about the quality of student discourse that honor some of the progressive discourse commitments, but not others (improvability as a positive attribute of conceptual artifacts; empirical testability; and openness/non-sectarianism).

Using the same student discourse data as in Analyses 1 and 2, I focused this analysis on the largest cluster of student notes that coded to a particular topic category in Analysis 1. Examining a specific topic is important because, philosophically, it is difficult to explain and defend what counts as scientific progress at a general level (Bereiter, 1994; Bereiter et al., 1997).
I chronologically ordered these notes to create sequences of connected notes to see how they developed over time.

I focus on describing sequences wherein multiple students appear to honor commitments for progressive discourse and contribute to advancing the group’s understanding of a particular problem. These episodes take place over a few days, involve at least two interlocutors, and are excerpts from longer threads of discussion involving the larger online course community. The episodes interweave various topics arising from the course readings, materials, and the participants’ own experiences. Each episode is described in detail as it unfolded in situ, and considers the instructional intent, the students involved, and which progressive discourse commitment on the DFI card was honored. I also suggest why a particular episode might be progressive or stopped being so.

From a knowledge-building perspective, this group-level assessment of discourse attempts to capture the interdependent processes between the multiple students’ notes that support the development of progressive discourse. I thus attempt to use coded idea units from Analysis 2 to trace how ideas are improved, tested, and modified in response to new ideas from inside and outside of the group.

From such laborious latent analyses of knowledge building discourse, quantification of the relationships can be developed in future research. Doing so will make the labor-intensive assessment method described in this thesis more refined and thus usable to practice.

**Intercoder Reliability**

Intercoder reliability can be defined as "the extent to which independent coders evaluate a characteristic of a message or artifact and reach the same conclusion" (Lombard, Snyder-Duch, & Campanella-Bracken, 2002, p. 589). Considered the primary test of objectivity in content analysis studies, a number of indices exist to report it.

The simplest and most commonly used statistic for intercoder reliability is percent agreement. It accommodates any number of coders, but fails to account for agreement by chance. Lombard et al. (2002) thus consider this index suitable for use only with nominal variables. Indices that account for chance agreement among raters include Cohen's kappa, Scott's pi, and Krippendorff's alpha. Some researchers recommend calculating percent agreement along with another indice (De Wever, Schellens, Valcke, & Van Keer, 2006; Lombard et al., 2002). For example, De Wever, Schellens, Valcke, and Van Keer favor calculating both percent agreement...
and Krippendorff’s alpha to report intercoder reliability in quantitative content analysis studies. However, other researchers like Potter and Levine-Donnerstein (1999) argue that statistics like Cohen's kappa are overly conservative. This is because chance agreement in coding schemes with several categories may be negligible (Garrison & Anderson, 2003). Further, unlike psychological applications for which indices like Cohen’s kappa was established, distributions for the categories are not well known for the qualitative content analyses conducted for this dissertation. Therefore, percent agreement to establish intercoder reliability was deemed appropriate for this exploratory thesis.

To assess reliability formally during the coding of the full sample, it is important to use a representative sample from the full sample. All intercoder reliability calculations in the current study used more than 50 units or 10% of the full sample, as recommended by Lombard et al. (2002).

In terms of appropriate coefficients, Neuendorf (2002) reviewed norms set out by several methodologists and concluded that a “coefficient of .90 or greater would be acceptable to all be acceptable to all, .80 or greater would be acceptable in most situations, and below that, there exists disagreement” (p. 145). However Lombard et al. (2002) noted that a coefficient of .70 “is often used for exploratory research” (p. 593) and may be adequate for the current study.

**Preparing the alternate coder.** Another graduate student in the department of Curriculum, Teaching, and Learning served as the alternate coder for the latent content analysis in this project, which will be discussed in an ensuing section. First, the alternate coder learned how student notes from Knowledge Forum were parsed into segments and coded by reading detailed instructions containing examples. Second, the alternate coder practiced segmenting and coding student discourse that were not part of the actual selection used to calculate the intercoder agreement levels. Third, I reviewed the segmentation and coding with the alternate coder in person until she demonstrated a clear understanding of the coding process. We were able to achieve agreement through negotiation of differences in coding.

**Calculating intercoder reliability.** To calculate the percentage agreement, the codes assigned by the alternate coder to the and myself were entered into a spreadsheet originally designed by Waterston (2006). This spreadsheet compared the codes programmatically to calculate a percent agreement, where values range from .00 (no agreement) to 1.00 (perfect agreement). In cases where multiple codes were assigned to a single unit, the program also
calculated part marks for agreement. For example, if both coders assigned two codes to a unit and only one code matched, then that unit had fifty percent agreement, or a value of .50.
Chapter Five: Results and Discussion for Iterations 2 and 3

This chapter is organized into three main sections, with further subsections in each. The first section presents an analysis of online participation patterns in order understand what progressive discourse looks like in the student discourse data. This sets the stage to discuss the interventions that appear to foster increased levels of progressive discourse. The second section will present analyses of self-report and student discourse data sources on the DFI card intervention. The last section will discuss the analyses of self-report and student discourse data sources on the KF scaffold intervention. Together, the analyses of the quality of progressive discourse and the interventions that supported them will provide insights into the emergence of progressive discourse in online graduate courses.

1. Detecting the Emergence of Progressive Discourse Through the Analysis of Online Participation Patterns

This dissertation investigated the research question, “How can online progressive discourse be fostered among students in semester-long online graduate education courses?” To answer this question, it is helpful to know what progressive discourse looks like when it emerges and to be able to assess it in a particular CMC transcript.

Bereiter et al. (1997) identified the following characteristics as distinguishing progressive discourse from other kinds of discourse:

- A focus on understanding
- A focus on collaboration, not controversy
- A focus on student-centered social practices
- A focus on a written trace of the discussion, not some report, exhibit, or presentation

This section begins by presenting findings from the manifest analyses that observe these characteristics in the student discourse data from Iterations 2 and 3. Findings from more latent analyses of the student discourse that interpret meanings in these same data are then presented.

Results of Analytic Toolkit Analysis

Knowledge Forum’s Analytic Toolkit (Burtis, 2002) was used to provide an overview of the students’ participation in the course discussion views for Iteration 2 and Iteration 3. This

89
serves to contextualize the findings in the following sections from the knowledge building perspective. Notes written by the instructor, the teaching assistant, and visitors, as well as notes in views for course administration, technical questions, and social café, were omitted. The students’ reading, writing and linking activity in the two online graduate courses for the main study are shown in Table 15:

Table 15

Overview of Student Participation in Knowledge Forum in Two Online Graduate Courses

<table>
<thead>
<tr>
<th>Activity</th>
<th>Course 2 (n=17)</th>
<th>Course 3 (n=20)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td># Notes Created</td>
<td>62.0</td>
<td>23.89</td>
</tr>
<tr>
<td>% Notes Linked</td>
<td>80.7%</td>
<td>11.40%</td>
</tr>
<tr>
<td>% Notes Read</td>
<td>78.5%</td>
<td>19.69%</td>
</tr>
</tbody>
</table>

Table 15 indicates that the students had high rates of writing and reading in both databases. Students contributed a mean of 62 and 56.8 notes over thirteen course discussion views, which means that students created an average of 3.7 notes and 2.8 notes per week in Course 2 and Course 3. Students also read an average of 78.5% and 70.4% of their peers’ notes. Although students in Course 2 appear to have slightly higher levels of reading and writing activity, Course 3 students seem to have higher percentage of notes linked in Course 3 (91.4%) compared to Course 2 (80.7%). The next section examines in more detail what these links—build-ons and references—suggest about the emergence of progressive discourse.

1a. Extent to which Students Build on to and Reference Other Students’ Notes to Advance Their Understanding and Build Knowledge

A focus on understanding is a defining feature of progressive discourse. The extent to which students build on to each other’s notes to form “threads” or “trees” to advance understanding might provide insights into the occurrence of progressive discourse.

Researchers have noted that face-to-face discourse aimed at constructing shared understanding feature dozens of turns of talk, whereas online discussions do not (Guzdial & Carroll, 2002; Roschelle, 1992). Moreover, studies have found that online course discussions largely consist of short threads or small build-on trees. For instance, Guzdial (1997) found an
average thread length of 2.2 notes across 18 courses using online discussion. Likewise, Hewitt & Teplovs (1999) reported an average thread length of 2.69 across seven online graduate courses using an earlier version of Knowledge Forum.

This dissertation study used the Analytic Toolkit to compute frequencies of different build-on tree sizes found in the two online graduate education courses comprising the main study (see Table 16):

<table>
<thead>
<tr>
<th>Course</th>
<th>Small Build-On Tree (2-5 notes)</th>
<th>Medium Build-On Tree (6-20 notes)</th>
<th>Large Build-On Tree (21-40 notes)</th>
<th>Very large Build-On Tree (Over 40 notes)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( f )</td>
<td>( % )</td>
<td>( f )</td>
<td>( % )</td>
</tr>
<tr>
<td>Course 2</td>
<td>29</td>
<td>48%</td>
<td>16</td>
<td>27%</td>
</tr>
<tr>
<td>Course 3</td>
<td>30</td>
<td>42%</td>
<td>22</td>
<td>30%</td>
</tr>
</tbody>
</table>

As Table 16 shows, the majority of student discourse in each course involved small build-on trees comprised of two to five notes, which is consistent with thread lengths reported in the online discourse literature discussed above. Yet, larger build-on trees were also found in both courses. These larger build-on trees are promising in that they may allow more turns of talk such as found in productive face-to-face discussion and may sustain more progressive discourse.

Turning to referencing, in Knowledge Forum, students can reference other participants’ ideas in the body of their note by either inserting an automatic hyperlinked reference to other notes in the database, or by including an excerpt or paraphrase of another participant’s previous message. The Analytic Toolkit was used to analyze students’ creation of hyperlinked references in the two courses (see Table 17):
Table 17

*Frequencies of References Created in Knowledge Forum in two Online Courses*

<table>
<thead>
<tr>
<th>Course</th>
<th>View</th>
<th># References Created</th>
<th># of Students Who Created References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course 2</td>
<td>Week 3</td>
<td>38</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Week 10</td>
<td>40</td>
<td>10</td>
</tr>
<tr>
<td>Course 3</td>
<td>Week 3</td>
<td>23</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Week 10</td>
<td>8</td>
<td>7</td>
</tr>
</tbody>
</table>

This analysis found that students in Course 2 inserted more hyperlink references into their notes than students in Course 3. This manifest analysis does not account for excerpts and paraphrases of other participants’ notes that students included in their notes. A later section will present findings from Latent Analysis 2 that captures other forms of referencing that students included in their contributions.

1b. Extent to Which Students Collaborate to Co-Authored Notes

Another characteristic of progressive discourse is a focus on collaboration. One observable indicator of collaboration is the presence of co-authored notes (see Table 18).

Table 18

*Frequencies of Co-Authored Student Notes in two Online Courses*

<table>
<thead>
<tr>
<th>Course</th>
<th>View</th>
<th># Co-Authored Notes</th>
<th>% of Notes in View</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course 2</td>
<td>Week 3</td>
<td>14</td>
<td>12%</td>
</tr>
<tr>
<td></td>
<td>Week 10</td>
<td>9</td>
<td>8.1%</td>
</tr>
<tr>
<td>Course 3</td>
<td>Week 3</td>
<td>6</td>
<td>4.7%</td>
</tr>
<tr>
<td></td>
<td>Week 10</td>
<td>4</td>
<td>3.2%</td>
</tr>
</tbody>
</table>

Co-authored notes in Knowledge Forum may enhance individual and group processes when they are contributed to public spaces or views (Scardamalia, 2004). Perhaps not surprisingly, co-authored notes comprised only a small percentage of the notes in each course discussion view. In each view, the Instructor always posted a co-authored note titled “Feedback on Discussion Moderation” to encourage students to provide commentary for the discussion.
leaders. The discussion leaders’ practice was usually to co-author three discussion questions to invite participation, sometimes with additional co-authored notes to introduce an additional activity involving a supplementary technology to Knowledge Forum such as synchronous chat (e.g., Course 2 Week 3, Course 3 Week 3). These co-authored notes by discussion leaders appear to be procedural. Interestingly, the leaders also co-authored comments to give peers feedback during course discussions in one view (e.g., 6 notes in Course 2 Week 3). These notes tended to summarize the notes in a thread and set forth emergent questions, which would be helpful to bringing about progressive discourse. Co-authored notes contributed by students outside of the student discussion leader role were somewhat less common (e.g., 3 notes in Course 2 Week 3, 2 notes in Course 2 Week 10). In Course 2, these included transcripts of synchronous chats conducted using FirstClass and Skype, as well as setting forth an agenda to understand what the chats might be good for. None of the co-authored notes in Course 3 were by students outside of their discussion leadership role.

One possibility is that students did not take advantage of the co-authoring feature in Knowledge Forum because they were unfamiliar with it; other commonly used asynchronous conferencing environments such as Blackboard™ do not offer this feature. Another possibility may be that the students were not directly instructed to use this feature to enhance collaborative discourse. Co-authoring may have also exceeded student interpretations of course requirements for participation in Knowledge Forum. Previous research on online behavior suggests that students typically develop habits and behaviors that are effective in fulfilling course requirements but are less conducive for learning (Hewitt, 2005; Peters, 2005).

In contrast, wikis emphasize collaboration and co-construction. Preliminary studies (e.g., Hewitt & Peters, 2006) suggest that wikis can be used to support knowledge building in graduate course contexts, and that engagement in the wiki activity might promote high-level cognitive processes as students carried out deeper investigations.

1c. Extent to Which Students Exhibit Independence From the Instructor

The instructor or facilitator can play a central role in keeping threaded discussion on topic (Berge, 1995; Davie, 1989). By constraining the number of online discussions and drawing attention to important discussions that are faltering, for example, instructors may be able to reduce the likelihood that these threads will “die” accidentally (Hewitt, 2005). However,
following a knowledge-building pedagogy, it is crucial to foster student independence from the instructor by turning responsibility for cognitive work over to the students.

Visualizations of Course 2 discourse data were generated using Ruby on Rails and JavaScript code “to pull information from the Knowledge Forum 4.6 tuplebase format and insert it into mainstream MySQL databases” (Teplovs, 2006). Figure 5 below shows a visualization of Knowledge Forum activity for Course 2, week 3.

**Figure 5.** Visualization of Course 2, Week 3 discussion view activity.

In this figure, the vertical axis labels are pseudonyms of Iteration 2 participants. The horizontal axis is time, increasing to the right. The red bars to the right of the pseudonyms represent the total number of notes contributed by a participant. The black-outlined rectangles represent single notes. The green lines connecting the rectangles are build-on links; the red lines indicate the references; and the blue lines represent annotations. This visualization does display the rich interconnected quality of the discourse that was taking place in this view, but does not necessarily make progressive discourse apparent.

Further visualizations of Course 2 discussion data generated seem to illustrate the discussion patterns that unfolded in Course 2. Figure 6 focuses on the build-on note pattern between the participants’ notes:
Figure 6. Visualization of Course 2, Week 3 discussion build-on activity.

The green connecting lines indicate build-on notes in Course 2, Week 3. The circles represent participants, identified by the first initial of the participant’s pseudonym. For participants with the same first letter name, the first three letters of the pseudonym are shown. This is consistent with previous research that has identified similar student-centered patterns of interaction (Hara et al., 2000; Lipponen et al., 2003; Schrire, 2006).

It may be useful to compare Figure 6 illustrating a student-centered interaction pattern with Figure 7 displaying an instructor-centered interaction pattern. In Figure 7, the students build-on to the instructor’s note, and do not reference each other’s notes as much. The green lines indicating build-on notes in Figure 8 emanate out from the Instructor in a unilateral or monologic type of interaction.
Teacher discourse style can significantly affect the level and quality of student participation and interaction in computer-mediated discussions (e.g. Ahern, Peck, & Laycock, 1992; Howell-Richardson & Mellar, 1996). Ahern et al. found that teacher questioning fosters more referenced interaction than a conversational group, but that a statement-only group provides quadruple the number of peer-peer interactions. They thus recommended a more whole-group approach, arguing that peer-peer interactions should not be seen as noise in the instructional context, but essential to the cognitive development of the students. Similarly, Howell-Richardson and Mellar examined moderator styles and reported that a more conversational style was associated with more group-oriented rather than task-oriented messages and greater inter-message references.

In the current study, I focused on analyzing student-centered discourse rather than instructor-centered discourse for the following reasons. First, the instructor possessed extensive background knowledge of the technology, pedagogy, and content in contrast to the students. Though the effect of the difference in power and status between the instructor and students is important, it was not the primary focus of this exploratory study on characterizing progressive discourse. Second, the instructor’s instructional goal was to remove impediments to progressive
discourse. Consistent with the knowledge-building pedagogical approach, the instructor chose not to assume cognitive responsibility for the students’ learning and made an effort to endorse a “Teacher C model” that turned the strategic cognitive activity over to the students (Bereiter & Scardamalia, 1987a; Scardamalia, 2002). Third, quantitative indicators of participation showed that the Instructor and teaching assistant (TA) were participants in the fully online context, but did not dominate the discussion. In Course 2, the instructor and TA accounted for 13.4% of the total notes contributed to the database in the selected views; in Course 3, the instructor and TA accounted for 11.6% of the total notes contributed to the database in the selected views.

1d. Extent to Which Students Engage in Discourse Versus Completion of a Task

Defining the purpose of the group in terms of a task necessarily “implies something that must be or can be completed” (Woodruff & Brett, 1999, p. 281). Defining the purpose of the group in terms of learning is more productive for knowledge building, when students consider ideas as conceptual artifacts that can be continually improved through discourse to deepen understanding. To understand whether students focused on discourse versus completion of a task, a more latent analysis of the discourse was conducted.

Results of Latent Analysis 1: Qualitative Coding of the Topic of Students’ Notes

As described in the methods chapter, this analysis examined a reduced sample of 407 student notes in two weekly discussion views. Views were selected from the beginning and end of the two online graduate courses, in order to reveal any changes in the discourse that might emerge during the course. Through qualitative coding, six categories of topics and 39 different subcategories emerged from the data (see Table 19). Note that coding notes to multiple subcategories resulted in 603 coded notes that exceeds the sample of 465 notes.
Table 19

*Description and Frequencies of Topic Categories of Students’ Notes*

<table>
<thead>
<tr>
<th>Topic Category</th>
<th>Subcategory and Description</th>
<th>Number of Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Different CMC Environments</strong></td>
<td><strong>CMC</strong> - notes relating to both synchronous and asynchronous computer-mediated communication (CMC) environments.</td>
<td>79</td>
</tr>
<tr>
<td></td>
<td><strong>Asynchronous CMC</strong> - notes relating to CMC environments in which there is no time requirement. These notes are mainly concerned with text-based threaded discourse interaction in computer conferencing systems (e.g., Knowledge Forum).</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td><strong>Synchronous CMC</strong> – notes relating to real-time CMC. These notes are mainly concerned with text-based chat tools (e.g., MSN, FirstClass chat), but may also refer to audio and video conferencing media (e.g., Skype, Breeze).</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td><strong>MOO</strong> – notes relating to multi-user environments and variants (e.g., MUD, MUVE, MMOG) that may combine both asynchronous and synchronous components.</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td><strong>Breeze</strong> – notes relating to Macromedia Breeze, a combination web-conferencing environment featuring presentation, whiteboard, video, chat, etc.</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td><strong>Skype</strong> – notes relating to Skype, an internet audio and video-conferencing system.</td>
<td>7</td>
</tr>
<tr>
<td><strong>Course readings and materials</strong></td>
<td><strong>Scaffolding in open-ended learning environments</strong> – notes relating to Land (2000), which was one of the readings for Course 2, week 3.</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td><strong>Belief vs. design mode</strong> – notes relating to modes of thinking Bereiter and Scardamalia (2003), which was one of the readings for Course 2, week 10.</td>
<td>41</td>
</tr>
<tr>
<td></td>
<td><strong>Design principles</strong> – notes relating to design principles in support of knowledge building processes as discussed in Hewitt and Scardamalia (1998), which was one of the readings for Course 2, week 10.</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td><strong>Faces of constructivism</strong> – notes relating to Phillips (1995), which was one of the readings for Course 3, week 3.</td>
<td>16</td>
</tr>
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<td></td>
<td><strong>Building vs. borrowing knowledge</strong> – notes relating to Schwartz &amp; Fischer (2003), which was one of the readings for Course 3, week 3.</td>
<td>31</td>
</tr>
<tr>
<td></td>
<td><strong>Metacognition</strong> - notes relating to Hacker (1998), which was one of the readings for Course 3, week 3.</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td><strong>Multiple intelligences</strong> – notes relating to video of OISE experts presenting a range of opinions on Gardner’s multiple intelligences theory, which was part of the course materials for Course 3, week 3.</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td><strong>Learning Journals</strong> – notes relating to a powerpoint presentation, which was part of the course materials for Course 2, week 10.</td>
<td>2</td>
</tr>
<tr>
<td><strong>Knowledge building</strong></td>
<td><strong>Idea improvement</strong> - notes relating to the knowledge building principle of idea improvement that considers ideas to be conceptual artifacts that may be improved rather than static facts.</td>
<td>16</td>
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<tr>
<td></td>
<td><strong>KB classrooms</strong> – notes relating to knowledge building classroom settings, especially Sharon’s elementary school classroom in which students used Knowledge Forum to discuss problems such as global warming.</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td><strong>KF scaffolds</strong> - notes relating to Knowledge Forum’s scaffold and scaffold support features</td>
<td>20</td>
</tr>
<tr>
<td><strong>Management of course discussion activities and rejection of experiences</strong></td>
<td><strong>Chat agenda</strong> - notes relating to setting an agenda for a synchronous chat as part of course discussion activities organized by the student discussion leaders.</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td><strong>Chat experience</strong> - notes relating to reflections on a chat with classmate(s) as part of course discussion activities organized by the student discussion leaders.</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td><strong>Chat scheduling</strong> - notes relating to the scheduling of synchronous chats with other classmates as part of course discussion activities organized by the student discussion leaders. These notes included contact information and preferred times.</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td><strong>Chat transcript</strong> - notes relating to both the use of chat transcripts to mediate learning in asynchronous CMC environments and the attachment of actual chat transcripts in which the students participated.</td>
<td>12</td>
</tr>
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<td></td>
<td><strong>Emotions</strong> – notes relating to the expression of feelings in different CMC environments; for example, constraints that asynchronous text-based CMC has for conveying an author’s intended emotion to readers because of the lack of non-verbal cues.</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td><strong>Emoticons</strong> – notes relating to the use of emoticons, a group of keyboard characters typically represents a facial expression or emotion, to express feelings in text-based CMC.</td>
<td>3</td>
</tr>
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<td></td>
<td><strong>Avatars, aliases</strong> – notes relating to the use of an electronic image or pseudonym to represent a participant in CMC. For example, students may construct avatars that represent their unique identities in multi-player gaming environments, or use an alias that may provide some anonymity online.</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td><strong>Analytic Toolkit</strong> – notes relating to quantitative indicators of participation in to Knowledge Forum that students in Course 2 were able to access.</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td><strong>Assessment</strong> – notes relating to assessment and evaluation of student learning in an individual course, across the program, e-portfolios, etc.</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td><strong>Teaching online</strong> – notes relating to practical teaching tips and tricks in mostly asynchronous CMC environments.</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td><strong>Contributing by writing notes in Knowledge Forum (KF)</strong> - notes relating to participating in online discourse by contributing a written note in an</td>
<td>8</td>
</tr>
</tbody>
</table>
asynchronous forum.

**Contributing beyond writing notes in KF** – notes relating to the participating in an online course beyond contributing a written note; for e.g., reading other students’ notes, reading relevant literature, and developing ideas via email.

**Motivation** – notes relating to the drive or incentives that influence student participation in asynchronous CMC course environments, one of the course discussion questions posed by the student discussion leaders in Course 3, week 10.

**Students’ motivation for participation** - notes relating to the student’s goal orientations for learning in asynchronous CMC environments, with a focus on intrinsic motivation, as part of the course discussion questions posed by the student discussion leaders in Course 3, week 10.

**Instructor’s expectations for participation** – notes relating to the students’ goal orientations for participating in asynchronous CMC environments, with a focus on extrinsic motivation as part of the course discussion questions posed by the student discussion leaders in Course 3, week 10.

**Community building** - notes relating to creating a positive online course climate that is respectful of individuals’ different interests. These notes may involve interpersonal communication via non-verbal communication channels such as facial expressions, and body language that promote feelings of trust and safety. Students in the main study (Course 2 and 3) had opportunities to share bios and collaborate in group activities and assignments.

**Community empowerment** – notes relating to creating an online course climate that is inclusive of students’ individual differences, e.g., learning disabilities, language learners, etc.

**Community in the workplace** – notes relating to sharing descriptions of the community, or the lack of a community atmosphere, in the participants’ workplace context. These contexts included K-12 classrooms, school board offices, post-secondary education departments in colleges and universities, hospitals, corporate settings, and government offices.

**Teaching practice**

**Constructivist teaching** - notes relating to constructivist pedagogical strategies used by participants in their workplace contexts such as problem-based learning approaches in medical education.

**Equity issues** – notes relating to issues of addressing the needs of diverse students in online teaching and learning. These notes discussed implications of online learning for people with a language barrier or people with disability, e.g., visual impairments, learning disabilities.

**Access to ICTs in schools** – notes relating to the availability or lack of availability of internet communication technologies for teaching and learning in K-12 classroom contexts.

**Professional development** – notes relating to workshops, working meetings, and conferences for teachers’ professional development outside of coursework.

**Total** 603
Some topics in Table 18 are oriented more towards completion of tasks rather than discourse. These tended to fall under the category “Management of course discussion activities and rejection of experience.” For example, the subcategory “Chat scheduling” involved 40 notes. These notes were usually quite short, and often contained only contact information and times that a student was available. The notes were about complying with the student discussion leader’s request for students to schedule chats with their peers during that week.

Other subtopics dealt with course administration issues. For instance, students appeared to be anxious about grading and requested the instructor to clarify what counted towards their participation grade (e.g., Contributing by writing notes in Knowledge Forum, Contributing beyond writing notes in Knowledge Forum, Assessment, Analytic Toolkit). These notes seem to be more about achieving high grades in the course rather than about focusing on ideas as conceptual artifacts.

While not necessarily oriented towards tasks, a subcategory such as “Emotions” suggests that some students rejected the course theme to engage in progressive discourse and preferred to express feelings and establish rapport with their peers. In notes coded to topics such as “Community” and “Teaching Practice,” students also tended to write commentaries about the course climate or describe how the course concepts related to their own teaching practice. Notes coding to these topics may have enriched the students’ course experience, but did not show evidence of progressive discourse.

Fortunately, some topic categories showed some evidence of progressive discourse. These topics focused on conceptual artifacts: designs (Different CMC Environments), concepts (Course readings and materials), and theory (Knowledge Building). For instance, in the largest cluster of 79 notes coded to the topic “Different CMC Environments,” students developed from writing short, superficial notes sharing personal opinions or listing attributes of CMC environments, to contributing longer, reflective notes considering designs of various CMC environments. They also used the DFI cards and KF scaffolds to build on to peers’ ideas in a respectful and collaborative manner.

**Results of Latent Analysis 2: Quantitative Coding of Ideas in Students’ Notes**

This analysis examined what kinds of ideas students’ notes contained in Iteration 2 and Iteration 3. Finding out what proportion of the students’ ideas were coded as explanations versus facts is important scientifically because progress occurs when a new theory explains more facts
than an older one. This analysis thus investigates whether students are meeting the common understanding and expansion commitments to progressive discourse. The intercoder reliability was .88 for the segmentation and .83 for the coding, which are acceptable for this exploratory study. In total 1107 ideas were coded: 569 ideas in Course 2 and 539 ideas in Course 3.

In Course 2, the highest proportion of ideas coded to references (27.4%). Of the total number of ideas produced in the course, own ideas presented 20.7%, problems presented 13.9%, source-based ideas presented 12.8%, socio-affective connections 12.1%, metacognitive comments presented 10.4% and technological issues presented 2.6%.

In Course 3, own ideas (29.4%) formed the highest proportion of ideas. Socio-affective connections presented 18.8%, references presented 18.4%, source-based ideas again presented 12.8%, problems presented 9.9%, metacognitive comments presented 9.1%, and technical issues presented 1.7% of the total ideas produced in the course.

Figure 8 summarizes the relative proportions of ideas categories for each Iteration. Note that the following abbreviations are used: Problem (P), Own Ideas (OI), Source-Based Ideas (SBI), References (R), Metacognitive Comments (MC), Socio-Affective Connection (SAC), and Technical Issues (TI).

![Figure 8: Relative proportion of categories of idea units in Course 2 and Course 3](image-url)
This analysis found that Course 2 students referenced other students’ notes more than students in Course 3 to advance understanding, consistent with the findings for the manifest analysis of the number of hyperlink references that students inserted in section 1b. References here included quoting: a portion of another student’s note (Referencing Peer); an authoritative source (Referencing Source); or the Instructor (Referencing Instructor) as well as inserting a hyperlinked reference to another note, view, or website URL. These references move beyond expressions of socio-affective connections and acknowledge socio-cognitive contributions (c.f. Laferrière & Allaire, 2006). When students cite other students’ ideas rather than copying and claiming them as their own they create a “richly connected hypertext document”(Scardamalia, 2002) suggesting collaborative effort.

Similar to findings in Muukkonen’s (2005) research, this study also found that students in both courses presented more of their own ideas than source-based ideas. Mapped to Bereiter’s (2002b) commitments, this suggests that students honor the commitment to work together towards common understanding by providing their own explanations more than they honor the commitment to expand the factual base by incorporating new facts from authoritative sources into the discussion. Also supporting this result is the finding that the majority of problems (questions) that students in Course 2 (87.3%) and Course 3 (75.5%) presented were explanatory, rather than factual.

In knowledge building, students identify a problem of understanding and pose “wonderment questions” to explore them through progressive discourse (Scardamalia & Bereiter, 1991). In so doing, they set forth their own ideas and negotiated a fit between personal and others’ ideas, exercising epistemic agency to build knowledge (Scardamalia, 2002). The findings of Analysis 2 suggest that the online graduate students in this study posed explanatory questions to explore ideas and presented their own ideas in reference to their peers’ ideas, but integrated less source-based ideas from authoritative sources to expand the base of facts. This may occur because expert students like graduate students develop metacognitive control strategies (Oshima & Oshima, 2002). However, metacognitive comments presented only a small proportion of ideas in both Course 2 (10.4%) and Course 3 (9.1%).

Previous research suggests that threaded discourse in online courses often involve divergent processes rather than convergent ones conducive to deepening conceptual understanding (Hewitt, 2001). Students may contribute their own ideas, but integrating these
ideas with those from peer-reviewed research in sources would promote more progressive discourse. Content analysis studies have also revealed “topic drift” (Fahy, Crawford, & Ally, 2001) in threaded discourse, an impediment to realizing progressive discourse on a particular problem. Latent Analysis 2 is a content analysis of ideas in students’ notes. As it is a reductive analysis, other analyses may be needed to understand the structure and dynamics of progressive discourse (Bereiter, 2002b; Stahl, 2002; van Aalst & Hill, 2006). This study thus developed an in-depth analysis of discourse for groups to trace the interdependent individual contributions to group discourse. These sequences of multiple students’ notes will be described using the theme categories from content analysis discussed here. This analysis will be presented in each of the later instructional scaffolding sections.

In light of the literature and the findings from manifest and latent analyses of student discourse presented here, it was evident that detecting emergence of progressive discourse through the analysis of online participation patterns from the two online graduate courses is challenging. We next turn to discuss the two forms of instructional scaffolding that appeared to be effective in supporting the development of progressive discourse, and present findings from the in-depth analysis of discourse for groups of students that was developed.

2. How the Discourse for Inquiry (DFI) Card Intervention Affected Student Discourse

This section presents analyses of students’ self-report and online discourse data to understand how making explicit the normally tacit commitments to progressive discourse using the Discourse for Inquiry (DFI) cards affected individual students’ contributions to advancing the group discourse online. The Researcher encouraged the students to print out and refer to the cards while writing notes, but the use of the cards was not required. Students could choose to disregard the DFI cards if they did not seem useful in mediating their group discourse online. Analyses of students’ self-reports data from learning journals, weblogs, questionnaire and responses will be compared with analyses of the students’ discourse to triangulate and provide some “trustworthiness” to the results (Barab & Squire, 2004)

From the design researcher and instructor perspectives, we wanted to use the DFI cards to create a new culture or social infrastructure in the computer conferencing environment that would support progressive discourse. Describing the knowledge building principle of improvable ideas as key to understanding progressive discourse, Scardamalia (2002) states that for students to work continuously to improve the quality, coherence, and utility of ideas through discourse,
“the culture must be one of psychological safety, so that people feel safe in taking risks—
revealing ignorance, voicing half-baked notions, giving and receiving criticism” (p. 78).
Likewise, social infrastructure refers to the supporting social structures that enable the desired interaction to take place among participants in a computer-supported collaborative learning environment (Bielaczyc, 2001, 2006).

Although Knowledge Forum offers much advanced software-based scaffolding, we were interested in exploring the social layer of scaffolding among peers. We knew that graduate students, being expert learners, are significantly more likely to engage in progressive discourse than undergraduate students who are novices (Oshima & Oshima, 1999). However, we also knew that goals the for discourse are less clear online (Nussbaum, 2005; Oshima & Oshima, 2002). The literature also shows that students are often reluctant to disagree or debate with each other online (e.g., Curtis & Lawson, 2001; Marttunen, 1997). Thus, emphasizing the goal for the students to remain open to new ideas and to challenge each other’s ideas in respectful ways might be useful. Online and distance education researchers highlight the need for instructors to structure online discussions in this way (e.g., Pawan et al., 2003; Ertmer et al., 2007; Rourke & Kanuka, 2007). Thus we employed the DFI cards to make explicit Bereiter (2002b)’s commitments for progressive discourse from the beginning of each course.

We anticipated that the DFI cards would be most effective when introduced at the beginning of the course to newer online learners and less advanced graduate students. Expectations for participation are set at the beginning of a course. Students taking their first online course, or students with less online learning experience, have not yet developed an online repertoire. Master’s students, particularly K-12 teachers in the professional master’s program (M.Ed.) who have less research experience, might benefit from supports for progressive discourse more than doctoral students already accustomed to progressive discourse that moves beyond sharing and comparing of information (Gunawardena et al., 1997) and social interchange (Kanuka & Anderson, 1998) to co-construction of knowledge.

2a. Extent to Which Students Perceived the DFI Cards to be Useful

In learning journals (Course 2) and weblogs (Course 3), students were asked to respond to a question about the extent they used DFI cards in interacting with classmates in Knowledge Forum, and the role DFI cards played in giving and receiving feedback:
To what extent do you use the DFI cards in interacting with classmates? If you don’t use them, what is your reasoning? (Course 2, week 4)

What role have the DFI cards played in terms of giving/getting feedback? (Course 3, week 9)

Accordingly, the student responses to these questions will be discussed in the context of each course.

Course 2 Student Self-Reports on DFI Cards in Learning Journals

In Course 2, students were provided with four DFI cards: Managing Meetings, Managing Group Discourse, Managing Problem Finding, and Managing Problem Solving. All 17 students in Course 2 responded in their learning journals regarding the extent to which they used the DFI cards in interacting with their peers.

Promisingly, 82% of students in Course 2 acknowledged some value in the concepts and strategies on the DFI cards. Yet only 18% of the students reported that they were actively using the cards during week 4. Two of these three students were new master’s students who were taking their very first online course. These students used the cards to develop their own online communication style, monitor the progression of group discourse, and assess their role in advancing the group discourse:

My interest in communication dynamics is strong and therefore I find the DFI cards interesting for the purpose of managing communication and ensuring “a step forward in an ongoing process of inquiry,” always if possible. In the context of DFI cards, I have also questioned myself after writing a note accentuating the negative, “Maybe I should’ve said it differently” and expecting the worst, “is my contribution in tune with others,” this week. I am confident that these perceptions will change however, with more time and experience in the KF learning context. I am also perceptive to and interested to see evidence of how others are incorporating the cards; the language that is being used in the progression of discussion. I have definitely seen evidence of it this week with other classmates. (Maria, M.A. Student, Course 2, Week 4)
I feel that I have used some of them in my interaction with classmates in the course so far. For example, I have looked for good ideas, showed appreciation, and acknowledged others’ contributions. I have tried to focus on good ideas rather than attacking bad ones. However, upon reflection, perhaps I have not tried to encourage others to disagree with me or respond to my postings. And I usually don’t have enough evidence to support my positions in my postings so far. I have not hypothesized alternative stances either. Clearly, the DFI cards would help deepen the learning and the insights of the postings and perhaps should be used more often when I post messages. (Evelyn, M.A. Student, Course 2, Week 4)

A further 33% of students in Course 2 suggested that they intended to use the cards in the remaining weeks of the course. These students described printing out the DFI cards in week 4, and keeping them visible by their computer for future reference. Three of these five students chose to write unsolicited learning journal entries detailing their use of the DFI cards. For example, Yvonne reported not using the DFI cards in week 4, but wrote earlier in week 1 of having turned to the card *Managing Meetings* card to help her overcome anxiety about posting notes in Knowledge Forum. Later, in week 8, Yvonne describes her discomfort with giving critical feedback:

In terms of opposing a classmate’s idea, I am as uncomfortable in this role in person, as I am online. Perhaps this is because in my mind, the distinction between person and idea is still blurred, so I tend to avoid confrontation – I recognize that my choice of the words “confrontation” here adds to the negative connotation making me even less likely to engage in such an activity…oh the power of words! Although I know the DFI cards present some useful phrasing for voicing opposing viewpoints. (Yvonne, M.Ed. Student, Course 2, Week 8)

In this learning journal entry, Yvonne expresses discomfort with opposing her peers’ ideas both face-to-face and online, but identifies DFI cards as presenting useful phrases for challenging peers’ ideas in a critical yet constructive way. Yvonne’s discourse changes to
incorporate challenges in the following weeks, and will be examined in the section on student discourse.

Another student who chose to take advantage of the DFI cards is Chloe. Chloe showed the most change in the quality of her participation. In her learning journal, Chloe reveals changes she made in her interactions with peers, including how she stopped addressing notes to particular peers to better encourage comments from other peers, and how she began to use the DFI cards to advance beyond sharing of information and to work towards knowledge building:

I have the “Discourse for Inquiry” cards in front of me at all times and I am really trying to incorporate them into my contributions but I fear I am falling short. I asked Adam if he used them during one of our discussions and he said no as the concepts are so ingrained into him that he doesn’t need them any longer. I can only hope that one day I can say the same thing but right now I need them and would be happy even to get to the point where I can say that I am contributing to knowledge building and the advancement of knowledge instead of just knowledge sharing. (Chloe, M.Ed. Student, Course 2, Week 7)

In this excerpt, Chloe describes her persistence in trying to incorporate the DFI cards into online contributions. Admittedly Chloe’s close collaboration on course activities and assignments with Adam, who has already internalized the progressive discourse commitments embodied on the DFI cards, scaffolds Chloe to work towards knowledge building goals. Yet, it is also clear that Chloe persists in using the DFI cards to scaffold her own participation until she no longer needs them.

On the other hand, 18% of students in Course 2 reported not using the DFI cards. One explanation for this may be that these cards were more useful towards the beginning of the course, and by week 4 were no longer needed. As one student explained,

I have not used the DFI cards since the first week. I felt I needed them to guide and prod me in developing some notes. Once I got rolling with WebKF, I responded in a more natural and intuitive way. (Dylan, M.Ed. Student, Course 2, Week 4)
Another explanation may be that students with extensive online learning and graduate education experience no longer needed the kind of scaffolding the cards provided. For example, both Adam and Laurel had already completed six online graduate courses before this one:

I do not use them. I would have probably used them a year ago, but this is already my 7th (8th?.. 9th?..) online KF course and I believe I have already developed my own online communication style. (Adam, M.A. Student, Course 2, Week 4)

The Managing Group Discourse cards are relevant…but are often natural responses to online environment…especially if you have been involved in a few courses…definitely something I would have benefited more from as a first-time online student (before I had become ingrained with all my online bad-habits). (Laurel, Ed.D. student, Course 2, week 4; ellipses added)

As the excerpts from learning journals by Adam and Laurel illustrate, experienced online learners chose not to use the DFI because they had already established an online communication style. Chloe’s earlier entry referred to the good habits from the DFI cards concepts as being already “ingrained” into Adam so that he no longer needed them to engage in progressive discourse. In contrast, using the same adjective, Laurel suggests that she has become “ingrained” with bad habits. Although Laurel does not explain this term, her usage is suggestive of firm-rooted online student practices that can enable students to navigate through threaded discussion environments efficiently, but do not promote learning (see for e.g. Hewitt, 2005).

For experienced online learners, the Managing Group Discourse and Managing Meetings DFI cards thus provided basic strategies for online interaction. For these learners, the most beneficial card appeared to be the Managing Problem Finding and Managing Problem Solving cards most relevant to progressive discourse:

The DFI cards I feel I can benefit from the most are the Managing Problem Finding/Solving cards. These cards are particularly important to the development
of Knowledge and progressive discourse in an online community. (Laurel, Ed.D.
student, Course 2, week 4)

While it was hoped that the DFI cards would help M.Ed. students who were in-service
teachers to engage in progressive discourse, none of the students who reported using the cards in
week 4 were teachers in the K-12 system. Instead, they were corporate trainers, educational
technology consultants, or post-secondary instructors.

One possible explanation is that the norms for progressive discourse outlined on the DFI
cards may be very different from and more formal than those that exist in the culture of teaching.
The DFI cards, especially the Managing Problem Solving card, promoted a culture of scientific
research that encouraged students to work together to improve the quality, coherence, and utility
of ideas. This card thus outlined strategies and self-questions to help students engage in
collaborative problem solving. In contrast, a “norm of noninterference” exists in the culture of
teaching, where “shared problem solving rarely occurs and teachers are expected to work things
out on their own” (Feiman-Nemser & Floden, 1986, p. 506). Therefore, norms on the DFI cards
for collaboration and problem solving may be largely unfamiliar to in-service teachers and may
be more familiar to students working in real-world knowledge-based organizations and post-
secondary contexts.

In summary, for Course 2, the findings from analyzing the learning journal data
supported the expectation that students would perceive the DFI cards to be most useful at the
beginning of the course, and that newer online learners and newer graduate students would find
them most useful. The analyses also suggested that the most beneficial card for progressive
discourse was the problem-solving DFI card. Against our expectations, professional master’s
students who were K-12 teachers were the least likely to perceive the DFI cards as helpful for
interacting with their peers and to report using them. As the teachers’ peer culture in elementary
and secondary schools have very different and much more informal norms, these participants
may have found the norms emphasized in the DFI cards too constraining and formal.

Course 3 Student Self-Reports in Weblogs and Questionnaires on DFI Cards

Weblogs. Only 6 of the 20 students in Course 3 wrote a response in their weblogs to the
week 9 reflection question, “What role have the DFI cards played in terms of giving/getting
feedback and also for seeing theories as useful for problem solving?” There may be several
reasons for the low response rate of 30%. One reason may be that students were asked to reflect on their course experiences so far, not just on the DFI cards. Another may be that the question was posed towards the end of the course rather than the beginning of the course, when Course 2 students indicated the DFI cards were most useful. Further, Course 3 was comprised of more experienced online learners than Course 2. Fifty-five percent of Course 3 students were experienced online learners who had taken four or more online courses, compared with 35% of Course 2 students. As experienced online learners, students in Course 3 may not have needed the support of the DFI cards to give and get feedback from their peers, particularly towards the end of the course. Furthermore, the question did not target the problem finding and problem-solving card that students in Course 2 had indicated previously as being most relevant to progressive discourse, particularly for experience online learners. Admittedly, then, there were methodological problems in the way the question was posed that may have contributed to the low response rate. To compensate, questionnaire data were also collected and will be discussed following presentation of the weblog data.

All six students who commented in their weblogs about DFI cards were experienced online learners. The respondents included two K-12 teachers, two corporate trainers, one educational technology consultant, and one health care professional. In general, the reflections on the DFI cards were short and shallow, but representative of weblog entries written in response to the weekly reflection questions in this course (see also Freeman, 2008).

Similarly to Course 2, 33% of respondents stated that the DFI cards covered important concepts, but did not use them:

I have to confess that I haven’t referred to the DFI cards since the very beginning of the course and will have to go back and revisit them. I remember thinking at the time that they were well done and that they reminded me of “job aides” or “quick references” I’d seen in the corporate world. (Brian, M.Ed. Student, Course 3, Week 9)

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6 Course 3 students were prompted to elaborate on what they found most challenging and most supportive of their learning in the preceding nine weeks with example questions: What role did the DFI cards play in giving and getting feedback? How working individually versus in a group affects their motivation and learning? What ideas or theories that they found most challenging and why?
Another 33% of respondents reported having reduced their use of the DFI cards. Chloe, who came to use the DFI cards following Course 2, week 4, writes:

I haven’t been using the DFI cards this semester although they are still pinned to the bulletin board beside my computer. I used them religiously last semester and I don’t think that I need them any longer, although I could be wrong…(Chloe, M.Ed. Student, Course 3, Week 9)

Interestingly, a final 33% of respondents suggested that they referred to the DFI cards occasionally, albeit less towards the end of the course. For example,

I reflect on the cards every now and then. I have to admit that I was more conscious about using the cards at the beginning of the term when I was contributing to the discussions. I don’t think about the cards as much (I don’t know if this is necessarily a good thing!) (Sue, Course 3, week 9)

**Questionnaires.** Given the small number of weblog responses about DFI cards in Course 3, questions to solicit more information on students’ perceptions about the cards were added to the post-course questionnaire (Fujita & Freeman, 2005).

Out of 20 Course 3 students, 16 completed the post-course questionnaire (response rate 80%). All responded to the following statements on the DFI cards using the 5-point scale of “strongly disagree,” “disagree,” “uncertain,” “agree,” and “strongly agree.” The responses to these questionnaire items are presented in Table 20:
Table 20
Distribution of Student Responses to the DFI Cards Items in Course 3 Post-Course Questionnaire

<table>
<thead>
<tr>
<th>Questionnaire Item</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Uncertain</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>DFI cards provided helpful strategies for giving constructive peer feedback (questionnaire item 10)</td>
<td>6%</td>
<td>13%</td>
<td>56%</td>
<td>19%</td>
<td>6%</td>
</tr>
<tr>
<td>DFI cards provided helpful strategies for problem finding (questionnaire item 11)</td>
<td>6%</td>
<td>13%</td>
<td>56%</td>
<td>25%</td>
<td>0%</td>
</tr>
<tr>
<td>DFI cards provided helpful strategies for problem solving (questionnaire item 12)</td>
<td>6%</td>
<td>13%</td>
<td>50%</td>
<td>31%</td>
<td>0%</td>
</tr>
<tr>
<td>DFI cards were helpful for my learning (questionnaire item 13)</td>
<td>6%</td>
<td>25%</td>
<td>38%</td>
<td>31%</td>
<td>0%</td>
</tr>
</tbody>
</table>

More than half (56%) of students were uncertain about whether the DFI cards provided helpful strategies for constructive feedback (questionnaire item 10); however responses were slightly more positive than negative: 19% agreed and 6% strongly agreed. Comparison of these findings with responses on two related items—questionnaire items 8 and 9 not included—clearly show that the instructor had the most influence followed by the student discussion leaders, on encouraging constructive peer feedback. To the statement, “The instructor encourages constructive peer feedback in Knowledge Forum conference” (questionnaire item 8), 75% of respondents agreed and 6% strongly agreed with the statement. To the statement, “The student moderators encourage peer feedback in Knowledge Forum conference” (questionnaire item 9), 47% of respondents agreed and 13% strongly agreed.

In terms of DFI cards providing helpful strategies for problem finding, again 56% of students were uncertain, though there were slightly more positive responses than negative ones: 25% agreed whereas 13% disagreed and 6% strongly disagreed.
With regard to DFI cards providing strategies for problem solving, though 50% of students still remained uncertain, the responses were more positive than negative: 31% agreed. Course 3 students thus indicated the most positive responses for the problem-solving DFI card. This finding is consistent with comments in Course 2 students learning journals.

However, only 31% of Course 3 students perceived the set of DFI cards as being helpful for their learning on the questionnaire. This may be due to the fact that Course 3 students who expressed the most positive perceptions about the DFI cards on the questionnaire were the same students who commented positively on the role that DFI cards played in giving and getting peer feedback in their weblogs. Interestingly, the only K-12 teacher who expressed positive perceptions about the DFI cards on the questionnaire was a knowledge-building teacher at an inner-city elementary school. The other K-12 teacher, a science teacher who wrote in her weblog that DFI cards were “very helpful with respect to focusing my ideas,” was not able to complete the questionnaire due to family reasons.

To understand why the DFI cards seemed to be more helpful for students in Course 2 than in Course 3, further analysis of questionnaire data focused on the largest subset of participants in Course 3, the 38% who identified themselves as in-service teachers enrolled part-time in M.Ed. programs. K-12 teachers comprise the majority (86%) of students in the M.Ed. program in Course 3. Cross-tabulations showed that these teachers also expressed the most negative perceptions about the DFI cards on the questionnaire. Corporate trainers and health care professionals also enrolled in M.Ed. programs expressed the most positive perceptions about the DFI cards on the questionnaire. The findings from of the questionnaire data dovetail with those from the learning journals and weblog data. One possibility may be that culture of collaborative knowledge work and the culture of research is an integral part of professions like corporate training and health care, but less so in the profession of teaching (Bereiter, 2002b; Scardamalia, 2002). Research has found that K-12 teachers in M.Ed. programs have limited interactions with peers and faculty beyond bounded course contexts and supervisory relationships, and know the least about research culture (Fujita & Freeman, 2006).

Moreover, teachers may find the explicit focus on the usefulness, adequacy, improvability, and developmental potential of ideas in “design mode” thinking to be too formal, as they are more accustomed to “belief mode” thinking that characterizes schooling (Bereiter & Scardamalia, 2003, 2006). In design mode, students learn to treat ideas not as fixed entities, as
the case in belief mode, but as conceptual artifacts that may be improved through scientific research. In belief mode, students engage in argument—agree or disagree with, present evidence for and against—to resolve doubts. Teachers may thus find it challenging to be engaged as a designer of primary research rather than a consumer of this research particularly as for many this is their first encounter with many of the ideas in the course readings.

In short, findings from self-reported data sources—learning journals, weblogs, and questionnaires—suggest that DFI cards were most helpful at the beginning of the course, for newer online learners who were not K-12 teachers in the M.Ed. program, and that the most relevant card was the problem-solving card, which made explicit the progressive discourse commitments. The DFI cards appeared less helpful later in the course, for experienced online learners, and for K-12 teachers in the M.Ed. program. Students’ use of the DFI cards diminished once they felt they had internalized the commitments. Experienced learners were reluctant to unlearn practices that met their learning needs and to adopt unfamiliar knowledge-building goals to create and improve public knowledge.

2b. How the DFI Cards Changed (or did not Change) the Students’ Discourse

I do not claim that the episodes presented here are typical of the student discourse in the databases. Rather, I present situations that illuminate how the DFI cards might have changed the students’ discourse. In the transcripts, the segments in which students quoted or referenced their peers were omitted to avoid repetition. Knowledge Forum’s scaffold supports are indicated with italics, and abbreviated idea unit coding is shown in uppercase letters within brackets. Each episode focuses on interdependent actions that a group of students within the course community carry out to engage in progressive discourse.

The first episode portrays multiple nested contributions spread over four days in Course 2, week 3. This week’s student discussion leaders, Laurel and Dylan, asked the course community to discuss “What value do asynchronous and synchronous tools have in augmenting collaboration and communication.” This group consists of students within the course community who are interested discussing in how different kinds of CMC environments can mediate learning and knowledge creation. The students use both asynchronous discussion (KF) and synchronous chat (FirstClass) environments, and draw on other course materials.

An advanced M.A. student, Adam, initiates the discussion by questioning the capability of synchronous chat tools for supporting idea improvement and knowledge building. Adam’s
note challenges the discussion leaders’ responsibilities and creates a disturbance by taking on the epistemic agency for asking questions (Scardamalia, 2002; Scardamalia & Bereiter, 1991). There is an underlying tension between the synchronous tool that Laurel and Dylan asks the other students to try using, and the course theme to engage in progressive discourse.

Episode 1 Transcript from Course 2, Week 3 Discussion

<table>
<thead>
<tr>
<th>Student</th>
<th>Transcript</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day 1</td>
<td></td>
</tr>
<tr>
<td>1 Adam</td>
<td><em>Different opinion</em> I would like to share my concern about the possibility of idea improvement and advancement (a.k.a. knowledge building) in synchronous environments like chat or instant messaging. <em>(OU)</em></td>
</tr>
<tr>
<td></td>
<td><em>Reason</em> I believe idea improvement takes certain time—to reflect, to revise, improve, and generalize—that is hardly available in synchronous online communication tools. <em>(OU)</em></td>
</tr>
<tr>
<td></td>
<td><em>I need to understand</em> if anybody can think of a specific case of idea improvement (as opposed to idea sharing) during a chat session <em>(PE)</em></td>
</tr>
<tr>
<td>2 Belinda</td>
<td><em>(building on to Adam’s I need to understand): I need to understand</em> how you define idea improvement? Before I can answer your question, I would need to know what constitutes and improvement <em>(PE)</em></td>
</tr>
<tr>
<td>Day 2</td>
<td><em>(building on to Adam’s I need to understand) I understand that some</em></td>
</tr>
<tr>
<td>3 Paul</td>
<td>synchronous environments allow you to copy a transcript of your chat session and paste it into a word processor. Couldn’t knowledge building be promoted by reflecting on the ideas captured in the transcript and discussing those reflections in future sessions? <em>(RP, OE, PE)</em></td>
</tr>
<tr>
<td>Day 4</td>
<td><em>(responding to Belinda’s I need to understand; accepting Paul’s suggestion by citing a chat transcript with Chloe, Yvonne, and Sharon):</em></td>
</tr>
</tbody>
</table>
Adam: If an idea has certain application like explaining the world around us or generalizing experience or being a mental model, an improved idea does the same thing but—BETTER…

Chloe: ok, so idea improvement addresses the exceptions and counterexamples

Adam: it is necessitated by counterexamples…or perceived imperfections…counterexamples to an effective theory/good conceptual artifact (RP, RS)

In this transcript, a group of three students contribute to developing a robust understanding of “idea improvement” and how synchronous tools can mediate this process. They engage in the kind of discourse that one might expect to see if students upheld all six progressive discourse commitments as outlined on the Managing Problem Solving DFI card.

Initially, Adam challenges Laurel and Dylan’s statement by asking an explanatory problem (PE). Adam is engaging in design mode activity here by formulating conceptual artifacts vulnerable to criticism and disconfirmation. Belinda responds to Adam’s own unelaborated idea (OU) of idea improvement, in which she asks for a definition to transform her understanding of this term. Belinda thus poses an explanatory problem (PE) to expand the facts related to understanding the problem. Paul reframes the discussion to transform his understanding of how synchronous tools can support idea improvement. Paul’s suggestion to use chat transcripts in asynchronous discussion is framed for empirical testability. Finally, Adam takes responsibility for fulfilling Belinda’s request for a definition and accepts Paul’s suggestion, which shows openness to modify original ideas in response to criticism. Adam thus quotes new information, an excerpt from a chat that transformed Chloe’s understandings of idea improvement. This chat transcript that Adam quotes serves as a conceptual artifact to mediate this group’s understanding of the relationship between synchronous and asynchronous tools to support idea improvement and knowledge building.
I argue that the understanding of the role of synchronous tools in supporting knowledge building has deepened for all participants as a result of these embedded interactions. Students build on each other’s notes to work on a common problem of understanding. They reference peers (RP) consistently by typing direct quotes in the body of their note or by inserting KF’s hyperlinked referencing feature to work on the problem. The individual students’ contributions are nested together. Their goal appears to be to engage in progressive discourse rather than to simply complete the synchronous chat activity as the discussion leaders suggested. The episode ends as the group’s goal is attained.

The second episode illustrates beginning movements towards progressive discourse that are not completed. This episode is of potential interest because it provides insight into the barriers to progressive discourse encountered in online graduate education contexts where students are often teachers who find it difficult to adopt norms of discourse for inquiry. The following transcript comes from the last three days (days six to eight) in Course 2, week 10. Due to the uneven number of students in the course Christine, an M.A. student, did not have a partner with whom to lead discussion. Thus I supported Christine as her co-discussion leader during this week’s discussion. The analysis focuses on one of Christine’s discussion questions:

Is it appropriate to use “emoticons” to support asynchronous CMC learning? Can the use of “emoticons” enhance participants’ interaction and facilitate their discussions in asynchronous CMC environment?

This group of students is interested in discussing the topic considering the use of emoticons to support asynchronous CMC learning. They communicate in KF by using DFI cards, KF scaffolds, course readings, and outside resources that the students cite. There is a tension between the course theme to engage in progressive discourse on course concepts and a proposed emergent rule to use emoticons to enhance communication and promote shared understanding between members of the course community. Yvonne, a M.A. student, opens the dialogue below by questioning the belief that emoticon use will facilitate increased participation
I can see the value of using emoticons more in synchronous environments where responses are spontaneous, compared to asynchronous environments where there is more time to compose thoughtfully a note. In a chat scenario, emoticons can be used to indicate that a particular comment was intended as a joke (to help prevent misunderstandings because humor is subjective). A well-selected and well-placed emoticon could also serve the same purpose in asynchronous communications. (OE)

*Opinion* However, there is a danger that too many will distract from the message. Additionally, in WebKF, having emoticons compete against the scaffolding supports could dilute the discourse—this is akin to mixing social dialogue (which is better directed to a social café view or an annotation) with contributions to consumer attention. Finally, we must remember that the goal of WebKF is to build knowledge. Although establishing a social presence and comfortable environment promotes student interaction and paves the way towards collaboration, we need to move beyond the sharing of emotions for progressive discourse to occur. (OE)

*Evidence* For example, “Despite the lack of non-verbal cues in CMC, Chinese students claimed to be able to sense the sender’s emotions from the written text: ‘The use of symbols was superfluous because I sensed their mood by reading their writings,’ Hwang replied. Cheng responded similarly: ‘It is easy to judge someone’s personality from their writing. You can tell whether they are passive or aggressive through their communications.’ (Tu, 2001, p. 54). It would be interesting to learn more about the preferences of other ESL students. However, the question still remains: is there a link to emoticon use and increased participation? I do not believe so. (SU, PE)

2 Christine

Yvonne questioned in her note

Do emoticons add value? if there is a link to emoticon use and increased participation. She suggested that “In a chat scenario, emoticons can be used to indicate that a particular comment was intended as a joke (to prevent misunderstandings because humor is subjective). A well-selected and well-placed emoticon could also serve the same purpose in asynchronous environment.” Jeff pointed out in his note questions... that disadvantages of asynchronous CMC environment “are low social context cues...[that] do not support body language and other nonverbal cues that help students avoid misunderstandings in communication “ (RP, RP)

Different opinion Since emoticons can be used to prevent misunderstanding, if participants can select well and do not overuse emoticons, it’s possible to see a positive link between emoticon use and increased participation. (OU)

Any thoughts? (Closing)

Day 7

3 Adam (annotation on Christine’s note) I personally would strongly doubt any relation between emoticon use and participation. (OU)

4 Christine (annotation on own note) Adam, would you like to give your reasoning? (PE)

Day 8

5 Evelyn (building on to Christine’s OU) Evidence In Week 4, it was established in a debate Conclusion Relationships cannot exist without trust that trust is a criteria for online relationships. Meaning that, online learners need to understand and trust each other in order for risk-taking activities (and more online participation) to take place.

Putting our knowledge together Emoticons would help increase online
participation, as they help learners understand each other better, thus, be willing to risk-take and participate more. (OU)

My theory is that emoticons would help increase online participation especially in the early stages of the discourse. I noticed that many classmates have included a picture or two in the class biographies posted during the first week. I think the pictures, in some way, serve as emoticons and set the tone for our discourse, so we have an expectation of what kind of state of mind each person is in when beginning the course. Just a though—I personally even added little pictures in my learning journals each week. I wonder if anyone responds differently and feels like he or she wants to read more and respond more because of the pictures. =) (OE)

In this transcript, four students—Yvonne, Christine, Adam, and Evelyn—make movements towards engaging in progressive discourse on the topic of emoticons and interaction in asynchronous CMC environments. The students satisfy the progressive discourse commitment to work toward mutual understanding, but falter on fulfilling the other commitments.

Yvonne references Christine’s question (RP) and states her belief that emoticon use will not result in increased participation in asynchronous discussions using an “Opinion” scaffold. Yvonne acknowledges that emoticons may be more useful “to help prevent misunderstandings” in synchronous rather than asynchronous environments. However, she reminds her peers that their goal in Knowledge Forum is “to build knowledge,” and that “…we need to move beyond the sharing of emotions for progressive discourse to occur.” Yvonne likens emoticons to “social chatter” that could “dilute” progressive discourse aimed at co-construction of knowledge. Further, Yvonne uses the “Evidence” scaffold to cite a peer-reviewed journal article (Tu, 2001) (SU), incorporating relevant empirical research to support her ideas. Yvonne introduces new information from research, but neither Christine nor Evelyn admits these as facts into the group discourse.

Christine responds to Yvonne’s note (RP) and presents another perspective (OU) using a “Different opinion” scaffold. Christine also inserts hyperlinked references to Jeff’s note (RP) that
emphasizes that low social context cues and non-verbal cues are disadvantages in the asynchronous environment. Christine uses Jeff’s ideas as evidence for her belief that emoticons may be used to prevent misunderstandings and positively impact participation. In other words, Christine engages in argument aimed at persuading readers to her point of view and in which she does not accept research findings cited by Yvonne.

Adam annotates Christine’s note to express his doubt of “any relation between emoticon use and participation.” Adam indirectly lends support to Yvonne’s ideas, but does not elaborate or provide any evidence to bear on his view. As a result, Christine requests to Adam to provide reasoning for his ideas. Although Adam reads Christine’s annotation, he does not cooperate to grant Christine’s request and further the purpose of the discussion.

In an attempt to remove this impediment to progressive discourse, I referenced two studies aligned with Yvonne and Adam’s ideas, but not ruling out Christine’s beliefs concerning emoticons and increased participation. For example, one study found that emoticons’ contributions were outweighed by verbal content, but also found that any negative message aspect—verbal or graphic—shifts message interpretation in the direction of the negative element (Walther & D’Addario, 2001). Similarly, another study by Wang, Sierra, & Folger (2003) did not establish any benchmark between emoticon frequencies and participation levels in the online course they studied.

Although Evelyn reads my note, she rejects this new information from research and confirms Christine’s beliefs that perhaps overestimate the importance of emoticons. Evelyn references Christine’s note (RP) and inserts a hyperlinked reference to a co-authored note from a previous discussion view involving a debate (Course 2, week 4) that argued for the need for online learners to understand and trust each other to engage in risk-taking activities. Evelyn suggests that this can facilitate “increased”—which I infer to be higher quality—interaction. Nonetheless, Evelyn’s referencing across views is interesting in that she uses ideas generated by her peers to synthesize her ideas with others’ (OU) using a “Putting our knowledge together” scaffold. She also changes the wording from Yvonne, Jeff, and Christine slightly from “prevent” or “avoid” misunderstanding to “help learners understand each other better.”

Accordingly, this episode reveals how barriers to progressive discourse can impede beginning movements towards progressive discourse. It is progressive at the beginning when Yvonne contributes a note that considers the utility of emoticons and suggests design mode
thinking, what emoticons are good for and not good for in asynchronous CMC environments. Later in the episode, it ceases to be progressive when both Evelyn and Christine hold steadfast to their beliefs about the value of emoticons in asynchronous CMC, and these beliefs seem to transcend the research findings. The findings from this analysis are consistent with research on teachers’ individual learning in collaborative settings that show changes in cognition are largely concerned with confirmation of own ideas or teaching practice (e.g., Meirink, Meijer, & Verloop, 2007). Teachers clearly enjoy talking about concepts relevant to their work, but the norms of schooling has taught them to be polite and nonjudgmental rather than to participate in critical dialogue about ideas and practice (S. M. Wilson & Berne, 1999).

With the exception of Adam, the participants in this episode are relatively inexperienced online learners and master’s students who have little experience with the culture of inquiry. Whereas Adam reports having internalized the commitments to progressive discourse and does not need to refer to the DFI cards, the other participants reported the need to use the cards in their learning journals. As discussed in a previous section of this chapter, Yvonne stated in her learning journal that in her interactions off-line and online, she tends to “support previously-stated opinions” and “avoid confrontations.” Yvonne acknowledged, however, that the DFI cards offered her “useful phrasing for voicing opposing viewpoints” that might have helped her to voice ideas that provided a divergent perspective.

While it may not be possible to infer students’ cognitive or metacognitive processes based on analyzing the textual content in a note (Bereiter & Scardamalia, 1987b; Rourke & Anderson, 2004), I would argue that Yvonne presents a divergent perspective of the topic of emoticons from one that Jeff and Christine presented earlier in Course 2, week 3 discussion. Jeff and Christine had had argued strongly that social goals for community and conveying emotions almost supersede cognitive goals in online course participation. Thus, Yvonne’s contribution is progressive in the sense that this former junior-level elementary teacher attempts to improve ideas and advance understanding rather than to create controversy. As suggested on the Managing Group Discourse DFI cards, Yvonne acknowledges the merits of their ideas before introducing better ones supported by research. She also uses descriptive words rather than evaluative ones in forwarding her ideas.

The episode ceased to be progressive when Christine and Evelyn sought to confirm their beliefs that emoticons would increase participation in asynchronous environments. This episode
might have been more progressive had Yvonne and Adam collaborated to provide further explanations in response to Christine and Evelyn’s comments.

Patterns that emerged through mapping sequences of progressive discourse in the data include a student finding a problem and requesting explanation from peers with a question (PE); peers referencing the idea unit segment containing the question (RP) and proposing an explanation from their own ideas (OE); and peers integrating the ideas from the course readings into explanations (SE). When students contributed unelaborated ideas of their own, unsupported by evidence (OU), their peers would reference the segment and ask a question of clarification or express disagreement, which in turn sparked a knowledge building turn.

In summary, using the DFI cards, the students’ discourse changed, at times, to resemble that of an advanced participant committed to progressive discourse. Characteristics of this discourse include the following:

- Explicitly referencing segments or inserting hyperlinks of peers’ notes to engage critically with or challenge an idea
- Posing “wonderment questions” to reframe the idea for further inquiry;
- Forwarding better ideas by using theory to explain facts introduced into the group discourse; and
- Concluding the episode by presenting a tentative synthesis of group understanding.

For students who did not use DFI cards or had ceased using the DFI cards prematurely, discourse remained at an exploratory stage, an exchange of short notes with shallow or descriptive reflections on personal (teaching) experiences. This satisfied the teachers’ professional development goals for individual learning by acquisition of content and pedagogical knowledge and provided social connection within the professional learning community.

3. How the Knowledge Forum (KF) Scaffolds Affected Student Discourse

This section presents findings on how the Knowledge Forum (KF) scaffolds affected the student discourse in the two online graduate education courses based on analyses of the following data: scaffold use report from the Analytic Toolkit; self-reports in learning journals, weblogs, and questionnaires; and transcripts of course discussion. As described in the methods chapter, students in the main study had access to both the existing scaffolds that came with KF
called Theory Building and Opinion, as well as customized scaffolds specifically designed to support progressive discourse. In Course 2, these included the Idea Improvement scaffolds designed by two students, Adam and Chloe and the Feedback scaffolds designed by the researcher. In Course 3, the instructor and design researcher combined and collaboratively refined the Idea Improvement and Feedback scaffolds into one customized set called Idea Advancement.

3a. Extent to Which Students Used the Scaffolds

Using log file data accessed via the Analytic Toolkit this study found patterns in the students’ use of KF scaffolds that affected their discourse. First, there was an overall increase in the total number of scaffolds used from Iteration 2 to Iteration 3, as shown in Table 21:

Table 21  
*Frequencies of Knowledge Forum Scaffolds Used in two Online Graduate Courses*

<table>
<thead>
<tr>
<th>Course</th>
<th>Theory Building</th>
<th>Opinion</th>
<th>Progressive Discourse</th>
<th>Total Number of Scaffolds</th>
<th>Total Number of Student Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>f</td>
<td>%</td>
<td>f</td>
<td>%</td>
<td>f</td>
</tr>
<tr>
<td>Course 2</td>
<td>128</td>
<td>42%</td>
<td>91</td>
<td>30%</td>
<td>87</td>
</tr>
<tr>
<td>Course 3</td>
<td>167</td>
<td>36%</td>
<td>200</td>
<td>43%</td>
<td>98</td>
</tr>
</tbody>
</table>

As Table 21 shows, Course 3 students used more total scaffolds than Course 2 students. Course 3 students also used more Opinion than the Theory Building or Idea Improvement scaffolds than Course 2 students. A Pearson chi square test showed a statistically significant difference between the two Iterations, $\chi^2$ (2, N=771) = 14.46, p<.001.

This study investigated the use of KF scaffolds as one intervention to support the development of progressive discourse. Thus, finding that students used the Opinion scaffolds more than the instead of the Theory Building scaffolds or Idea Improvement scaffolds especially designed for progressive discourse was disappointing, but not surprising given the challenge to engage students in this kind of discourse online.
To understand whether the types of scaffolds used in student notes changed over time within each course, the frequencies of different types of KF scaffolds used were calculated for the first third and last third of the course, excepting the first week and last week. These weeks were omitted because they were used as introductory and evaluation sessions.

When calculated, this analysis showed that Course 2 students used all of the scaffold types more frequently in the last third of the course compared to the first third (see Figure 9). In the first third of the course, students did not use scaffolds at all in week 2 or week 4. The Progressive Discourse scaffolds were also not available until week 9.

![Figure 9. Types of Knowledge Forum scaffolds used by students in Course 2.](image)

In comparison, all three types of scaffolds were available from the beginning of Course 3. Promisingly, the students’ use of Theory Building and Progressive Discourse scaffolds increased and their use of Opinion scaffolds decreased from the first third to the last third of the course (see Figure 10).
Figure 10. Types of Knowledge Forum scaffolds used by students in Course 3.

The increasing use of scaffolds for theory building and progressive discourse over scaffolds for expressing opinion over in the final iteration is a positive finding for the software-based intervention in this design-based research study.

**Results from Analysis Mapping Bereiter’s (2002b) Commitments for Progressive Discourse to KF Scaffold Use**

In addition, a more explicit mapping between Bereiter’s (2002b) commitments for progressive discourse and specific scaffold supports that students used was carried out (see Table 23). As discussed in the methods chapter, this manifest analysis assumes that scaffolds accurately reflect the discourse processes in the text, and is susceptible to critique unless a neutral observer can predict the scaffold supports that the students used in the database. This found that 79% of the time a graduate student can predict the scaffold supports that another graduate student would use.
<table>
<thead>
<tr>
<th>Bereiter’s (2002) Progressive Discourse Commitments</th>
<th>Scaffold Supports</th>
<th>Number of Scaffolds Used in Course 2</th>
<th>Number of Scaffolds Used in Course 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Week 3</td>
<td>Week 10</td>
</tr>
<tr>
<td>Focus on ideas as conceptual artifacts</td>
<td>My Theory</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>IDEA</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Current statement of idea</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Improvability as a positive attribute of conceptual artifacts</td>
<td>A better theory</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Different opinion</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>WHAT DO WE NEED THIS IDEA FOR</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>IDEA ADVANCEMENT</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>How idea could be advanced</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>How idea is useful</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Common understanding</td>
<td>I need to understand</td>
<td>4</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>I need to understand and My Theory co-occurring within a single note</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>PROBLEM/QUESTION</td>
<td>-</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>I need to understand and PROBLEM/QUESTION co-occurring within a single note</td>
<td>-</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Putting our knowledge together</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Expand the factual base</td>
<td>New Information</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Empirical testability</td>
<td>This theory cannot explain</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>Openness/Non-sectarianism(^8)</td>
<td>How can we test X</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>My Theory</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>A better theory</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Different opinion</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>IDEA ADVANCEMENT</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Problem/limitations</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>How ideas could be advanced</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

\(^7\) Idea Improvement scaffolds were only available from Week 9 in Course 2; Idea Advancement scaffolds were only available in Course 3.

\(^8\) Bereiter (2002) notes that a weakness of the common understanding commitment is that it may be achieved in the absence of critical thinking. The openness commitment overlaps with the other commitments in attempting to overcome this weakness.
This analysis found that students appear to meet the commitment to work towards common understanding more often than other commitments. To lesser degrees they also fulfill the conceptual artifact, improvability, and openness commitments. Strikingly, students are not expanding the factual base or exploring empirical testability. Students rarely used the New Information scaffold to contribute new facts or to extend the range of issues related to understanding the problem. Likewise, students seldom used the “This theory cannot explain” or “How can we test X” scaffolds to bring evidence to bear on their questions and propositions. This might occur because students do not know how to incorporate sources in the process of discourse for inquiry. Without the facts from sources, it is difficult to empirically test the theories that students contribute online. This makes it challenging to detect progress made in the group discourse.

This finding is in line with results from content analysis in Latent Analysis 2, which suggested that students tend to present their own ideas or reference their peers’ ideas. Students integrate less source-based ideas to strengthen explanations. This finding is also consistent with the barrier to progressive discourse discussed in the second episode of in-depth analysis of discourse for groups that was presented for the Discourse for Inquiry intervention. The episode of progressive discourse ceased to be progressive when students ignored evidence supporting an explanation opposite to deeply held beliefs and argued to persuade others to support their view.

Some scaffold supports were found to have particularly poor predictability for coders. For example, in Course 2, week 10, students incorporated the “PROBLEM/QUESTION” support in a way similar to the way they were using “I need to understand”. This might have occurred because students were starting to understand the importance of the distinction between working on problems of understanding versus answering questions to build knowledge (Bereiter & Scardamalia, 2003). To reduce the possibility of ambiguity, “PROBLEM/QUESTION” was changed to “Problem/limitations” for Course 3. One interesting related finding is that “My Theory” and “I need to understand” supports did not co-occur within a single note, whereas “PROBLEM/QUESTION” and “I need to understand” did co-occur. It could be that “My Theory” and “I need to understand” appear in group discourse with multiple notes working towards common understanding.

Another challenge involved a few students who used scaffolds in ways that did not reflect the discourse processes the scaffold was intended to support. For example, one student
indiscriminately used scaffolds such as “My Theory,” “IDEA ADVANCEMENT,” and “New Information” to bracket opinions and personal narratives. This occurred in 5 instances (1.6% of total scaffolds used in the course). Another student in Course 2 inserted the “WHAT DO WE NEED THIS IDEA FOR” scaffold into a note to express concerns about the negative connotation of this scaffold. In nearly all instances, students did appear to use the supports for the discourse process that was intended for them. Still, the quality of explanations students bracketed using a scaffold like “My Theory” varied greatly. Further research is needed to rate the quality of explanations students contributed using scaffolds in the online graduate education courses, when discussing ill-defined problems rather than well-established scientific phenomena. The next section explores how students perceived the usefulness of using scaffold supports in Iterations 2 and 3.

3b. Extent to Which Students Perceived the KF Scaffolds to be Useful

In Course 2, students were asked to respond in their learning journals to the following question about whether they had tried using KF scaffolds:

Have you tried using scaffold supports? What do you find helpful or not helpful in reading and writing notes with them? (Course 2, week 10)

In Course 3, students were not asked to respond to a specific question about KF scaffolds in their weblogs; however, 45% of students spontaneously wrote about the KF scaffolds. Further, 80% of students completed the post-course questionnaire containing three items about KF scaffolds. These students provided responses to the following statements about KF scaffolds using a 5-point scale of “strongly disagree,” “disagree,” “uncertain,” “agree,” and “strongly agree”:

Scaffolds in KF focus my reading of others' notes
Scaffolds in KF focus my writing of notes
KF notes with scaffolds are more impersonal than KF notes without scaffolds

In the subsections that follow, I present students’ positive and negative perceptions—the strengths and weaknesses—of the KF scaffolds. I explore the affordances and constraints of this technological feature with respect to the perceived possibilities they offer to the students who use
them in each course (Allaire, Laferrière, & Gervais, 2007; Gaver, 1991; Gibson, 1979). Then, I compare these findings with the observed data of how students actually used the scaffolds in illustrative episodes of progressive discourse from both courses. This may provide some insight about when KF scaffolds are helpful to support progressive discourse, and for whom.

**Course 2 Student Self-Reports in Learning Journals on KF Scaffolds**

All 17 students in Course 2 responded in their learning journals that they had tried using the KF scaffolds. Despite 35% of students in Course 2 reporting that they disliked the KF scaffolds, all students also conceded that scaffolds focused their thinking while they composed a note. As Chloe, who used KF scaffolds for the first time in this course and found them helpful wrote,

> The reason I find scaffolding to be so useful is that they provide a means to organize and structure your input. Using scaffolds makes me stop and think about my input into the discussion, and putting forth an idea or is it an opinion, does it need elaboration or am I asking a question. I also find that I am much more succinct when I use scaffolds. (Chloe, M.Ed. student, Course 2, Week 10)

This quote reveals that KF scaffolds helped Chloe organize and structure her notes to communicate her ideas more effectively. The scaffolds prompted Chloe to stop and think about her thinking, or to be metacognitive, while writing a note. This made her notes more concise, which suggests that the scaffolds helped Chloe to articulate her ideas, thereby communicating these ideas more clearly to others.

Another student who found that KF scaffolds helped make ideas more precise is Belinda, who noticed that notes with KF scaffolds “...tended to be shorter and more focused. This would clearly help with the challenge of “reading overload.” (Belinda, M.Ed. student, Course 2, week 10). Belinda’s quote also alludes to another way in which KF scaffolds may support students’ thinking in Knowledge Forum. Originally, KF scaffolds were designed to make explicit the usually private metacognitive processes that expert writers employ during written composition to less experienced writers (Scardamalia & Bereiter, 1991). By using scaffolds to write notes, however, students may also be assisting the reader make sense of the text (personal communication, Thérèse Laferrière, May 27, 2006).
Supporting this latter idea is the view expressed by 18% of students in Course 2, that KF scaffolds focused reading of other students’ notes. For example, Evelyn reveals that KF scaffolds help her read longer, more complex notes containing multiple sources of evidence:

I personally find that for long messages with a lot of evidence and complex ideas, the colour and the structure makes things stand out and it is easier to read with messages that have scaffolds sometimes. (Evelyn, M.Ed. student, Course 2, Week 10)

Evelyn’s quote lends support to the idea that scaffolds make the author’s organization within a note more visible, which helps the reader understand a note. In turn, this promotes progressive discourse because students can respond to a peer’s note more productively:

When others use scaffolds in their notes it helps me understand their input better and I can respond accordingly. (Chloe, M.Ed. student, Course 2, Week 10)

Additionally, 12% of students mentioned that scaffolds helped them efficiently scan through, or search for a particular item in a group of notes:

I have found the scaffolds very helpful when going back through the notes, if I am trying to find something specific, the scaffolds help to streamline the process. (Anne, M.Ed. student, Course 2, Week 10)

In this quote, Anne suggests that scaffolds help them scan notes and search for specific information so that the state of the discussion is known and it may be advanced.

Likewise, Ian attests that scaffolds are helpful for reading by making explicit the logical connections between concepts contained in multiple notes:

I found them useful in reading them since I could tell what note this logically connected to and whether or not I had read it. That way, if I felt like thinking about the idea further or responding, I could easily find one place to efficiently read and re-read the connected post. (Ian, M.Ed. student, Course 2, Week 10)
Hara et al. (2000) suggested that when students can find notes that are interesting or important to them, for example through appropriate topic titles in the “subject line,” reading efficiency and overall learning will increase. KF scaffolds may not only assist students in finding promising ideas in the progression of the discussion to revisit, but may also help in collaborative, distributed reasoning when students use scaffolds to direct quotes from a previous note. Similar to inserting a hyperlink reference in a note to acknowledge ideas in another participant’s note, scaffolds may thus permit students to re-read relevant segments of previous notes dealing with the common problem in its original form within the body of the same note and contribute to progressive discourse.

Despite recognizing that scaffolds focused writing and reading of notes, students’ attitudes towards using scaffolds in their own course participation were largely ambivalent. As noted earlier, 35% of students in Course 2 openly admitted that they did not like the KF scaffolds. Two negative themes about KF scaffolds emerged when the students’ learning journals in Course 2 were analyzed qualitatively:

1. The constraint KF scaffolds imposed on creative thinking; and
2. The usability of the technological design in the KF version (version 4.5.3) used.

**KF scaffolds: Structure or straightjacket?** From a knowledge-building perspective, one characteristic of a mature producer of knowledge is “disciplined creativity” (Scardamalia & Bereiter, 2003). Emergent processes that give rise to new knowledge and understanding of existing knowledge involve self-organization (Bereiter & Scardamalia, 2006). Because KF scaffolds can assist students in organizing their own thinking, writing, and possibly reading of other’s notes, scaffolds may promote disciplined practices aimed at deepening understanding of a concept from course readings through progressive discourse.

Unfortunately, students in Course 2 did not like the “disciplined” aspect of creative knowledge work that scaffolds were designed to support. Indeed, 35% of Course 2 students complained that scaffolds provided too much structure that constrained personal expression and interaction. For instance, Belinda, an M.Ed. student, felt “too boxed in” by scaffolds that failed to “reflect her personality.” Laurel metaphorically compared KF scaffolds to straightjackets used to restrain patients to prevent them from harming themselves and others.
I’ve been thinking about the perception of World 3 knowledge—and the fact that the knowledge we put out there is not always perceived by others in the same context. Therefore scaffolds offer a way to structure how other individuals synthesize our knowledge...By structuring our knowledge through scaffolds it seems that we are offering the opportunity for progressive discourse…or are we limiting the kind of discourse that could occur? (Laurel, Ed.D. student, Course 2, Week 10 learning journal)

Laurel voiced the view that scaffolds afford structural support but constrain the kind of discourse that could unfold, not only in her learning journal, but also in similarly titled notes in both week 3 and week 10 course discussions. Other students echoed Laurel in expressing ambiguity about using scaffolds in writing notes. For example, Yvonne, a M.Ed. student said, “Providing so much structure seems to take the heart and soul out of the posting experience.”

Clearly, scaffolds afford structural support for a socio-cognitive kind of discourse conducive to instructor and researcher expectations for progressive discourse. This affordance may have been in conflict, however, with the students’ goals for developing more personal, socio-affective relationships online with classmates perhaps via supportive communication. Albrecht, Burleson, & Goldsmith (1994) identify supportive communication as “a fundamental form of human communication” and “a primary means by which interpersonal relationships are created and sustained” (p. 419). Belinda suggests that scaffolds provided too much structure to permit this kind of more personal communication that enables people to get to know others when she says,

I have wondered throughout the course what Adam is really like. While I think I saw glimpses, I have wondered how he would “sound” without the use of scaffolds. (Belinda, M.Ed. student, Course 2, Week 10 learning journal)

Further, because students tended to see ideas as strongly connected with the individual rather than something that was objectified, they did not like scaffolds that were openly critical of another student’s ideas. For example Paul stated,
The WHAT DO WE NEED THIS IDEA FOR? scaffold is perhaps the least affirming thing I have ever seen in an online environment. Whenever I see it, it feels like the recipient has been insulted.” (Paul, Ed.D. student, Course 2, Week 10 learning journal)

Usability of KF scaffolds. Despite the advanced computer skills that the majority of Course 2 students reported, or perhaps because of their knowledge of the attributes of good design, 59% of Course 2 students identified usability issues in using KF scaffolds. I refer to “usability” in this study following Jakob Nielsen’s (2003) definition: “a quality attribute that assesses how easy user interfaces are to use.” According to Neilsen, the five key elements for usability are learnability, efficiency, memorability, errors, and satisfaction.

Over half of Course 2 students described KF scaffolds as being difficult to use. In the version of Knowledge Forum (version 4.5.3) used in this study, scaffolds appear to the left of the “Content” box in the “New Note” window (see Figure 11):

![Figure 11. New note window in Knowledge Forum (version 4.5.3).](image)
The available scaffolds (i.e. Theory Building, Opinion, Idea Advancement in Course 3) appear on a drop list, and once a particular scaffold is selected by turning blue, several corresponding scaffold supports or sentence openers are visible below. To insert a scaffold support such as “My theory” into a note, the author of the note selects a scaffold support by left-mouse click, and clicks again on the “Add” button. This causes the Content dialogue box to display the html code for the selected scaffold support and its identification number. For example, “My theory” scaffold appears thus (in this example, note ID number is 2836):

<kf:support support="my theory" ID=2836></kf:support>

Whenever these steps are repeated, the html code appears at the bottom of the “Content” box. The author moves this code by copying and pasting it to the desired location in the note. Once in place, the author types in text that the scaffold support is to bracket where the cursor is located, in between the greater and lesser signs.

Although similar to wiki functionality, students found learning to use scaffolds difficult. Even Adam, an advanced MA and the most prolific user of KF scaffolds in Course 2 admitted, I do not find using KF scaffolds authentic, or natural: the reason for saying this is that such 'scaffolds' and 'supports' do not exist outside of Knowledge Forum, therefore, using them requires special training and deliberate attention.

While students who encountered scaffolds in Course 2 for the first time were able to learn from the modeling of KF use by advanced peers like Adam, 18% of the students also reported being intimidated about learning how to use KF scaffolds in this way. For example, Jeff confides, Not to say I was not encouraged, but I was definitely scared by the fluency of my peers… I thought people were just showing their technological practical understanding (Jeff, M.Ed. student, Course 2, Week 10)

To address these students’ needs, it may be helpful to allocate more instructional time at the beginning of the course to explain the function of the KF scaffolds, to offer opportunities for
students to practice incorporating this technological feature into online contributions, and to offer a guideline limiting the number of scaffolds to be used in a single note to reduce cognitive overload from poor screen readability.

Still, improving the usability of KF scaffolds merits consideration, since students would be more likely to adopt this intervention if it were less prone to human error and more pleasant to use. Evelyn, a full-time master’s student who was comfortable with technology and experimented with inserting images and embedding sound files in her learning journal each week noted that using html codes to insert KF scaffolds into notes posed challenges:

Also, when I add them, they appear in the bottom of the message, the code may fall all over the place accidentally and make the message unreadable. Therefore, I see that there are difficulties writing notes with them. (Evelyn, M.Ed. student, Course 2, Week 10)

Human error in cutting and pasting parts of the code for the scaffold support can result in an “unreadable” note once contributed. While errors can be fixed by clicking “Edit” on the contributed note and hand coding the html in the Content box, a more direct interface could alleviate the error-prone quality of the scaffold feature.

Ian, a computer science teacher, wonders if he would have written higher quality notes that integrated ideas from other notes if the scaffolds were easier to use:

With respect to writing with them, I usually responded to single posts or seemingly single ideas, without incorporating possibly other connected posts. I guess I did this more for convenience, since I wanted to post something quickly without going through the time required for scaffolding. I wonder if I would acted differently if the scaffolding procedure was easier. (Ian, M.Ed. student, Course 2, Week 10)

Ian’s entry points to a tension that exists between instructor and researcher’s expectations for students to use KF supports to engage in progressive discourse and the individual students’ expectations for the course. Tabak (2004) refers to the former as “exogenous design,” and what the students’ accustomed practices in online courses that do not advance discourse as
“endogenous design.” Such tensions in designs will be explored more in depth in the student transcripts, but next I turn to Course 3 student self-reports on KF scaffolds.

Course 3 Student Self-Reports in Weblogs and Questionnaires on KF Scaffolds

Weblogs. Whereas all students in Course 2 responded in their learning journal to a particular question soliciting their perceptions about KF scaffolds, Course 3 students were not asked a specific question about KF scaffolds. Rather, 45% of Course 3 students spontaneously wrote about scaffolds in their weblogs. As in Course 2, all of the nine students who blogged about the KF scaffolds in Course 3 acknowledged that they focused thinking, reading, and writing. A student who had the fourth highest rate of using KF scaffolds in Course 3 enthused,

I think I am addicted to them. Scaffolds make it so easy and clear to respond to questions. I really enjoy reading responses that incorporate scaffolds…I also find scaffolds very useful in organizing my thoughts and ideas. (Sue, M.Ed. student, Course 3, Week 5 weblog entry)

Sue’s statement indicates that scaffolds simplify the process of writing notes by providing support for organizing her ideas during composition, and that they make reading of other students’ notes more enjoyable. Although Sue does not explain why reading notes with scaffolds is pleasurable, it may be that they help her see how others organize their ideas, an explanation that April points to in her weblog thoughts on the use of KF scaffolds:

These techniques also allow me to see from a different student’s perspective as they organize their ideas. (April, M.Ed. student, Course 3, March 7, 2005 week 9 weblog entry)

Here, April implies that KF scaffolds allow her to see how another student organized their thinking while writing a note. Having access to an author’s normally hidden metacognitive processes during composition via scaffolds may help students gain insight into how another student categorized their ideas, which is a kind of modeling of metacognitive thinking.

Course 3 students also wrote about KF scaffolds as an example of one of the affordances in the Knowledge Forum discussion environment compared to affordances of weblogs in response to the instructor’s following week 8 reflection questions:
How do Knowledge Forum and weblogs support the development of ideas? Do they both support aspects of distributed constructionism? Of distributed intelligence?

An example of such a weblog response comes from Hanna, who identified scaffolds as one affordance in Knowledge Forum supporting the development of ideas:

The ability to locate information and build-on it is supported more completely in WebKF through scaffolding, attachments, and search processes amongst others.

(Hanna, M.Ed. student, Course 3, week 8 weblog entry)

Hanna considered Knowledge Forum “a more able tool than blogs” to support distributed constructionism (M. Resnick, 1996) from her “current understanding” because features such as scaffolds enable her to find distributed information within the community and build-on or construct new knowledge to advance what is known.

Similarly, Jane considered KF scaffolds as an affordance in Knowledge Forum to support problem solving. As she reflected on the week’s reading on distributed intelligence (Pea, 1993), Jane wrote,

The affordances which foster distributed processes in problem solving include rotating moderators to pose the questions (find & represent the problem), the scaffolds which help to guide our thinking/discussion (planning a solution), and responses (executing a plan, checking the solution with personal examples). (Jane, M.Ed. student, Course 3, week 8 weblog entry)

Jane was the second highest user of scaffolds in Course 3. Interestingly, she conceptualizes the affordances in the Knowledge Forum discussion environment to support “distributed processes in problem solving.” Thus, the KF scaffolds foster the planning of a solution in problem solving, which emphasizes metacognitive control over the development of ideas via progressive discourse.
Nonetheless, like the Course 2 students, Course 3 students expressed mixed feelings about KF scaffolds. Similar negative themes related to the constraining effect of KF scaffolds emerged in Course 3 as in Course 2:

The scaffolding could sometimes be a hindrance, though. While it was very useful when reading other people's postings (especially people who like to ramble!), I found that there were times that I wanted to use the scaffolds but felt limited. Perhaps it is also a matter of getting used to creating my posts differently (Andrea, M.Ed. student, Course 3, Week 9 weblog entry)

As Andrea explains, while KF scaffolds were useful in reading others’ notes by encouraging peers to write more concise notes, the scaffolds also limited personal expression and required her to learn an unfamiliar, more disciplined way of writing notes. Some students found it difficult to change their online habits. For instance, April said,

What I like but often do not include in my own message are the scaffolding attributes. These attributes help to organize ideas. I have tried to include these but I feel less confident in presenting my ideas. (April, M.Ed. student, Course 3, March 7, 2005)

Clearly, April was uncomfortable about incorporating KF scaffolds to highlight her ideas in online contributions. The discomfort that April experiences in using KF scaffolds in Course 3 is similar to the feelings expressed by 18% of students in Course 2. Unfortunately, not all of the students in Course 3 blogged about KF scaffolds, so it was not possible to discern the proportion of Course 3 students who found KF scaffolds difficult to learn to use. Therefore, additional data on students’ perceptions of the KF scaffolds were collected using the post-course questionnaire in Course 3.

Questionnaires. Sixteen of 18 Course 3 students completed a post-course questionnaire containing three items about the KF scaffolds for a response rate of 80%. Students provided responses using a 5-point scale of “strongly disagree,” “disagree,” “uncertain,” “agree,” and “strongly agree” (see Table 22).
Table 22

<table>
<thead>
<tr>
<th>Questionnaire Item</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Uncertain</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scaffolds in KF focus my reading of others’ notes (questionnaire item 14)</td>
<td>0%</td>
<td>25%</td>
<td>0%</td>
<td>62.5%</td>
<td>12.5%</td>
</tr>
<tr>
<td>Scaffolds in KF focus my writing of notes (questionnaire item 15)</td>
<td>0%</td>
<td>25%</td>
<td>12.5%</td>
<td>50%</td>
<td>12.5%</td>
</tr>
<tr>
<td>KF notes with scaffolds are more impersonal than KF notes without scaffolds (questionnaire item 16)</td>
<td>12.5%</td>
<td>25%</td>
<td>31.3%</td>
<td>31.3%</td>
<td>0%</td>
</tr>
</tbody>
</table>

The questionnaire responses revealed that 62.5% of students agreed and 12.5% of students strongly agreed that KF scaffolds focused reading of notes. Similarly, 50% of students strongly agreed and 12.5% of students strongly agreed that KF scaffolds focused writing of notes. As expected, the students who expressed these positive perceptions about KF scaffolds on the questionnaire were also the same students who had written voluntarily about KF scaffolds in their weblogs. Clearly, KF scaffolds were interesting to and supported the online participation of these students.

A quarter of Course 3 students (25%) disagreed with the statements that KF scaffolds focused reading and writing of notes. Not surprisingly, none of the students who expressed these negative perceptions about KF scaffolds had written entries about KF scaffolds in their weblogs.

The third questionnaire statement about the impersonal nature of KF notes with scaffolds compared to KF notes without scaffolds was designed to explore a negative perception that a number of students in both courses had voiced in notes contributed to the weekly course discussion views. This showed that more students disagreed or strongly disagreed with the
statement that KF notes with scaffolds are more impersonal than KF notes without scaffolds, though just under a third (31.3%) were either uncertain or agreed.

To understand why three of the Course 3 students disagreed with both statements about scaffolds for both reading and writing, cross-tabulations by occupation and degree program were calculated. This analysis showed that two of these students were currently not K-12 teachers and enrolled in doctoral studies; one student was a K-12 teacher in the M.Ed. program. A likely explanation for the two doctoral students could be that both of these students were already experienced online learners and expert graduate students who did not require the support for reading and writing offered by the KF scaffolds. Both had completed their master’s degrees online and were actively involved as research team members on their supervisor’s funded research project at a field centre.

Another explanation could be that the KF scaffolds were not easy to learn to use for students who were already struggling to learn online. Dale, an M.Ed. student who disagreed that scaffolds focused reading and writing, also had great technical difficulty participating in course discussions. Dale had a slow, dial-up internet connection which reduced his ability to navigate speedily around Knowledge Forum. For example, instead of composing new notes in the course discussion views, Dale uploaded documents into the view as attachments. These attachments were often corrupted and unreadable to the other students. During the first few weeks of the course, the researcher offered technical help by correcting the corrupted files and contributing the text as new notes written by Dale. Given the technological difficulty that this student experienced in simply writing notes in Knowledge Forum, inserting scaffolds and hand-coding the html may have been too challenging.

Despite the negative responses from a small proportion (25%) of Course 3 students, the majority of Course 3 students were generally more positive about the scaffolds than the DFI cards. This may be because the scaffolds serve as metacognitive prompts to focus individual students’ thinking and learning, whether they are aimed at collective knowledge building goals or not.

3c. How KF Scaffolds Change (or do not Change) Student Discourse

Turning to how students actually used the KF scaffolds in their discourse, this study found positive relationships between KF scaffolds on the students’ discourse including increased length of notes, and quality of individual contributions to the group discourse.
Relationship between use of scaffolds and length of notes. To understand the relationship between the use of KF scaffolds and length of notes, the mean word counts of student notes with scaffolds and without scaffolds were compared. A paired samples t-test found that notes with scaffolds contained significantly more words than notes without scaffolds, \( t(33) = 3.626, p < .001 \).

Previous researchers (e.g., Hara et al., 2000; Schrire, 2004, 2006) have suggested that the length of messages is one sign of the depth of online student interaction and reflection on course readings. One possibility is that students might be using scaffolds to bracket what another peer has written, then to ask questions or to elaborate on it. For example, the “I need to understand” support might highlight a piece of text from another student’s note that requires clarification, and the “My theory” support might contain an explanation. Students might also metacognitively reflect at greater length about ideas when they compose notes, as they must decide on an appropriate support to label each segment of text. Presumably, when students engage in progressive discourse, they would read each other’s notes in depth to monitor the progression of the group discourse. This would permit them to contribute a note that addresses a gap in the discussion or synthesize good ideas to advance understanding.

However, recent studies analyzing students’ reading behaviors in asynchronous computer conferencing environments (Hewitt & Brett, 2007; Hewitt, Brett, & Peters, 2007) have reported that students “scan” or only superficially examine the larger notes (≥300 words) that they open. Since notes with scaffolds tend to be longer than notes without scaffolds, students may only scan these notes, which presents a challenge to fostering progressive discourse.

Relationship between use of scaffolds and individual contributions to group discourse. I previously analyzed two episodes of group discourse in relation to DFI card use. In this section, I will present two more episodes of discourse that appears to meet commitments for progressive discourse and discuss how scaffold use may have affected individual contributions to group discourse.

Episode 3 traces contributions by multiple students taking place over two days in Course 3, week 3. A group of students in the course community are responding to student discussion leaders Paul and Brian’s question, “What opportunities do online environments present for coordinating experiences into representations and mappings and then systems as learners work toward understanding?” The students are working together in Knowledge Forum to engage in
progressive discourse on the concept of building versus borrowing featured in one of their course readings for the week by Schwartz and Fischer (2003). Schwartz and Fischer highlight the importance of a principle of learning that assumes that building knowledge at any age is an active and step-wise process, in which learners build new knowledge upon less complex understandings.

In this third episode of progressive discourse, tensions arise between the course theme to engage in progressive discourse, the course requirements for participation, and individual student learning goals. In this case, the student’s learning goal is Dana’s intention to learn HTML tags to format a note composed in KF. The dialogue below opens as a M.Ed. student, Chloe, agrees with another M.Ed. student, Dana, that asynchronous CMC environments can facilitate “building an understanding of a concept.” In addition, Chloe suggests that synchronous tools were even more helpful in deepening her understanding in Course 2:

Episode 3 Transcript from Course 3, Week 3 Discussion

<table>
<thead>
<tr>
<th>Student</th>
<th>Transcript</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day 1</td>
<td></td>
</tr>
<tr>
<td>Chloe</td>
<td></td>
</tr>
</tbody>
</table>

(building on to Dana’s note) *Opinion* From my prior experiences in on-line courses I find this statement to be true. I have been able to eventually use other students’ knowledge to help me better understand concepts. However, it is the very act of “bouncing back and forth” that sometimes throws me off course, i.e., I want the answer now not when someone else takes the time to read my note and reply. Where I have had better success is when I have had synchronous chats using tools such as MSN messenger. (RP, OE)

*Reason* In synchronous chats I can ask a question of another student and get an immediate response if, of course, they know the answer. I feel more comfortable asking for clarification and examples about a topic. I don’t worry as much about wording or grammar and therefore I find it to be more similar to having a f2f chat. (OE)
Example If Dana and I had chatted I could have told her in less than a minute that you need to use the HTML `<b>` and `</b>` surrounding the word you wanted bolded (OU)

How idea is useful If others also have this same opinion then perhaps we should think of incorporating both methods (synchronized and asynchronized chats) into all online courses as we are doing in this week’s discussion. (OU)

Problem/limitation It requires two or more people to be in front of their computers at the same time, which takes away from the benefits of asynchronous forms such as Knowledge Forum that doesn’t require that. Does anyone else have any further thoughts? i.e. benefits/weaknesses of my idea? (PE)

Day 2 April Chloe, you provided a great response to Dana’s posted message. It is true that synchronous features such as chat would help you resolve any questions that you have. In thinking about the process of asking questions and reflecting this to my own personal classroom experiences, I must agree with Schwartz and Fischer who state that teachers should stop answering some questions or providing quick answers…(SAC, MC; quotes and rest of note omitted here)

Chloe (annotation on April’s note) Very true, it never occurred to me to think of it that way. Lately I have been so busy with school, work, and the kids that I tend to look for the quickest solution, rather than appreciating the journey I just want to get to the destination. (MC, SAC)

Drew (building on to Chloe’s Problem/limitations): I think there is a tradeoff in this respect. What we gain in immediate response time when having a chat or face-to-face conversation, we lose in terms of a variety of viewpoints and consideration time. While postings are not so direct and
immediate, they allow time for a number of people to respond to a question. They also allow people to consider the question in depth and formulate considered responses. This is of benefit to complex questions, but I agree that a more immediate form of contact is better for questions of clarification or simple content. (OE)

I wonder if the immediate response would be borrowing and the considered response would be a better attempt at building. And yet, maybe the considered response is just a more complex form of borrowing. Need to think about this more… (SE, MC)

Sue Perhaps the question is not whether one is better than another but rather, “What role do synchronous/asynchronous learning environments play in a particular course?” For example, if you are taking a course which requires students to grasp concepts at key stages of a course before moving onto other concepts—you may find that synchronous chats are beneficial. Students would have the opportunity to ask questions, clarify concepts and you would have a feel for whether the majority of students were able to build onto the concept or move onto another subject area. This could occur in a relatively short chat period vs. a longer chat period using an asynchronous forum. (OE)

In this transcript, a group of four students engage in progressive discourse on the concept of building versus borrowing—the challenge of actively constructing ideas. Chloe, April, Drew, and Sue are meeting progressive discourse commitments to work toward mutual understanding, to consider improvability as a positive attribute of conceptual artifacts, and to openness/non-sectarianism. In this episode, the KF version that the students were using required knowledge of HTML tags in order to format notes (bolding, inserting tables, etc.).

Chloe uses the “How idea is useful” support to propose that all online environments incorporate both synchronous and asynchronous communication. Chloe explains that synchronous chats were particularly helpful to deepen her personal understanding in Course 1. Having prior knowledge of HTML, Chloe states that she could have taught Dana how to use the
HTML tags in “less than a minute” during a synchronous chat. Fortunately, Chloe uses the “Problem/Limitations” support to bracket text might suggest that she is remaining open to having her belief about quick answers to be subjected to criticism to engage in progressive discourse.

April politely and indirectly challenge Chloe’s focus on obtaining quick answers via synchronous chat. April elaborates source-based ideas (SE) from Schwartz and Fischer (2003) and integrates these with her own classroom teaching experiences in her note. April emphasizes that students need to coordinate experiences on their own to create representations and that instructors should stop answering some questions to bring this about. April’s contribution mediates growth in Chloe’s conceptual understanding that active construction of ideas is not about borrowing quick answers. Chloe’s annotation on April’s note suggests that some shift in Chloe’s thinking took place, which again shows a commitment to openness.

Drew’s contribution is to accept responsibility for further exploring problems and limitations of synchronous tools in response to Chloe’s request bracketed by the “Problem/limitations” support. Drew integrates his own ideas (OE) and source-based ideas (SE) from course readings to do so. Sue’s contribution is to build onto Drew’s note and reframe the discussion polarizing synchronous and asynchronous learning environments into a more useful one for practice that emphasizes the different roles that each can play in the design of a particular course.

This exchange suggests an “exploratory talk” pattern more accurately described as Initiation, Discussion, Response, Feedback (IDRF) (Wegerif, 1996) than the more typical Initiation, Response, Feedback (IRF) pattern of pedagogical interaction (Sinclair & Coulthard, 1975). The students engage in student-centered discussion focused on understanding the concept of building versus borrowing the rather than on completing tasks. Although Chloe is the only student in this episode who uses KF scaffolds, she uses the scaffolds to highlight ideas that are improvable (How idea is useful) yet remains open to new ideas from others (Problem/limitation). A possible interpretation might be that Chloe formulates conceptual artifacts that are vulnerable to criticism and disconfirmation, which allows this group of students to explore new ideas through collaborative discussion.

Later, in week 10, Course 2 students revisit the role that synchronous and asynchronous tools play in the design of online courses in different content areas, referencing successful programs in subjects like music and drama that some students initially did not believe would be
suitable for the online learning. The fourth episode of progressive discourse traces contributions made by multiple students over a period of five days in Course 3, week 10. While studying theoretical perspectives of online community through readings on the social dimension of asynchronous learning networks (Wegerif, 1998), on building learning communities (Hiltz, 1998), and on practice fields and communities of practice (Barab & Duffy, 2000), the student discussion leaders, Gordon and Lorna, organized the week 10 discussion around three questions:

Question 1: Please comment on the issue of community and how it has been established in your workplace. Relate this to the on-line community of our course.

Question 2: Asynchronous learning, as defined by Picciano⁹ is “learning at anytime or in any place using internet and world wide web software tools as the main vehicles for instruction.” Under this model, students would be free to access the on-line program at their own convenience. What role does student motivation play in one’s contributions to an asynchronous learning environment?

Question 3: In his article, Heath¹⁰ states: “Some fields…will never be suited to extensive computer mediation, especially those concerned with questions of meaning and value, of culture and philosophy.” In your opinion, can every class be offered online? Do internet courses have the same or different content than their in-class equivalents?

The episode below was selected from discussion on the third question, in which 75% of students in Course 3 participated. One tension in the following episode arises between the instructional goal for students to learn the theoretical perspectives of online community and their interpretation of the problem of understanding. Implied in Gordon and Lorna’s discussion of third question is the notion that some subjects are not suited to online course delivery. This idea emerges from the students’ own interests, but it is not clear how this idea relates to theoretical perspectives of online community. As the group discourse unfolds, however, the students actually begin to address, at least indirectly, the theoretical concepts of online community.

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⁹ Gordon and Lorna are referencing Picciano (2002), an outside reading not included in the course reading list.
¹⁰ Gordon and Lorna are referencing Heath (1998), an outside reading not included in the course reading list.
Episode 4 begins as Sharon, a M.A. student and a K-12 teacher, opens the dialogue with a note titled “Not drama” (see Figure 11):

Figure 11. Discussion thread on the topic of subjects suited for online course delivery from Course 3, Week 10.
Episode 4 Transcript from Course 3, Week 10 Discussion

<table>
<thead>
<tr>
<th>Student</th>
<th>Transcript</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Day 3</strong></td>
<td></td>
</tr>
<tr>
<td>1 Sharon</td>
<td>The only course that I can think of which would be nearly impossible to do online at this time would be drama or music. I think the performance-based subjects require face to face interaction. But, I could be wrong. (OU) Any ideas on how to do that? (PE)</td>
</tr>
<tr>
<td>2 Jen</td>
<td>(annotation on Sharon’s note) Maybe with enough broadband both would be possible! Lots of theory could be provided online (OU)</td>
</tr>
<tr>
<td><strong>Day 7</strong></td>
<td></td>
</tr>
<tr>
<td>3 Hanna</td>
<td>(builds on Sharon’s note) Teaching music online might not be so far-fetched. The school board I work with has been involved in a partnership with the Communications Research Centre, CANARIE and a handful of other schools across the country to attempt virtual music education (through video conferencing and asynchronous technologies). It’s been fairly successful. One project they were involved in consisted of teachers and students from a local arts high school teaching Inuit students from a small isolated community in Northern Québec how to play violin with the assistance of members of mentors from the National Arts Centre Orchestra. This year the same northern school is bringing a lost Inuit tradition back to their community. Interested girls at the school are invited to learn throat singing from an Inuit elder in Ottawa (there are no throat singers left in the community itself). <a href="http://www.musicgrid.ca">http://www.musicgrid.ca</a> (SE)</td>
</tr>
</tbody>
</table>

In this transcript, Sharon proposes that performance-based subjects such as drama or music may be unsuitable for online courses. However, Sharon also acknowledges that she could be wrong, thereby honoring the progressive discourse commitment to remain open to others’ ideas on how these subjects may be offered online if it would advance understanding.
Jen, a PhD student and a post-secondary instructor, annotates rather than builds-on to Sharon’s note with an alternate idea. Jen suggests that with enough broadband, both drama and music may be offered online. Jen also indirectly disagrees with Heath (1998). She suggests, “lots of theory could be provided online.” Unfortunately, Jen’s ideas are unelaborated (OU). By annotating Sharon’s note rather than building on to it, Jen does not take responsibility for advancing progressive discourse by exploring the consequences of disagreeing with Sharon’s ideas. For instance, Jen could have expanded the basis for the discussion by accepting responsibility for testing her own theory about broadband.

This discussion thread remains undeveloped for four days. Research investigating online patterns of participation and longevity of threads suggest that the common practice of reading and responding to new notes means that students ignoring older notes (Brett, Woodruff, & Nason, 1999; Hewitt, 2005). However on day 5, Hanna, a M.Ed. student and educational technology consultant for a school board, builds on to Sharon’s note to express her interest.

Hanna references a project website with which her school board has been involved, http://www.musicgrid.ca. This project partnered Communications Research Centre (a agency of Industry Canada, the governmental department with the mission to foster a growing, competitive, knowledge-based Canadian economy), CANARIE (a non-profit advanced Internet development organization whose mission is to accelerate Canada's advanced Internet development), and several schools across the country to connects students, teachers, and mentors in small group videoconferences via live webcast, which were also available asynchronously. Using asynchronous video tools, mentors were also able to provide timely feedback to teachers and students.

One of the projects that Hanna describes in detail involves teachers and students from an arts high school in Ottawa teaching Inuit students in an isolated community in Northern Quebec to play violin with the mentorship of members of the National Arts Centre Orchestra. Hanna also describes details of a current music project in which the same northern school is reviving a lost Inuit tradition of throat singing in their community by connecting with an Inuit elder located in Ottawa as there are no throat singers left in their community.

The projects that Hanna describes not only provide support for the possibility of offering a performance-based subject like music online, but also are suggestive of the theoretical perspectives of community that the students were to discuss in Course 3, week 10. For example,
Inuit students learning violin at a distance may be seen to be becoming a part of an authentic community of practice of musicians—peers, teachers, and practicing musicians—as legitimate peripheral participants (Lave & Wenger, 1991; Wenger, 1998). In sum, by referencing the website and presenting examples of successful online music projects, Hanna presents source-based ideas (SE) and new information to support the idea that music could be offered online.

This episode of progressive discourse ends as the group attains the goal of exploring how a performance-based subject like music could be offered online. It may be argued that without the foregrounding of Sharon’s openness to considering the possibility of performance-based subjects being offered online, and Jen and Sabine’s unelaborated ideas in response to Sharon, Hanna may not have presented new facts to deepen the shared understanding of this group of students.

The multiple students’ contributions here could be considered collaborative, promotive interactions (Johnson & Johnson, 1998), in which individuals encourage and facilitate each other’s efforts to reach the group’s goals to deepen understanding of how performance-based subjects like drama could be offered online.

Interestingly, none of the students in this episode inserted KF scaffolds into their notes in this last episode. However, it might have been helpful for Hanna to use New Information to highlight her contribution. This would have drawn the group’s attention to an aspect of progressive discourse that is often absent in online graduate courses, the commitment to expand the factual base. Extending the range of issues related to understanding a problem might also assist students in meeting another progressive discourse commitment for empirical testability. As mentioned in the section discussing self-report data in weblogs, Hanna considered features such as scaffolds to enable her to find distributed information within the community and build on to advance what is known. Perhaps increasing the usability of KF scaffolds would help students like Hanna to take advantage of these software-based supports more often.
Chapter Six: Conclusions And Implications

Whereas many studies have examined online collaboration, less is known about how instructors may move students to the next step and support the development of online progressive discourse. The purpose of this dissertation was to investigate what kinds of instructional interventions foster the emergence of progressive discourse. This chapter summarizes the main conclusions that emerged through the analyses of the data presented in the previous chapter. The implications for these results for analyzing the quality of online discourse and designs of instructional scaffolding in online learning environments are discussed. After reviewing the limitations, the chapter ends with directions for future research and conclusions.

Summary

Chapter five presented findings from a variety of manifest and latent analyses of student discourse data aligned with Bereiter’s (2002b) commitments to progressive discourse. An overview of the students’ participation was provided through commonly used measures such as note count, replies, and thread sizes. These were able to determine some qualities of the online discourse, but did not shed light on the development of progressive discourse. In subsequent sections, a comparison of the manifest and latent analyses of this data suggest the following about discourse that occurs when students honor the commitments:

The students:

- reference each other’s discussion notes more
- collaborate to co-author more notes
- interact with peers more and exhibit less dependence on the instructor
- focus on conceptual artifacts such as designs, concepts and theories, rather than on topics oriented towards completion of tasks
- contribute notes that reference peers’ ideas but forward their own ideas, ask questions to request further explanations and integrate facts from authoritative sources

These findings are consistent with the knowledge building pedagogical approach taken in the current study. Each iteration of the study implemented new designs of interventions to increase the level of progressive discourse processes among students.
Two interventions appeared to foster increased levels of progressive discourse: the use of the Discourse for Inquiry (DFI) cards, and the introduction of specialized Knowledge Forum (KF) scaffolds. The remaining sections of chapter five thus described how these interventions brought about change in the students’ discourse.

From analyses of the students’ self-report and online discourse data, peer scaffolding in the form of DFI cards appeared to be most helpful in fostering the development of progressive discourse:

- when introduced at the beginning of the course
- for newer online learners and newer graduate students to help them establish productive practices for online learning and problem solving
- for students who are not K-12 teachers in the M.Ed. program, but who are corporate trainers, educational technology consultants, post-secondary instructors and health care professionals already familiar with the culture of collaborative knowledge work and research
- to change the students’ discourse, at times, to resemble those of more advanced graduate students who explicitly reference segments of their peers ideas, pose questions to reframe the ideas for further inquiry, integrate facts and theory from sources, and present tentative synthesis of the group’s understanding
- when students continue to use the DFI cards throughout the course

The DFI cards were intended to provide students, particularly students who were practicing teachers unfamiliar with the norms of progressive discourse, with strategies for giving constructive peer feedback, problem finding and problem solving. However, a significant barrier to fostering progressive discourse was the tendency for teachers to reject these norms and revert to belief-mode thinking (Bereiter & Scardamalia, 2003, 2006) and devotional discourse (Woodruff & Brett, 1999) typical of traditional schooling.

Through analyses of students’ scaffold use, self-report and online discourse data, the following trends in the students’ use of the software-based scaffolding as found in Knowledge Forum’s scaffold support feature were found:
• an increase in the use of scaffolds over iterations of the study
• the proportion of scaffolds for Theory Building and Progressive Discourse increased during each iteration
• the proportion of Opinion scaffolds decreased during the final iteration
• notes with scaffolds contained significantly more words than notes without scaffolds
• students used scaffolds to meet the commitment to work towards common understanding the most
• to lesser degrees, students also fulfill the conceptual artifact, improvability, and openness commitments
• students are not expanding the factual base or exploring empirical testability

The KF scaffolds were intended to focus students’ reading and writing of notes to structure online discussion in progressive ways. Nonetheless, students reported negative perceptions about scaffolds, particularly how scaffolds constrained creative thinking and pointed to usability issues.

**Implications for Analyzing the Quality of the Discourse**

This study addressed a problem that remains in knowledge building research, to characterize the complex interaction between individual and group understanding in online discussion environments (Lee et al., 2006). Historically, researchers analyzing online discourse to improve the depth of learning that occurs in computer-supported collaborative learning environments have focused on the content of individual contributions. Existing content analysis schemes (e.g., Garrison et al., 2001; Gunawardena Lowe, & Anderson, 1997; Henri, 1992) thus tend to classify the content of individual student notes into hierarchical categories of interactions and phases of knowledge construction or inquiry.

In this study, I took an approach consistent with the knowledge building theoretical framework guiding this study to analyze online discourse that occurs when students uphold Bereiter’s (2002) commitments to progressive discourse. Commitments to progressive discourse might be considered cognitive responsibilities that individuals uphold rather than the characteristics of discourse that are easily observable in transcripts. Identifying possible indicators in group discourse and corresponding analyses for each of the progressive discourse commitments is an important contribution. I also described in depth what episodes of progressive
discourse look like as it unfolds in situ in online graduate course contexts. This analytical approach offers researchers a starting point to analyze the development of progressive discourse for knowledge building in online CMC transcripts. Ideally, automated analysis tools built into the database that detect the emergence of progressive discourse would be developed in the future to make it more applicable to educational practice.

**Implications for Designs of Instructional Scaffolding**

This section suggests some practical implications of this research for instructional scaffolding in online education, teacher professional development, and knowledge building.

**Online Education**

In the context of growing opportunities for online graduate courses and degree programs, it is important to understand various instructional strategies can promote discussion that deepens learning. Research shows that critical discourse (Garrison et al., 2001; Rourke & Kanuka, 2007) and knowledge construction (Gunawardena et al., 1997; Kanuka & Anderson, 1998) rarely occur online. Since students may unknowingly engage in practices that impede progress in threads, it is recommended that instructors constrain the number of discussions and draw attention to threads that have faltered (Hewitt, 2005).

To foster progressive discourse, instructors should explicitly orient students to the computer conference as a forum for deepening understanding and building knowledge. This culture of conferencing is unfamiliar to many students, so emphasizing critiques as constructive feedback rather than as personal attacks is crucial to keep the discussion collaborative. Instructors should also accord value to progressive discourse as an integral part of course participation and intervene when students encounter barriers to progressive discourse. For example, students may be prompted to consider if they are evaluating evidence from sources rather than opinions.

**Teacher Professional Development**

Bridging the culture between teaching and research is an ongoing challenge in online professional development. In learning journals and weblogs, there were clear indications that DFI cards induced a positive change in the way certain students contributed to the group discussion. The Managing Meetings card helped students overcome anxiety about posting notes in Knowledge Forum. The Managing Group Discourse card assisted students in giving feedback
to peers in critical, but constructive ways. Most relevant to this thesis project, The Managing Problem Solving card made explicit the commitments to progressive discourse. Analyses of the questionnaire data revealed, however, that none of the students who reported using the cards were teachers in the K-12 system. Instead, they were corporate trainers, educational technology consultants, post-secondary instructors, and health care professionals who were already familiar with the culture of collaborative work and research. In-depth analysis of discourse for groups supported these findings, as episodes of progressive discourse ceased to be so when teachers did not solve problems but rather engaged in devotional discourse (Woodruff & Brett, 1999). This study’s findings are consistent with literature suggesting that teachers mostly contribute personal narratives in online discussions (Pawan et al., 2003) and confirm their own ideas or teaching practice rather than change cognition through collaborative learning (Meirink et al., 2007).

One implication from these findings is that instructors should provide graduate students, especially K-12 teachers, with more support to acculturate to collaborative knowledge work and the research. Bereiter and Scardamalia (2006) admit that dealing critically with conceptual artifacts in design mode has typically been the work only of advanced graduate students. Thus, instructors could draw attention to the difference between belief mode thinking that characterizes much of their teaching practice and design mode thinking that is key to collaborative knowledge work. Teachers resisted the unfamiliar, formal, and constraining norms of progressive discourse, but found resonance with the pragmatic concerns of design mode thinking:

What is this idea (concept, design, plan, problem statement, theory, interpretation) good for?
What does it do and fail to do?
How can it be improved? (Bereiter & Scardamalia, 2006, p. 701)

Another implication from findings of KF scaffold use is that since teachers were able to use KF scaffolds corresponding to each commitment for progressive discourse, this might be a more effective strategy to bring about change in the students’ discourse over time. The next section examines this possibility in more depth.

**Knowledge Building**

The DFI cards offered social supports for knowledge building to complement the technological supports that Knowledge Forum already features. Analysis of KF scaffold use
suggested that the customized scaffolds for Progressive Discourse (Idea Improvement, Idea Advancement) assisted students to engage in progressive discourse. The use of Opinion scaffolds decreased during the final iteration, which suggests that students were trying to find and solve problems rather than to express opinions. In doing so, they may have written longer, more reflective notes containing more words. Promisingly, students appeared to meet, in various degrees, the commitment to work towards common understanding, to focus on conceptual artifacts, to consider improvability as a positive attribute, and to maintain openness/non-sectarianism. Interestingly, certain aspects of progressive discourse were absent. Students did not uphold the commitment to expand the base of facts or to explore empirical testability. In analyses of the self-report data the usability of the scaffolds was identified as a problem. Although similar to wiki functionality, students found it difficult to learn how to use the scaffolds from both social and technical tool perspectives.

The implications of these findings are that instructors should provide special training for students to learn how to use scaffolds from the beginning of the course. Over iterations, the procedure for introducing students to Knowledge Forum’s scaffold support feature was changed. In addition to step-by-step instructions on how to use the technological feature, theoretical and empirical rationales for scaffolding (e.g., Land, 2000; Vygotsky, 1978; Wood, Bruner, & Ross, 1976) were also provided. In addition, to encourage students to work with ideas rather than opinions, only Theory Building and Opinion scaffolds might be offered. Since notes with scaffolds are longer, students may “scan” these longer notes rather than read them in depth (Hewitt & Brett, 2007; Hewitt et al., 2007). Instructors should emphasize to the students the importance of reading all notes carefully.

Another implication that emerges from the analysis of KF scaffold use is that it might be helpful for instructors to explain that ideas might be distinguished as facts or explanations (theories) in progressive discourse. In scientific inquiry, progress is made when one theory explains more of the facts than another theory. This is a disciplinary standard that may not be familiar to graduate students in education. However, as Lagemann (2008) observes, disciplinary standards shape how a researcher frames a problem and guides the way inferences are made to improve “the doing” of educational research. In Knowledge Forum, the “New information” could be used to contribute facts from authoritative sources. In turn, this should allow students to
test theories empirically using the “This theory cannot explain” and “How can we test X” scaffold supports. Doing so would foster more progressive discourse.

Alternatively, the design of the asynchronous conferencing environment might be changed. Various client versions of Knowledge Forum (e.g. versions 3.4, 4.6, 4.7) feature a graphical interface that allow students to cluster notes together and reveal connections between them in a visible way. This interface might provide another way for students to organize notes to show progress in the discourse. For example, notes that contain facts could be clustered together and connections made to notes that explain these facts. This should make it easier for students to tell when an idea (theory, explanation) has been improved.

Preliminary research suggests that wikis could support knowledge building in graduate course contexts (Hewitt & Peters, 2006). Co-authored notes were rarely seen in the Knowledge Forum student discourse data in this study. In wikis, the collaborative writing process is the focus. The findings of this study suggest that Knowledge Forum supported the generation of many explanations, but did not encourage students to contribute facts. Wikis could offer an environment that promotes the gathering of new information and facts to extend the range of issues. This should increase the level of progressive discourse among students.

Limitations

Given the small sample size and the exploratory nature of this dissertation, I do not claim to generalize the findings reported here. The findings in this thesis are only suggestive, but they do illustrate ways in which graduate students can uphold the commitments to move beyond expressions of socio-affective connection and opinion to discuss ideas in ways that lead to more useful explanations.

The recommended standards for verification in a design-based research study are trustworthiness, credibility, and confirmability (Barab & Squire, 2004). In this study, audit was performed for the more qualitative coding and intercoder reliability was calculations for the more quantitative coding. However, because collective standards for quality are still in development in the design-based research community, it is not certain that these procedures were the most appropriate ones to ensure quality of the current study.

The findings from two interventions that were particularly effective in fostering progressive discourse are reported here. It was beyond the scope of the current study to investigate whether the reading selections chosen to orient students to progressive discourse in
Iterations 2 and 3. Inferring whether students knew the concepts contained in a particular reading selection prior to the course or as a result of reading it the course is not possible from studying textual transcripts. Interviews would provide more insight into the effectiveness of the reading selections.

To make the labor-intensive qualitative assessments of students’ patterns of participation and level of progressive discourse more useable in practice, quantification of the relationships can be developed in future research as described in the following section.

**Directions for Future Research**

A significant issue arising from this study is the need for future research to draw a more complete picture of the kinds of complex and dynamic social and semantic relationships that exist between participants that support the development of progressive discourse in online learning environments.

One area of research that I would like to pursue is to extend the suggestive findings about progressive discourse from this study with more quantitative analyses. Visualization tools (e.g., Teplovs, 2008; Yoon, 2008a, 2008b) would be an exciting way to explore the interdependent group processes of progressive discourse in more quantitative ways. While analyzing the kinds of ideas students contributed within notes (Latent Analysis 2), I noticed that students included expressions of socio-affective connection (12.1% of ideas coded in Course 2, 18.8% of ideas coded in Course 3) in addition to academic, socio-cognitive contributions. It would be interesting to examine quantitatively how social connections influence the peers that students reference, question, and provide new information to. Social network graphs can reveal hidden information that participants use to make strategic decisions about who to interact within a discussion activity (Yoon, 2008b).

It may also be fruitful to contrast the qualitative coding of topics (Latent Analysis 1) conducted in this study with notes clustered together by semantic similarity based on Latent Semantic Analysis (Teplovs, 2008). Another approach would be to create a database that overlays codes applied to ideas (Latent Analysis 2) over the clusters to automate the in-depth analysis of discourse for groups to make it more applicable to practice.
Conclusion

Progressive discourse is essential for achieving knowledge building in online graduate courses. Although norms for quality, quantity, relevance and manner are applicable to all kinds of discourse (Grice, 1975), when the commitments to progressive discourse (Bereiter, 2002b) are not met in group discourse, knowledge building is not possible. Previous studies on scaffolding knowledge building dialogue (e.g., Sorensen & Takle, 2005; Takle, Sorensen, & Herzmann, 2003) offer some useful insights, but these studies draw on Stahl’s (1999) definition of collaborative knowledge building as one that employs critical thinking skills (brainstorming, articulation, reacting, organizing, analyzing, and generalizing) rather than on Scardamalia and Bereiter’s (2003) conceptualization of knowledge building that focuses on the creation and improvement of ideas of value to a community.

This dissertation study investigated how online progressive discourse could be fostered in semester-long online graduate courses by making explicit the commitments to progressive discourse through two kinds of instructional scaffolding. Theoretically, it is critical to consider the commitments in toto. They are the commitments of the community rather than of an individual, and when a group of students collectively honor all of the commitments, progressive discourse emerges in the group discourse. Findings suggest that peer-based scaffolding in the form of DFI cards is most effective when introduced at the beginning of the course to make all of the students aware of the commitments. This is consistent with recommendations for community building in existing models for online teaching and learning (Salmon, 2000), as well as studies investigating social supports in technology-supported learning environments (e.g., Bielaczyc, 2006; Lai & Law, 2006). Findings also indicate that software-based scaffolding in the form of KF scaffolds offers a promising way to support diverse students in meeting each of the commitments over time. Research suggests that computer supports can help students improve learning and knowledge building (Scardamalia & Bereiter, 1994; Scardamalia et al., 1994). Findings from the current study suggests KF scaffolds offer particular affordances for increasing the length and reflexivity of written notes; assisting students in reading their peer’s notes by making the metacognitive processes of the author apparent; and enabling students to search quickly for specific information in peer’s notes. These features of the software should help students to engage in more progressive discourse for knowledge building in the online course community.
The online course community contexts studied in this thesis project may be more accurately considered a learner’s community (Henri & Pudelko, 2003), a practice field (Barab & Duffy, 2000), or a bounded course community (B. G. Wilson et al., 2004) rather than a true community of practice (Wenger, 1998). While the course contexts are separated by login and password from the public, they do provide an opportunity for graduate students pursuing academic goals to engage in the discourse of the larger academic discourse community and develop a sense of self as a researcher. Alternatively, students pursuing professional goals have the opportunity to learn from peers (outside of their workplace communities of practice) who have common teaching problems and to develop an identity as an accomplished member of their own community able to implement research-based practice. Engaging in progressive discourse may have the greatest relevance for doctoral students and for master’s students who plan to pursue doctoral research. For students with academic goals, technological supports (e.g. blogs) for participation in the larger academic community of practice beyond the course boundary and individual development (Freeman, 2008) would be useful.

However, the focus of the research reported here was to explore ways to foster the development of progressive discourse within the boundaries of online graduate courses. Models for online teaching and learning present a trajectory where given appropriate technological and pedagogical support, all students progress from gaining access to the environment, interacting socially, exchanging information, to knowledge construction and development (Salmon, 2000). However, a perennial problem is moving students to knowledge construction and critical discourse that is the hallmark of higher education (Gunawardena et al., 1997; Garrison et al., 2001). The current study offers some original insights for using two interventions to support the development of progressive discourse central to knowledge building, a radical approach to refashion traditional educational practice to prepare students for creative work and innovation in the knowledge economy (Bereiter & Scardamalia, 2003).

Methodologically, an in-depth analysis of discourse for groups aligned with the commitments for progressive discourse was developed. Content analysis methods typically used to assess online discourse focus on the quality of individual notes. Previous studies on scaffolding knowledge building dialogue have explored sequences of critical thinking types that increase or decrease the length of discussion threads (Sorenson & Takle, 2005). However, this study took an approach consistent with the knowledge building framework guiding the study to
analyze online discourse that emerges when a group of students fulfill the commitments to progressive discourse. Instructors and designers interested in innovations for deepening collaborative learning and knowledge building online can use these insights to help students interact with each other in progressive ways. While it is challenging for individual students to adopt cultural norms of inquiry that are unfamiliar to them, given time and appropriate peer and software-based supports it may be possible to move students along the trajectory towards progressive discourse in which self-organization and creative work with ideas are achievable in online learning.


Rovai, A. P. (2002). Building sense of community at a distance. *International Review of Research in Open and Distance Learning, 3*(1), 1-16.


Appendix A: Participant Informed Consent Document

(On Departmental Letterhead)

To: Students in ______ (name of course) ______________________

From: Nobuko Fujita

Re: Informed consent form for online discussion study

I am a doctoral student in the Department of Curriculum, Teaching and Learning at the Ontario Institute for Studies in Education of the University of Toronto (OISE/UT) working under the supervision of Professor Clare Brett. To satisfy my thesis component of my degree requirements, I am collecting research data and am soliciting your help. I am interested in understanding more about what group processes support discourse and collaboration in online knowledge building environments. Such information is helpful for two reasons: 1) in improving teaching by showing how online courses can be most effectively implemented; and 2) in providing research data over time that tells us more about how online learning can be most usefully structured to benefit participants.

During this course, I am requesting: 1) your permission to use your online contributions to the database, anonymously as a part of the research data; 2) to complete an online questionnaire to get an idea of who you are and your experience with computer conferencing during class time; and 3) to be interviewed twice by me on audio-tape about your experience working online during the course and use that information as data for this study. The questionnaire should take you about 5 minutes to complete. You are free to decline to answer any questions during the interviews, which should last about 15 minutes and will take place at OISE/UT in room 11-279 at 5:00 pm, 30 minutes before class starts at 5:30 pm. You are also free to decline to have your online contributions and questionnaire responses used as part of the data. If you do not consent to participate in the study, your online notes will not be read, you will not get a questionnaire, and you will not get interviewed.

Your decision to take part or not take part in this study will not influence your grade in the course. Your course instructor will not have access to the completed consent forms and will not know who has agreed to have their data included from either the online contributions, online questionnaire, or interviews.

Confidentiality
All questionnaire, online conference, and interview data will have identifying information (your name, course, etc) removed and your survey responses identified by a number. Further, no participant will be identified by name in any research conference or publication in which these data are discussed. All identifying information (names, locations, etc) will be changed to codes and pseudonyms by the investigator, Nobuko Fujita. Only she and her supervisor, Prof. Clare Brett, will have access to the collected data. No names will be attached to any of the materials. All data files will be encrypted using the password facilities of Microsoft Office 2000 for word and data processing files. The data files will be stored on compact disk and kept in a locked cabinet for five years, after which they will be destroyed. The results from the research are intended to inform the future design of computer conferencing courses and be reported in academic journals.
I understand that these data will be used anonymously and that I may withdraw my permission at any time and without providing a reason by contacting the investigator, Nobuko Fujita by email: nfujita@oise.utoronto.ca or phone: (705) 745-8907. Alternatively, you may contact Prof. Clare Brett by email: cbrett@oise.utoronto.ca or phone: (416) 923-6641 ext. 2596. These contacts will also be available throughout the study to answer any questions or concerns I may have. I will keep a copy of the consent form for my records.

Name of Participant (please print)  Signature  Date

______ I agree to allow my notes in this course and survey data to be used as part of the research described above

______ I give my permission for my interview responses to be included as data in this study

______ I would like to receive a summary of the research results via email once the study is completed
Appendix B: Instructor Informed Consent Letter

(On Departmental Letterhead)
To: Professor ______________________
From: Nobuko Fujita
Re: Informed consent form for online discussion study

I am a doctoral student in the Department of Curriculum, Teaching and Learning at the Ontario Institute for Studies in Education of the University of Toronto (OISE/UT) working under the supervision of Professor Clare Brett. To satisfy my thesis component of my degree requirements, I am soliciting your help in the data collection stage.

I am interested in understanding more about what group processes support discourse and collaboration in online knowledge building environments. Such information is helpful for two reasons: 1) in improving teaching by showing how online courses can be most effectively implemented; and 2) in providing research data over time that tells us more about how online learning can be most usefully structured to benefit participants.

I would like to discuss a number of discussion activities that may be integrated into the design of the online course component that would be appropriate to your course. The activities may include interactive online discussion and individual online contribution writing with scaffolds for a more progressive, scientific type of discourse. Should you agree, student-participants will be requested 1) for permission to use their online contributions to the database, anonymously as a part of the research data; 2) to complete an online questionnaire to get an idea of who they are and their experience with computer conferencing during class time; and 3) to be interviewed twice by me about their experience working online during the course and use that information as data for this study. The survey should take your students about 5 minutes to complete. Participants will be free to decline to answer any questions during the interview, which should last about 15 minutes and will take place outside of class time. Participants are also free to decline to have their online contributions and questionnaire responses used as part of the data.

The students’ decision to take part or not take part in this study will not influence their grades in your course. The signed consent forms will be filed securely in a locked cabinet in my office, after which they will be destroyed. You will not know who of your students has consented or not consented to participate in the study to ensure privacy and confidentiality.

Confidentiality
All questionnaire, online conference, and interview data will have identifying information (name, course, etc.) removed and survey responses identified by a number. Further, no participant will be identified by name in any research conference or publication in which these data are discussed. All identifying information (names, locations, etc) will be changed to codes and pseudonyms by me, and my supervisor, Prof. Clare Brett, and I will have access to the collected data. No names will be attached to any of the materials. All data files will be encrypted using the password facilities of Microsoft Office 2000 for word and data processing files. The data files will be stored on compact disk and kept in a locked cabinet for five years, after which they will be destroyed. The results from the research are intended to inform the future design of computer conferencing courses and be reported in academic journals.
If you give me permission to collect data from students in your class giving consent, please date, sign and return one copy of this letter to me. Thank you for taking the time to consider my request. I look forward to the opportunity of working with you.

Yours truly,
Nobuko Fujita

I agree to allow the investigator, Nobuko Fujita, to collect data from students in my class provided they consent to participate in her study. I understand that only Nobuko and her thesis supervisor, Prof. Clare Brett, will have access to the data or which students gave consent. I understand that the students’ participation will not influence their grades in my course.

______________________________  ________________________
Signature                      Date
Appendix C: Online Questionnaire for Iteration 1

Please complete the following biographical data survey:

1. Gender:
   _____ Male
   _____ Female

2. Age:
   _____ <25
   _____ 26 to 35
   _____ 36 to 45
   _____ 46 to 55
   _____ >55

3. Academic department (e.g., CTL, HDAP) ____________________________
4. Academic specialization (e.g., Curriculum, Teacher Development) ________________

5. Degree program
   _____ M.Ed.
   _____ M.A.
   _____ Ed.D.
   _____ Ph.D.
   _____ Other

6. Registered
   _____ full-time
   _____ part-time

7. Year of study?
   _____ 1st
   _____ 2nd
   _____ 3rd
   _____ 4th
   _____ 5th
   _____ 6th
   _____ 7th or higher

8. Total number of graduate courses taken at OISE/UT _________
9. Total number of courses taken totally online _________
10. Total number of courses taken with online component _______

11. If you have taken an online course, what software did it use? (Indicate all that apply)
   _____ Blackboard
   _____ FirstClass
   _____ Lotus Notes
12. How would you rate your computer skill level at the beginning of this course?
   ______ High
   ______ Average
   ______ Low
   ______ None

13. Please describe any previous experience with collaboration, including those using computers and online learning:

_________________________________________________________________________________
_________________________________________________________________________________
_________________________________________________________________________________
_________________________________________________________________________________

[\text{Etc. I haven’t finalized these questions by any means. These questions were originally on course evaluation surveys, whereas I am using it to develop a better profile of the participants…}]
Appendix D: Pre-Intervention Interview Questions for Iteration 1

How do you decide which online discussion notes to read?

How do you initiate online discussion?

When there is an existing discussion thread, how do you decide to build-on to it?

Prompt: Do you respond to certain classmates or placement of notes?

When you build-on to discussion threads, what kind of feedback do you give?

a. Do you give feedback that supports another classmate’s ideas, but does not present new ideas? Why or why not?

b. Do you give critical feedback that challenges or opposes a classmate’s ideas? Why or why not?

c. If you give critical feedback, how do you go about doing it?

Do you make any efforts to encourage classmates to contribute to online discussion? Prompt:
Can you give me an example of what you do?

Does the instructor influence your level of critical feedback to your classmates in any way?
Prompt: Can you explain how the instructor’s attitudes or behaviors either encourage or inhibit your feedback?
Appendix E: Post-Intervention Interview Questions for Iteration 1

1. How do you decide which online discussion notes to read?

2. How do you initiate online discussion?

3. When there is an existing discussion thread, how do you decide to build-on to it?
   Prompt: Do you respond to certain classmates or placement of notes?

4. When you build-on to discussion threads, what kind of feedback do you give?
   a. Do you give feedback that supports another classmate’s ideas, but does not present new ideas? Why or why not?
   b. Do you give critical feedback that challenges or opposes a classmate’s ideas? Why or why not?
   c. If you give critical feedback, how do you go about doing it?

5. Do you make any efforts to encourage classmates to contribute to online discussion?
   Prompt: Can you give me an example of what you do?

6. Does the instructor influence your level of critical feedback to your classmates in any way?
   Prompt: Can you explain how the instructor’s attitudes or behaviours either encourage or inhibit your feedback?

7. Is the social contract activity helpful for your online learning?
   Prompt: What do you find helpful or not helpful?

8. Does the social contract activity help you collaborate in group projects?
   Prompt: Why was it helpful or not helpful?

9. Do you use any supplementary media (e.g., synchronous chats, graphics, video clips) in the database?
   Prompt: Describe what you use and why?
Appendix F: Discourse for Inquiry Cards for Iteration 2

Discourse for Inquiry (DFI) cards were originally developed as classroom materials for a research study by Woodruff and Brett (1999). In that study, preservice teachers and grade 5/6 students used strategies on the cards to help them develop working norms and discourse structures in an effort to promote inquiry. The DFI cards were updated to Bereiter’s (2002) commitments to progressive discourse and adapted to our online graduate course context with many inservice teachers. Attached are three cards:

- managing meetings – group process: dealing with anxiety (green)
- managing problem finding and problem solving (blue)
- managing group discourse- voicing supporting and opposing views (pink)

These cards may be useful for establishing a framework for our online collaborative discussion. They may help reduce the level of anxiety that you may feel about discussing complex ideas online, structure your discourse to promote inquiry, and provide better feedback to your peers, especially when you have very strong opinions on an issue. Read the attached DFI cards over and become comfortable with the strategies involved. You may want to print them out for reference and store them by your computer. If you print them out, you can cut the first page in half horizontally, then fold the cards in half vertically and tape/glue/staple them together. If you have questions about them, please ask them in the Course Questions View.

DISCOURSE FOR INQUIRY

MANAGING MEETINGS

Group Process: Dealing with Anxiety

The following two strategies are based on two propositions:
1. Emotions are not free floating; they are connected to your interpretations of events—i.e., they are specific.
2. Whatever is being discussed; part of how you feel about the situation is related to how you see yourself in that situation; i.e., you act and talk within a context which has an influence on you.

Strategies to help
1. Method of personification (personal & metaphorical).
   Cast your inner voices as characters in a personal psychodrama. Candidates from past and present may include parents, teachers, friends, colleagues, spouses, and yourself—in childhood, adolescence, and adulthood. Goal here is to identify them, name them, accept their existence then explore their concerns—the consequences of their warnings. You have to decide what role you want to play and learn what to expect from each of the characters. Better a known than an unknown enemy; it resembles the next strategy in that you anticipate their “criticisms” and work out a realistic response to those criticisms.
2. Method of objectification (logical and objective).

...continued on reverse

DISCOURSE FOR INQUIRY

MANAGING PROBLEM FINDING

When evaluating ideas:
- Is the description of the current situation accurate?
- Is the evaluation of the current situation acceptable (i.e., the assumptions)?
- Is the proposal for change a practical one?
- Might there be other consequences of the change not yet considered?

Integrating material:
- How are these ideas the same or different to x?
- Would this author and x agree on an issue of?

Analyzing own theories:
- What is my position on _____?
- What evidence do I have for that view?
- If I don’t have much evidence, why do I feel so strongly about this position?
- How does the argument presented here fit with my own thinking on _____?
- Given the relative evidence, can the two positions be reconciled or is one stronger than the other?

DISCOURSE FOR INQUIRY

MANAGING PROBLEM SOLVING

Keep the focus on ideas:
- Think of ideas as conceptual artifacts. Conceptual artifacts have logical and explanatory kinds of relations between them. One conceptual artifact could imply, be derived from, contradict, be an alternative explanation for, be a generalization of, limit, etc. another.
- Consider improbability as a positive attribute of ideas. Share ideas as works in progress so there is something explicit to work with and to improve in discussion.
- Work toward common understanding satisfactory to all. Not an answer necessarily, as major differences in opinion may exist, but a step forward in an ongoing process of inquiry.
- Develop and pull together evidence for and against, questions and hypotheses generated by the group members. Frame questions and conjectures in ways that enable evidence to be brought to bear on them, (“what would it mean if...?” “how could we test that?...?” “if we assume x is true, how does that help us understand y...?”)
- Be open to examining all ideas and beliefs critically if it will help advance the group discourse. You can’t challenge everything all the time, but you can test out the consequences of disagreeing with an idea (“suppose we take x idea as wrong/right, what consequences does that have for this theory?”)
- Be flexible about theorizing or hypothesizing alternative stances. Entertain stances opposite to your own opinions or beliefs. Play devil’s advocate.
MANAGING GROUP DISCOURSE

When voicing a supporting view:
- Look for the good ideas in other’s thinking: “Relating these ideas to your teaching makes the concept much clearer!”
- Show appreciation for good ideas: “That was a really helpful analysis of the problem because it lets us pull together all these points.”
- Introduce a better idea as a friendly amendment: “Would you be willing to consider this qualification/addition...?”
- Credit others for contributing to your thinking: “I hadn’t even thought of looking at it that way and it helped me think of another example.”
- Acknowledge others’ contributions such as tact, frankness, patience, etc.: “That was really well put.”

When voicing an opposing view:
- Find fault with ideas, not the person: “I’m not clear how that position/idea helps move the argument ahead, perhaps we could look at it this way...”
- Acknowledge the merits of a person’s position before criticizing: “I think that issue is a really important one to take into account, but I also think x needs to be taken into account.”
- Focus on introducing good ideas rather than attacking bad ones: “Perhaps if we could focus on this aspect of the problem it might help us pull the ideas together...”
- Let people save face by finishing talking when you think they are wrong: that is, don’t interrupt to correct them, or make it evident that you disagree. Online, read to the end notes you disagree with and reflect on the whole argument.
- Encourage people to disagree with you: respond objectively (focused on ideas) rather than defensively (focused on bolstering your position).
- Use descriptive words to present a clear picture of the problem. Avoid using words such as weak, strong, incompetent, indecisive, dictatorial, as these are very evaluative and will make people defensive.
- Use assertive, not aggressive language in discussing how ideas could be improved. If you can add, “you dummy” to the end of the sentence, it was an aggressive statement.
Appendix G: Discourse for Inquiry Cards for Iteration 3

In the Wilson et al. (2004) reading for Week 1, the authors explain that the emergence of community in formal courses depends on group’s collective personality or character, and the distributed participation of group members. They further suggest that participation is mediated by the rules, incentives, and structures that form the course infrastructure. In this course, we will be using the Discourse for Inquiry (DFI) cards, which may help us develop productive norms that will contribute to community building. The DFI cards were originally developed as classroom materials for a research study by Woodruff and Brett (1999). In that study, preservice teachers and grade 5/6 students used strategies on the cards to help them develop working norms and discourse structures in an effort to promote inquiry. For 1608, the DFI cards were updated to Bereiter’s (2002) commitments to progressive discourse and adapted to our online graduate course context with many inservice teachers. You can refer to the DFI cards while writing your online contributions. They are designed to work with the Idea Advancement scaffolds, and may be useful in selecting the appropriate scaffold supports to add to your note. Attached are two cards. The managing problem finding and problem solving (blue); and managing group discourse – voicing supporting and opposing views (pink). Please read the DFI cards over for Week 1, and become comfortable with the strategies involved. When you print them out for reference to store them by your computer, make sure that the page scaling is not selected in the print dialogue window. Once printed, you can cut the page in half horizontally, then fold the cards in half vertically and tape/glue/staple them together. References: Woodruff, E. & Brett, C. (1999). Collaborative knowledge building: Preservice teachers and elementary students talking to learn. *Language and Education, 13*(4), 280-302.
DISCOURSE FOR INQUIRY

MANAGING GROUP DISCOURSE

When voicing a supporting view:
- Look for the good ideas in other's thinking: “Relating these ideas to your teaching makes the concept much clearer.”
- Show appreciation for good ideas: “that was a really helpful analysis of the problem because it lets us pull together all these points.”
- Introduce a better idea as a friendly amendment: “would you be willing to consider this qualification/addition...?”
- Credit others for contributing to your thinking: “I hadn't even thought of looking at it that way and it helped me think of another example.”
- Acknowledge others' contributions such as tacit, frankness, patience, etc.: “That was really well put.”

DISCOURSE FOR INQUIRY

MANAGING GROUP DISCOURSE

When voicing an opposing view:
- Find fault with ideas, not the person: “I'm not clear how that position/idea helps move the argument ahead, perhaps we could look at it this way...”
- Acknowledge the merits of a person's position before criticizing: “I think that issue is a really important one to take into account, but I also think x needs to be taken into account.”
- Focus on introducing good ideas rather than attacking bad ones: “Perhaps if we could focus on this aspect of the problem it might help us pull the ideas together...”
- Let people save face by finishing talking when you think they are wrong: that is, don't interrupt to correct them, or make it evident that you disagree. Online, read to the end notes you disagree with and reflect on the whole argument.
- Encourage people to disagree with you: respond objectively (focused on ideas) rather than defensively (focused on bolstering your position).
- Use descriptive words to present a clear picture of the problem. Avoid using words such as weak, strong, incompetent, indecisive, dictatorial, as these are very evaluative and will make people defensive.
- Use assertive, not aggressive language in discussing how ideas could be improved. If you can add, “you dummy” to the end of the sentence, it was an aggressive statement.

DISCOURSE FOR INQUIRY

MANAGING PROBLEM FINDING

When evaluating ideas:
- Is the description of the current situation accurate?
- Is the evaluation of the current situation acceptable (i.e., the assumptions)?
- Is the proposal for change a practical one?
- Might there be other consequences of the change not yet considered?

Integrating material:
- How are these ideas the same or different to x?
- Would this author and x agree on an issue of?

Analyzing own theories:
- What is my position on _____?
- What evidence do I have for that view?
- If I don't have much evidence, why do I feel so strongly about this position?
- How does the argument presented here fit with my own thinking on _____?
- Given the relative evidence, can the two positions be reconciled or is one stronger than the other?

DISCOURSE FOR INQUIRY

MANAGING PROBLEM SOLVING

Keep the focus on ideas:
- Think of ideas as conceptual artifacts. Conceptual artifacts have logical and explanatory kinds of relations between them. One conceptual artifact could imply, be derived from, contradict, be an alternative explanation for, be a generalization of, limit, etc. another.
- Consider improbability as a positive attribute of ideas. Share ideas as works in progress so there is something explicit to work with and to improve in discussion.
- Work toward common understanding satisfactory to all. Not an answer necessarily, as major differences in opinion may exist, but a step forward in an ongoing process of inquiry.
- Develop and pull together evidence for and against, questions and hypotheses generated by the group members. Frame questions and conjectures in ways that enable evidence to be brought to bear on them. (What would it mean if...? “how could we test that...? “if we assume x is true, how does that help us understand y...
- Be open to examining all ideas and beliefs critically if it will help advance the group discourse. You can't challenge everything all the time, but you can test out the consequences of disagreeing with an idea (“suppose we take x idea as wrong/right, what consequences does that have for this theory?”)
- Be flexible about theorizing or hypothesizing alternative stances. Entertain stances opposite to your own opinions or beliefs. Play devil's advocate.
## Appendix H: Coding Scheme for Content Analysis of Discourse Used by Zhang, Scardamalia, Lamon, Messina, & Reeve (2007)

<table>
<thead>
<tr>
<th>Category</th>
<th>Subcategory and defining features</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problems</td>
<td>Factual: Questions to be answered with factual information (who, where, when, how many, etc.)</td>
<td>What is translucent, transparent and opaque? Can light bounce off a chalkboard?</td>
</tr>
<tr>
<td></td>
<td>Explanatory: Questions satisfactorily answered with an explanation (why, how what-if, etc.)</td>
<td>How do solar panels work? Why do shadows exist? What happens when colored light goes into water?</td>
</tr>
<tr>
<td>Scientificness</td>
<td>1. Pre-scientific: Misconceptions based on naïve conceptual framework (scheme)</td>
<td>I think shadows exist because they show you things are there. Everything has a shadow unless it’s underground.</td>
</tr>
<tr>
<td>of ideas (4-point scale)</td>
<td>2. Hybrid: Misconceptions that have incorporated scientific information but show mixed misconception/scientific frameworks</td>
<td>A shadow is sunlight that reflects off your body and makes almost the same shape but at different times either its smaller or bigger. In the morning I think that the shadow is bigger and when it comes close to night your shadow gets smaller…</td>
</tr>
<tr>
<td></td>
<td>3. Basically scientific: Ideas based on scientific framework, but not precisely scientific.</td>
<td>A student built onto the above note used as an example of pre-scientific ideas and made an improvement: “If there is no light, there can’t be a shadow”.</td>
</tr>
<tr>
<td></td>
<td>4. Scientific: Explanations that are consistent with scientific knowledge.</td>
<td>…a shadow is created by the sun or artificial light hitting an opaque object. Shadows change size either depending on the size of the object or the light source, say the sun’s position…</td>
</tr>
<tr>
<td>Comment</td>
<td>Conceptual: Elaborates one or more relevant concept.</td>
<td>e.g., developing others’ ideas, stating alternative ideas, providing further resources or inquiry suggestions, making rise-aboves, etc.</td>
</tr>
</tbody>
</table>
|                                   | Formal: Identifies an issue relevant to the discourse in Knowledge Forum.                        | e.g., spelling, grammar, graphs, scaffolds, keywords, etc..}
<table>
<thead>
<tr>
<th>Empirical data</th>
<th>Experiments: Reports results of self-identified experiments.</th>
<th>My theory is that light travels in waves because when we did an experiment with projectors and a tennis ball hanging from the ceiling on a piece of string. And when we shone light on it the tennis balls’ shadow was clear. But the strings shadow had some light on it, proving that some light got behind the string. This happened because light travels in waves.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observations or past experiences: Notes and reports relevant phenomena; recalls life experiences.</td>
<td>My theory is that light travels in a wave lines because if you drive behind a bus you’ll see heat that look in a wave.</td>
<td></td>
</tr>
<tr>
<td>Expert resources</td>
<td>Introduce new information: Rephrases or summarizes information from readings, the Internet, or teacher, parent, etc.</td>
<td>[New information] Shadow = a darkness made when light shines onto a opaque (nontransparent) thing. …A small light source makes a dark shadow called a umbra. A large light source makes a small umbra and a lighter shadow called a Penumbra.</td>
</tr>
<tr>
<td>Go beyond given information: Uses expert resources to aid/advance personal ideas and understandings.</td>
<td>My theory is that light travels in waves because almost where ever you look for how light travels it will almost always say that light travels in waves also my book said that light waves are shorter than ULTRA VOILET WAVES...</td>
<td></td>
</tr>
</tbody>
</table>
Appendix I: Coding Scheme for Content Analysis of Discourse Used by Muukkonen, Lakkala, & Hakkarainen (2005)

<table>
<thead>
<tr>
<th>Category</th>
<th>Defining features</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problem</td>
<td>All questions produced by the students.</td>
<td>What kind of knowledge is better learned with the use of mental pictures?</td>
</tr>
<tr>
<td>Own Explanation</td>
<td>Students’ own ideas and thoughts, their own explanations for the problem being investigated, or generalizations of their experiences.</td>
<td>I agree, but I believe that in terms of mental pictures, people are facing the same cognitive problems as there are in general about the use of memory. The limitations are not in the storing capacity, but in the ability to retrieve the details stored in memory.</td>
</tr>
<tr>
<td>Source-Based Explanation</td>
<td>Explanations that contained explicit reference to an article, book, or other study material on which the student had based the explanation.</td>
<td>In the same book by Turunen and Paakkola [...] this topic of scientific visualization is also discussed. According to the authors, by use of imagination we are able to connect and change the mental pictures collected in our brain. They claim that imagery is a special kind of activity of the mind.</td>
</tr>
<tr>
<td>Metacomment</td>
<td>Assessments of one’s own learning process, assessment of own understanding, advancement of the discourse, functionality of the FLE-tools, or explanation of what would follow.</td>
<td>This discussion has shown that we have clear conceptions of mental pictures and that we are interested in using them as tools for thinking.</td>
</tr>
<tr>
<td>Quote</td>
<td>An excerpt of another participant’s earlier message within the one currently being posted.</td>
<td>During the lecture, we talked about conceptual change and how rarely it takes place during studying.</td>
</tr>
<tr>
<td>Reference to lecture</td>
<td>A reference to content to have been said or done during the lecture, serving often to set the context for the reader.</td>
<td></td>
</tr>
</tbody>
</table>