A CASE STUDY OF ONLINE COLLABORATIVE LEARNING

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This case study investigated 12 graduate students' online collaborative experiences and attitudes in an instructional design course. The instructor divided students into 4 groups based on their academic backgrounds. Content analysis of asynchronous group discussion board messages was used to measure degrees of collaboration of each group in terms of participation, interdependence, synthesis, and independence. In addition to the group discussion board messages, 3 other data sources—group projects, student attitude survey, and student reflections—were analyzed. Results showed that ineffective communication, conflict among group members, and negative attitude toward group work posed major challenges to online collaboration. The results also showed that the more collaborative groups produced better quality projects and had more positive attitudes toward online collaborative learning. However, the social loafing phenomenon was present in each group. Recommendations on how to successfully implement group collaboration in online courses are provided.

Distance education in the United States has greatly increased in popularity in the past 10 years. According to *Distance Education at Degree-Granting Postsecondary Institutions: 2000-2001,* a report issued by the U.S. Department of Education's National Center for Education Statistics (Tabs, 2003), more than half (56%) of U.S. 2- and 4-year colleges and universities offer distance education courses. In addition, enrollment in distance education courses has nearly doubled since 1995. This enormous growth has generated interest in defining quality for online learning (Meyer, 2002).

Many educators advocating distance learning believe that interaction is a vital element in the educational process (Moore, 2001; Moore & Anderson, 2003). In spite of the availability of communication tools (electronic mail, discussion boards, and chat rooms), online instruction has focused more on student-to-content, student-to-interface, and student-to-instructor interaction, but less on student-to-student (peer) interaction. In a traditional classroom, students interact pedagogically and socially. Two students in the same class may meet in the library and discuss their common interests, as well as share perspectives, opinions, and

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insights. In distance learning, however, this is less likely to happen. Thus, some skeptics argue that using a computer as a tool depersonalizes learning (Barker & Bills, 1999).

Although online learning is often viewed as an isolating experience, the paradox is that the online instructional environment tends to be more learner-centered rather than teacher-centered (Bober & Dennen, 2001). Distance educators are increasingly finding that their role is not to teach course materials to students directly, but rather to facilitate learning and enable peer interaction to flourish. Participation and opportunities for creativity that are less common in conventional classes are becoming commonplace in well-designed online environments (Abrami & Bures, 1996).

Collaborative learning itself is hardly a new idea. People have been learning in groups for thousands of years. Collaborative learning has been influenced by two major theoretical frameworks: constructivism and sociocultural approaches. Piaget's constructivism theory indicated that individuals learn and develop knowledge through social interaction rather than individual exploration (Piaget, 1969). The second theoretical framework is the sociocultural approach, which comes from Vygotsky (1978). He proposed the concept of zone of proximal development, which means that children can develop skills with adult guidance or peer collaboration that cannot be attained alone. By drawing on a larger collective memory and the multiple ways in which knowledge can be structured among individuals working together, groups can attain more success than individuals working alone (Bruer, 1993; Palincsar, 1998).

Online collaboration is the computer-mediated version of the traditional in-class collaborative learning. The benefits of online collaboration are that it better prepares students for their future employment where workers involved in a project might be geographically separated (Dede, 1996), it helps learners to achieve complex and higher-level concepts and skills (Abrami & Bures, 1996), it decreases the tendency to procrastinate (Kitchen & McDougall, 1999), and it brings about different perspectives and explanations (Laurillard, 2002). In contrast, the downsides of online collaborative learning include students' resistance to group projects because the outcomes rely heavily on the input of others and the arguments among students do not necessarily result in knowledge attainment (DeNigris & Witchel, 2000; Ko & Rossen, 2001; Laurillard, 2002).

According to Hathorn and Ingram (2002), various researchers have identified four critical attributes of the discussion patterns within an online collaborative group: participation (Zafeiriou, Nunes, & Ford, 2001), interdependence (Johnson, Johnson, & Smith, 1998), synthesis of information (Kaye, 1992), and independence (Laffey, Tupper, Musser, & Wedman, 1998). Of these four attributes, participation is the most basic requirement of a collaborative group because it is impossible to collaborate without individual contributions to problem solving. The second attribute of interdependence requires interaction between group members to bring about active responses to one another. The third attribute of synthesis of information requires the product of collaboration to reflect input from every group member. Finally, a collaborative group should be independent of the instructor; which means that whenever a question occurs, group members should attempt to collaborate with each other rather than turning to the instructor for answers. However, the coding methods for the four attributes of the discussion patterns within an online collaborative group have not been widely investigated.

Today the benefits of online collaborative learning are widely known,, but few instructors strive to implement collaborative strategies (Roberts, 2004). Much of the research in this area has only focused on strategies for promoting collaboration and communication at a distance using various technologies but has not specifically focused on the group work as an instructional strategy (Bonk & King, 1998; Koschmann, 1996; Koschmann, Hall, & Naomi, 2002). Furthermore, few studies have

examined the details of group discussions and explored degrees of online collaboration among groups.

In this study, we conducted a case study to investigate students' online collaborative experiences and attitudes in an online instructional design course at a university in the midwestern United States. The learning experience was centered on activities in which students worked in small groups on an authentic instructional design project. The purpose of the study was to answer the following questions:

1. What are the challenges to online collaboration?
2. How do group members deal with challenges during collaboration?
3. What is the relationship between the degree of collaboration and the quality of the group project?
4. What are students' attitudes toward online collaboration?

METHOD

Theoretical Framework

This research was conducted as a mixed methods case study. According to Merriam (1998), the purpose of the case study is to "gain an in-depth understanding of the situation and meaning for those involved. The interest is in process rather than outcomes, in context rather than a specific variable, in discovery rather than confirmation" (p. 19). The design of this research was a single case study focused on exploring participants' collaboration experiences and attitudes toward collaboration in online learning communities. The case was a graduate-level online instructional design course offered at a university. The subunits of the case were individuals, groups, and the online learning community as a whole.

Participants

Participants were 12 graduate students enrolled in an online instructional design course offered by the educational technology program over the span of the entire 16-week semester. Five of the participants had taken online courses previously, but none of the courses involved collaborative group work. All participants agreed to participate in the study at the beginning of the semester and pseudonyms have been used to protect the identity of the participants.

The instructor (the second author) purposefully divided students into four groups based on their academic backgrounds. Group 1 (Susan, Cathy, and Nelson) and Group 2 (Allen, Mary, and Jennifer) consisted of students from different academic backgrounds, while Group 3 (Kate, Tim, and Diane) and Group 4 (Jane, Ann, and Tiffany) consisted of students of similar academic backgrounds.

Online Course Format

The online instructional design course was taught by an instructor using a Web-based course management system called Blackboard. Blackboard allows instructors to place their syllabus, lecture notes, PowerPoint presentations, and examples of projects online for students to access at any time. In addition, Blackboard offers various types of online collaboration tools such as e-mail, file exchange, and discussion board for the purposes of communication and information sharing.

Blackboard also has a "Group" function, which allows the instructor to place students into different groups and records interaction among group members. The e-mail function enables group members to compose e-mail messages and to send them out to everyone in the group or to selected recipients only. Group members are able to upload and download files by using the file exchange function. The group discussion board is designed for asynchronous use, which allows participants to have a conversation at different times. Messages posted in the group discussion board are organized into forums that contain threads or topics. A thread is a continuous chain of postings on a single topic. Students can follow a thread to

read and discuss the postings relating to a particular topic. In addition, both file exchange and group discussion board functions allow students to exchange word documents, pictures, Web sites, or even multimedia files freely without having to worry about taking up group members' e-mail storage space.

To cultivate group collaboration, the instructor assigned three people to form a group. Each group then discussed and decided on a topic of interest to create a design document and a self-paced lesson for that topic throughout the semester. The group projects accounted for 50% of the final grade and the individual projects (book chapter reviews and final exam) accounted for 40% of the grade. In order to encourage equal contribution among students, all students were informed in the beginning of the semester that peer evaluation would be counted as 10% of their final grade.

In the process of creating a design document and a self-paced lesson of the chosen topic, each group had to complete five group projects. The first project covered needs assessment, learner analysis, and contextual analysis. The second project contained task analysis, instructional objectives, and questions and feedback. The third project included instructional sequencing, instructional strategies, and message design. For the first three projects, each group worked on first drafts together, provided feedback to and received feedback from group members, revised first drafts based on the peer feedback, and posted the second drafts via file exchange.

After reviewing and grading each of the projects, the instructor used Microsoft Word's track changes function to provide feedback on the second drafts and posted his feedback on file exchange so that the feedback was accessible to all group members. Each group then revised the drafts again based on the instructor's feedback and compiled these three projects as part of the design document. They then created a draft of a self-paced lesson according to the design document. The fourth project required students to conduct a formative evaluation to test the draft of the self-paced lesson on the target audience and write up an evaluation report. Evaluation results and learner feedback were then taken into consideration when each group revised their self-paced lesson and design document. Finally, each group submitted a final version of the design document (projects 1 to 4) and self-paced lesson (the fifth project) during the last week of the semester.

Collaborative learning groups in this study confronted real-life, complex situations that were ill-structured and had no clear solution (Bruffee, 1993), the locus of control was shifted from the teacher to the learning groups (Bruffee, 1993; Crook, 1994), and learners were entrusted with the ability to govern themselves in order to help them acknowledge dissent and cope with difference (Gerlach, 1994; Flannery, 1994). The goal of implementing online collaborative learning component in this course was for students to learn the subject matter content, apply problem-solving and critical thinking skills, and employ appropriate social skills necessary to work together collaboratively.

Data Sources

According to Creswell (1998), researchers are encouraged to use multiple sources to provide corroborating evidence. Four different data sources: group discussion archives, group projects, student attitude survey, and student reflections were used for this study.

Group Discussion Archives

Content analysis is an accepted method of studying text documents in communication, which involves identifying categories and counting the number of items in the text that appears in the categories (Silverman, 1993). Participants were informed to conduct their group work on the group discussion board. If the group decided to use e-mail to communicate with each other, they were instructed to send a copy of their e-mail to the instructor and teaching assistant (the first author) of this

course. To minimize the Hawthorne effect, the specific research questions were not given out to participants.

Group Projects

Each group had to complete five group projects for a total of 50 points throughout the semester. Project 1: needs assessment, leaner analysis, and contextual analysis (10 points); project 2: task analysis, instructional objectives, questions and feedback (10 points); project 3: instructional sequence, instructional strategies, and message design (10 points); project 4: formative evaluation (5 points); and project 5: final design document and self-paced lesson (15 points). The purpose of this data source was to evaluate the groups' performance in the course.

Attitude Survey

The attitude survey contained a total of 18 items. The original survey was developed by Wang, Poole, Harris, and Wangemann (2001) and was used to assess teenagers' attitudes toward online collaborative learning. We modified some items from the original survey to address the course context and the target population of graduate students. These survey items were posed as statements. Students' responses to statements were assigned a score of 5 for the most positive response, and a score of 1 for the least positive response. The attitude survey probed the participants' attitudes toward doing collaborative work in an online environment, their level of confidence in collaborating with others in problem solving, and their level of competence in using technological tools to do collaborative work. Sample survey items were "I think that most learning situations in an online learning environment should be set up primarily as collaborative activities," "I feel very confident in my ability to work with a group of others online in solving a problem or completing a task," "I can effectively use the Web to find information and help me to complete a task I have to do." The Cronbach's alpha reliability coefficient for the 18 Likert-scale items was .85.

Student Reflections

Students were asked to respond to a set of open-ended questions to reflect on the course as well as their online collaboration experiences. These questions focused on the nature of group collaboration that included: "Did you like or dislike working collaboratively as a group in an online setting? Why or why not?", "What are positive or negative things about online collaborative settings? Please explain.", and "What did your group do to get your projects completed?"

Procedures

One week prior to the semester, the instructor sent an orientation packet which contained course information, Blackboard tutorials, and answers to frequently asked questions about the course to students. To engage students in a learning community, the instructor required students to e-mail him their biographies and pictures during the first week of the semester. He then posted this information on Blackboard so that students were able to read each others' descriptions of their backgrounds and see what others looked like. The instructor then systematically divided 12 students based on their academic background information into four groups.

Before working on their projects, each group was required to discuss the team agreement on the group discussion board forum within one week and to reach some consensus on how to manage group projects in the course. The discussion involved five questions posted by the instructor: (1) How will you ensure that each project is turned in on time? (2) Who will compile the final draft of the document and ensure that it meets the criteria in the syllabus? (3) How frequently are you planning to check your e-mail and group discussion board every week? (4) How will you handle the almost inevitable situation when a team member does

not complete his or her work by the agreed date? and (5) How will you handle differences of opinion? The team agreement was important because it raised some potential problems in group work ahead of time and set the tone on how group members were planning to collaborate before they started the task.

After deciding on a topic and discussing the team agreement, students had to work collaboratively as a group to create a design document and self-paced lesson on the chosen topic for the remaining period of the semester. During the collaboration period, students' participation in the group discussion and performance on the group projects were recorded by Blackboard. In the final week, the instructor posted an attitude survey on Blackboard that participants were instructed to fill out along with a set of open-ended questions to reflect their online collaborative learning experiences. They then sent the attitude survey back to the instructor as an e-mail attachment.

Data Analysis

We analyzed the following four data sources: group discussion archives, group projects, attitude survey, and student reflections. Group discussion archives were collected and content analysis was performed to determine the level of collaboration in the discussion. Basic coding procedures were adopted from Hathorn and Ingram's study (2002), which used the same collaboration attributes as mentioned in the introduction section above and thus established validity of the coding system for measuring participation, interdependence, synthesis, and independence in the study. All threaded discussions and messages were arranged chronologically by date and time and then each message was divided into statements. A statement is a complete sentence or a complete idea within a sentence. Each statement was then coded into four attributes of collaboration discussion patterns. To determine and ensure reliability of the coding on each attribute, we coded the statements separately and discussed the discordant coding until consensus was reached.

The first two attributes of collaboration discussion patterns are participation and interdependence. Participation was measured by counting the number of messages and statements made by each group to compare their levels of participation. Interdependence is defined as the pattern of participation and interaction among group members to bring about active responses to one another. To measure interdependence, statements posted under the discussion board were first classified into categories of on-task or off-task behavior. On-task statements included group management and direct discussion of the project. Off-task statements included self-introduction, personal experiences, mention of weather, or other similar statements unrelated to the project. Furthermore, only on-task statements were analyzed to reveal the number of interaction patterns in this study. For a group of three people, the simplest interaction pattern is demonstrated as a-b, which means two out of three people were interacting with each other and the third person in the group was not involved in the discussion. In contrast, the most complex pattern of interaction is demonstrated as a-b-c-x (x could be a, b, or c), which means not only all three people contributed their ideas to the discussion, but one of them also summarized their ideas and found a solution to the problem in the end.

The third and fourth attributes of collaboration discussion patterns involves synthesis and independence. Synthesis of information was measured by counting the number of statements that contributed to generating new ideas. Independence was measured by the number of messages each group addressed to the instructor. In a collaborative group, participants are supposed to display a certain degree of autonomy. Group members should rely on each other and work together to solve problems instead of referring questions to the instructor. Therefore, the group that addressed fewer messages to the instructor displayed a higher level of independence. While there are

many different ways that we could have correlated the different attributes, we chose to look at only the raw numbers from the four different attributes generated by each group. We then ranked the groups according to these attributes so that we could better understand how these groups performed relative to each other, rather than examining the relationships between the different attributes separately.

An evaluation of each group's performance on the projects was obtained from the instructor. To prevent potential grader-bias, each project was graded independently by both the instructor and the teaching assistant based on grading rubrics. Specific feedback was then provided to each group, and the final grades on the group projects were used to evaluate the quality of projects. With regard to attitude survey, the means of survey items were calculated and ranked across participants as well as groups to determine their attitude towards online collaboration. Lastly, student reflections were aggregated into categories and then collapsed into meaningful patterns to serve as the framework for discussion.

RESULTS

The results are reported in this section for collaboration challenges, overcoming challenges, the relationship between degree of collaboration and quality of project, and student attitudes towards online collaboration.

Collaboration Challenges

In Group 1, Nelson received few contributions from his group members. Even though Susan dropped out of the course after a month due to unforeseen circumstances, he found that the contributions from Cathy were often counterproductive. Cathy would ask questions that could be easily answered by reading through the resources (e.g. announcements, minilectures, and examples) posted by the instructor and assigned book chapters. He also indicated that Cathy did not check her e-mail or group discussion board on a regular basis and it usually took days for Nelson to get any feedback from her, if any. On the other hand, Cathy felt left out of the learning process and mentioned that Nelson took charge of everything and did not give her a chance to learn.

Group 2's challenge occurred in the middle of the semester. A friend of Allen's had a family death. Distracted by that, Allen contributed very little to the group work. His group members pointed out that they often would not hear from him for days and his feedback to the group project was superficial, such as "Good job" or "Nice work!" Unfortunately, Allen was the only subject matter expert who was familiar with the topic on which the group had been working. Therefore, Jennifer and Mary had a difficult time trying to understand the topic and come up with an instructional design plan.

Tim was the leader of Group 3 who stated that coordinating the group was the biggest challenge for him. What frustrated him the most was how time-consuming the collaborative aspect of the course turned out to be, as reflected in his statement, "The asynchronous nature makes arguments or discussions that would normally only take 15 minutes in a synchronous environment, take days or weeks." Diane felt that some face-to-face meetings would have been helpful. However, due to schedule conflicts, their group never met in person. The worst experience the group had was the time when Kate volunteered to take charge of one project. She did not communicate with her group members for a whole week so Tim and Diane had to take over the responsibilities to complete the project within a short period of time.

Group 4 used group discussion board for most of their communication in the first half of the course. In the second half, since Ann and Tiffany both worked at the same school, they decided to meet face-to-face and work collaboratively. Due to time and distance constraints, Jane was unable to join them. Thus, she did her part of the work alone and felt left out. There were a few times when Jane accused her group members of meeting secretively without her.

Not only was the communication channel blocked between her and the rest of the group, but the trust between group members was also severely damaged.

Overall, communication turned out to be the biggest challenge in online collaboration. Participants in this study found that it was difficult to work collaboratively without face-to-face meetings. Yet, time and distance constraints usually prevented such sessions, so they had to communicate with each other via group discussion board and e-mail. Some participants also stated that it was frustrating not to hear from their group members for days and when they finally received feedback from them, the due date was approaching.

The second challenge was conflicts between group members. Conflicts existed in every group because students did not have the freedom of doing whatever they wanted and the group interest was above the individual interest. During the collaboration process, some participants felt that they should convince the whole group to accept their opinions, whereas others were more accommodating. We also found that some participants were more open-minded and willing to take suggestions from group members, whereas others had difficulty taking criticism and were not willing to adapt their own working styles to others.

Furthermore, a few participants had a very negative attitude toward group work to start with, were not open to suggestions, and purposefully built up a barrier between group members and themselves. For example, in Group 4, not only were supportive statements missing in their dialogues but Jane often made negative statements toward her group members. After her group members revised her work, she would say, "Why did you find it necessary to disregard the work that I did? I will be designing the self-paced lesson based on MY task analysis!" This statement hurt other group members' feelings so much that they stopped communicating with each other one month before the semester ended.

Overcoming Challenge

Ineffective communication was the most obvious in Group 1, where Nelson did the majority of the projects by himself first. To overcome this challenge and acquire more feedback from Cathy, Nelson not only posted his messages on the group discussion board but also sent the same messages via e-mail to Cathy. Additionally, Group 3 indicated that editing turned out to be a time-consuming process in online collaboration and the turnaround time would usually be more than three days. To overcome this challenge, the group leader, Tim, scheduled phone calls with individual group members to get the editing part done synchronously. They found an hour's work over the phone was more effective than days of e-mail exchanges.

Solving conflicts between group members was not easy. Some participants liked to work on projects at the last minute before the projects were due and had to learn how to work ahead of time in group work. The other solution to solving conflicts was "majority rules" when consensus among group members could not be reached. Unfortunately, some participants felt discouraged and disengaged when their ideas did not prevail, thus causing more conflicts within a group. In such cases, community-building comments and strong commitment to group projects proved to be effective in solving conflicts among group members, as demonstrated by Group 2.

For instance, Group 2 members regularly congratulated each other on a job well done, appreciated each other's work, and took feedback seriously. When expressing different perspectives of opinions, they tried to avoid harsh tones, but used phrases like "just one thing to consider," "what do you think …," "what if …," and so forth . In addition, in spite of lacking sufficient contribution from Allen and dealing with an unfamiliar topic, Jennifer and Mary did not give up and continued to communicate with each other. Group 2 set their group deadlines two days prior to the project due date. They agreed to check the group discus-

sion board on certain days of each week so that communication was open among group members. Jennifer took the role of group leader and pulled the whole group together. When Jennifer had a family emergency, Mary was able to take over the leadership. These behaviors were not anticipated or addressed during the course, but rather occurred spontaneously.

Degree of Collaboration and Quality of Project

The level of collaboration in terms of participation, interdependence, synthesis, and independence among four groups are shown in Table 1. The level of participation was determined by total statements posted on the group discussion board. It is obvious that Group 2 was the most active group among four groups. Three participants in the group posted a total of 700 statements throughout the semester. It is also worth noting that even though there were only two participants in Group 1, they posted a total of 389 statements, which was more than the 245 statements posted by Group 3 and 163 statements posted by Group 4.

The level of interdependence among group members was determined by interaction patterns. Group 2 generated a total of 18 interaction patterns, while Group 1 and Group 3 each generated a total of 14 interaction patterns. Group 4 generated only 6 interaction patterns, revealing the lowest interdependence among group members. In terms of synthesis, Group 2 made a total of 104 statements that helped them generate new ideas and solve problems, while Group 1 and Group 3 made a total of 47 statements and 45 statements respectively. In contrast, Group 4 made a total of only 18 statements that generated new ideas.

Lastly, the level of independence was measured by the number of messages each group sent to the instructor. Both Groups 2 and 3 worked almost entirely independently throughout the semester. They each sent only 4 messages to the instructor to clarify instruction. In contrast, Group 1 sent a total of 18 messages and Group 4 sent a total of 24 messages to the instructor. In addition, two of the group members in Group 4 scheduled two face-to-face meetings with the instructor, indicating the lowest independence.

The rankings for all four groups on participation, interdependence, synthesis, independence, degree of collaboration, and project quality are shown in Table 2. The ranking for the degree of collaboration was determined by the sums of rankings for the level of participa-

TABLE 1
Levels of Collaboration

	Group 1	*Group 2*	*Group 3*	*Group 4*
On-task	347	667	242	158
Off-task	42	33	3	5
Total statements (participation)	389	700	245	163
Interaction pattern (interdependence)	4 a-b 10 a-b-x (14)	5 a-b 1 a-b-a 3 a-b-c 2 a-b-a-b 2 a-b-a-c 1 a-b-a-a 2 a-b-a-b-a 2 a-b-x (18)	6 a-b 2 a-b-a 2 a-b-c 4 a-b-c-x (14)	3 a-b 2 a-b-c 1 a-b-c-x (6)
Statements generating new ideas (synthesis)	47	104	45	18
Message to the instructor (independence)	18	4	4	24

TABLE 2
Rankings for Variables

Group #	*Participation*	*Interdependence*	*Synthesis*	*Independence*	*Degree of Collaboration*	*Project Quality*
1	2 (389)	2 (14)	2 (47)	3 (18)	2	2
2	1 (700)	1 (18)	1 (104)	1 (4)	1	1
3	3 (245)	2 (14)	3 (45)	1 (4)	2	2
4	4 (163)	4 (6)	4 (18)	4 (24)	4	4

tion, interdependence, synthesis, and independence. Smaller sums indicated higher degrees of collaboration. The sums of rankings for all four groups were: 9 (Group 1), 4 (Group 2), 9 (Group 3), and 16 (Group 4). Since Group 2 had the smallest sum, it ranked in first place and had the highest degree of collaboration among the four groups. Both Group 1 and Group 3 ranked in second place and had a similar degree of collaboration. Group 4 had the largest sum and appeared to be the least collaborative of the four groups. With regard to group projects, Group 2 produced the best quality of projects (94%), Group 1 and Group 3 produced similar quality of work (87%), and Group 4 received the lowest grade on the group projects (75%). This shows a clear correlation between degree of collaboration and the quality of the group project.

Student Attitudes

The mean scores and standard deviations of 18 attitude survey items collected from the participants and across four groups are tabulated and ranked as shown in Table 3. The overall mean score across the 18 student attitude survey items was 3.71.

In terms of the five most positive responses on the survey, participants felt confident in using the technology to communicate with each other (M = 4.73). They liked sharing information and ideas with other learners in this class and felt confident using the Web (M = 4.55). They also felt comfortable receiving feedback from group members (M = 4.36) and believed the feedback from peers would help them improve their work (M = 4.36). The four statements that had the least positive responses were "I prefer problem-based learning activities in which we do projects as collaborative groups rather than working on individual projects (M = 2.09)," "I really like working in collaborative groups online (M = 2.27)," "I think that most learning situations in an online learning environment should be set up primarily as collaborative activities (M = 2.36)," and "I found our group discussion on team agreements at the beginning of the semester helpful (M = 2.82)."

In terms of attitude across groups, Group 2 had the most positive attitude toward online collaborative learning (M = 4.26), followed by Group 1 (M = 4.14) and Group 3 (M = 3.44), while Group 4 had the least positive attitude toward online collaborative learning (M = 3.15).

Although the small number of groups' members precluded inferential analyses, we also used group discussion archives and student reflections to determine the groups' attitudes towards online collaboration, which revealed similar finding as the attitude survey.

We found that Group 1 and 3 had mixed attitudes towards online collaborative learning. In Group 1, Nelson was disappointed with his collaboration experience, but he was positive that collaboration in general was helpful for online students. In Group 3, Kate disliked working as a group from the start and wanted more real-time interaction and face-to-face contact. Tim thought that dividing up duties among group members where each group member takes primary responsibility for one part of the project would have been easier than collaboration. In contrast, Diane was the only

TABLE 3
Student and Group Attitude Survey Scores

Rank	*Survey Items*	*Mean*	*SD*
1	I can effectively use a computer to communicate with other people.	4.73	0.47
2	I like to share information and ideas with other learners.	4.55	0.52
2	I feel very confident using the web.	4.55	0.69
4	I feel comfortable receiving feedback from peers.	4.36	0.50
4	I believe receiving feedback from peers will help me improve my work.	4.36	0.67
6	I can effectively use the Web to find information and help me to complete a task I have to do.	4.27	1.19
6	I can effectively use a computer to communicate with other people using threaded discussion boards.	4.27	1.19
8	I believe providing feedback from peers will help me learn more.	4.18	0.87
9	I feel comfortable providing feedback to my peers.	4.00	1.00
10	I can effectively use a computer to communicate with other people using chat rooms.	3.73	1.35
11	I think that most learning situations in an online learning environment should be set up as individual activities.	3.64	0.92
11	I enjoy using the computer to communicate with my classmates online.	3.64	1.12
11	I feel very confident in my ability to work with a collaborative team online in solving a problem or completing a task.	3.64	1.29
14	If I were asked to collaborate online with a group of adults who I never met face-to-face to solve a problem or complete a task, I would feel very confident in being able to accomplish the request.	3.18	1.40
15	I found our group discussion on team agreements at the beginning of the semester helpful.	2.82	1.33
16	I think that most learning situations in an online learning environment should be set up primarily as collaborative activities.	2.36	0.81
17	I really like working in collaborative groups online.	2.27	1.27
18	I prefer problem based learning activities in which we do projects as collaborative groups rather than working on individual projects.	2.09	0.83
Overall		3.71	1.27

Rank	*Group #*	*Mean*	*SD*
1	2	4.26	0.96
2	1	4.14	1.09
3	3	3.44	1.35
4	4	3.15	1.28
Overall		3.71	1.27

Note: All items measured on a 5-point scale from 1 to 5. Thus, the higher the score, the more positive the response.

person in the group who found the collaborative learning effective.

Group 2 had a positive reaction toward online collaboration and enjoyed working as a team. Both Allen and Mary thought that online collaborative learning was a great way to exchange experience and knowledge with group members. Jennifer felt that she received constant support and encouragement from her group members. She mentioned that she not only benefited from group members' knowledge but also gained self-confidence from group work. In contrast, Group 4 had a very negative attitude toward online collaboration. There were conflicts among group members and the group was in a "two against one" situation, which prevented them to work collaboratively as a group.

DISCUSSION AND RECOMMENDATIONS

This case study investigated 12 graduate students' online collaborative experiences and attitudes in an instructional design course. Content analysis of asynchronous group discussion board messages was used to measure degrees of collaboration of four different groups in terms of participation, interdependence, synthesis, and independence. In addition to the group discussion board messages, three other data sources—group projects, student attitude survey, and student reflections—were further analyzed.

Ineffective communication among group members seems to be a major challenge to online collaboration. According to Daradoumis and Xhafa (2005), group consolidation is the process of establishing acquaintances among group members. Answering team agreement questions at the beginning of the semester was a negotiation process between group members. We had hoped that the team agreement could serve as a contract within a group to guide group members' behaviors. Unfortunately, participants in this study did not think the team agreement was very useful, as reflected by the low rating on the survey item "I find our group discussion on team agreements at the beginning of the semester helpful." We believe that the team agreement was not as effective as we expected because it was only enforced at the beginning of the semester. When participants were writing the team agreement initially, they had not started working on group projects yet and could not foresee any challenges and problems that they might encounter later. We also found that groups that had fewer communication problems were those in which members kept their promises and specified clearly how frequently they would check their e-mail and group discussion board. We recommend that the discussion of the team agreement should be carried out throughout the semester so that students have a chance to revisit the original agreements, establish new agreements, and decide what behaviors are acceptable or need to be changed.

One interesting finding is that each group had one participant who did not work as hard or contribute as much as the rest of the group. These individuals' contributions to the group projects were minimal and seldom provided timely and constructive feedback. It might be caused by the mentality that an individual can get by without doing his or her fair share on the group project. Such behavior is the well-documented social loafing phenomenon (Jackson & Williams, 1985; Karau & Williams, 1993). Copious research suggests that people process information less thoroughly when they can get away with it, but more thoroughly when the situation demands (Plaks & Higgins, 2000; Chaiken, Giner-Sorolla, & Chen, 1996; Fiske & Taylor, 1991).

It is encouraging to find that participants used various tools to solve ineffective communication issues with their group members in this study. When online communication tools did not work well for a particular task, alternative communication methods were used. For instance, when simple editing was needed on a draft, group phone calls were a more efficient way to accomplish the task. To prevent ineffective communication, conflicts among group members, and negative attitudes toward group work, we suggest that the instructor should advocate that communicate, cooperate, compromise, complement, and commitment (the five Cs) be incorporated within the group setting (Ku, Cheng, & Lohr, 2006). Practicing these five attributes might also enable group members to have better working relationships with each other.

With regard to measuring the degree of collaboration, the coding scheme for the content of the discussions developed by Hathorn and Ingram (2002) was useful for examining degrees of collaboration, but it provided little information on why one group was more collaborative than another group. Using multiple data sources allowed us to go into greater depth to explain collaboration patterns, and to understand the possible relationships between

degrees of collaboration, the quality of the project, and student attitudes toward their collaboration experiences.

We found that whether group members had similar or different academic backgrounds did not seem to have an impact on the degree of collaboration in this study. Although consisting of students from different academic backgrounds, Group 2 was the most collaborative group that posted most statements on the group discussion board, initiated most interactions between group members, generated most new ideas through discussion, and solved problems independently with the least amount of the instructor's guidance. Group 2 also created a supportive and encouraging environment to work together, and demonstrated that rules of good behavior were necessary to promote positive interactions among group members. These findings confirmed that a higher degree of collaboration can help learners achieve complex and higher-level concepts, bring about different perspectives, and encourage deep processing of information (Abrami & Bures, 1996; Bernard, Rojo de Rubalcava, & St-Pierre, 2000; Laurillard, 2002). Attitude results also confirmed that a higher degree of collaboration resulted in greater learner satisfaction (Johnson & Johnson, 1999).

With regard to student attitudes toward online collaboration, it was encouraging to find that participants recognized the importance of exchanging feedback among peers, enjoyed sharing ideas with each other, and felt competent in utilizing technology tools to communicate with other people. However, what reduced positive attitudes towards online collaborative learning were frustrations of not being able to contact each other. The difficulty of communicating with other members is not a technical problem but a social loafing phenomenon, as mentioned above. Thus, we believe the key to successful online collaboration is to restrict the social loafing phenomenon.

We suggest that more interventions from instructors are needed to eliminate the social loafing phenomenon in online collaborative learning. Reminders from the instructor such as "Please contact me if you have concerns with your group or group members" might be helpful to detect early sign of social loafing from particular students. In terms of evaluation, the intention that peer evaluation would count for 10% the final grade in the present study was apparently not effective enough to constrain some of the social loafing behaviors. According to Graham and Misanchuk (2004), overemphasizing group accountability causes social loafing, while overemphasizing individual accountability undermines the cohesiveness of the group. We believe that it is best to balance group accountability and individual accountability. Students should be informed that although each group only needs to turn in one project, group members might receive different grades depending on their contributions to the group projects. In addition, since the peer evaluation used in this study only served the purpose of summative evaluation, more formative or periodic evaluations after each project was due should be implemented to prevent participants from social loafing. We recommend that peer evaluation as well as self evaluation with specific contributions to the projects should be conducted right after each group project has been submitted. In addition to evaluating group members' contribution to the project, we suggest that each student also needs to be evaluated on his or her social skills, work habits, and academic learning.

One of the limitations of this study is that Group 1 was reduced from three to two members when one of the students had to withdraw for personal reasons. Another limitation is that participants were informed at the beginning of the semester that they should use the group discussion board as the primary collaboration tool, and they should forward their e-mail correspondences to us if they chose to use e-mail. However, few participants followed the instructions, which resulted in missing data. In addition, we were unable to track collaboration when students decided to meet in person or communicate via phone. In future studies, the group must post meeting minutes if group

members decide to use alternative communication tools other than online tools.

The results of this study may help instructors to have a more systematic understanding of the technological, pedagogical, managerial, and social approaches to online learning with group collaborative learning components. Future studies might involve the interviewing of participants about their online collaborative learning experiences because such data are likely to add another layer of rich information. Future studies can also investigate whether groups of students who know and like each other (e.g., self-selected groups or cohort groups) collaborate and perform better on the projects than groups of students who are meeting each other for the first time (e.g., instructor-assigned groups or regular groups) in the online collaborative environment.

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