

A COMPARATIVE STUDY OF THE EFFECTS OF INSTRUCTIONAL DESIGN-
BASED SCAFFOLDING AND MANAGEMENT-BASED SCAFFOLDING ON
LEARNING IN ONLINE COLLABORATIVE GROUPS

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by
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A COMPARATIVE STUDY OF THE EFFECTS OF INSTRUCTIONAL DESIGN-BASED SCAFFOLDING AND MANAGEMENT-BASED SCAFFOLDING ON LEARNING IN ONLINE COLLABORATIVE GROUPS

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ABSTRACT

The purpose of this study was to examine the effect of scaffolding conditions in fully online collaborative groups on a performance outcome, social experiences, and interaction processes. To achieve this, a performance outcome, social ability, satisfaction, interaction types, and interaction levels were compared across different scaffolding conditions. Additionally, the study sought to identify variables that influenced student's perceived satisfaction and group performance in an online group.

This study used a posttest-only control-group as a research design. There were three treatment conditions and one control group. The treatment conditions were resource distribution scaffolding, instructor's feedback scaffolding, and combined distribution and feedback scaffolding. Both quantitative data (e.g. numbers of posted messages, essay score, social ability score, and satisfaction score) and qualitative data (online discussion transcripts) were collected and analyzed to answer the research questions in this study.

The results of this study indicated no statistically significant effects of scaffolds on the group performance, perceived satisfaction, social ability, interaction levels, and interaction types. In addition, mediation could not be established for the theoretically interesting relationships. However, student's social ability was related to perceived

satisfaction. Discussions and implications of the results of this study were presented. In addition, a discussion of limitations and further research directions were also provided.

CHAPTER 1 INTRODUCTION

Overview

Learning through interaction with peers, known both as cooperative and collaborative learning, has been recognized as an effective instructional method that positively contributes to students' learning and achievement (Krol, Janssen, Veenman, & Van der Linden, 2004; Lou, Abrami, & d'Apollonia, 2001; Schroeder, 2007; Slavin, Hurley, & Chamberlain, 2003). This is supported by decades of research in secondary education which indicates that learning through social interactions, particularly when engaging learners in complex authentic tasks or projects, results in significantly higher outcomes such as achievement, higher-level reasoning, multiple viewpoints, retention, motivation, transfer of learning, and social competencies (Johnson and Johnson 1989). Due to the benefits recognized in learning through social interactions in traditional classrooms, many researchers and educators have implemented collaborative learning approaches in online learning contexts expecting similar effects to occur. However, a body of research has shown that simply putting students to work together does not guarantee that individuals in a group automatically cooperate (e.g. Cohen, 1994) and act as a group, especially groups that are newly formed, or formed for a comparatively short time, or where group members work under conditions where individual learning goals are predominant (Reimann, 2003). Similarly, this is also the case for groups with no or little experience in online group work (Salmon, 2000). These difficulties in collaborative

online learning may be because students are rarely asked to construct knowledge collaboratively (Mandl, Gruber, & Renkl, 1996). In addition, the reduction of social cues in many computer-mediated communication (CMC) environments can make collaboration more difficult.

In CMC, difficulties arise (e.g. turn-taking, giving feedback, mutual understanding; McKinlay, Procter, Masting, Woodburn, & Arnott, 1994; Whittaker & O’Conaill, 1997) due to problems such as reduced cognitive and social grounding (Dillenbourg & Traum, 1996, 2006) as well as coordination of the joint solution of the task at hand (e.g. with regard to work coordination such as time management, division of labor, and integrating individual contributions; Daly, 1993; Hiltz, Johnson & Turoff, 1986, Hermann, Rummel & Spada, 2001). Without adequate support, collaborating partners often fail to complete their joint task or find that it requires too much time and effort (Anderson et al., 1997; Galegher, Kraut & Egidio, 1990; Olson et al., 1993; Straus & McGrath, 1994).

Research indicates that providing some amount of structuring may help teams achieve effective collaboration (Kollar, Fischer, & Hesse, 2003; Lehtinen, 2003; Lipponen, 2000; Weinberger, Ertl, Fischer, & Mandl, 2005). Under this circumstance, groups benefit from guidance for cooperation and collaboration. Such guidance can consist of monitoring group members' progress and providing scaffolding where necessary (Zumbach, Reimann, & Koch, 2006). By these means disorientation, conflicts, and cognitive load can be reduced.

Educators and researchers have developed numerous ways to scaffold collaboration such as behavioral, technological, or a combination of both. Zumbach, Schonemann, and Reimann (2005) developed a taxonomy of scaffolding methods as depicted in Figure 1. In their taxonomy, they classify scaffolding into instructional design-based scaffolds and management-based scaffolds. In instructional design-based scaffolds, all decisions are made before the collaboration begins and there is a blueprint for how collaboration will be conducted, while in management-based scaffolds, the major decisions are made based on observations from learners' ongoing interaction, and decisions are made at "run time".

Both instructional design-based and management-based scaffolding techniques have long been used in traditional classrooms and have been shown to have positive effects. Early research results show that these scaffolding techniques may be effective when used in computer-mediated settings as well. For example, previous studies (Komis, Avouris, & Fidas, 2003; Muehlenbrock, 2001) show dyads with design-based scaffolds (distributed learning resources) were more active, exchanged more contributions and became more involved in deeper discussions compared to dyadic groups with individuals owning all relevant materials. Management-based scaffolding has also been shown to be promising in enhancing cooperative behavior (Zumbach et al., 2006).

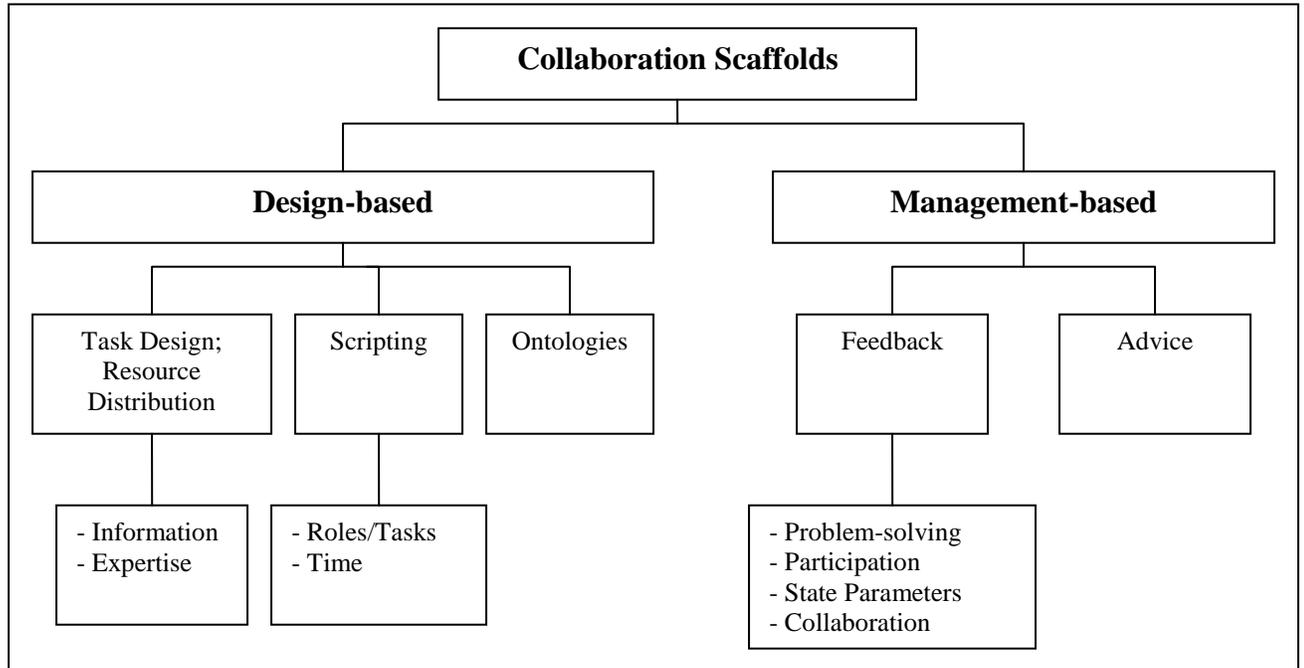


Figure 1. Approaches to scaffolding collaboration (Zumbach, Schonemann, and Reimann, 2005)

Statement of the Problem

In summary, extensive research shows that simply putting students in groups does not guarantee that collaboration and learning from collaborative activity will automatically occur. To achieve the positive effects of collaborative learning, instructors need to establish conditions that support collaboration as suggested by research on cooperative learning conditions (Johnson, Johnson, & Smith, 1998). Following this idea, distance researchers have adopted design-based scaffolding and/or management-based scaffolding strategies used in traditional learning to computer-mediated settings. Design-based scaffolding and management-based scaffolding approaches have shown benefits

for shaping group behavior in computer-mediated settings (e.g. Fidas et al, 2005; Komis et al, 2003; Zumbach et al, 2002; Zumbach et al., 2006). However, early studies were mainly conducted in laboratory settings so we do not know whether similar results will be found in naturally occurring online learning settings. Additionally, while prior research testing the effect of management-based scaffolding has often been delivered by automated systems, course management systems (e.g. blackboard, WebCT) that are used as mediums for course delivery in higher education are not able to deliver feedback automatically. One feasible substitute approach is to deliver feedback information by the instructor. We do not know whether delivering feedback in a different form would maintain the same positive effects of management-based scaffolding demonstrated in prior research. Therefore, there is a need for empirical research to examine the effect of different scaffolding approaches on performance outcomes, social experience, and collaboration in online setting.

Significance of the Study

Online learning is an alternate learning mode that has been increasingly adopted in higher education. However, researchers and practitioners have learned that being in different physical and temporal environments can cause students to be less interactive and less productive, which may lead to non-meaningful learning and unpleasant learning experiences. Therefore, researchers and educators are seeking ways to make online education meaningful and provide positive experiences for online learners. Investigating the impact of collaborative learning strategies can help educators gain understanding of

how these strategies affect the interaction process, learning outcomes, and social experience. These results should be useful and informative to researchers designing and testing innovations for online learning and for educators in designing more effective online courses.

Purpose of the Study

The main purpose of this study is to examine the effect of scaffolding conditions on performance outcomes, social experience, and interaction processes. To achieve this, a performance outcome, social ability, satisfaction, interaction types, and interaction levels are compared across different scaffolding conditions. A between-group post-test only experimental design is employed in the study. Additionally, the study seeks to identify variables that contribute to the prediction of student's perceived satisfaction and performance in an online group.

The Research Questions

Q1: What scaffolding condition will have the highest impact on students' performance as measured by a group written essay score?

Rationale: By dividing resources among members of a dyad, it is expected that participants will develop and experience the need for collaboration. Therefore, the group with distributed learning resources should have an increased number of collaborative events and a higher performance in a written essay compared to groups without the

design-based scaffold. Providing feedback on participation behavior by the instructor should lead to an increased number of contributions by each participant compared to groups without the management-based scaffold. Ultimately, the feedback should increase participants' awareness about the importance of their exchange and, therefore, lead to a more elaborate discussion and performance. Considering the mentioned positive influences of providing distributed learning resources and feedback, it is expected that providing a combination of both interventions should lead to additive effects on performance.

Hypothesis: It is expected that the group with combined scaffolds, distributed learning resources and instructor's feedback, will outperform other groups on the written essay. Groups with either distributed learning resources or an instructor's feedback scaffold will have better essay scores than the group without any scaffold.

Q2: What scaffolding condition will have the highest impact on students' perceived social ability?

Rationale: By dividing resources among members of a dyad, it is expected that participants will develop and experience the need for collaboration. Therefore, the group with distributed learning resources should have an increased number of interactions compared to groups without the design-based scaffold. Higher interaction should lead to better social experience. Providing feedback on participation behavior by the instructor should raise participants' awareness about the importance of their exchange and interaction with others and it should reflect participants' group interaction effort as well.

Ultimately, the group with feedback should experience higher social ability compared to groups without the management-based scaffold. Considering the mentioned positive influences of providing distributed learning resources and feedback, it is expected that providing a combination of both interventions should lead to additive effects on students' perceived social ability.

Hypothesis: It is expected that the group with combined scaffolds, distributed learning resources and instructor's feedback, will experience higher perceived social ability than other groups. Groups with either distributed learning resources or an instructor's feedback scaffold will perceive higher social ability than the group without any scaffold.

Q3: What scaffolding condition will have the highest impact on students' perceived satisfaction?

Rationale: By dividing resources among members of a dyad, it is expected that participants will develop and experience the need for collaboration. Therefore, the group with distributed learning resources should have an increased number of collaborative events and higher performance; consequently, this will lead to positive group process and group product compared to groups without the design-based scaffold. Receiving feedback regarding group communication and coordination from an instructor on how a group performs should reduce negative group behaviors, such as social loafing and free riding. Consequently, a group with less negative group behavior should experience more group satisfaction compared to groups without the management-based scaffold. Considering the

mentioned positive influences of providing distributed learning resources and feedback, it is expected that providing a combination of both interventions should lead to additive effects on satisfaction.

Hypothesis: It is expected that the group with combined scaffolds, distributed learning resources and instructor's feedback, will experience higher perceived satisfaction than other groups. Groups with either distributed learning resources or an instructor's feedback scaffold will experience higher satisfaction than the group without any scaffold.

Q4. Overall, how do scaffolding conditions influence interaction behavior during the collaboration processes?

- a) What scaffolding condition will have the highest impact on level of interaction?
- b) What scaffolding condition will have the highest impact on types of interaction?

Rationale: By dividing resources among members of a dyad, it is expected that participants will develop and experience the need for collaboration. Therefore, the group with distributed learning resources should have an increased number of interaction levels and interaction types that reflect collaboration compared to groups without the design-based scaffold. Providing feedback on participation behavior by the instructor should raise participants' awareness about the importance of their exchange and interaction with others and it should reflect participants' group interaction effort compared to groups

without the management-based scaffold. Considering the mentioned positive influences of providing distributed learning resources and feedback, it is expected that providing a combination of both interventions should lead to additive effects on level of interaction and types of interaction.

Hypothesis a: It is expected that the group with combined scaffolds, distributed learning resources and instructor's feedback, will have higher levels of interaction, as measured by exchange total count, length of posting, and viewed posting total, than other groups. Groups with either distributed learning resources or an instructor's feedback scaffold will have higher levels of interaction than the group without any scaffold.

Hypothesis b: It is expected that the group with combined scaffolds, distributed learning resources and instructor's feedback, will have more types of interaction reflecting collaborative skills than other groups. Groups with either distributed learning resources or an instructor's feedback scaffold will have more types of interaction reflecting collaborative process than the group without any scaffold.

Q5. Does social ability mediate the relationship between scaffolding conditions and perceived satisfaction?

Rationale: Learning satisfaction is a result of how an individual perceives being satisfied with a group process and a group product. Scaffolds shape how group members socially interact and support effective use of available resources, group members, tools, and learning materials, to accomplish a learning task. A learning context that facilitates social ability should enhance learning satisfaction.

Hypothesis: Social ability mediates the relationship between scaffolding conditions and perceived satisfaction.

Q6. Does the type of interaction mediate the relationship between scaffolding conditions and group performance?

Rationale: Scaffolding should cause group members to interact in a manner that supports collaborative learning. The group that shows evidence of collaborative interaction while working to accomplish a learning task should produce effective group performance.

Hypothesis: Type of interaction mediates the relationship between scaffold conditions and group performance.

Q7. Does the level of interaction mediate the relationship between scaffolding conditions and group performance?

Rationale: The scaffolding conditions should cause group members to put more effort into interaction. A substantial level of interaction should allow more opportunities for group members to collaborate, e.g. to discuss, debate, or exchange of ideas, which ultimately cause better group performance.

Hypothesis: Level of interaction mediates the relationship between scaffolding conditions and group performance.

Q8. Overall, what are the best explanations of performance and satisfaction in an online cooperative group?

Rationale for group performance: Group performance, as measured by a written essay score, is a result of students working together in a group. Therefore, a group should have a certain level of interaction and collaborative interaction behaviors that focus on a collaborative task to produce a product.

Hypothesis for group performance: Interaction level and interaction types will explain essay performance.

Rationale for learning satisfaction: Satisfaction from participating in group work is a result of satisfaction the individual perceived in the group process experience, as well as the product the group's solution produced. Therefore, perceived social climate the individual experienced during collaboration should reflect on the learning satisfaction.

Hypothesis for learning satisfaction: Social ability will explain learning satisfaction.

Definition of Constructs

- *Collaborative learning:* an educational method which is based on students working together in small groups so that everyone can participate on a collective task that has been clearly assigned toward an educational goal (Cohen, 1994).

- *Social ability*: an individual's ability to use social information and influence others to accomplish something of value during an activity in a social context (Laffey, Lin, & Lin, 2006).
- *Instructional design-based scaffold*: a method to scaffold collaboration by design involves the selection of specific tasks and resource distributions (Zumbach et al., 2005).
- *Management-based scaffold*: a method to scaffold collaboration by providing scaffolding based on "run time" data collected from tracing the interaction between group members (Zumbach et al., 2005).
- *Satisfaction*: Positive feelings or attitudes an individual has toward a group's decision (Green & Taber, 1980).
- *Instructor feedback*: In this study context, the instructor feedback is defined as information given by the instructor to students about their collaboration effort basing on monitoring the group's interaction.

Chapter Summary

Chapter 1 explains the foundations of the study and describes the purposes, research questions, and rationale of this study. The effects of the scaffolding conditions on measured outcomes and predictors of performance and satisfaction are investigated.

CHAPTER 2 LITERATURE REVIEW

Introduction

The purpose of this study is to examine the effects of instructional design-based scaffolding and management-based scaffolding in online learning environments on achievement, the collaboration process, and social experience. The study also investigates what factors influence students' satisfaction and performance in online cooperative groups.

To explicate the framework for this study, prior research is reviewed and summarized for the following areas:

- Theories and empirical research on cooperative and collaborative learning.
- Theories and empirical research on collaboration scaffolds including instructional design-based scaffolds and management-based scaffolds.
- Theories and research related to interaction and social ability.

Cooperative Learning and Collaborative Learning

Theoretical Foundation

Collaborative learning is an umbrella term used by various educational approaches to characterize joint intellectual effort by students, or students and teachers together (Goodsell et al., 1992). Collaborative learning has its home in social constructivism (Vygotsky in Gokhale, 1995). In this view, a learner is an active

constructor of knowledge through social interaction with one's environment including the important members of that environment. Through interaction, the learner develops meanings and understandings out of social encounters. It is a pedagogy with a fundamental assumption that people make meaning together and that the process enriches them (Matthews, 1996, p.101). There are numerous instructional approaches based on collaborative learning, such as working on a group project, giving certain roles to group members for an assignment, and providing learning tasks with structured ways of communicating and interacting with peers.

Jucks, Paecher, & Tatar (2003) categorized numerous approaches to collaborative learning into two general categories: cognitive perspectives and socio-emotional perspectives. *Cognitive perspectives* take root from a social constructivism that views knowledge as socially constructed by interactions of individuals with the society (McCarthy & McMahon, 1992). Learning can be regarded as a result of internalization of such social interaction (Vygotsky, 1986). Individuals are guided by others, instructors as well as more capable peers, in their development of skills. This perspective views knowledge acquisition as an active construction process on the part of the participants involved in the learning process. Examples of instructional methods based on cognitive perspectives are Reciprocal Peer Tutoring (Fantuzzo, Riggio, Connelly, & Dimeff, 1989) and Scripted Cooperation (O'Donnell & Dansereau, 1992). *Socio-motivational perspectives* differ markedly from the cognitive perspectives (Slavin, 1983a, 1992). The socio-motivational perspective focuses on rewards and goal structures under which students work together, as well as emphasizes that collaborative activity and success are

mainly mediated by motivation (Jucks et al., 2003). Student Teams Achievement Divisions (Slavin, 1983b) and Jigsaw (Aronson, Blaney, Sikes, Stephan, & Snapp, 1978) are examples of collaborative instructional methods based on the socio-motivational perspectives.

Cooperation VS Collaboration

The terms collaborative learning and cooperative learning are closely related and often used interchangeably in educational research (Johnson & Johnson 2004; McWhaw, Schnackenberg, Sclater, & Abrami, 2003). There is no universally accepted meaning of the terms collaborative learning and cooperative learning (Resta & Laferrière, 2007). However, some scholars have provided distinctions between these terms. For example, Cooper and Mueck (1990) describe cooperative learning as a “structured, systematic instructional strategy in which small groups work together toward a common goal” (p.68) and collaborative learning as characterized by relatively unstructured processes through which participants negotiate goals, define problems, develop procedures, and produce socially constructed knowledge in small groups. Panitz (1996) views collaboration as a philosophy of interaction and personal lifestyle, while cooperation is viewed as a structure of interaction designed to facilitate accomplishment of an end product or a goal through people working together in groups. Slavin (1997) associates cooperative learning with well-structured knowledge domains and collaborative learning with ill-structured knowledge domains. Roschelle and Teasley (1995) state that “cooperation is accomplished by division of labor among participants, as an activity where each person is

responsible for a portion of the problem solving...” while collaborative learning involves the “... mutual engagement of participants in a coordinated effort to solve the problem together” (p.70). Supporting this view, Dillenbourg (1999) agreed that “cooperation refers to a more fixed division of labor” (p.22).

Although there are differences pointed out by some scholars, Kirschner (2001) notes that both collaborative learning and cooperative learning share far more similarities than differences. The commonalities as suggested by Matthews, Cooper, Davidson, and Hawkes (1995) are the following:

- Learning takes place in an active mode.
- The teacher is more a facilitator than a “sage on the stage.”
- Teaching and learning are shared experiences.
- Students participate in small-group activities.
- Students must take responsibility for learning.
- Discussing and articulating one’s ideas in a small-group setting enhances the ability to reflect on his or her own assumptions and thought process.
- Social and team skills are developed through the give-and-take of consensus building.
- Students profit from belonging to a small and supportive academic community.
- Students experience diversity which is essential in a multicultural democracy.

Additionally, both terms acknowledge the essential influence of John Dewey and his belief about education as social enterprise (Matthews et al., 1995). Therefore, this study presents cooperation and collaboration as synonymous terms due to their shared features and common theoretical foundations. In this study, we will use the term collaborative learning to mean an educational method which is based on students working together in small groups in which everyone can participate on a collective task that has been clearly assigned toward an educational goal (Cohen, 1994).

Elements of Collaboration

Extensive research has shown that collaboration does not automatically happen when students are assigned to work together in groups. One of the key mediating variables to collaboration is the degree to which participants perceive that they are interdependent in that they share a mutual fate and their success is mutually caused (Johnson & Johnson, 1989). Numerous barriers to effective collaborative efforts, such as free-rider effect, sucker effect, social loafing, and dysfunctional division of labor, are avoided when collaboration is structured to ensure that the conditions mediating its effectiveness are present (Johnson et al., 1989). To be collaborative, learning groups must be carefully structured to include the five basic elements identified by Johnson, Johnson, & Smith (1998): (1) positive interdependence to ensure that students believe they “sink or swim together,” (2) promotive interaction to ensure that students help and assist each other, (3) individual accountability to ensure that everyone does their fair

share of the work, (4) social skills to work effectively with others, and (5) group processing to reflect on and improve the quality of group work.

Although all five elements are crucial, positive interdependence is the most important factor, emerging from research and theory, in structuring a situation to be collaborative (e.g. Barkely, Cross, & Major, 2005; Johnson & Johnson; 1992; Lewin; 1935, 1948). As stated by Lewin (1935, 1948) the essence of a group is the interdependence among members. Positive interdependence can be achieved through tasks, resources, goals, rewards, roles, or environment (Brush, 1998). Johnson and Johnson (1989) advocate positive interdependence as a key for successful collaboration. The productivity and problem-solving success of any group is strongly affected by the degree of positive interdependence existing among group members (Johnson, Maruyama, Johnson, Nelson, & Skon, 1981). From the classroom-based research, it is generally accepted that positive interdependence is the most important condition of designing successful collaborative learning groups (e.g. Johnson, Johnson, & Stanne, 1989). Studies (e.g. Johnson, Johnson, & Smith, 1991) investigating the nature of positive interdependence indicate: (1) that positive interdependence provides the context within which promotive interaction takes place, (2) that group membership and interpersonal interaction among students do not produce higher achievement unless positive interdependence is clearly structured, (3) that the combination of goal and reward interdependence increase academic achievement over goal interdependence alone, and (4) that resource interdependence does not increase achievement unless goal interdependence is also present.

Benefits of Collaborative Learning in Classroom-Based Settings

There is a substantial amount of empirical evidence indicating that collaborative learning can be effective in generating positive academic and affective outcomes in traditional classroom settings (Johnson, Johnson, & Smith, 1991). Meta-analyses have consistently reported that collaborative learning has favorable effects on achievement and productivity, psychological health and self-esteem, interpersonal attraction and social support, intergroup attitudes, and attitudes toward learning (e.g. Johnson & Johnson 1989; Johnson, Johnson, & Smith, 1991a, 1991b; Johnson, Maruyama, Johnson, Nelson, & Skon, 1981; Qin, Johnson, & Johnson, 1995).

For example, Johnson, et al. (1998) conducted another meta-analysis of over 305 college studies on cooperative, competitive, and individualistic learning. Compared to competitive and individualistic learning, cooperative learning promoted higher individual achievement, meta-cognitive thought, willingness to take on difficult tasks, persistence in working toward goal accomplishment, intrinsic motivation, transfer of learning, and greater time on task. The study also reported that students in cooperative learning settings perceived greater social support in their academic and personal life from peers and instructors, and gained more social skills than those students who learned through competition.

Qin and colleagues (1995) conducted a meta-analysis on 63 findings to investigate the effects of cooperative and competitive efforts on problem-solving. The result indicates that members of cooperative groups outperformed individuals in

competitive groups in all types of problem solving classified as linguistic (solved problems through written and oral language), nonlinguistic (solved problems through symbols, math, motor activities, or actions), well-defined, and ill-defined problems. The results also held for all age groups (elementary and secondary) and quality of studies (low, medium, and high).

Bilgin and Geban (2006) investigated the effects of the cooperative learning approach based on conceptual change condition over traditional instruction on students' conceptual understanding and achievement of chemical equilibrium concepts. The result showed that students in the experimental group had better conceptual understanding and achievement of computational problems related to the chemical equilibrium concepts. Furthermore, students' science process skills accounted for a significant portion of variations in conceptual understanding and achievement related to the computational problems.

Doymus, K. (2008) compared the effect of cooperative learning (jigsaw) and individual learning methods on students' understanding of chemical equilibrium in first-year general chemistry course. The result indicated that the jigsaw group was more successful in learning achievement, measured by post-test multiple choice questions and open-ended questions, than the non-jigsaw group.

Besides generating positive cognitive outcomes, collaborative learning also correlates to positive affective outcomes (e.g. Slavin, 1995; Springer, Stanne, & Donovan, 1999) such as higher motivation, higher self-esteem, more favorable attitude towards learning, and increased persistence. For example, Springer, Stanne, and

Donovan (1999) conducted a meta-analysis of research on college students to investigate the effects of small-group learning on learning outcomes and attitudes. The study reported that students in small-group learning had greater achievement-related outcomes and students also reported positive attitudes toward learning materials and greater self-esteem than students who learned in other learning methods.

Law (2008) conducted two studies investigating the effects of collaborative learning on second-graders' motivation and learning from text. In the first study, students (n = 160) in collaborative learning groups were compared with their counterparts (n = 107) in traditional instruction groups. The results revealed a statistically significant difference between the two groups, with more favorable perceptions of teachers' instructional practices and better reading comprehension in the instructional intervention groups than in the traditional instruction groups. In the second study, 51 second-graders participated in the instructional intervention program. The results showed that students' positive collaborative behavior and attitudes were related to their motivation and reading comprehension. When students perceived that their peers were willing to help each other and were committed to the group, they tended to be more motivated and performed better in reading comprehension.

Recent studies in higher education contexts show that collaborative learning generally facilitates student motivation and community feeling (Cabrera et al., 2002; Summers, Beretvas, Svinicki, & Gorin, 2005; Summers & Svinicki, 2007). For example, Summers and colleagues (2005) conducted a study on 1,494 undergraduate students to assess the effects of collaborative group-learning methods in real classrooms on students'

perception of classroom community. They used feelings of campus connectedness, academic classroom community, and effective group processing as measured variables for students' classroom community feeling. The result indicated that the use of group work methods was positively related to students' feelings of classroom community, significantly more than for classrooms that did not use group work techniques. Further analysis indicated that campus connectedness and collaborative learning predicted positive academic classroom community. For classes using more formal cooperative group work, campus connectedness and group processing-evaluation predicted positive academic classroom community.

Summers and Svinicki (2007) conducted a study on 213 undergraduate students to test the relationship between classroom community and students' achievement goals in higher education and to offer a possible explanation for differences in this relationship for cooperative and non-cooperative classrooms. Structural equation modeling techniques revealed that students' perceptions of interactive learning significantly mediated the relationship between students' goals and their sense of classroom community, but only for classrooms that used cooperative learning techniques. In the traditional lecture-style course surveyed, students' feelings of classroom community and interactive learning were significantly lower than in cooperative learning classrooms. Finally, while mastery goals were significantly higher for cooperative learning students, performance-approach goals were significantly higher for traditional lecture students.

Approaches to Scaffold Collaboration

Online discourse may differ from face-to-face discourse with regard to basic communication processes. In computer mediated communication (CMC) settings, it can be difficult to establish common ground of mutual understanding. Hence, online discourse may suffer from insufficient group coordination or from deficiencies in the coherence contributions (Jucks et al., 2003).

The problem can be overcome by structuring the communication and collaboration processes of learning groups (Jucks et al., 2003). To ensure collaboration, a number of instructional supporting measures have been developed to stimulate learning favorable activities (see Cohen, 1994; Slavin, 1996).

Educators and researchers have developed numerous ways to scaffold collaboration such as behavioral, technological, or a combination of both. The main aim of collaborative scaffolding is to help students collaborate and act as a group (Zumbach et al., 2005). There are numerous approaches that have been designed to scaffold collaboration. Zumbach and colleagues (2005) suggested a collaboration scaffolding taxonomy (Figure 1) as a means to classify the scaffold methods and help structure the collaboration. In this taxonomy, they classify scaffolding into two main categories: (instructional) design-based and management-based scaffolds. The general distinction between the two is that; in design-based scaffolding, all decisions are made before the collaboration begins and there is a blueprint for how collaboration will be conducted,

while in management-based scaffolding, the major decisions are made based on observations from learners' ongoing interaction, and decisions are made at "run time".

Instructional Design-based Scaffolding

Zumbach et al. (2005) identified three approaches that can be used to scaffold collaboration by design. The first approach is to design a specific task or use resource distribution as a way to structure collaboration. The logic behinds this approach is that students are required to collaborate in order to accomplish a goal because of task demands and the manner in which information necessary for accomplishing the task is distributed. This can be done either by distributing expertise among group members in an early stage of group forming (Hermann, Rummel & Spada, 2001; Rummel et al., 2002) or varying resources (e.g. learning materials) among group members. However, the second approach is more applicable and more feasible for ad-hoc group or groups that form for a short period of time (Zumbach et al., 2005) like an online collaborative learning group.

The second approach is scripting of collaboration. This approach involves assigning specific roles and structuring communication or condition among group members. A well-known example of a collaboration method that follows this approach is the Cooperation Script developed by O'Donnell (1999). Scripts are activity programs that aim to facilitate collaborative learning by specifying activities in collaborative settings, sequencing these activities, and assigning the activities to individual learners. This approach has proven to be effective in enhancing turn-taking (Pfister & Mühlpfordt, 2002; Reiserer, Ertl & Mandl, 2002), elaborating design rationales (Shum, 1997), and

increasing reflection (Diehl, Ranney & Schank, 2001). However, scripting collaboration can lead to some negative effects, for example, interruption of natural discourse and over-scripting (e.g Dillenbourg , 2002; Reimann, 2003).

The third approach is providing groups with specific communication and collaboration ontologies. This approach specifies a vocabulary in a kind of notation for expressing information that can be exchanged. A classical example is the IBIS notation (Conklin, 1993), developed to support computer-supported collaborative decision making and organizational memory, and Dan Suther's (1995) work on external representations.

Zumbach and colleagues (2005) assert that design-based scaffolding approaches are particularly appropriate for groups that are working together for the first time and/or whose members have little domain knowledge. In such circumstances, strong external guidance can help members to focus on the task and to avoid extrinsic cognitive load. Keeping in mind that work groups in online learning courses tend to form temporarily and last for a short period of time (one to two weeks), therefore, the resource distribution approach is a good fit method for the design-based scaffolding to be used in this study.

Instructional design-based scaffolding by resource distribution approach

Resource distribution refers to a method that structures learning materials in a way that each group member possesses pieces of information that are necessary to accomplish a learning task's goal. That means individuals need to communicate with their group members to access necessary pieces of information that one does not have. This method uses resources as a way to impose positive interdependence in a

collaborative group. This is to ensure that group members must see value in working together for collaborative learning to occur (Johnson et al., 1991). Positive interdependence is “the degree to which participants perceive they are interdependent in that they share a mutual fate and that their success is mutually caused” (Johnson & Johnson, 1991b, p. 174).

Resource distribution research in face-to-face context

From classroom-based research, two benefits of the resource distribution method have been established. Firstly, it stimulates students to consider others as sources of information. Secondly, it reduces competition issues and social comparison between group members (Johnson & Johnson, 1996; Johnson, Johnson, & Stanne, 1989). This may be further explained by the observations made by Gruber (2000) and Butera and colleagues (1994) about the effects of relying upon partners for information. Resource interdependence means that each one possesses incomplete information. Therefore, the only way to get access to all information so as to understand the problem is through interaction with partners. Hence, the first benefit of sharing complementary information is that it makes interaction relevant and behaviors oriented towards information exchange can result from this representation of interaction.

Moreover, Lambiotte et al. (1987) suggest that sharing complementary information could favor the partners' involvement in the task, interactions, and effort towards explanation. Similarly, two studies by Buchs, Butera, and Mugny (2004) indicated that working on complementary information (distributed resources) enhances

collaboration. It supports more positive interactions between partners. Buchs and Butera (2001) pointed out that interaction processes became more crucial when students depended on partners for access to information than when they discussed identical information. In their study, the quality of relationship modulated performance under resource interdependence condition, but did not on resource independence.

However, empirical studies have indicated that resource interdependence needs to be structured with goal interdependence in order to impact achievement, the collaboration process, and positive relationships among group members (Johnson, Johnson, Ortiz, & Stanne, 1991; Johnson, Johnson, & Stanne, 1989; Ortiz, Johnson, Johnson, 1996). When used in isolation from positive goal interdependence, positive resource interdependence produced the lowest individual achievement and problem-solving success.

Resource distribution research in computer-mediated context

Early results of providing collaborative scaffolding by means of distributed resources in computer-mediated learning settings shows that this approach improves the collaboration process and facilitates interaction among group members. For example, Komis, Avouris, and Fidas (2003) conducted a laboratory study to investigate the effect of resource heterogeneity on real-time computer-supported collaborative problem solving among high school students. The result showed that the group with heterogeneous resources produced solutions of similar quality to that of the reference group that possessed homogeneous learning material. However, the overall collaboration effort was

better in the group with heterogeneous resources; they were more active, exchanged more messages, and involved in deeper discussions.

Similarly, Fidas, Komis, Tzanavaris, and Avouris (2005) conducted a laboratory study to investigate the effect of providing heterogeneity primitives (learning resources) in real time collaborative problem solving in secondary school. Their results show no difference in quality of produced solutions between control and experimental groups but the group with heterogeneous resources was more active in terms of actions and dialogues and took roles that indicate collaborative activity.

Management-based Scaffolding

In contrast to instructional designed-based scaffolding, management-based scaffolding focuses on regulation to structure collaboration. This approach aims to support group members in managing their interaction. Managing collaborative interaction means supporting group member's metacognitive activities related to their interaction (Soller, Martinez, Jermann, & Muehlenbrock, 2005). This may be facilitated by providing feedback to students, coaching group interaction, or giving a course of action to improve group process. Regulation approaches support collaboration by taking action once the interaction has begun (Soller, et al., 2005). Therefore, scaffolding based on collaboration management works with "run time" data collected from tracing the interaction between group members and the interaction information is reflected back to students, for example, as graphical visualizations of student actions or instructors' feedback on students' participation.

The idea of scaffolding interaction can be traced to CSCL communities. CSCL practitioners and researchers recognize that regulation of the interaction and regulation of the task are closely related mechanisms and that their co-occurrence facilitates collaborative task accomplishment. Jermann, Soller, and Lesgold (2001) proposed a framework for computer-supported interaction regulation. The framework imitates a negative feedback loop and consists of four phases. It starts with collecting data about users' activities in a system (phase 1), aggregating raw data into pedagogically sound indicators (phase 2), diagnosing the interaction (phase 3), and making a recommendation of remedial actions (phase 4). They described systems that support phase 1 and 2 as mirroring tools because they are designed to reflect student actions. Systems that support phase 1 to 3 are termed as metacognitive tools because they provide the learners or human coaches with information about the state of the interaction as well as aid in the analysis of interaction (Simoff, 1999; Wortham 1999; Zumbach, Muehlenbrock, Jansen, Reimann, & Hoppe, 2002). Some metacognitive tools display the current and desired state of interaction side by side to facilitate and orient a diagnosis of the interaction (Jermann, 2002). Lastly, guiding systems perform all four phases in the regulation process and then propose remedial actions to learners.

Management-based scaffolding implementation in computer-supported systems

A number of computer-supported systems are designed to regulate interaction using the mirroring approach. This approach aims to make students or teachers aware of participants' actions without interpreting or evaluating these actions. Raising awareness

about actions, either taken in shared or private workspace, of oneself and others by making them visible may help students maintain representation of their teammate activities and influence collaboration. There are systems that are designed to collect discussion dialogues and actions and represent the information along a timeline in graphical forms. For example, Plaisant, Rose, Rubloff, Salter, and Shneiderman (1999) implemented the learning histories for a simulation-based engineering learning environment called SimPLE (Simulated Processes in a Learning Environment). The system aims to help students learn the basics of vacuum pump technology from a simulation. As learners manipulate the control of the simulation, they can view a history of their actions displayed in graphical forms under each target variable. The display showed a series of boxes along a timeline, indicating the intervals in which the users act, and the system's messages. Although Plaisant and colleagues did not design the system to be used by two persons at the same time, the learning history might be used to mirror the collaborative situation by displaying the actions of learners side by side and offering a representation of concurrent actions, which helps students monitor their behavior, reflect on their progress, and coordinate their actions.

Chat Circles, developed by Donath, Karahalios, and Viégas (1999), is a graphical interface for a synchronous chat communication that reveals the structure of the conversation. It contained a chat-based mirroring tool that kept track of ongoing conversations and displayed a visually recorded conversational pattern of one's own and others' participation. Each participant was represented by a colored circle on the screen in which the participant's words appear. Participants' circle grew and brightened when they

sent out a message, and faded when they were silent. Each participant was made aware of other active, animated participants and could watch the emergence and dissolution of the conversational group.

Simoff (as cited in Jermann et al., 2004) described a system that visualized discussion threads as nested boxes. The thickness of the boxes' edges represented the number of messages produced in response to the opening message for a particular thread. In an educational environment, thicker boxes might mean deeper conversations, hence deeper understanding. Simoff's system did not contain this normative information explicitly, although it could be transmitted ad hoc to explain the meaning behind the graphical properties of the tool.

Some systems contain metacognitive modules that provide the current state and desired state of the interaction to users. Ogata, Matsuura, and Yano (2000) developed a Knowledge Awareness Map by utilizing the notion of social network analysis. The map is a special social network tool that also includes a "knowledge piece," which describes information linked to participants. It graphically showed users who were discussing or manipulating their knowledge pieces. The distance between users and knowledge elements on the map indicated the degree to which users have similar knowledge based on their mental socially oriented problem-solving heuristics. Another example of a system utilizing a metacognitive tool is Jermann's system (2002). The system displayed a graphical representation of the balance between problem-solving actions and participation in dialogue to a dyad. The subjects had to tune four traffic lights in a small simulated town. Every minute, the system computed a ratio based on the number of

actions (changes in the traffic light) and the number of word produced by the participants. This indicator was displayed by an interaction meter that looks like a speedometer in a car. One end of the scale corresponds to exclusive talking while the other end corresponds to exclusive problem-solving. The color red on the interaction meter represented the problem-solving action, while the color green represented the talking action. The normative information was used by the subjects in the experiment to regulate their problem-solving behavior. The experimental results showed that the dyads in the condition with interaction meters talked more and produced more numerous and more precise plans for action than the dyads in the control condition.

Management-based scaffolding research in computer-supported systems

Taking the potent effectiveness of the early work on computer-supported systems that implemented interaction regulation, several CSCL studies have examined the effectiveness of providing feedback in the form of visualization and automated feedback. Early results have shown the positive influence of feedback on the production function as well as group well-being. For example, Zumbach, Mühlenbrock, Jansen, Reimann, and Hoppe (2002) conducted an exploratory study on the provision of automated feedback based on groups' participation collected by the system and learner's self-rated emotional and motivation level. In an experimental group with permanent graphical visualization of group members' motivation and emotional level and displays of relative amounts of each group member's contributions, there were slightly positive effects of these visualizations. Compared to a control group without feedback, there was no significant difference in

total number of postings. However, further analyses suggested more positive communication behaviors in feedback groups. The dyads in the experimental condition had more equally distributed contributions and had a significant difference in the number of dyadic interactions. Furthermore, the authors found a positive influence on intrinsic motivation. The authors explained the limited effect might be due to the use of ad-hoc groups and short learning times (approximately two hours of collaboration). However, the treatment had no effect on the subjects' knowledge acquisition. Both groups mastered the post-test, measuring domain knowledge, performing significantly better than on the pre-test.

Following up their previous study with a larger sample size, Zumbach and Reimann (2003) examined two different types of feedback-mechanisms, feedback based on interaction behavior and feedback based on problem-solving processes, to scaffold problem solving and interaction in an asynchronous PBL course. The first feedback mechanism, which aimed to enhance the group's well-being, was automatically generated visual aids that displayed group members' participation and motivation. The second form of feedback was a group's problem-solving strategies and its progress during different problem solving stages in the form of a meta-document created by the instructor. The results showed that groups with meta-document feedback had better results in knowledge tests and created qualitatively better problem solutions, produced more contributions to the task, and expressed a higher degree of reflection concerning the groups' organization and coordination than the groups without the feedback in the form of a meta-document. The members of groups with interaction histories feedback had significantly better

emotional attitudes toward the course and enhanced motivation for the task. The authors concluded that the different kinds of feedback positively influence different aspects of group behavior. Feedback in the form of interaction histories seemed to have an effect on the group's well-being function, whereas feedback in the form of meta-document histories seemed to influence a group's production function.

A study by Zumbach, Reimann, and Koch (2006) applied design- and management-based scaffolding techniques aimed at enhancing collaborative behavior. Based on assumptions of how successful online learning groups act together, they developed feedback-based mechanisms aimed at contributing to group functions of well-being, member support, and productive learning outcomes. Two studies were conducted to analyze the effects of these mechanisms. The first study provided automatic feedback about interaction, motivational, and emotional parameters and the result showed the advantages of the feedback on the processes of group well-being, parameters of participation, and interaction. In the second study, the feedback approach for monitoring and fostering collaborative behavior was combined with a design-based approach using distributed learning resources. Results suggest that by distributing learning materials, collaboration can be positively influenced. In addition, monitoring students' interactions and providing feedback on collaboration triggered collaborative behavior, facilitated problem-solving processes, and enhanced the group climate.

Martino and colleagues (2009) investigated the effect of providing feedback on group activity during online multiplayer games. Participants worked in a group of ten to play three twenty-minute game sessions and they could communicate with the other

players, who were connected one-to-one via Skype textual chat. Based on the communication in the group chat, social network analysis information, specifically centrality and reciprocity values, was extracted and graphically fed back to the groups before each game session resumed. They compared interaction levels and group experience (measured by social presence) of three treatment groups (centrality feedback, reciprocity feedback, and no feedback). The results showed that feedback improved the exchange of messages with respect to groups with no feedback. However, only centrality feedback maintained its effect over time. The effect of feedback was partially found in the social presence measure; there was a significant difference between the centrality feedback group and the control groups in the group awareness item. An exploratory study by Leshed and team (2009) on a chat-based system (GroupMeter) that provided visual feedback on team members' language use showed that an automated, real-time linguistic feedback mechanism elicited behavioral changes in groups. Using a within-subjects design, twenty-five undergraduate students were randomly assigned to seven groups of two to five members. Each group went through three conditions: Fish visualization, Bar visualization, and no visualization. Participants used distributed collaborative chat rooms to brainstorm on three problem tasks. In each task, they would see a different visualization of the language they used at the end of each task. The results indicated that when receiving feedback (either Fish visualization or Bar visualization), teams expressed more agreement in their conversations and reported greater focus on language use as compared to when not receiving feedback.

Based on prior research in CSCL, management-based scaffolding appears to have potential for enhancing collaborative behavior. However, these management-based scaffolds, which appear promising, have not been widely adopted in online learning environments. This may be due to the type of course management systems that are widely used in higher education (Falvo & Johnson, 2007), such as Blackboard or WebCT, which do not have support for such management facility. To implement management-based scaffolds in a computer-based form may require extra investment on the part of the instructor, or may not be technically feasible in the online system. Considering these issues, providing management-based scaffolding in the form of human interaction, e.g. an instructor providing feedback on collaborative performance, seems to be a feasible approach to learning about management-based scaffolding in online higher education. Therefore, this study employed the instructor as an agent to deliver group interaction information to students. The instructor observed and collected information about students' interaction and reflects them back to students.

Social ability

Education is a social practice. Therefore, the determinants of what students gain from participating in learning activities are not just how well the student interacts with the subject matter of the lesson, but also how well the student interacts with other members of the group during the lesson activity. In computer-mediated settings, students often find it hard to interact effectively with peers and an instructor and this diminishes their engagement and motivation to persist. Having a positive social experience as part of

a learning experience seems to foster a positive attitude towards learning, improve cognitive outcomes, and help the learner persist in learning. How one perceives positive or negative learning experiences is determined by many factors including learning contexts, learning tasks, interactions with fellow students and an instructor, and one's accomplishment. One way to measure a level of social learning experience in online learning is through social ability.

Social ability is a term explicated by Laffey and his colleagues (2006) to represent students' experience and perception of social interaction in online learning settings. The term is defined as a person's capacity to associate with fellows and to use shared resources, including members, online tools, and learning resources, to accomplish something of value. They further explain social ability as a relationship between the tools, the individual, and the tasks. From their study, they found three factors of social ability which are (a) social presence referring to the ability of learners to project themselves socially and emotionally in a community (Garrison & Anderson, 2003), (b) social navigation representing an ability to use information of what others are doing as a guide for one's own action, and (c) social connectedness referring to a sense of membership and social ties among participants.

Laffey et al. (2006) studied student experiences in fully online courses and examined how the social ability of students differed in different course designs. They found students who worked on self-paced materials with encouragement to interact with other students and those who worked collaboratively with others perceived significantly higher social ability than those who worked on self-paced materials and interacted solely

with an instructor. They also found that social ability and its three factors were predictors of learning satisfaction and an intention to use the online learning technology. These results indicate that social ability is influenced by the nature of the designed learning practices and associated with beneficial outcomes.

Yang and colleagues (2006) studied the relationships between social ability and students' academic motivation in online learning environments and also further explicated the social ability construct. In addition to the three original factors of social ability defined in Laffey et al.'s (2006) study, the additional factors were perceived written communication skills and perceived online privacy and a general sense of social presence was replaced with peer social presence and instructor social presence. They found that perceived peer social presence, perceived written communication skills, perceived instructor social presence, comfort with sharing personal information, and social navigation are factors that define social ability. They also found that different motivational constructs vary in their relationship with social ability factors.

Lin, Lin, and Laffey (2008) investigated the relationships of social ability and motivation with learning satisfaction in fully online graduate courses. They found that motivational constructs specifically task value and self-efficacy, and social ability influence learning satisfaction. Along the same lines, a study by Tsai and colleagues (2008) also confirmed that social ability is related to other social constructs and influences learning experience in online settings. They examined a model of how social constructs, namely sense of community, social ability, perceived ease of use and usefulness of social awareness tools, and self-reported participation, affect satisfaction

within online learning. The results indicated that social ability was predicted by perceived ease of use of social awareness tools and self-reported participation. Satisfaction with online learning was explained by sense of community, social ability, and self-reported participation. Sense of community was a mediator of the relationships between social ability and satisfaction and between perceived usefulness and satisfaction. Additionally, social ability, perception of usefulness of social awareness tools, and self-reported participation served as predictors for students' sense of community.

Analysis of Online Interaction

Social learning theories (e.g. Vygotsky, 1978; Wenger, 1998) suggest that interactions are related to learning. These theories emphasize that learning occurs as a result of social practices (Berger & Luckman, 1966; Vygotsky, 1978; Wenger, 1988). Vygotsky's (1978) Zone of Proximal Development stresses the importance of interaction with others as helping learners construct their own knowledge. Similarly, Wenger (1998) describes learning as social participation. Participating in a social unit provides meaning to experiences and engagement in the world, and provides shared perspectives and resources for sustaining engagement in activity.

Interaction is essential for learning in collaborative online work groups (Nichol & Blasbki, 2005). Without interaction with learning partners, collaboration cannot occur. It is a means of the collaboration process. Therefore, interaction is one of many constructs that interests researchers. Researchers in CMC have employed different approaches to measure interaction in work groups. Many researchers have looked at interaction through

quantity of participation, e.g. number of postings created and postings read, as an indicator of interaction among group members while others are more interested in the pattern of interaction and what qualitative types of dialogues are undertaken by students while working on tasks.

Studies that have investigated online interaction from a quantitative participation dimension such as looking at frequencies of postings and message length conclude that amount of interaction is related to learning satisfaction and achievement. For example, Rovai and Barnum (2003) argue that the level of student interaction and participation is important to their perceptions of learning. They found that graduate students reported higher levels of perceived learning when they posted more messages to the discussion board. This finding is consistent with previous studies (Fredericksen, Pickett, Picciano, 2002; Hao, 2004; Richardson & Swan, 2003; Stonebraker & Hazeltine, 2004; Swan, 2001) that found positive relationships among interaction, learning satisfaction, and perceived learning.

Many researchers argue that assessing only quantity of participation is not sufficient to represent students' learning processes and interaction. Findings from a study by Roberts (2007) indicate that interaction levels are a poor indicator of the quality of work that groups produce when working in online contexts. A key finding from this study indicated that the volume of contribution by a team did not appear to be directly related to the quality of work that was produced. Hence, researchers have increasingly adopted a discourse analysis approach to go beyond surface level analyses (Strijbos, Martens, Prins, & Jochems, 2006) and characterize interaction patterns.

Several studies look at interaction based on task types shaping group interaction. For example, Brewer and Klein (2006) investigated the effects of types of positive interdependence, roles and rewards, on students' achievement, affiliation motive, and attitudes in collaborative online discussion groups. They quantitatively analyzed interaction behaviors into cognitive interaction (statements about course topics), group process interaction (statements intended to accomplish a task, managing group behavior, or encouraging teammates), and off task interaction (statements about topics not related to the course). A significant positive correlation suggested that participants with higher numbers of interactions attained higher post-test scores. The results also revealed that the type of interdependence had a significant impact on student attitudes. Overall, participants in the reward interdependence groups had significantly higher agreement in statements describing the benefits from working with others and they generated better ideas as a group than those in no-structured-interdependence groups. Attitude statements regarding the importance of team members earning a high score and every member being highly successful were significantly higher for participants in both conditions given rewards. Additionally, the results showed that participants with high affiliation motives had significantly higher agreement with statements describing positive attitude for participating in group work.

Jonassen and Kwon (2001) compared the perceptions of participants, the nature of the comment made, and the patterns of communication in face-to-face and computer-mediated groups in problem solving activities. They examined patterns of interactions in terms of the problem solving activities engaged using the Poole and Holmes (1995)

Functional Category System. The categories of the coding scheme were problem definition, orientation, solution development, non-task, simple agreement, and simple disagreement. The findings indicated that students in computer-mediated groups used more task-directed and focused communication while solving both well-structured and ill-structured problems and that students' patterns of communication in the computer-mediated groups better reflected the problem-solving nature of the task when compared with face-to-face groups. Face-to-face groups tended to follow a linear sequence of interactions. Additionally, students in computer-mediated groups perceived a higher quality of communication and had more satisfying experience than did face-to-face groups.

Jeong and Davidson-Shivers (2006) used the dialogic theory of language as a framework to examine interaction patterns between males and females in online debates where students engaged in collaborative argumentation. They classified messages into argumentations, evidences, critiques, and elaborations. The findings revealed no differences in number of responses to messages with critiques, responses to critiques with personal rebuttals, and message types posted by males and females.

Schellens and Valcke (2005) use a classification scheme, which is parallel to *Gunawardena et al.*'s Interaction Analysis Model (1997), that is geared towards knowledge building rather than learning to investigate collaborative learning in asynchronous discussion groups. The results revealed that students in the discussion groups were very task-oriented and had discussion dialogues representing higher proportions of high phases of knowledge construction. Students had significant increases

over time in the cognitive interaction, task-orientation, and higher phases of knowledge construction.

Östlund (2008a) conducted an exploratory study to investigate factors influencing peer-learner interactions and collaborative learning activities in an asynchronous computer-mediated learning environment over 20 weeks. The results indicated that students did not collaborate with assignments beyond requirements and there was little evidence of factors characterizing effective collaborative learning activities as analyzed by the Collaborative Learning Model developed by Soller (1999).

Based on the cited research above, it is suggested that study of online interaction in groups should go beyond frequencies of posting and message length. Taking into account the nature of discourse and messages delivered in dialogues during their interaction should provide more in-depth knowledge about interaction patterns.

Chapter Summary

In conclusion, the review of literature has summarized theories and empirical research on collaborative learning and collaboration scaffolding approaches. The chapter identified empirical research for design-based scaffolds and management-based scaffolds conducted in classroom context and computer-mediated settings. Finally, the review of literature summarized theories and research related to social ability and analysis of online interaction. Based on the research and theories, the potential benefits of providing design-based scaffolding and management-based scaffolding are expected to hold in online learning environment.

CHAPTER 3 METHOD

Introduction

This chapter describes the research design, data collection procedures, subjects, instrumentation, and data analysis approaches that were used in this study. The study used quantitative methods and employs a post-test-only control-group experimental design to compare the effects of three collaboration scaffold methods with the control condition on outcome variables. The independent variable was a collaboration scaffold that had four levels. Dependent variables were a written essay score, social ability, satisfaction, and interaction. To measure the effects of different strategies for scaffolding collaboration, various data sources were employed to measure outcomes. A written essay score measuring group performance was obtained from a group's assignment. In addition, automatically recorded data capturing a group's discussion during the experimental treatment provided an objective measure of actual student behavior and interaction during collaborative tasks. The captured data included the number of postings, length of each posting, frequency with which each posting was viewed, and content of the postings. Moreover, self-report questionnaires measuring students' social ability and perceived learning satisfaction were administered at the end of collaborative group work to gain understanding of students' experiences working in online groups.

Multiple data analysis methods including descriptive statistics, ANOVA, correlation, regression, and coding and analysis of discussion dialogues were used to

provide in-depth understanding of the effects of the treatments in an online learning environment. Table 1 represents the timeframe of data collection in this research.

Table 1

The Timeframe of the Research

Week	Before Experimental Week	Experimental Week (June 22 – 28)	Experimental Week (June 29 – July 5)	After Experimental Week
Activities	Complete an online demographic survey	Discuss a case problem in a group discussion board	Complete a group written essay	Complete an online social ability and satisfaction survey

Context and Participants

This study was conducted in the “9467 Technology to Enhance Learning” course in the School of Information Science and Learning Technologies in Summer 2009. It was an eight-week course and was delivered fully online using the Blackboard Course Management System™. The aim of the course was to educate learners on how to integrate various technologies into classroom teaching in order to support students’ meaningful learning. The emphasis of this course was on helping teachers learn to use technologies to engage and support their students’ thinking, especially higher order thinking and problem solving. The nature of the course activities included weekly discussion and individual and/or group assignments based on topics covered each week. Reading material was mainly from the textbook “Meaningful Learning with Technology” by Jonassen, Howland, Marra, and Crismond (2008). For each week, guidance to

complete weekly activities and assignments were provided in “Course Documents” and “Assignments” pages for students to access. Extra reading materials were available online in “Course Documents.”

There were 74 graduate students enrolled in the “9467 Technology to Enhance Learning” course in Summer 2009. All students were invited to participate in the study. Participants were randomly assigned into dyads to discuss a case problem and write a group essay. There were two groups that had three members. Each group was randomly assigned to one of four discussion conditions representing 3 collaborative scaffolding conditions and one control condition.

Participant Recruitment

At the first week of the course, the instructor sent out an email to introduce the research study to students and to invite them to participate in the study (see Appendix J). The email invitation included an embedded link to an online consent form for students to give permission for use of their data in the study. The email explained about the purpose of the study, students’ involvement in the study, and incentives for participation. Students were informed that they would do the regular class activities regardless of their participation in the study. The only extra work that the students would do, if they decided to participate in the study, was complete two surveys seeking information about demographic data and their experience after participating in the collaborative task. The names of participants who completed the surveys would be added to a lottery for six gift

certificates of fifty dollars in value and the drawing would be done at the end of the course. Students who completed the consent form became participants of this study.

Experimental Conditions

Group 1: Treatment 1: Distributed Learning Resources (design-based scaffold)

In this condition, each member in a group accessed a case problem posted in the Course Documents but individuals had access to different reading materials related to the case. Student A was given reading material focusing on the employers' point of view about internet snooping (see Appendix A), such as issues and concerns about using the internet in the workplace and why internet monitoring was necessary. Student B was given reading material from the employees' point of view (see Appendix B), such as concerns related to privacy issues. Students were to interact freely without monitoring and feedback from the instructor.

Group 2: Treatment 2: Instructor's Feedback (management-based scaffold)

In this condition, each member of a group accessed a case problem and similar reading material. The reading material contained perspectives from both employers and employees on internet snooping (see Appendix C). However, during the discussion week, the instructor monitored students' discussion and provided feedback on students' contribution on a regular basis. The feedback focused on the interaction, but not the content of the discussion topic.

Group 3: Distributed Learning Resources + Instructor's Feedback (design-based scaffold + management-based scaffold)

In this condition, each member in a group accessed a case problem but individuals had access to different reading materials related to the discussion issue. Student A was given reading material from the employers' point of view (see Appendix A), such as issues and concerns about using the internet in the workplace and why internet monitoring was necessary. Student B was given reading material from the employees' point of view (see Appendix B), such as concerns related to privacy issues. During the discussion week, the instructor monitored students' discussion and provided feedback to students on a regular basis. The feedback focused on the interaction, but not the content of the discussion topic.

Group 4: Control Group

In a control group, each member in a group had access to a case problem posted in the Course Documents and access to similar reading material. The reading material contained perspectives from both employers and employees on internet snooping (see Appendix C). Students were free to discuss the case problem without the instructor's monitoring and feedback.

Case Problem for a Group Discussion and Written Essay Assignment

One crucial factor of successful collaboration is the nature of the learning task (Arvaja, Häkkinen, Eteläpelto, & Rasku-Puttonen, 2000). Unlike fact seeking questions and unambiguous tasks, open-ended and discovery tasks (Cohen, 1994) can promote joint problem-solving and reasoning. Tasks that are too obvious and unambiguous do not leave space for questions, negotiations, explanations and arguments. Therefore, the selected learning task should provide real group tasks and context that stimulate questioning, explaining, and demanding collaborative activities (Järvelä, Häkkinen, Arvaja, & Leinonen, 2004).

The nature of the case problem is a controversial/dilemma issue. Dilemmas are ill-structured and unpredictable types of problem solving since there is often no solution that is satisfying or acceptable to most people, and there are compromises implicit in every solution (Jonassen, 2000). Therefore, solving a dilemma as a type of task is appropriate for the collaborative learning task of the study. A consensus-building task also requires discussion among group members. A consensus-building type task is used because it exposes students to differences in value systems and viewpoints, as well as gives them practice in resolving these differences. The essence of a consensus-building task is the requirement that differing viewpoints be articulated, considered, and accommodated where possible (Dodge, 2002).

Prior to the study, the researcher worked closely with the instructor to develop the case problem and reading materials (see Appendix A-C). The reading materials provided

information on perspectives of employers and employees regarding internet monitoring in a workplace.

The case problem is a social dilemma (Schroeder, 1995) related to the Internet monitoring issue in school. The selected discussion topic was “Should the school monitor K-12 teachers’ internet use in school?”

Case Problem: “Should the school monitor K-12 teachers’ internet use in school?”

K-12 teachers now have access to the internet at school and even in the classroom. The internet is a wonderful place, the home of resources and opportunities that have the potential of changing a person’s life in highly desirable ways. Unfortunately, the internet is also a dangerous place, the home of content and opportunities that have the potential of changing a person’s life in highly undesirable ways.

According to the American Management Association reports, "nearly 75 percent of all American companies now use some form of surveillance to spy on employees." Some schools have already started monitoring K-12 teachers’ internet use.

Based on the information you have, you will discuss and share the stand that you take on the issue with your partner, supported by reasons and evidence. You may include alternative points of view and counterarguments (and supporting reasons) and consider both arguments and counterarguments when developing your final conclusion. After discussing it with your partner, your group will write a group essay stating the group’s stand on the issue and post it in the group’s Discussion Board.

Instructor’s Feedback

Instructor feedback was the mechanism for providing management-based scaffolding in this study. The statement of feedback given to each group depended on the ongoing interaction among group members. The purpose of the feedback was to provide information as a reflection on the group’s interaction. It did not provide information on

how students should work on the case. An instructor provided feedback at 3 points during the weeks of group work.

Feedback 1 (2nd day of the project: June 23rd)

The feedback focused on the following aspects:

- To check whether students got started on the assignment
 - o If yes, this feedback would state
 - “Very well done. Your group got started early. Getting started early on the project will give you more time to discuss and get a quality case solution”
 - o If no, this feedback would state
 - “We have only two weeks to complete the task. I strongly recommend that you get started early so you and your peer would have enough time to discuss the case and come up with a quality solution”
- To check whether students planned on how to get the work done
 - o If yes, this feedback would state
 - “It is a very good idea that you have planned on how to complete the work, and how often you would check on each other’s work.”
 - o If no, this feedback would state
 - “Since we just have two weeks to complete the task, I would highly recommend that you plan on how to get the work done such

as how often you will logon and response to your peer's posting, etc. Use the time wisely.”

Feedback 2 (5th day of the project: June 26th)

- To check on the progress of work. The feedback was provided based on a number of discussion exchanges,
 - If there were more than 4 exchanges, this feedback would be provided
 - “It seems like you are collaborating very well. You are on your way. Keep up with the good work”
 - If there were less than 4 exchanges, this feedback would be provided
 - “It is at the middle of the project and it seems like your group has not been very active. I would encourage everyone to contribute in the discussion and work on the project. Don't wait until the last minute.”

Feedback 3 (10th day of the project: July 1st)

- To check on the progress of work. The feedback was provided based on the discussion progress.
 - If the group had started writing the essay, this feedback would be provided
 - “Your group has done very well. Keep going and carefully consider the inputs of your teammate for the case report”

- If the group had not started writing the essay yet, this feedback would be provided
 - “There are a few days left before turning in the assignment. Your group should work harder on this assignment.”

Research Design

This study applied a posttest-only control-group design to investigate the effects of collaboration scaffold techniques on group performance, social ability, perceived satisfaction, and interaction in an online group. This design controls for confounding effects, such as threat to internal validity (Creswell, 2003). By having a control group and a comparison group, a single group threat, specifically repeated testing maturation, to internal validity is avoided. It avoids the experimental contamination from extraneous factors due to repeated measures. Additionally, selection problems are controlled by randomization, which makes it probable that the extraneous variables of individual participant characteristics will be equivalent between groups (Gould, 2001). Data were collected from online questionnaires, students’ assignments, and a transcript of the online discussion board. The design is illustrated in Table 2 below.

Table 2
 Posttest-Only Control-Group Design

Experimental Group 1 (Treatment 1: Distributed learning resources only)	O ₁ O ₂ O ₃ O ₄
Experimental Group 2 (Treatment 2: Instructor’s feedback only)	O ₁ O ₂ O ₃ O ₄
Experimental Group 3 (Treatment 3: Distributed learning resources + Instructor’s feedback)	O ₁ O ₂ O ₃ O ₄
Control Group: (No treatment: Similar learning resources + no instructor’s feedback)	O ₁ O ₂ O ₃ O ₄

Note: O1 represents a written essay, O2 represents social ability score, O3 represents perceived satisfaction, and O4 represents interaction pattern.

Data Collection

At the beginning of the course, the course instructor sent an email invitation, which included a link to an electronic informed consent form (see Appendix D), to invite students to participate in the study. The participation invitation was also posted in an Announcement page of the Blackboard Course Management System. At the beginning of the second week, the instructor sent a follow-up email to encourage students to participate in the study. Students who completed the consent form became participants of the study. The participants were randomly assigned into groups of two. Only two groups had three group members. Each group was then randomly assigned to one of four experimental groups.

The link to the consent form also directed participants to complete an online demographic survey (see Appendix E). The survey sought to obtain participants’ information regarding gender, age, current academic status, prior online learning experiences, and prior online collaborative learning experiences.

A group listing (providing information regarding a list of assigned partners to work with), instructions to complete a unit, a case problem, assigned reading materials, and an essay scoring guide were available in a Course Document one day prior to the treatment. The documents were posted one day before the treatment began to minimize the chance of participants accessing unassigned readings. During the experimental weeks (Week 3 and Week 4 of the course), participants accessed the Course Document to obtain information about that week's activities (see Appendix I), and then worked with their partners using a private group discussion board to discuss the case problem and worked on a group essay. Individual group discussion boards were set up for each group to use for discussing the case problem and working on the group essay. Only assigned members, the instructor, and the researcher had access to the assigned group discussion board. Participants were instructed to use two weeks to work on the task by using week one to discuss the case problem and reach a group consensus, and week two of the experiment to collaborate on writing a group essay. The task of writing a group essay was to write about the group's decision reporting the stand the group took on internet surveillance with supporting arguments (see Appendix G). Participants were instructed to use the File Exchanges function, which was available in the private group discussion, to share group written essays during the writing process. Each group had one week to complete and electronically submit the group essay to the instructor.

At the end of week two an electronic survey collecting information about collaborative experiences during the experimental week (see Appendix H) was administered. The embedded link to the surveys was posted in the Announcement Page of

the Blackboard for the participants to complete within two weeks after collaborative group work. After the end of the experimental period, group discussion data were captured from Blackboard. The discussion transcript of each group was coded and analyzed using a collaborative learning skills coding scheme (see Appendix F). The essays were graded with the participants' names removed. The essay grades were posted to students' grade book after all participants completed the collaborative experiences survey.

Names of participants who won a lucky drawing were posted in the course Announcement page on the final week of the course.

Measures and Instruments

Group Performance Outcome

A score from a group essay was used to assess group performance. The group essay was a part of the class assignments. To finish the assignment, a group of two or three members was required to discuss the case problem by following the assigned instructions and submitting the group essay addressing the stand the group took on the issue. Each group had one week to discuss the case problem and one week to compose the written essay. The essay assignment asked students to consider all relevant information, including assigned reading materials as well as information discussed during the group discussion to compose the essay. In the essay, the group needed to identify their position on the issue, provide supporting arguments and counter arguments,

generate a conclusion, and produce persuasive arguments to readers. A holistic rubric (see Appendix G) using five components was used to evaluate the quality of the group essay. The scoring rubric was generated by the course instructor and the researcher. The full score was 15 with 0-3 for each category. Students in the same group received the same score and the score was a part of the course grade. There were two raters, the researcher and a doctoral student, to grade the essay papers. Before coding the actual essay of this study, the researcher trained the doctoral student to use the rubric. The researcher and the doctoral student independently rated the practice essay and then compared the rated essay. If there was disagreement in rating, it would be discussed to reach a consensus. The inter-rater reliability for the essay was 0.77 which generally represents substantial reliability (Stemler, 2004).

Social Ability (Appendix H)

Students' perceived social ability was measured with a modified Online Learning Experience Study Questionnaire (Yang et al., 2006) by removing perceived written communication skills items and comfort with sharing personal information items. The instrument is a measure of participants' social experience of working in online courses and represents the social ability experienced by participants while undertaking course activities (Lin, 2006). The instrument consists of three subscales: perceived peers social presence, perceived instructor social presence, and social navigation with reported original Cronbach's coefficient alpha of .93, .91, and .88 respectively. It asks participants to rate 24 items based on 1-7 Likert scale with 1 indicating "strongly

disagree” and 7 indicating “strongly agree”. For the relevance of this study, the description of “the course” in the original scale was altered to “the group work” and “other students” was altered to “my group members.” The survey was administered through a web-based survey after the end of the experimental week for individual participants to complete. It took about 10 minutes to complete. In the present study, the reliability (Cronbach’s coefficient alpha) was .92, .90, and .89 for perceived peers social presence, perceived instructor social presence, and social navigation respectively.

Satisfaction (Appendix H)

Students’ satisfaction was measured with a satisfaction survey used in a study by Lin (2007), which was modified from an instrument by Green & Taber (1980). The instrument assesses the perceived solution satisfaction and process satisfaction of individual participants in a group project. Solution satisfaction is assessed with five items about the quality of the solution, individual input reflected in the solution, commitment to the solution, confidence in the solution, and responsibility for the solution. Satisfaction with a group’s discussion process is measured by five items assessing discussion efficiency, discussion fairness, discussion coordination, discussion confusion, and satisfactory discussion. The reported reliability coefficients of solution satisfaction and process satisfaction were both 0.88 (Green & Taber, 1980). There are ten item-questions rated on a 7-point Likert scales (1= strongly disagree to 7 = strongly agree). The survey was administered through a web-based survey after the end of the experimental period for individual participants to complete. It took approximately five minutes to complete the

survey. In the present study, the reliability coefficients were .70 and .91 on solution satisfaction and process satisfaction respectively.

Interaction Pattern

To gain understanding of group interaction and behavior during the collaboration process, a data log file of participants' contribution during the experimental period in private group discussion boards was collected. The information obtained from group discussion was classified into two main categories; level of interaction and type of interaction.

A) Levels of interaction were measured with the following variables:

- Posting total count: The average number of generated postings, including original posts and replies to original posts, by all individuals in a group.

$$\text{(Avg posting total count} = \frac{\text{total number of all postings generated}}{\text{number of all generated postings}})$$

- Length of posting: The average number of word counts of all generated postings by all individuals in a group.

$$\text{(Avg posting length} = \frac{\text{total number word counts of all postings generated}}{\text{number of all generated postings}})$$

- Viewed posting total count: The average number of times all postings were viewed by group members.

$$\text{(Avg viewed posting} = \frac{\text{total number of all postings have viewed}}{\text{number of all generated postings}})$$

B) Types of interaction patterns were measured by analyzing the dialogue of discussion posting. Based on the categorization of collaborative learning skills coding scheme by Soller (2001) (See Appendix F), the discussion transcript was coded and the frequency of each category was obtained.

There were two coders including the researcher and one educational researcher to code the discussion transcript. Before coding the actual transcript of this study, the researcher trained another researcher to code the transcript with practice transcripts. The researcher and another researcher independently coded the practice transcripts and then compared the coded transcripts. If there was disagreement in coding, it would be discussed to reach a consensus. The unit of analysis was at the message level. Using the message as the unit of analysis was associated with the following benefits; a) it is objectively identifiable, b) it produces a manageable set of cases, and c) it is a unit whose parameters are determined by the author of the message (Rourke, Anderson, Garrison, & Archer, 2001). In the present study, the inter-rater reliability was .81 which generally represents substantial reliability in content analysis of computer conference transcript (Rourke et al., 2001).

Data Screening and Manipulation Checks

To ensure that the study captured all communication and interaction during a group's work, participants reporting using more than 30 percent of other communication

tools, besides private group discussion board and File Exchanges function, to complete group activities during collaboration process were removed from the sample set of data analysis. Two participants utilized email 56 to 60 percent for their group communication and were removed from the dataset.

Additionally, to verify that participants followed the instructions, participants were asked about how strictly they followed the instructions to complete the task. Participants who reported reading unassigned reading and/or exchanging reading material with their group members were excluded from the analysis of the study. Six participants did not meet this criterion. Based on the manipulation checks criteria, a total of eight participants were excluded from data analysis.

Data Analysis

Data analysis included preliminary analysis and analyses that answered each of the research questions.

Preliminary Analysis

All data were subjected to accuracy screening. The data were screened and cleaned up for missing cases and outliers. Normality, homogeneity of variance, and linearity were checked. Descriptive statistics such as frequency, means, and standard deviation were obtained.

To verify that participants assigned to different experimental conditions did not have significant differences in collaborative experience and online learning experience, ANOVAs were conducted. Using data collected in the demographic survey, the results indicated that participants had similar prior collaborative experience and online learning experience across all treatment conditions. Therefore, the following statistical analyses were used for each research question. After data screening, manipulation checks, and preliminary analysis, 10 cases were excluded from data analysis. The final data set comprised 60 participants which represented 29 groups.

Data Analysis for Research Questions

Research Question 1: What scaffolding condition will have the highest impact on students' performance as measured by a group written essay score?

To answer Research Question 1, a one-way ANOVA was conducted to test whether there was any significant difference among group means. The independent variable was scaffold conditions and the dependent variable was the score on the written essay. The unit of analysis was groups.

Research Question 2: What scaffolding condition will have the highest impact on students' perceived social ability?

To answer Research Question 2, a one-way ANOVA was performed to test whether there was any significant difference among group means. The independent

variable was the different scaffold conditions and the dependent variable was the rating of three subscales of social ability. The unit of analysis was individuals.

Research Question 3: What scaffolding condition will have the highest impact on students' perceived satisfaction?

To answer Research Question 3, a set of one-way ANOVA was conducted to test if there was any significant difference among group means. The independent variable was the different scaffold conditions and the dependent variable was the rating of two subscales of satisfaction. The unit of analysis was individuals.

Research Question 4: Overall, how do scaffolding conditions influence interaction behavior during collaboration processes?

a) What scaffolding condition will have the highest impact on level of interaction?

To answer Research Question 4a, three separate sets of one-way ANOVA were conducted to find out the differences in the frequency of exchange total count, length of postings, and total count of postings viewed. The unit of analysis was groups.

b) What scaffolding condition will have the highest impact on types of interaction?

To answer Research Question 4b, the discussion transcript was coded and then analyzed by statistical analysis. After quantitatively analyzing the discussion transcript using the categorization of collaborative learning skills coding scheme by Soller (2001), separate sets of one-way ANOVA were performed to examine whether there were

differences between collaboration scaffold conditions on categorization of collaborative learning skills. The unit of analysis was groups.

Research Question 5: Does social ability mediate the relation between scaffolding conditions and perceived satisfaction?

To answer Research Question 5, a regression analysis was conducted. According to Baron and Kenny (1986), three conditions should be met to perform mediation analysis: (a) the scaffold condition must significantly affect the mediators (social ability and its subscales), (b) scaffold condition must significantly affect the dependent variables (perceived satisfaction), and (c) the mediators must significantly affect the perceived satisfaction variable when regressed in conjunction with the scaffold conditions. Provided all three conditions are met, the effect of the scaffold condition on the perceived satisfaction must be less in the third step than in the second step. The unit of analysis was individuals.

Research Question 6: Does the type of interaction mediate the relation between scaffold conditions and group performance?

To answer Research Question 6, a regression analysis was conducted. According to Baron and Kenny (1986), three conditions should be met to perform mediation analysis: (a) scaffold condition must significantly affect the mediators (type of interaction), (b) scaffold condition must significantly affect the dependent variables (group performance), and (c) the mediators must significantly affect the group

performance variable when regressed in conjunction with the scaffold conditions.

Provided all three conditions are met, the effect of the scaffold condition on the group performance must be less in the third step than in the second step. The unit of analysis was groups.

Research Question 7: Does the level of interaction mediate the relation between scaffold conditions and group performance?

To answer Research Question 7, a regression analysis was conducted. According to Baron and Kenny (1986), three conditions should be met to perform mediation analysis: (a) scaffold condition must significantly affect the mediators (level of interaction), (b) scaffold condition must significantly affect the dependent variables (group performance), and (c) the mediators must significantly affect the group performance variable when regressed in conjunction with the scaffold conditions. Provided all three conditions are met, the effect of the scaffold condition on the group performance must be less in the third step than in the second step. The unit of analysis was groups.

Research Question 8: Overall, what are the best explanations of performance and satisfaction in an online cooperative group?

To identify what variables had predictive power for group performance and perceived satisfaction, multiple sets of regressions were conducted. The unit of analysis

of group performance was groups. The unit of analysis of student satisfaction was individuals.

A summary of the research question, data collection procedure, instrumentation, and data analysis is presented in Table 3.

Table 3
Summaries of research questions, data collection, instruments, and data analysis

Research questions	Research design/data collection	Instruments	Data analysis
Q1. What scaffolding condition will have the highest impact on students' performance as measured by a group written essay score?	Scores of written case essay assignment	Data from group written essay	One-way ANOVA
Q2. What scaffolding condition will have the highest impact on students' perceived social ability?	Online questionnaire for social ability	Social Ability Instrument	One-way ANOVA
Q3. What scaffolding condition will have the highest impact on students' perceived satisfaction?	Online questionnaire for satisfaction	Satisfaction Survey	One-way ANOVA
Q4. Overall, how do scaffolding conditions influence interaction behavior during collaboration processes? a) What scaffolding condition will have the highest impact on level of interaction? b) What scaffolding condition will have the highest impact on types of interaction?	Log file of discussion transcript	Data from transcript analysis	One-way ANOVA

Q5. Does the social ability mediate the relation between scaffold conditions and perceived satisfaction?	Online questionnaire for social ability, Online questionnaire for satisfaction	Social Ability Instrument, Satisfaction Survey	Regression Analysis
Q6. Does the type of interaction mediate the relation between scaffold conditions and group performance?	Log file of discussion transcript, Scores of written case essay assignment	Data from transcript analysis, Data from student case solution essay	Regression Analysis
Q7. Does the level of interaction mediate the relation between scaffold conditions and group performance?	Log file of discussion transcript Scores of written case essay assignment	Data from transcript analysis, Data from student written essay	Regression Analysis

Q8. Overall, what are the best explanations of performance and satisfaction in an online collaborative group?

Log file of discussion transcript

Data from transcript analysis,

Multiple sets of Correlation Analysis

Scores of written case essay assignment

Data from student written essay,

Online questionnaire for social ability

Social Ability Instrument,

Online questionnaire for satisfaction

Satisfaction Survey

Chapter Summary

This chapter describes the overall method of this study. The study used quantitative methods as a framework for a research design. An experimental design used a post-test-only control group as an approach to compare the effects of different treatments on measured differences in performance, collaboration, social ability, and perceived satisfaction with the control group. Data were collected from multiple sources including self-report online questionnaires, scores from a group written assignment, and log files of discussion transcripts. Data analysis used ANOVA and regression analysis to examine whether differences existed among different treatments on measured outcomes, as well as what variables explained group performance and satisfaction.

CHAPTER 4 DATA ANALYSIS AND RESULTS

Introduction

Chapter 4 describes the procedures for manipulating data and applying statistical techniques used to analyze data, followed by the results of the analysis. The aim of this chapter is to examine the effects of three different scaffolding techniques as compared to a control group on measured outcomes in online collaborative groups. In this chapter the results address the following research questions:

1. What scaffolding condition will have the highest impact on students' performance as measured by a group written essay score?
2. What scaffolding condition will have the highest impact on students' perceived social ability?
3. What scaffolding condition will have the highest impact on students' perceived satisfaction?
4. Overall, how do scaffolding conditions influence interaction behavior during collaboration processes?
 - a. What scaffolding condition will have the highest impact on level of interaction?
 - b. What scaffolding condition will have the highest impact on types of interaction?
5. Does social ability mediate the relationship between scaffolding conditions and perceived satisfaction?

6. Does the type of interaction mediate the relationship between scaffold conditions and group performance?
7. Does the level of interaction mediate the relationship between scaffold conditions and group performance?
8. Overall, what are the best explanations of performance and satisfaction in an online collaborative group?

Data Compilation and Data Screening

The data sets were obtained from group essay, self-reported surveys, and discussion logs captured during two weeks of online collaboration. The data were subjected to preliminary screening including manipulation checks and preliminary statistical screening and analyses.

The compiled data set was first subjected to manipulation checks based on participants' responses to questions asked in the survey regarding their communication behavior and means of communication utilized to accomplish the assigned tasks during the collaboration week. Participants who reported reading unassigned reading materials and/or did not follow the activity guide were excluded from the data set. Additionally, participants who used communication mediums outside of Blackboard, besides the assigned private group discussion board and File Exchange, for more than 30 percent of their communication to complete the collaborative task were also deleted. Groups that had any members not passing the manipulation check criteria were also excluded from the data set.

Subsequently, the compiled data set was statistically screened. Outliers were detected based on Z scores. Cases having Z scores with absolute value above 3.29 were removed from the data set (Field, 2009). The final data set comprised 60 participants and 29 groups (see Table 4).

All research questions were tested with the significance level of alpha .05. To control for Type I error and Type II error and trade-off between these two errors, the alpha level .05 was chosen. Alpha of 0.05 is usually considered to be a small enough chance of detecting Type I error, whilst not being so small as to result in too large a chance of Type II error (Howell, 2006).

Table 4
Numbers of Participants

Experimental Condition	Groups	Individuals
Group 1: Instructional-based scaffolding (Distributed learning resources)	7	15
Group 2: Management-based scaffolding (Instructor's feedback)	9	18
Group 3: Combined scaffolding (Distributed learning resources + Instructor's feedback)	6	13
Group 4: Control group (Similar reading resources + No Instructor's feedback)	7	14
Total	29	60

Demographic Description of Participants

Prior to the treatment, a demographic survey was given to all participants to collect data on gender, age, and academic status as well as experiences with online learning and collaboration. Frequencies and percentage of participants by gender, age, and academic status are presented in Table 5.

After data screening and manipulation checks, the final sample included 60 participants. These 60 participants had been divided into 29 groups. Of the 29 groups, seven groups were in the distributed learning resources group, nine groups were in the instructor's feedback group, six groups were in the combined scaffolding group, and seven groups were in the control group.

The demographic data shown in Table 5 indicates there are no substantial differences in gender, age, and current academic status across all four treatments; participants were mainly females, approximately 70%-80%; the majority of participants were in the age range between 26-35 years of age (60%); and most participants (approximately 80%) were in master degree programs.

Table 5
Frequencies and Percentage of Participants by Demographic Variables

Demographic variable	Distributed learning resources N = 15 Number of Participant (%)	Instructor's feedback N= 18 Number of Participant (%)	Combined scaffolding N= 13 Number of Participant (%)	Control group N= 14 Number of Participant (%)	Total N= 60 Number of Participant (%)
Gender					
Male	4 (26.7 %)	3 (16.7 %)	2 (15.38 %)	3 (21.43 %)	12 (19.35 %)
Female	11 (73.3 %)	15 (83.3 %)	11 (84.62 %)	11 (78.57 %)	48 (80.65 %)
Age					
20-25	1 (6.7 %)	3 (16.7 %)	2 (15.38 %)	1 (7.1 %)	7 (11.67 %)
26-30	3 (20 %)	7 (38.9 %)	6 (46.15 %)	7 (50 %)	23 (38.33 %)
31-35	3 (20 %)	4 (22.2 %)	3 (23.08 %)	3 (21.4 %)	13 (21.67 %)
36-40	1 (6.7 %)	2 (11.1 %)	1 (7.69 %)	1 (7.1 %)	5 (8.33 %)
41-45	3 (20 %)	0 (0 %)	1 (7.69 %)	0 (0 %)	4 (6.67 %)
46-50	2 (13.3 %)	1 (5.6 %)	0 (0%)	1 (7.1 %)	4 (6.67 %)
51-55	2 (13.3 %)	1 (5.6 %)	0 (0 %)	1 (7.1 %)	4 (6.67 %)
Academic status					
Master	14 (93.3 %)	16 (88.9 %)	11 (84.62 %)	10 (71.4 %)	51 (85.0 %)
PhD	0 (0 %)	1 (5.6 %)	0 (0 %)	1 (7.1 %)	2 (3.33 %)
Others	1 (6.7 %)	1 (5.6 %)	2 (15.38 %)	3 (21.4 %)	7 (11.67 %)

Data Analysis and Results

Research Question 1

1. What scaffolding condition will have the highest impact on students' performance as measured by a group written essay score?

The analysis for question one compared students' performances, as measured by a group written essay score, among four scaffolding conditions. The independent variable

was the scaffolding condition (with four levels) and the dependent variable was the essay score. The unit of analysis for this research question was groups.

Assumption Checking

The following one-way ANOVA assumptions were checked before performing the analysis.

- Normality: The normality was checked by examining a histogram as well as skewness and kurtosis values of the dependent variable. Skewness for the essay score was $-.725$, which was within the acceptable range of -2.0 to $+2.0$; kurtosis was $-.394$, which was within the acceptable range of -5.0 to $+5.0$ (Kendall & Stuart, 1966). Therefore, the data were considered to be normally distributed.
- Homogeneity of variances: To test that each scaffolding conditions had the same variance on the essay score, the Levene's test was performed. From Levene's Test of Homogeneity, $F_{\text{Levene}} = 2.70$ with 3 and 25 degrees of freedom ($p = .07$, see Table 5). Thus, it revealed that equal variance could be assumed ($p > .05$).
- Independent observation: The expectation of independent observation was assumed since each group was asked to work individually. Therefore, the behavior of one group should not influence the behavior of another.
- Interval data: The dependent variable was measured on an interval scale.

Since the groups are of unequal value, Welch's variance-weighted ANOVA is recommended (Field, 2009). Welch's F adjusts F and the residual degrees of freedom to combat problems arising from violation of the unequal cell sizes.

Table 5
Test of Homogeneity of Variances of Essay

Levene Statistic	df1	df2	Sig.
2.70	3	25	.07

Results

The Welch's variance-weighted ANOVA was calculated in order to determine whether the group essay score was impacted by the scaffolding conditions. Table 7 shows the results of the ANOVA on the group essay score. With alpha set at .05, the result showed no significant statistical difference in the essay score among the scaffolding condition, $F(3, 13.39) = .12, p = .95$. For these four groups' means, the combined scaffolding group had the highest mean score than other groups (see Table 6), but there were no statistical significances. Therefore, all groups performed equally on the performance outcome.

Table 6
Descriptive Statistics on Group Essay

	Distributed learning resources (N=7)	Instructor's feedback (N=9)	Combined scaffolding (N=6)	Control group (N=7)
Variable	<i>M</i> (SD)	<i>M</i> (SD)	<i>M</i> (SD)	<i>M</i> (SD)
Essay	10.86 (3.132)	10.78 (4.177)	11.50 (1.761)	10.86 (4.776)

Table 7
ANOVA Results of Essay Score

	Statistic ^a	df1	df2	Sig.
Between Groups	.12	3	13.39	.95

The group sizes were unequal. Welch's variance-weighted ANOVA was used.

Research Question 2

What scaffolding condition will have the highest impact on students' perceived social ability?

The analysis for question two compared students' perceived social ability, as measured by the social ability scale, among four scaffolding conditions. The independent variable was the scaffolding condition (with four levels) and the dependent variable was the social ability and its three subscales. The unit of analysis was individuals.

Participants' perceived social ability was determined using a modified self-reported Online Learning Experience Study Questionnaire (Yang et al., 2006). The perceived social ability (SA) consisted of three subscales; peer social presence (PSP), instructor social presence (ISP), and social navigation (SN). Each subscale value was calculated by adding values of responses to questions in each category. The values assigned to responses for each question were 1-7 (1 = strongly disagree to 7 = strongly agree). The larger number represented higher perceived social ability experienced by participants. The SA score was a sum of all three subscales.

Assumption Checking

The following one-way ANOVA assumptions were checked before performing multiple sets of ANOVA.

- Normality: The normality was verified by examining skewness, kurtosis, and a histogram of the dependent variable. Skewness for the social ability, peer social presence, instructor social presence, and social navigation were -.16, -.97, -.57, and -.53 respectively, which was within the acceptable range of -2.0 to + 2.0;

kurtosis were -.738, .554, -.104, -.252, respectively, which was within the acceptable range of -5.0 to +5.0 (Kendall & Stuart, 1966). Therefore, the data were considered to be normally distributed.

- Homogeneity of variances: To determine whether the variances of the groups were similar, the Levene's test was obtained. The Levene's Test of Homogeneity illustrated in Table 8 revealed that equal variances were supported for social ability and all subscales ($p > .05$).
- Independence of observation: The expectation of independent observation was assumed since individuals in each group were a random sample from the population.
- Interval data: The dependent variable was measured on 7-point Likert scales. Most researchers agree that Likert, which provided the scale item has at least 5 and preferably 7 categories, are very commonly used with interval procedures. The fewer the number of points, the more likely the departure from the assumption of normal distribution, required for many tests (Garson, 2009). Therefore, the Likert scale could be treated as interval variables without reducing the robustness of the analysis.

Since the group sizes were unequal, Welch's variance-weighted ANOVA was selected to combat problems arising from violation of the unequal cell sizes (Field, 2009).

Table 8
Test of Homogeneity of Variances of Social Ability and Subscales

Variables	Levene Statistic	df1	df2	*Sig.
SA	2.06	3	56	.12
PSP	2.47	3	56	.07
ISP	1.47	3	56	.23
SN	1.20	3	56	.32

*p=.05

Results

Table 9 shows descriptive statistics of social ability. Based on group's means, participants in the distributed learning resources group reported having slightly higher social ability than other groups ($M = 138.73$). When examining the subscales, participants in the instructor's feedback group reported having slightly higher peer social presence ($M = 60.56$) and social navigation ($M = 33.00$) than other groups while participants in distributed learning resources group reported having slightly higher instructor social presence ($M = 45.93$) than other groups. In all social ability scales, participants in the combined scaffolding group seem to experience lowest social ability as indicated by group means.

To determine whether participants' perceived social ability differed significantly, four sets of Welch's variance-weighted ANOVAs were run. The results in Table 10 indicates no significant differences in participants' perceived social ability among the scaffolding condition, $F(3, 30.03) = 1.24, p = .31, \alpha = .05$. Examination on PSP, ISP, and SN at significance level .05 did not reveal significant results as well; $F(3, 28.39) = 1.66, p = .20$; $F(3, 30.35) = .04, p = .99$; $F(3, 29.96) = 1.33, p = .28$ respectively. Therefore,

participants in every scaffolding condition had fairly similar social experience in term of social ability.

Table 9
Descriptive Statistics on Social Ability and Subscales

Variables	Distributed learning resources (N=15) <i>M (SD)</i>	Instructor's feedback (N=18) <i>M (SD)</i>	Combined scaffolding (N=13) <i>M (SD)</i>	Control group (N=14) <i>M (SD)</i>
SA	138.73 (25.22)	138.56 (17.91)	127.08 (17.12)	132.57 (19.77)
PSP	60.27 (10.32)	60.56 (6.30)	53.31 (10.44)	58.50 (8.49)
ISP	45.93 (9.52)	45.00 (7.09)	44.92 (5.41)	45.07 (7.35)
SN	32.53 (10.15)	33.00 (6.89)	28.85 (6.62)	29.00 (7.71)

Table 10
ANOVA Results of Social Ability and Subscales

Variables	Statistic ^a	df1	df2	Sig.
SA	1.24	3	30.03	.31
PSP	1.66	3	28.39	.20
ISP	.04	3	30.35	.99
SN	1.33	3	29.96	.28

The group sizes are unequal. Welch's variance-weighted ANOVA is used (Asymptotically F distributed).

Research Question 3

What scaffolding condition will have the highest impact on students' perceived satisfaction?

The analysis for question three compared participants' satisfaction across four scaffolding conditions. The independent variable was the scaffolding condition (with four levels) and the dependent variable was satisfaction and its two subscales. The unit of analysis was individuals.

Satisfaction was measured by the satisfaction survey developed by Green and Taber (1980). The instrument measured satisfaction in terms of process satisfaction (PS) and solution satisfaction (SS). In this study, the survey was measured on a 7-point Likert scales. The values assigned to responses for each question were from 1-7 (1 = strongly disagree to 7 = strongly agree). The value was calculated by summing values of responses of questions from each category. The larger the number, the higher the satisfaction an individual experienced. The satisfaction score was a sum of values of process satisfaction and solution satisfaction.

Assumption Checking

The following one-way ANOVA assumptions were checked before performing multiple sets of ANOVA.

- Normality: The normality was checked by examining the values of skewness and kurtosis and a histogram of the dependent variable. The skewness for the satisfaction, solution satisfaction, and process satisfaction were -1.45, -1.09, and -1.63 respectively which was within the +2 to -2 range; the kurtosis were 2.581, .531 and 3.182, respectively, which was within a range of -5 and +5 (Kendall & Stuart, 1966). Therefore, the normality of data could be assumed.
- Homogeneity of variances: To determine whether the variances of the groups were similar, the Levene's test was obtained. The result is shown in Table 11. From Levene's Test of Homogeneity, it was revealed that equal variances assumption was supported for satisfaction and its subscales ($p > .05$).

- Independence of observation: The expectation of independent observation was assumed since individuals in each group were random sample from the population.
- Interval data: The dependent variable was measured on 7-point Likert scales. Most researchers agree that Likert, provided the scale item has at least five and preferably seven categories, are very commonly used with interval procedures. The fewer the number of points, the more likely the departure from the assumption of normal distribution required for many tests (Garson, 2009). Therefore, the Likert scale could be treated as interval variables without reducing the robustness of the analysis.

To account for the unequal group sizes, Welch's variance-weighted ANOVA was chosen in order to control the Type I error rate when the assumption was violated (Field, 2009).

Table 11
Test of Homogeneity of Variances of Satisfaction and Subscales

Variables	Levene Statistic	df1	df2	*Sig.
Satisfaction	.21	3	56	.89
SS	.26	3	56	.86
PS	.27	3	56	.85

*p=.05

Results

The descriptive statistics, as displayed in Table 12, show participants in the distributed learning resources group experienced higher satisfaction during the collaboration processes ($M = 62$), as both measured by solution satisfaction ($M = 31.80$)

and process satisfaction ($M = 30.20$), than others. Groups with the combined scaffolding reported experiencing the lowest satisfaction ($M = 59.43$) in solution satisfaction ($M = 29.93$) as well as in process satisfaction ($M = 29.50$).

Separate Welch's variance-weighted ANOVAs revealed no statistically significant differences in satisfaction ($F(3, 28.98) = .87, p = .47$), either in terms of solution satisfaction ($F(3, 30.05) = 1.07, p = .38$) or process satisfaction ($F(3, 28.88) = .77, p = .52$). Table 13 displays ANOVA results.

Table 12
Descriptive Statistics on Satisfaction and Subscales

Variable	Distributed learning resources (N=15) <i>M (SD)</i>	Instructor's feedback (N=18) <i>M (SD)</i>	Combined scaffolding (N=13) <i>M (SD)</i>	Control group (N=14) <i>M (SD)</i>
Satisfaction	62 (8.86)	60.83 (7.40)	56 (11.00)	59.43 (10.01)
SS	31.80 (3.39)	31.17 (4.15)	29.46 (4.31)	29.93 (4.09)
PS	30.20 (5.88)	29.67 (4.89)	26.54 (7.13)	29.50 (6.76)

Table 13
ANOVA Results of Satisfaction and Subscales

Variables	Statistic ^a	df1	df2	Sig.
Satisfaction	.87	3	28.98	.47
SS	1.07	3	30.05	.38
PS	.77	3	28.98	.52

The group sizes are unequal. Welch's variance-weighted ANOVA is used (Asymptotically F distributed).

Research Question 4

Overall, how do scaffolding conditions influence interaction behavior during the collaboration processes?

4a. What scaffolding condition will have the highest impact on level of interaction?

The independent variable was the scaffolding condition with four levels and the dependent variable was level of interaction as measured by average posting count, average posting length, and average number of viewed postings. The unit of analysis was groups and the significance test was at alpha level .05.

The variables for level of interaction collected from private group discussion boards in the Blackboard Course Management System™ during the two weeks of collaboration, including average posting total (number of total postings divided by number of members), average posting length (total length of all postings divided by number of postings generated), and average viewed posting (number of total viewed postings divided by number of group members). A series of ANOVAs were performed to test whether the scaffolding condition had impact on level of interaction.

Assumption Testing

The following one-way ANOVA assumptions were checked before performing a multiple sets of ANOVA.

- Normality: Skewness and kurtosis as well as a histogram were verified for the data set that indicates that data are normally distributed. The skewness for the average posting total, average posting length, and average viewed posting were .89, .19, and .28 respectively, which were within the acceptable range of -2 to +2 range; kurtosis were .594, -.995, and -.495, respectively, which were within the acceptable range of -5 and +5 (Kendall & Stuart, 1966).

- Homogeneity of variances: To determine whether the variances of the groups were similar, the Levene's test was obtained. From Levene's Test of Homogeneity, as illustrated in Table 14, it was revealed that equal variances assumption was supported for the variables of level of interaction ($p > .05$).
- Independence of observation: The expectation of independent observation was assumed since each group was asked to work independently from other groups. Therefore, the behavior of one group should not influence the behavior of another.
- Interval data: The dependent variable was measured on an interval scale.

Since four groups did not have equal cell sizes, Welch's variance-weighted ANOVA was chosen to combat the violation of the assumption (Field, 2009).

Table 14
Test of Homogeneity of Variances of Level of Interaction

Variables	Levene Statistic	df1	df2	*Sig.
AvgPostingTotal	.64	3	25	.60
AvgPostingLength	1.82	3	25	.17
AvgViewedPosting	.34	3	25	.80

*p=.05

Results

Table 15 displays descriptive statistics of level of interaction. There were slight differences in level of interaction among scaffolding conditions. The group receiving instructor's feedback showed the highest level of interaction as measured by average number of posting ($M = 10.28$) and average viewed posting ($M = 6.81$). The control group had the highest average posting length ($M = 135.69$).

Results from ANOVAs demonstrated no statistically significant differences in average posting total, average posting length, and average viewed posting, $F(3, 13.17) = .04, p = .99$; $F(3, 13.66) = 2.57, p = .10$; and $F(3, 13.64) = 1.58, p = .24$ respectively (see Table 16).

Table 15
Descriptive Statistics on Level of Interaction

Variable	Distributed learning resources (N=7) <i>M (SD)</i>	Instructor's feedback (N=9) <i>M (SD)</i>	Combined scaffolding (N=6) <i>M (SD)</i>	Control group (N=17) <i>M (SD)</i>
AvgPostingTotal	10.07 (4.37)	10.28 (4.89)	10.25 (4.80)	9.64 (3.20)
AvgPostingLength	134.87 (41.05)	128.68 (41.27)	101.11 (21.68)	135.69 (25.55)
AvgViewedPosting	5.73 (1.19)	6.81 (1.39)	5.59 (0.89)	5.55 (1.36)

Table 16
ANOVA Results of Level of Interaction

Variables	Statistic ^a	df1	df2	Sig.
AvgPostingTotal	.04	3	13.17	.99
AvgPostingLength	2.57	3	13.66	.10
AvgViewedPosting	1.58	3	13.64	.24

The group sizes were unequal. Welch's variance-weighted ANOVA is used (Asymptotically F distributed).

4b. What scaffolding condition will have the highest impact on types of interaction?

The independent variable was the scaffolding condition with four levels and the dependent variable was interaction types. The unit of analysis was groups and the critical value was set at alpha level .05.

Types of interaction patterns were measured by analyzing the dialogue of discussion posting collected from the private group discussion boards. Based on the categorization of collaborative learning skills coding scheme by Soller (2001) (See Appendix F), the discussion transcript was coded and the frequency of each category was obtained. The three main categories of interaction types were conversation, active learning, and creative conflict. A series of ANOVAs were performed to test whether the scaffolding condition had impact on each category of interaction types.

Assumption Testing

The following one-way ANOVA assumptions were checked before performing multiple sets of ANOVA.

- Normality: The normality was verified by examining a histogram, skewness, and kurtosis of the dependent variable. The skewness of each variable of interaction types was obtained from descriptive statistics. The skewness of conversation, active learning, and creative conflict were .56, 1.08, and .34 respectively, which was within the -2 to + 2 range; kurtosis were .128, .952, and -.952 respectively, which was within the acceptable range of -5 and +5 (Kendall & Stuart, 1966). Hence, the data were considered to be normally distributed.
- Homogeneity of variances: To determine whether the variances of the groups were similar, the Levene's test was obtained. From Levene's Test of Homogeneity, as shown in Table 17, it was revealed that equal variances could be assumed for conversation and creative conflict but not for active learning.

- Independence of observation: The expectation of independent observation was assumed since each group was asked to work independently from other groups. Hence, the behavior of one group should not influence the behavior of another.
- Interval data: The dependent variable was measured on an interval scale.

Since four groups did not have equal cell sizes and the variances among groups were unequal, Welch's variance-weighted ANOVA was recommended to combat the violation of the homogeneity of variance assumption (Field, 2009).

Table 17
Test of Homogeneity of Variances of Interaction Types

Variables	Levene Statistic	df1	df2	*Sig.
Conversation	2.07	3	25	.13
Active Learning	3.13	3	25	.04
Creative Conflict	.13	3	25	.94

*p=.05

Results

Table 18 displays descriptive statistics on the interaction types that indicate the collaborative learning skills the groups employed during the cooperative task. There were slight differences in the collaborative learning skills exhibited in different scaffolding conditions. Based on the categorization of collaborative learning skills coding scheme, the control group was shown to have more communications reflecting “Conversation” skill ($M = 44.86$) when performing the collaborative task compared to other groups; while the instructor’s feedback group and the combined scaffolding group demonstrated having the highest dialogues in the “Active Learning” skill ($M = 38.11$) and in the “Creative

Conflict’ skill ($M = 7.33$) respectively. However, results from ANOVAs demonstrated no statistically significant differences in all three categories of interaction types (see Table 19).

Table 18
Descriptive Statistics on Interaction Types

Variable	Distributed learning resources (N=7) <i>M (SD)</i>	Instructor’s feedback (N=9) <i>M (SD)</i>	Combined scaffolding (N=6) <i>M (SD)</i>	Control group (N=17) <i>M (SD)</i>
Conversation	34.71 (12.80)	41.89 (15.44)	44.00 (24.75)	44.86 (18.97)
Active Learning	34.86 (8.42)	38.11 (19.54)	27.17 (5.81)	35.29 (13.19)
Creative Conflict	7.14 (4.22)	7.11 (3.92)	7.33 (3.27)	6.00 (3.87)

Table 19
ANOVA Results of Interaction Types

Variables	Statistic ^a	df1	df2	Sig.
Conversation	.59	3	12.67	.64
Active Learning	1.82	3	13.61	.19
Creative Conflict	.16	3	13.43	.92

The variances and group sizes were unequal. Welch's variance-weighted ANOVA is used (Asymptotically F distributed).

Research Question 5

Does social ability mediate the relation between scaffolding conditions and perceived satisfaction?

This research question sought to identify the mechanism that underlies the relationship between the scaffolding condition and the participants’ satisfaction via the inclusion of social ability. It examined if there was another variable, besides the

scaffolding conditions, that could affect the satisfaction experienced in collaborative group. Specifically, this research question tested whether the scaffolding condition had a direct causal relationship with participants' satisfaction or the scaffolding condition caused participants' perceived social ability, which in turn caused the participants' satisfaction. The independent variable was the scaffolding condition. The dependent variable was the satisfaction and the mediator was the social ability. To test the research question, the procedure suggested by Baron and Kenny (1986) was used as a guideline to examine the mediation effect.

In order to perform mediation analysis, three conditions should be met: (1) the scaffold condition must significantly affect the dependent variables (perceived satisfaction), (2) scaffold condition must significantly affect the mediators (social ability and its subscales), and (3) the social ability must significantly affect the perceived satisfaction variable when regressed in conjunction with the scaffold conditions. Therefore, three sets of regression were performed. The unit of analysis was individuals.

Assumption Testing

The following simple regression assumptions were checked before performing the analysis.

- Linearity: A plot of standardized residuals against standardized estimates of dependent variables was graphed to test a linear relationship between the independent and the dependent variables. Since it showed a random pattern, the linearity assumption was assumed.

- Homoscedasticity: A standardized scatterplot of the standardized predicted dependent variables by standardized residuals was graphed. Since the plots showed a random pattern, the assumption of homoscedasticity was supported.
- Interval data: Social ability and satisfaction were treated as interval scales but the scaffolding condition was nominal data. Therefore, the categorical regression was selected instead of ordinary least squares regression which required continuous scales of all variables (van der Kooij, Meulman, & Heiser, 2006; Moss, 2008).

Results

Three sets of categorical regression were performed to test whether the mediation could be established. The results showed that the scaffolding condition was not correlated with the satisfaction (step 1, see Table 20); the scaffolding condition was not correlated with the social ability (step 2, see Table 21); the social ability predicted the satisfaction when the scaffolding condition was controlled (step 3, see Table 22). Most analysts believe that the essential steps in establishing mediation are steps 2 and 3 (Kenny, 2009), therefore the results suggested that the mediation could not be established.

Table 20
ANOVA for the Regression Equation, Scaffolding Condition on Satisfaction

	Sum of Squares	df	Mean Square	F	Sig.
Regression	3.33	3	1.11	1.10	.358
Residual	56.67	56	1.01		
Total	60.00	59			

Table 21
ANOVA for the Regression Equation, Scaffolding Condition on Social Ability

	Sum of Squares	df	Mean Square	F	Sig.
Regression	3.29	3	1.11	1.08	.364
Residual	56.71	56	1.01		
Total	60.00	59			

Table 22
ANOVA for the Regression Equation, Scaffolding Condition and Social Ability on Satisfaction

	Sum of Squares	df	Mean Square	F	Sig.
Regression	20.91	4	5.228	7.36	.00*
Residual	39.90	55	.711		
Total	60.00	59			

*Significant at alpha .05

Research Question 6

Does the type of interaction mediate the relation between scaffold conditions and group performance?

This research question sought to identify the mechanism that underlies the relationship between the scaffolding condition and the group performance via the inclusion of the type of interaction. It intended to test whether (a) the scaffolding condition had a direct causal relationship with the group performance or (b) the scaffolding condition caused the type of interaction, which in turn caused the group performance. The independent variable was the scaffolding condition. The dependent variable was the essay score. The mediators were the three categories of interaction types.

Following Baron and Kenny's (1986) guide on mediation analysis, the following procedures were utilized: (1) the scaffold condition must significantly affect the dependent variables (essay), (2) the scaffold condition must significantly affect the mediators (interaction types), and (3) the interaction types must significantly affect the essay variable when regressed in conjunction with the scaffold condition. Therefore, a series of regression were performed. The unit of analysis was groups.

Assumption Testing

The following simple regression assumptions were checked before performing regression analyses.

- Linearity: A plot of standardized residuals against standardized estimates of dependent variables was graphed to test a linear relationship between the independent and the dependent variables. Since the scatterplots showed random patterns, the linearity assumption was supported.
- Homoscedasticity: A standardized scatterplot of the standardized predicted dependent variables by standardized residuals was visually examined. Since the plots showed a random pattern, the assumption of homoscedasticity was supported.
- Interval data: The essay score and interaction types were measured as interval scales but the scaffolding condition was a nominal scale. Therefore, the categorical regression was selected instead of ordinary least squares regression, which required continuous scales of all variables (van der Kooij, Meulman, & Heiser, 2006; Moss, 2008).

Results

Three separate sets of mediation analysis were performed, having each interaction type as a mediator. The regression results indicated that the scaffolding condition was not correlated with the essay score (see Table 23). The scaffolding condition was not correlated with all categories of interaction types (conversation, active learning, and creative conflict) (see Table 24). Each interaction types had no correlation with the essay score when the scaffolding condition was controlled (see Table 25). Since the steps suggested by Kenny, Kashy, and Bolger (1998) for mediation analysis were not met, it suggested no mediation among these variables.

Table 23
ANOVA for the Regression Equation, Scaffolding Condition on Essay

	Sum of Squares	df	Mean Square	F	Sig.
Regression	.18	3	.06	.05	.98
Residual	28.82	25	1.15		
Total	29.00	28			

Table 24
ANOVA for the Regression Equation, Scaffolding Condition on Interaction Types

	Sum of Squares	df	Mean Square	F	Sig.
outcome: Conversation					
Regression	1.49	3	.496	.45	.719
Residual	27.51	25	1.10		
Total	29.00	28			
outcome: Active learning					
Regression	2.51	3	.84	.79	.51
Residual	26.49	25	1.06		
Total	29.00	28			
Outcome: Creative conflict					
Regression	.58	3	.19	.17	.92
Residual	28.42	25	1.14		
Total	29.00	28			

Table 25
ANOVA for the Regression Equation, Scaffolding Condition and Interaction Types on Essay

	Sum of Squares	df	Mean Square	F	Sig.
predictors: Conversation and scaffolding condition					
Regression	1.02	4	.26	.22	.93
Residual	27.98	24	1.17		
Total	29.00	28			
predictors: Active learning and scaffolding condition					
Regression	1.29	4	.32	.28	.89
Residual	27.71	24	1.16		
Total	29.00	28			
predictors: Creative conflict and scaffolding condition					
Regression	1.91	4	.48	.42	.79
Residual	27.09	24	1.13		
Total	29.00	28			

Research Question 7

Does the level of interaction mediate the relation between scaffold conditions and group performance?

This research question examined the mechanism that underlies the relationship between the scaffolding condition and the group performance the level of interaction was accounted for. It aimed to explain whether the scaffolding condition had a direct causal relationship with the group performance or the scaffolding condition caused the level of interaction, which in turn caused the group performance. The independent variable was scaffolding condition. The dependent variable was the essay score. The mediators were the level of interaction.

To test the research question, the procedures suggested by Baron and Kenny (1986) were used as a guideline to examine the mediation effect. In order to perform mediation analysis, three conditions should be met: (a) the scaffold condition must significantly affect the dependent variables (essay), (b) the scaffold condition must significantly affect the mediators (level of interaction), and (c) the level of interaction must significantly affect the essay variable when regressed in conjunction with the scaffold condition. Therefore, a series of regression were performed. The unit of analysis was groups.

Assumption Testing

The following simple regression assumptions were checked before performing regression analysis.

- Linearity: A plot of standardized residuals against standardized estimates of dependent variables was graphed to test a linear relationship between the independent and the dependent variables. Since it showed a random pattern, the linearity assumption was supported.
- Homoscedasticity: A standardized scatterplot of the standardized predicted dependent variables by standardized residuals was visually examined. Since the plots showed a random pattern, the assumption of homoscedasticity was supported.
- Interval data: Essay score and level of interaction were measured as interval scales but the scaffolding condition was a nominal scale. To accommodate the

nominal data, the categorical regression was selected (van der Kooij, Meulman, & Heiser, 2006; Moss, 2008).

Results

Three separate sets of mediation analysis were performed, having each type of level of interaction as a mediator. The regression results indicated that the scaffolding condition was not correlated with the essay score (see Table 26) and all types of level of interaction (AvgPostingCount, AvgPostingLength, and AvgViewedPosting) (see Table 27). Each level of interaction had no correlation with the essay score when the scaffolding condition was controlled (see Table 28). Since the steps suggested by Kenny, Kashy, and Bolger (1998) for mediation analysis were not met, it suggested no mediation among these variables.

Table 26
ANOVA for the Regression Equation, Scaffolding Condition on Essay

	Sum of Squares	df	Mean Square	F	Sig.
Regression	.18	3	.06	.05	.98
Residual	28.82	25	1.15		
Total	29.00	28			

Table 27
ANOVA for the Regression Equation, Scaffolding Condition on Level of Interaction

	Sum of Squares	df	Mean Square	F	Sig.
outcome: AvgPostingCount					
Regression	.21	3	.07	.06	.98
Residual	28.79	25	1.15		
Total	29.00	28			
outcome: AvgPostingLength					
Regression	4.10	3	1.37	1.37	.28
Residual	24.90	25	.99		
Total	29.00	28			
outcome: AvgViewedPosting					
Regression	7.11	3	2.37	2.71	.07
Residual	21.89	25	.88		
Total	29.00	28			

Table 28
ANOVA for the Regression Equation, Scaffolding Condition and Level of Interaction on Essay

	Sum of Squares	df	Mean Square	F	Sig.
predictors: AvgPostingCount and scaffolding condition					
Regression	1.49	4	.37	.32	.86
Residual	27.51	24	1.15		
Total	29.00	28			
predictors: AvgPostingLength and scaffolding condition					
Regression	.32	4	.08	.07	.99
Residual	28.68	24	1.20		
Total	29.00	28			
predictors: AvgViewedPosting and scaffolding condition					
Regression	.19	4	.05	.04	.99
Residual	28.81	24	1.20		
Total	29.00	28			

Research Question 8

Overall, what are the best explanations of performance and satisfaction in an online cooperative group?

This research question examined what variables correlated with participants' performance and satisfaction in an online collaborative group. To answer this research question, Pearson's correlation coefficient analysis was used to test whether there was any relationship between other variables to the essay score or participants' satisfaction.

Assumption testing

The following assumptions were checked before performing correlation analysis.

- Normality: Both skewness and kurtosis were verified for the data set that indicated that data were normally distributed. Skewness was within the acceptable range of -2.0 to +2.0 and kurtosis was within the acceptable range of -5.0 to +5.0 (Kendall & Stuart, 1966). Therefore, the assumption of normality was met for all variables.
- Linearity: A plot of standardized residuals against standardized estimates of dependent variables was graphed to test a linear relationship between the independent and the dependent variables. Since it showed a random pattern, the linearity assumption was supported.
- Homoscedasticity: A standardized scatterplot of the standardized predicted dependent variables by standardized residuals was graphed. Since the plots showed a random pattern, the assumption of homoscedasticity was supported.

- Interval data: All variables were measured as interval scales. Therefore, this assumption was met.

Since data are interval and normally distributed, Pearson's correlation coefficient was used.

Results

The result showed that perceived social ability had a moderate positive relationship with the participants' satisfaction, with a coefficient of $r = .580$ at $p < .01$. This indicated that social ability accounted for 33.64 % of the variability (R^2) in participants' satisfaction in an online cooperative group. Further examination of social ability subscales showed peer social presence had a strong positive correlation ($r = .787$, $p < .01$) and social navigation had a moderate positive correlation ($r = .438$, $p < .01$) with the participants' satisfaction. In examining the relationship between social ability and satisfaction subscales, social ability was shown to have a weak positive correlation with the solution satisfaction ($r = .349$, $p < .01$) and a moderate positive correlation with process satisfaction ($r = .650$, $p < .01$).

For student performance, the result indicated no significant correlations between the essay score and interaction behavior (interaction types and level of interaction) both at .05 and the .01 level (see Table 30).

Table 29
Pearson Correlation Matrix among social ability and satisfaction (N=60)

	ISP	SN	SS	PS	Social ability	Satisfaction
PSP	.391**	.584**	.566**	.824**	.820**	.787**
ISP		.627**	.007	.221	.785**	.149
SN			.236	.510**	.883**	.438**
SS				.665**	.349**	.870**
PS					.650**	.947**
Social ability						.580**

** Correlation is significant at the 0.01 level

Table 30
Pearson Correlation Matrix among Interaction Types, Level of Interaction, and Essay (N=29)

	AvgPosting	AvgPosting Length	AvgViewed Posting	Conver sation	Active Learning	Creative Conflict
Essay	-.173	-.030	.006	-.160	-.209	-.238
AvgPosting		-.522**	.011	.627**	.512**	.549**
AvgPostingLength			.372*	-.138	.206	-.017
AvgViewedPostin				.240	.229	.255
Conversation					.344	.447*
ActiveLearning						.596**

** Correlation is significant at the 0.01 level

* Correlation is significant at the 0.05 level

CHAPTER SUMMARY

Using both quantitative and qualitative approaches to analyze data and to answer the research questions for this study, the summary of the results are as follows. From a series of ANOVAs, there were no statistically significant differences between scaffolding condition in group performance (essay), social experiences (social ability and satisfaction), and interaction behavior (level of interaction and interaction types) in online cooperative groups. However, there was a positive moderate correlation between students' perceived satisfaction and social ability.

CHAPTER 5 DISCUSSION

This chapter discusses and interprets the results presented in Chapter 4. The organization of this chapter is as follows: summary of the study, summary of findings, discussion, limitations of the study, implications for researchers and educators, recommendations for future studies, and conclusions.

Summary of the Study

As online learning has become increasingly prevalent as an alternative educational mode in higher education, educators and researchers have adopted instructional approaches which have been proven successful in traditional face to face classrooms for trial in online contexts expecting similar successful outcomes. One prominent approach is collaborative learning, which has been recognized as an effective instructional method that positively contributes to students' learning and achievement (Krol et al., 2004; Lou et al., 2001; Schroeder, 2007; Slavin et al., 2003). However, a body of research has shown that simply putting students to work together does not guarantee that individuals in a group automatically collaborate (e.g. Cohen, 1994) especially in online classes where students are rarely asked to construct knowledge collaboratively (Mandl et al, 1996), and a reduction of social cues often makes collaboration more difficult in computer-mediated communication (CMC) environment.

Research indicates that providing some amount of structuring may help teams achieve effective collaboration (Kollar et al., 2003; Lipponen, 2000; Weinberger et al.,

2005). Among numerous approaches to scaffolded collaboration, instructional design-based (distributed learning resources) and management-based scaffolding techniques (instructor's feedback) (as classified in a taxonomy of scaffolding methods by Zumbach, Schonemann, and Reimann, 2005) have been used in traditional classrooms and have been shown to have positive effects. Early laboratory research (e.g. Komis et al., 2003; Muehlenbrock, 2001; Zumbach et al., 2006) results show that these scaffolding techniques may effectively enhance collaborative behavior and learning when used in computer-mediated settings as well. This study attempted to apply the techniques to a fully online learning environment and determine their impacts on groups' interaction behavior, social experiences, and a group performance.

In summary, the purpose of this study was to compare how different types of scaffolding techniques (distributed learning resources, instructor's feedback, and combination of distributed learning resources and instructor's feedback) would affect the group performance, interaction behavior, and social experiences. It also sought to identify factors that influence student's perceived satisfaction and performance in an asynchronous online collaborative group.

The study adopted a quantitative approach employing a between-group post-test only experimental design. The study was conducted in a fully online course using the "9467 Technology to Enhance Learning" course in the School of Information Science and Learning Technologies in Summer 2009. The majority of participants were master's degree students who were classroom teachers or had education related professions. The data collection phase lasted for two weeks. It occurred during week 3 and week 4 of the class. Participants were randomly assigned to groups of two or three members. Each

group was randomly assigned to one of four scaffolding conditions; 15 participants (seven groups) were in the distributed learning resources group, 18 participants (nine groups) were in the instructor's feedback group, 13 participants (six groups) were in the combined scaffolding group, and 14 participants (seven groups) were in a control group. Individuals received assigned readings and worked in private discussion groups to discuss the case and write the group essay.

Four sets of data were collected during the period that participants collaboratively worked in groups and after the collaboration: (a) group essay score, (b) discussion logs which captured interaction behavior during collaboration processes, (c) social ability survey data that evaluated participants' social ability experience, (d) satisfaction survey data that reported participants' satisfaction in solution and process satisfaction.

Summary of Findings

The key findings for each research questions are summarized as follows.

Effects on measured outcomes

Group performance (Essay)

It was hypothesized that groups with combined scaffolding would perform better than other groups, while groups with any form of scaffolding, either the distributed learning resources or the instructor's feedback, would perform better than the control group. The data analysis on group performance yielded no significant statistical differences in group performance as measured by the group essay among four scaffolding groups.

Social ability

It was expected that differences in social ability would exist favoring the scaffolding groups over the control group. Specifically, participants with combined scaffolding would perceive the highest social ability, followed by the distributed learning resources group and the instructor's feedback group. However, the results indicated that there were no significant statistical differences in perceived social ability and its subscales.

Satisfaction

It was hypothesized that there would be differences in satisfaction assessed as process and outcome satisfaction based on scaffolding groups. Participants in the combined scaffolding group would report having the highest satisfaction, both in process satisfaction and solution satisfaction, while the distributed learning resources and the instructor's feedback groups would have higher satisfaction than the control group. Findings show no significant statistical differences in satisfaction, either in solution satisfaction or process satisfaction, among four scaffolding conditions.

Interaction behavior

Expectations were that groups with combined scaffolding would have the most effective interaction behavior as measured by level of interaction and interaction types, while groups receiving any forms of scaffolding, either distributed learning resources or instructor's feedback, would have better interaction when compared to the control group. Results show no differences in the interaction behavior. There were no significant

statistical differences in level of interaction measured as average posting count, average posting length, and average viewed postings. Additionally, there were no significant differences in interaction types (Conversation skill, Active Learning skill, and Creative Conflict skill).

Mediation effects

In the study, it was expected that social ability would mediate a causal relationship between the scaffolding condition and satisfaction, while the causal relationship between the scaffolding condition and group performance would be mediated by interaction behavior, level of interaction and interaction types. Findings on mediation analysis indicate no statistical causal relationship can be established among the initial variable (scaffolding condition) and the outcome variables (satisfaction and group performance) or the mediators (social ability and interaction behavior). Therefore, mediation could not be statistically detected.

Relations to satisfaction and group performance

Prior expectations were that social ability would be related to students' satisfaction, while the level of interaction and interaction types would influence group performance. Findings show that social ability had a moderate positive relationship ($r = .580$) with the participants' satisfaction. However, neither the level of interaction nor the interaction types were related to the group performance.

Discussion

Effect of scaffolding on group performance in the online cooperative group

Results of the study indicate that there were no statistically significant differences between groups with different scaffolding techniques and their performance on the group essay score. The finding of no differences between types of scaffolds and performance is consistent with some other studies, which reported that using distributed resources had no effect on performance outcome (Komis et al., 2003; Fidas et al., 2005). For example, in a laboratory study to investigate the effect of resource heterogeneity on real-time computer-supported collaborative problem solving among high school students, Komis and colleagues (2003) found that the group with heterogeneous resources produced solutions of similar quality to the group with homogenous learning material.

Similarly, prior studies reported no significant effects of a feedback scaffold in knowledge acquisition (Zumbach et al., 2002). For example, Zumbach and colleagues (2002) conducted a laboratory study on the provision of visual automated feedback based on groups' participation during two hours of using a web-based shared workspace among dyads. The finding showed no significant effect of the treatment on the subjects' knowledge acquisition compared to the control group. Additionally, Zumbach and Reimann (2003) examined two types of feedback-mechanisms (interaction behavior feedback vs. problem-solving processes feedback). Their study indicated that groups that received feedback about problem-solving had better problem solutions than groups with interaction feedback.

A possible explanation for the fact that scaffolds had no effect on the group essay may be due to the fact that the feedback provided by the instructor was on the interaction

behavior rather than focusing on the problem solution. It appears that the type of messages conveyed in the feedback plays an important role in the desired outcomes and stimulate different outcomes. Not all types of feedback will produce a positive effect on the performance outcome. Even when the instructor's feedback also pointed out to groups to pay attention to planning strategies and revising essays, which has been shown to be correlated to essay quality in prior research (Campbell, Smith, & Brooker, 1998; Freestone, 2009), we did not know if the groups followed the feedback or how well it was acted upon (Higgins, Hartley, & Skelton, 2002; Freestone, 2009), or what kind of revision strategies groups adopted. A body of research suggested that the way students revise the essay is important to the quality of the essay (Campbell et al., 1998). The findings of Hayes (1996) and Hayes, Flower, Schriver, Stratman and Carey (1987) showed that inexperienced university students focused revision activities on problems at or below the sentence level (mechanics) while experienced writers also attended to global problems (restructuring ideas).

Additionally, other individual differences of participants, such as writing skills (Powers, Fowles, & Welsh, 2001; Huddletson, 1954), argumentative skills (Ferretti, Lewis, & Andrews-Weckerly, 2009), and disciplinary variation (North, 2005), may mediate the effects of scaffolding on the essay score. As evidence in the study of Ferretti and colleagues (2009), the structure of students' argumentative strategies was highly predictive of essay quality.

A comparative study by North (2005) suggested that disciplinary variation has an effect on students writing; students with soft science backgrounds produced better quality essays than hard science backgrounds. They explained that prior experience in academic

writing in soft disciplines (e.g. social science, arts) tend to emphasize critical thinking, oral and written expression, and analysis and synthesis of course content, while hard disciplines tend to emphasize skills in dealing with facts and figures, with little writing required beyond the exposition of experimental results. Therefore, naturally students with soft science backgrounds tend to have better communication skills and consider different aspect of the issues that are important elements in argumentative essays. Considering participants in the current study were teachers and in the field of education, they were more likely to already be competent in writing, and scaffolding for group performance on a writing task may not have much impact on writing performance. Hence, by using only the essay as the criterion to measure performance outcome it may be hard to distinguish the effect of scaffolding on the group performance.

Effect of scaffolding on online experiences in the online collaborative group

Findings indicated that none of the scaffolds provided to the online collaborative groups had significant effects on students' online experiences either in satisfaction towards solution and process outcomes or social ability. The results contradicted prior studies in which groups receiving management-based scaffolding (feedback related to members' participation) as feedback while working in groups had better attitudes towards the group climate (Zumbach et al., 2003; Zumbach et al., 2006). An explanation for this discrepancy may be found in previous research and literature indicating that the impact of scaffolding varies by individual learners. As Kollar, Fischer, and Hesse (2006) argued in their review of empirical studies of providing scaffolding to support self-regulation, learners with different characteristics do not benefit equally from the scaffolds. This is

further illustrated by a phenomenological study that showed that while learners with a solitary learning style were willing to engage in collaboration and valued the multiple perspectives provided by online discussion with peers, they still preferred individual accomplishment and independent learning activities and disliked being forced into interdependent learning (Ke & Carr-Chellman, 2006). Their findings are congruent with Liu's (2008) study that whilst some students enjoyed interacting with other students, other preferred to study independently and keep interaction to a minimum. Along the same line, Sonnenwald and Li (2003) conducted a study on the effect of collaborative computer-mediated delivery systems on social interaction preferences (cooperative, competitive, or individualistic). In their study, dyads collaboratively worked to conduct science labs using the nanoManipulator remotely. The results suggested that students with stronger individualistic learning style preference, and students working with another student with a strong individualistic learning style preference, reported more negative perceptions when observing and learning about the system from his or her partner when collaborating remotely. Also, Stahl et al. (2006) and Nesbit et al. (2006) documented different instructional needs for learners with different characteristics specifically epistemological beliefs and motivation. Hence, it is possible that the impact of scaffolds on social interaction preference and motivation, differences in social experiences may not be apparent if these key individual differences are not observed or controlled.

Even without differences in the online experiences, participants in all groups reported relatively high satisfaction and social ability scores indicating that participants generally had positive experience from participating in collaborative task. The positive online experiences across the experimental group could be explained by prior studies in

users' experience with the use of technologies on affective outcomes. Research suggests that learners with more prior experience and training with computer-related activities (e.g. computer skills, internet technology, and prior experience with online courses) felt more satisfied and comfortable with their experience in an online environment (Bocchi, Eastman, & Swift, 2004; Tallent-Runnels, Thomas, Lan, & Cooper, 2006; Wilson, 2007). Based on the demographic survey, participants in this study had abundant online experiences with learning management systems. They had taken courses in an online format prior to taking this course (50% took at least 3-4 online courses and 75% took 5-6 online courses prior to this course) and they were confident that they would be successful in the online mode of learning and collaboration. In essence, when learners have more computer related experience, then they perceive online experiences to be more positive (Arbaugh & Duray, 2002; Hong, 2002; Arbaugh & Hornik, 2006). This may explain why participants in all groups had positive satisfaction and social ability from participating in the collaborative task.

Effect of scaffolding on Interaction behavior in the online collaborative group

Level of interaction

The interaction behavior during the collaboration processes was classified into level of interaction and interaction types. The level of interaction was measured by the average frequency of posting, average posting length, and average number of viewed postings. The findings fail to support the hypothesis and indicate no significant differences among the four scaffolding groups on all levels of interaction. The findings show scaffolding had no effect on the frequency of participation. The treatments did not

stimulate students to engage in extra participation. This may be due to the nature of online learners who typically are adults with full-time employment (Bocchi et al., 2004) and have significant family commitments and roles in the community (Tallent-Runnels et al, 2006). As students had commitments in their professional work and domestic lives that influenced the time and energy they could exert into collaboration (Östlund, 2008a, 2008b). Therefore, they appear to uniformly participate in order to complete the task across all groups without interaction beyond the task requirement. Secondly, differences in time zone and locations of team members may make it less likely for online learners to “go overboard” in terms of frequency of participation. Each group tended to have few short exchanges that reflect turn-taking in face-to-face conversation; rather each exchange tended to be long and covered many different issues related to the task. They tried to get many points across for each communication because getting a hold of another team member could sometimes be difficult.

Regarding the frequencies of viewed posting, groups tend to check postings frequently when they attempted to get a hold of team members. Therefore, participants checked their group discussion boards more often during the first few days of the collaborative task or when they expected to hear back from their members. After they had reached a consensus on a group’s stand on the debate issue, the average viewed posting per each post declined. This may be due to the fact that they had agreed upon the issue and had formulated a game plan. Therefore, they spent more time working on individually delegated tasks rather than interacting with other members once groups started working on the essay. During the essay writing process, students mainly contacted

their group members to get feedbacks on the written essay draft and to finalize the final essay before submission.

Interaction Types

Participants' interaction types in this study were analyzed using the categorization of collaborative learning skills coding scheme by Soller (2001). This coding scheme aims to study the interaction aspect focusing on collaboration skills revealed during the collaborative task. Every skill is represented by its' subskills. Subskills are the specific characteristics that represent each skill. A general overview of the *Conversation* skill encourages learners to progress through the task as they accept each other's reply and listen to their peers talking. The *Active Learning* skill expresses the idea of encouraging others to speak, ask questions, and provide explanation. The *Creative Conflict* skill indicates constructing arguments, explanations, and justifications.

The results showed no significant statistical differences in all three categories of collaboration learning skills. However, descriptive statistics indicate that the participants in all treatment groups engaged in conversations that included the Conversation skill ($M=34.71-44.86$) and the Active Learning skill ($M=27.17-38.11$) but less so the Creative Conflict skill ($M=6.00-7.33$).

Further examination of the breakdown of each collaborative learning skill category (see Table 31) (e.g. Conversation) into its corresponding subskills (e.g. Task, Maintenance, Acknowledgement) informs us that collectively the Maintenance subskill was dominantly used as the Conversation skill as a way to encourage other members to

progress through the task; whilst the Inform subskill was dominantly used as the Active Learning skill to direct or advance the conversation by providing information, expressing their ideas, or providing explanations and justifications. This implies that when the online groups were working on the collaborative task in this study, the group members generally approached the task by sharing and communicating information, ideas, experiences, and view points to other members as well as offering explanation, examples, and justification of their viewpoints but demanding fewer requests of their peers. This finding is similar to Kanniah and Krish's study (2010) on collaborative learning skills used in the weblog that learners generally preferred providing information as they actively exchange ideas in asynchronous settings. Fewer requests to their peers may be due to the fact that the participants were generally aware of the subject matter, and when they made a request they often requested further explanation to enrich the discussion.

A primary dialog representing the Maintenance subskill in the Conversation skill implies that participants value group cohesion and peer involvement. They generally used positive tones to get other members to get involved, suggest actions, and move the task forward. Participants usually made sure that other group members were on the same page before moving to other tasks. This is supported by the literature that effective collaborative groups maintain a positive group climate and use the social factor to elicit extended thinking (Kreijns, Krischner, & Jochems, 2002).

Table 31
A Percentage of Subskills of Three Interaction Types

Experiment Group	Conversation			Active Learning			Creative Conflict		Total
	Task	Maintenance	Acknowledgement	Request	Inform	Motivate	Argue	Mediate	
1 (Distributed learning resources group)	8.75	29.24	7.26	4.09	37.81	3.53	9.31	0	100
2 (Instructor's feedback group)	8.55	34.10	5.49	5.24	34.86	3.70	8.05	0	100
3 (Combined scaffold group)	7.86	39.49	8.70	4.04	28.03	2.55	9.34	0	100
4 (Control group)	8.95	37.49	5.64	5.14	32.67	3.15	6.97	0	100

Finally, the Creative Conflict skill, which is composed of the Mediate and Argue subskills, shows no use of the Mediate subskill because most groups had two members. In addition, if groups had questions or wanted clarifications on the task from the instructor, they posted questions in the Coffee Shop discussion area. Therefore, the Mediate subskill did not appear in the analysis of the discussion logs. Having few instances of the Argue subskill may be due to having students in the group who possessed a common knowledge base. Participants in the current study were professional teachers and they were familiar with internet monitoring in schools. Moreover, they experienced the employee perspective firsthand in their work daily. Therefore, less Argue subskill in

the conversation dialogue may be explained by the familiarity of domain knowledge of the participants who were likely to share similar positions on the issue. As suggested by Östlund (2008b) having a common knowledge base could also have an impeding effect on the discussion because the participants may have had the same opinions, so they tend to agree on the issue and focus more on providing information supporting their arguments and viewpoints. Although incidences of Creative Conflict were low in number, they seem to be important as the controversies were followed by extensive explanation, elaboration and justification. This usually built an active interaction as the participants worked together to come to a consensus on the group essay.

In summary, all treatment conditions elicited collaborative skills. As suggested by the study of Soller (2001), conversations of effective groups include a balance of different conversational acts, particularly an abundance of questioning, explaining, and motivation, whereas ineffective groups tend to show an imbalance of conversational acts, with an abundance of acknowledgement. Based on the types of conversational acts that group members used, it informs us that online groups in the current study possessed collaborative skills that lead to effective group learning and quality interaction. In addition, it is also interesting to observe that participants in this study generally had high scores in social ability and perceived satisfaction. This alignment between quality of interaction and social experiences seems to reaffirm the association of collaborative learning skills and affective outcomes suggested by many researchers (e.g. Johnson et al., 1989; Soller et al., 2005). Therefore, we may conclude that the collaborative skills possessed by team members led to quality interactions which in turn stimulated positive social experiences of online learners.

A possible explanation for the lack of differences in the interaction behavior of four treatment groups may be due to the nature of the task, which provides space for questions, negotiations, explanations and arguments. Therefore, the tasks and context itself can stimulate questioning, explaining, and demanding collaborative activities (Järvelä et al., 2004) without much need of scaffolding. Additionally, the design of the task and assessment created positive interdependence that individual depended on peer's contribution and the grade was dependent on the group performance rather than the individual performance (Brewer & Klein, 2006).

Relation of social ability to satisfaction and interaction to performance

The results of the present study indicate that there is a relationship between perceived social ability and satisfaction. This result is consistent with prior research that social ability influences and is a predictor of students' perceived satisfaction (Laffey et al., 2006; Lin et al, 2008). Supporting the same line, Gunawardena and Zittle (1997) and Gunawardena and Duphorn (2000) found that social presence, the social climate perceived by students and created by using computer-mediated communication, is a good predictor of and correlate with learner satisfaction.

However, quantity and quality of interaction have no relationship to the performance outcome. Finding no relationship between the group performance and the interaction level comes as no surprise and is similar to a prior study (Roberts, 2007), which also indicated that the amount of interaction has no relationship with actual performance, and quantity of interaction is not a good indicator for students' actual learning or the quality of work that groups produced. However, it was expected that there

would be a relationship between certain categories of collaboration skills and group performance. The results from the current study shows that interaction types were not associated with the group performance.

As previously discussed, other variables such as individual differences may play a more determinative role in the performance outcome than the interaction behavior in the context of this study. Clearly, the relationship between group performance and interaction behavior should be investigated further, using studies similar to the present one but also accounting for other individual differences (e.g. writing skills, argumentation skills). Plainly, more research is needed to verify this relationship.

Limitations of the Study

Several limitations of this study need to be acknowledged. One limitation of this study is the small sample size. There were only 60 students participating in the study. Such a small sample size lacks power to identify statistically significant results, particularly when examining differences in groups and investigating causal relationships among variables. Therefore, a substantially larger sample size is recommended.

Second, this study is a field experiment carried out in a real setting. Unlike laboratory settings in which a researcher can have more control over treatments, a researcher cannot have control over actual students' behaviors and situations. For example, students might participate in the last few days to complete the task, some students did not follow the experimental protocol, some students used other tools to communicate with one another, some students dropped out during the course, or some students were on the road and could not have internet access to participate in the

collaboration. With these uncontrollable circumstances, the internal validity of field experiments is likely to be lower than that of the laboratory experiments. However, the field experiments have higher external validity and offer the potential for a higher likelihood of generalizability (Pedhazur & Pedhazur Schimelkin, 1991). Since the study was implemented in a real learning context, which accounted for actual complexity of online learners and online learning context, the potential for generalization of the result to other courses could be justified.

Third, there are different units of analysis, individual and group, involved in the current study. This reduces the potential to investigate the effects of different variables on the measured outcomes, such as the influence of the interaction level (group) and social experiences (individual). With a larger sample size, using statistical methods that account for two different measurement units without reducing the robustness of the analysis is also possible.

Fourth, some individual differences, such as attitude towards collaboration, writing skills, and argumentation skill, were not captured in the study. These variables might affect group interaction behavior and group performance.

Fifth, the study was conducted in a summer class and the experimental weeks included a national holiday (Fourth of July). It was evident in the discussion logs that some groups planned to complete the assigned task as soon as possible because of their prior travel arrangements. This might affect the accuracy of interaction behavior. Future research might consider conducting the collaborative tasks during the regular semesters during which students may have fewer conflicts.

With these limitations, the results from this study should be interpreted with caution.

Implications for Researchers and Educators

Several implications could be drawn from this study. First, the study was conducted in a field setting whereas prior studies on collaboration scaffolding in computer-mediated learning environments were conducted in laboratory settings (e.g. Komis et al., 2003; Fidas et al., 2005; Zumbach et al., 2002). The current study carried out in a field setting could help researchers and educators better understand the difficulties as well as benefits that students might encounter in real online classroom when implementing such instructional supports.

Second, in contrast to prior studies, which utilized computers to deliver automated feedback to students, the feedback was delivered to students by the instructor in the current study. This implementation helps inform educators on the feasibility of translating the same feedback originally delivered by complex machines to more simple and practical approach in online learning environments.

Third, literature suggests that learning is a social practice where learning gains come from both cognitive and affective connections. Prior research in collaborative scaffolding focused on cognitive outcomes and investigated the satisfaction and attitude of affective dimension in group collaboration; this study adopted a systematic approach and was extended to investigate academic outcome, interaction, satisfaction, and social ability from participating in a collaboration task. Examination of multiple outcomes has

the potential to inform researchers of the effects on the scaffolding in a more comprehensive and coherent picture within a learning enterprise.

Fourth, the literature suggests that collaboration scaffolds have the potential to enhance social experiences and enhance interaction processes. However, the amount of scaffolding and the condition in which the scaffolding are undertaken may influence the value of scaffolds for online students. As evidenced in current study, when participants received two scaffolds together the effects of each scaffold was diminished.

Finally, the findings show that the online learners in the current study were generally capable of collaboration in group work. However, even for these students to get them to engage in deeper conversation that reflects a higher level of learning, instructional activities and pedagogical supports need to be carefully designed. Therefore, online activities should include tasks or supports that will stimulate discussion that elicits knowledge argumentation. Equally important, the course instructor should also consider students' life situation and individual preferred learning styles when designing the collaborative activities because if the students do not have the skills, motivation, or time, collaboration could be affected. Consequently, there are a number of challenges and factors to take into consideration when planning instructional activities for collaborative learning in fully online courses, in which busy, adult, distance-education students perceive that collaboration and interaction will add more in terms of learning than they lose in time and flexibility.

Recommendations for Future Studies

Based on the findings and limitations of the current study, the following recommendations for future research are provided. First, a similar research experiment with a larger sample size and that utilizes one unit of analysis should be conducted.

Second, even though some individual attributes were captured in the study, other dimensions of individual differences, such as writing ability, social interaction preferences, motivation, and self-regulation, should be examined using standardized instruments. With this information, we can investigate whether the scaffolds are affected by individual differences and lead to more precise interpretation of the result.

Third, this study relied on one essay as a measure of the group performance, which may not provide accurate assessment of the group performance. It is also worthwhile to investigate using multiple assessments.

Fourth, this study used frequencies derived from a coding scheme of collaborative learning skill to measure quality of interaction behavior during the group process. However, frequencies do not inform us about whether group members possess or utilize collaborative learning skills equally, and what are relationships and flows of the interaction process. Inclusion of other interaction analyses, such as social network analysis, may give us a more comprehensive picture of how interaction patterns are formed in online collaboration groups.

Fifth, the study only examined evidence from the collaboration. However, we do not know how online students feel when participating in online collaboration and how the scaffold benefits or hinders their task accomplishment, social experiences, and group

processes. Interview data could provide more in-depth information from the learners' perspective regarding the effects of and interaction with scaffolds.

Conclusions

This chapter summarizes and discusses the independent effects of different scaffolds on measured outcomes and mediation effects among scaffolds and outcome variables of online collaborative learning. The results indicated no significant effects of scaffolds on the group performance, perceived satisfaction, social ability, interaction level, and interaction types. In addition, mediation cannot be established among interested variables. However, students' social ability is related to perceived satisfaction.

This chapter also covered a discussion and implementation of the results. Implications were drawn cautiously based on the findings. Limitations, such as small sample size in each cell, unequal cell sizes, adopting two units of analysis, administering the treatment during the holiday week, not accounting for individual differences in analyses were also addressed in the chapter. While the results of this study do not show statistically significant impacts of scaffolding options, future research is suggested to overcome the limitations encountered, such as increasing sample size in each cell, capturing individual differences, and adopting other analysis methods.

APPENDIXES

Appendix A: Reading A (Case Information From The Employer Point of View)

Snooping is a hot topic because of deep-rooted feelings on both sides. Those in favor are usually groups or individuals such as employers. They feel that by monitoring data and other "office related" actions, they can better protect themselves from such things as sexual harassment suits and corporate espionage. A major factor is potential legal liability faced by employers when workers are exposed to offensive or graphic material on colleagues' computer screens, which could create a hostile work environment. In addition, companies are concerned about productivity drains caused by non-business uses of time and equipment, and also about proprietary information being leaked to competitors.

Washington, Dec. 7 - In today's workplace, high tech or not, nearly every move a worker makes while on the job is subject to some kind of snooping. E-mail and web access at work, coupled with tougher sexual harassment and liability laws, have given rise to a corporate appetite for unblinking surveillance technologies. Even covert videotaping is taking place in some workspaces, including restrooms. Is it legal? Yes, but experts favoring employer and employee alike say that doesn't make it prudent.

Miniature camera and off-the-shelf internet snooping software, driven by artificial intelligence, make it easy for employers of all sizes to pry into the workplace activities and gobble up suspect e-mail.

And the use of such workplace monitoring techniques is on the increase. Nearly 75 percent of all American companies now use some form of surveillance to spy on employees, according to a recent report by the American Management Association, doubling the number of firms that admitted to such activities.

But such practices are hardly new. Milton Hershey, the milk chocolate magnate, is known for having skulked around the company town of Hershey, Pennsylvania, taking notes on whether his employees kept their lawns cut. And he hired private investigators to find out who was tossing trash into Hershey Park, the company's theme park. Henry Ford created a "sociological department" staffed with 150 people to keep track of employee hygiene habits. And a decade ago, the Office of Technology Assessment, a now defunct federal agency, issued a report saying that workplace monitoring is "nothing new."

A WEB OF INTRIGUE

In today's fast paced workplace, employees are getting into the office earlier and leaving later. Taking a call from the school about your kids or making a doctor's appointment means you have to do so on company time. Such situations put workers in a jam.

The situation creates a legitimate hurdle for employers, too. Last year Forrester Research estimated that 17 percent of online holiday shoppers did so while at work.

“If you couple the 55 million online consumers expected this holiday season with the fact that 42 million Americans have internet access at work, it’s not hard to imagine a good number of those Net connected employees will be doing some holiday shopping on company time,” said Kevin Blakeman, president of U.S. Operations for SurfControl, a company that makes internet snooping software for employers.

Blakeman’s company encourages employers to set up an “acceptable use policy” that allows them to shop during the workday, either at lunch or after hours.

“Balance is the key,” says Scott Rechtschaffen, vice president of training for Employment Law Learning Technologies. “As a lawyer I advise employers to create a policy that reasonably protects the employer’s needs and the employee’s needs,” he says. “And such a policy is imminently doable.”

There are certain employers that take the position that “we are going to be very restrictive,” Rechtschaffen said. Most, he said, “take a balanced approach that will allow reasonable personal use, but that reasonable personal use cannot interfere with an employee’s productivity, quality or quantity of work and your duty to the company.”

WHOSE RIGHTS?

Businesses are at risk if they don’t develop some kind of policy for monitoring electronic communications, says Tom Patterson, managing director for E-commerce transactions at KPMG Consulting. “If you don’t do it and an employee goes out and writes hate mail or something with your company name at the end of that, I think it could definitely be argued that the company didn’t do its job in monitoring what was going on,” he says.

However, Patterson adds, “we’re probably several years away from a specific federal law that would mandate that monitoring happen. I think now you’re in the gray area which no company likes to be in.”

And in that gray area, perhaps companies are overcompensating, monitoring more than they should to protect themselves.

“Because employers cannot be sure in advance what sort of e-mail or Web browsing a particular employee might find offensive, they have an incentive to monitor far more internet activity than the law actually forbids,” law professor Jeffrey Rosen wrote in The New York Times this year.

Appendix B: Reading B (Case Information From The Employee Point of View)

Washington, Dec. 7 - In today's workplace, high tech or not, nearly every move a worker makes while on the job is subject to some kind of snooping. E-mail and web access at work, coupled with tougher sexual harassment and liability laws, have given rise to a corporate appetite for unblinking surveillance technologies. Even covert videotaping is taking place in some workspaces, including restrooms. Is it legal? Yes, but experts favoring employer and employee alike say that doesn't make it prudent.

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"The employer has to understand that workers must be able to call the doctor and make an appointment," said Laura Hartman, Grainger Chair of Business Ethics at the University of Wisconsin in a speech earlier this year. "Workers need to be able to conduct involuntary personal matters at the office."

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And in that gray area, perhaps companies are overcompensating, monitoring more than they should to protect themselves.

There also is a kind of unintended collateral damage that happens when workers are scrutinized at every keystroke.

At “precisely the moment many citizens are afraid to use e-mail because of concerns about privacy,” such monitoring is likely to increase the anxiety of workers, Rosen told a Congressional panel during testimony on the FBI’s own e-mail snooping program, Carnivore.

“Several surveys of the health effects of monitoring in the workplace have suggested that electronically monitored workers experience higher levels of depression, tension and anxiety, and lower levels of productivity, than those who are not monitored,” Rosen told Congress. “It makes intuitive sense that people behave differently when they fear that their conversations may be monitored.”

Appendix C: Reading C (Case Information From Both Side of Story)

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Appendix D: The Informed Consent Form

College of Education
School of Information Science and Learning
Technologies
University of Missouri-Columbia
Piyanan “Tak” Nuankhieo

111 London Hall
University of Missouri
Phone: (573) 356-1944
Email: pn3kf@mizzou.edu

Dear Students,

This letter is to request your permission to allow me access to your work during Week 3-4 in your Summer 2009 SISLT: Technology to Enhance Learning course for my dissertation research. **You do NOT need to do extra work** except for two short surveys. Upon your consent to the study, information from the group essay, online postings, and responses to surveys will be used to explore ways to better implement online instruction and gain knowledge about online learners’ experiences in collaborative work.

Your participation is completely voluntary, and you may withdraw from the study at any time. All records and information collected in this study are completely confidential. Name, student ID, and any data that can identify the participants will NOT be revealed. The information regarding the participants will be anonymous and will ONLY be accessed by the investigators for subsequent transcription and analyses. Results of this research will be presented and published in aggregate form with no personal identifiers. In any reporting of the data all individuals will be anonymous, so there is no risk of your participation in this study becoming publicly known. We do not foresee any risks or discomforts beyond those you normally experience in the course that might occur as a result of your consent to the study. There will be no reporting of the data before the end of the semester and your participation will **NOT** affect your grade in this class.

Upon completion and receive of the survey by the required date, your name will be added to a pool of participants for a drawing of two gift certificates with the value of \$50 each. Two participants will be selected for the \$50 financial incentive.

Please feel free to contact me, Piyanan “Tak” Nuankhieo, with any questions about the study and/or your participation. For additional information regarding human participation in research, please contact the University of Missouri Campus Institutional Board at (573) 882-9585 .

To give your consent, you must be 18 years of age or older. By providing your full name, pawprint, and e-mail address (all fields are required) and submitting the agreement below, you will provide consent to participate in this study.

Full Name: _____

Pawprint: _____

Email: _____

Thank You,
Piyanan "Tak" Nuankhieo

Appendix E: Demographic Survey

Instruction: In this survey, you will find questions about yourself and your experiences in online learning environment. Please answer each item as honestly as possible. It should take approximately 3-5 minutes to complete this questionnaire.

1. Gender:
 Male Female
2. Age:
 Under 20 20-25 26-35 36-45 46-55
 Over 55
3. Current academic status:
 Undergraduate Master PhD
4. What level of experience do you have with collaboration?
 No experience Some experience A lot of experience
5. What level of experience do you have with online collaboration?
 No experience Some experience A lot of experience
6. How many online courses have you taken prior this semester?
For this survey, ONLINE courses refer to those that are delivered fully online via course management systems such as Blackboard or Sakai. Please note!! If the course has a regularly-scheduled face-to-face class meetings (and uses online activities to supplement face-to-face activities) it is NOT considered to be a fully online course.
 None 1-2 3-4 5-6 7-8 More than 8
7. How confident are you that you can succeed in fully online learning?
 Not at all Somewhat confident Confident Very confident
8. How comfortable are you with our course's fully online learning environment?
 Not at all Somewhat comfortable comfortable Very comfortable
9. How confident are you that you will succeed in this course?
 Not at all Somewhat confident Confident Very confident
10. How confident are you that you can succeed in fully online collaborative activities?
 Not at all Somewhat confident Confident Very confident

11. How many courses have you taken with this instructor (not including this course)?
 None 1- 2 3- 4 More than 4

12. What course management system do you have experience with? (Please check all that apply.)

Blackboard

Sakai

WebCT

Angel

Moodles

Other (please specify)

Appendix F: The Collaborative Learning Conversation Skill Taxonomy by Soller (2001)

Skill	Subskill	Attribute	Sentence Opener
Conversation			
	Task	Coordinate Group Process	“OK. Let’s move on”, “Are you ready?”
		Request Focus Change	“Let me show you”
		Summarize Information	“To summarize”
		End Participation	“Goodbye”
	Maintenance	Request Attention	“Excuse me”
		Suggest Action	“Would you please”
		Request Confirmation	“Right?”, “Is this ok?”
		Listening	“I see what you’re saying”
		Apologize	“Sorry”
	Acknowledge	Appreciation	“Thank you”
		Accept/Confirm	“OK”, “Yes”
		Reject	“No”
Active Learning			
	Request	Information	“Do you know?”
		Elaboration	“Can you tell me more”
		Clarification	“Can you explain why/how”
		Justification	“Why do you think that”
		Opinion	“Do you think”
		Illustration	“Please show me”
	Inform	Rephrase	“In other words”
		Lead	“I think we should”
		Suggest	“I Think”
		Elaborate	“To elaborate”, “Also”
		Explain/clarify	“Let me explain it this way”
		Justify	“To justify”
		Assert	“I’m reasonably sure”
	Motivate	Encourage	“Very good”, “Good point”
		Reinforce	“That’s right”
Creative Conflict			
	Argue	Conciliate	“Both are right in that”
		Agree	“I agree because”
		Disagree	“I disagree because”
		Offer Alternative	“Alternatively”
		Infer	“Therefore”, “So”
		Suppose	“If ... then”
		Propose Exception	“But”
		Doubt	“I’m not so sure”
	Mediate	Teacher Mediation	“Let’s ask the teacher”

Appendix G: Essay Scoring Guide (15 points)

Quality standard	Score			
	3	2	1	0
Thesis/position statement	A thesis statement clearly defines your position on the issue.	A position statement adequately defines your position on the issue.	Your position statement is somewhat stated but it does not clearly identify your position.	No statement states your position on the issue.
Supporting arguments	You present solid arguments in support of your position with several relevant supporting facts, statistics and/or examples.	Your arguments are adequately supported with relevant facts, statistics and/or examples.	Every major point is supported with facts, statistics and/or examples, but the relevance of some is questionable.	Every point is not supported.
Counter arguments	You have presented, and refuted, arguments counter to your position with several relevant supporting facts, statistics and/or examples.	Your counter arguments are adequately supported with relevant facts, statistics and/or examples.	Every major point is supported with facts, statistics and/or examples, but the relevance of some is questionable.	Every point is not supported.
Organization	All arguments are clearly tied to an idea (your position) and organized in a tight, logical fashion.	Most arguments are clearly tied to an idea (your position) and organized in a tight, logical fashion.	All arguments are clearly tied to an idea (your position) but the organization is sometimes not clear or logical.	Arguments are not clearly tied to an idea (your position).
Persuasiveness	You are very persuasive; your word choice and arguments are very effective.	Some valid points, but argument is not as persuasive as it could be.	Arguments are only mildly persuasive.	Arguments are not persuasive.

My contribution was (%) _____
 My 1st partner's contribution was (%) _____
 My 2nd partner's contribution was (%) _____
 (Please fill this one only if your group has 3 members)

To what extent do you agree with the following statements:

1	2	3	4	5	6	7	
Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree	
1. I felt connected to my group members in this group activity.	1	2	3	4	5	6	7
2. My interactions with my group members were sociable and friendly.	1	2	3	4	5	6	7
3. My online interactions with my group members seemed personal.	1	2	3	4	5	6	7
4. In my interactions with my group members I was able to be myself and showed what kind of teammate I really was.	1	2	3	4	5	6	7
5. I felt like I was a member of a group in the group activity.	1	2	3	4	5	6	7
6. I felt comfortable expressing my feelings to my group members.	1	2	3	4	5	6	7
7. When I logged on I was usually interested in seeing what my group members were doing or had done.	1	2	3	4	5	6	7
8. I trusted my group members in this group activity to help me if I needed it.	1	2	3	4	5	6	7
9. The actions of my group members in the group activity were easily visible in our online system.	1	2	3	4	5	6	7
10. When I saw that my group members were confused I offered help.	1	2	3	4	5	6	7
11. My interactions with the instructor were sociable and friendly.	1	2	3	4	5	6	7
12. I felt comfortable expressing my feelings to the instructor.	1	2	3	4	5	6	7
13. My online interactions with the instructor seemed personal.	1	2	3	4	5	6	7
14. The actions of the instructor in the group activity were easily visible in our online system.	1	2	3	4	5	6	7
15. In my interactions with the instructor I was able to be myself and showed what kind of student I really was.	1	2	3	4	5	6	7
16. I trusted the instructor in the group activity to help me if I needed it.	1	2	3	4	5	6	7
17. When I logged on I was usually interested in seeing what the instructor was doing or had done.	1	2	3	4	5	6	7
18. I felt connected to the instructor during the group activity.	1	2	3	4	5	6	7
19. Knowing what my group members in the group activity had done helped me to know what to do.	1	2	3	4	5	6	7
20. Knowing that my group members in the group activity were aware of my work usually influenced how hard I worked and the quality of my work.	1	2	3	4	5	6	7
21. The actions of my group members in the group activity influenced the quality of my work (such as trying to write better messages or working more carefully).	1	2	3	4	5	6	7
22. Interacting with the instructor helped me accomplish group assignments with higher quality than if I were working alone.	1	2	3	4	5	6	7
23. Interacting with my group members helped me accomplish	1	2	3	4	5	6	7

assignments with higher quality than if I were working alone.							
24. The actions of the instructor in the group activity influenced the quality of my work (such as trying to write better messages or working more carefully).	1	2	3	4	5	6	7
25. I don't feel responsible for the results of our group discussion.	1	2	3	4	5	6	7
26. The conclusions of our group discussion reflected my input.	1	2	3	4	5	6	7
27. I feel committed to our group discussion.	1	2	3	4	5	6	7
28. I feel confident that conclusions of our group discussion were reasonable.	1	2	3	4	5	6	7
29. I don't feel personally responsible for the quality of our group discussion.	1	2	3	4	5	6	7
30. Our group discussion was efficient.	1	2	3	4	5	6	7
31. Our group discussion was uncoordinated.	1	2	3	4	5	6	7
32. Our group discussion process was fair.	1	2	3	4	5	6	7
33. Our group discussion was confusing.	1	2	3	4	5	6	7
34. Our group discussion was satisfying.	1	2	3	4	5	6	7

Appendix I: Activity Guide

Week 3-4: Investigating and Experimenting with Technologies

Preface

This week and next will be a little different from other weeks. In the next two weeks, you will have a firsthand opportunity to experience online “cooperative learning”. Yes, we can do that online like we do in our regular classrooms. This might be new to some of you but don’t worry, there are some tips below that will help you work in group successfully.

What we will do is provide you with the opportunity to work in assigned pairs to discuss and brainstorm on the issue, “Should the school monitor K-12 teachers’ internet use in school?” By working in pairs, you will sharing information, share different points of view, and help each other.

Additionally, your participation in this online group work will allow a graduate researcher here at MU to gather information about the experiences of online learners during group work and to explore better ways of supporting online discussions and online instruction. Therefore, your contribution is extremely important during these next two weeks.

Path to complete the Unit

1. Go to this week’s “Course Documents” and click on “Group Listing” to find your assigned partner and your assigned reading.
2. Access your assigned Discussion Board under the “Communication” link, then go to “Group Pages”. Let me know if you have problems accessing your assigned Discussion Board. Only you, your partner, and the instructor will have access to the Discussion Board assigned to you and your partner for this assignment.
3. Read “Your Task in this Assignment”.
4. Read your “Assigned Reading” in the “Course Documents” before participating in your assigned Discussion Board. You DO NOT have to read all the reading materials listed. ONLY read the assigned reading for you.
5. Participate in your assigned Discussion Board. (June 22 – 28)
6. Write an essay together with your partner. (June 29 – July 5)

Your tasks in this assignment

There are two tasks in this assignment.

1. Discussion Board Participation: Before participating in the Discussion Board, be sure to read the information assigned to you. For example, if your name label is A, please refer to document A. If your name label is B, please refer to document B. You will have one week (June 22-28) to discuss the topic of internet monitoring on your assigned Discussion Board. Use this week to discuss, debate, and exchange your point of view with your partner before reaching a conclusion about where the two of you stand. Be sure to thoroughly consider all aspects of the issue. Always provide reasoning (this

could be your personal experiences, news, facts, etc.) to support your arguments and/or counterarguments when discussing the issue with your partner. Do not jump to conclusions and simply agree with your partner to get the assignment done. There are no right or wrong answers. Therefore, use this opportunity to discuss and exchange your opinion on the issue as much as possible before making a decision on the stand you and your partner will take on this issue.

2. **Group Essay:** Based on the discussion from Week 3, you and your partner will write an essay stating your shared stand on the issue. You will have one week (June 29 – July 5) to complete the essay. Please refer to the “Essay Scoring Guide” (available in the ‘Course Documents’) to see what is expected to be included in your essay. Your essay should be about 300-400 words. You should use your assigned Discussion Board to plan and coordinate your writing. Only one of you will need to submit the final essay to the ‘Assignments Page’ as the document will have both names.

Tips for successful online group work

- Start to participate early. It is recommended to not wait until the last minute to complete the assignment. Remember there are two parts to this assignment: 1.) Group Discussion Board, and 2.) Group Essay.
- For a successful experience, you and your partner should discuss a plan and a timeline on how to get the work done early on.
- Be sure you pitch in and provide input with your partner. Do not let your partner do all the work. Bounce your ideas back and forth to get a quality discussion going and a decision making process. You do not want to just simply agree to get the work done. Your peers always appreciate your effort and prompt responses!

NOTE:

Since the graduate researcher will use your interactive discussions during these two weeks for her dissertation research, please be sure that you use your assigned Discussion Board as your means of communication.

Appendix J: An Email Invitation for Participating in the Study

Piyanan “Tak” Nuankhieo, a doctoral student at MU in the School of Information Science and Learning Technologies (SISLT), is conducting a dissertation research study during Week 3 and 4 of our class. She is primarily interested in interactions of online group collaboration. Upon your consent to the study, she will use the data gathered for her dissertation.

You are not required to do any extra work due to the participation in the study *except* for two short surveys (they take only 5 minutes each).

Upon completion and receive of the survey by the required date, your name will be added to a pool of participants for a drawing of two gift certificates with the value of \$50 each. Two participants will be selected for the \$50 financial incentive.

It simply allows her to use the data she collects to be part of her research. All records and information collected in this study are completely confidential and report of the data is all anonymous.

Here is the url to the online consent form, <http://www.tak.consent>. The consent form will be closed as of midnight, Friday, June 19, so please take a minute to submit it right away.

I would highly encourage everyone to participate in the study. Your sincere participation will inform our educators on how to support online instruction.

If you have any questions, feel free to contact me directly Laura@missouri.edu

Thank you.
Laura

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