THE RELATIVE EFFECTIVENESS OF POSITIVE INTERDEPENDENCE AND GROUP PROCESSING ON STUDENT ACHIEVEMENT, INTERACTION, AND ATTITUDE IN ONLINE COOPERATIVE LEARNING

A Dissertation

by

CHANG WOO NAM

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

December 2008

Major Subject: Educational Psychology

THE RELATIVE EFFECTIVENESS OF POSITIVE INTERDEPENDENCE AND GROUP PROCESSING ON STUDENT ACHIEVEMENT, INTERACTION, AND ATTITUDE IN ONLINE COOPERATIVE LEARNING

A Dissertation

by

CHANG WOO NAM

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

Approved by:

Chair of Committee,	Ronald D. Zellner
Committee Members,	Michael J. Ash
	Robin A. Rackley
	Victor L. Willson
Head of Department,	Victor L. Willson

December 2008

Major Subject: Educational Psychology

ABSTRACT

The Relative Effectiveness of Positive Interdependence and Group Processing on Student Achievement, Interaction, and Attitude in Online Cooperative Learning.

(December 2008)

Chang Woo Nam, B.A., Seoul National University;

M.A., Seoul National University

Chair of Advisory Committee: Dr. Ronald D. Zellner

The purpose of this study was to investigate the relative effectiveness of positive interdependence and group processing on student achievement, interaction, and attitude in online cooperative learning. All of the participants, 144 college students enrolled in one of three different courses, received initial general instruction about teamwork skills and cooperative learning at the start of the study. Participants were then randomly assigned to one of three treatment groups: positive interdependence, group processing, and no structure. The “positive interdependence” groups received subsequent positive interdependence skills training which were then utilized in their instructional activities. The “group processing” groups received subsequent group processing skills training for use in their instructional activities. The “no structure” groups received no additional instructional treatment beyond the initial basic teamwork and cooperative learning training.

Results indicated that there were significant differences among students in the "positive interdependence," "group processing," and "no structure" groups with respect to their achievement scores and interactions. Participants in the "positive interdependence" groups had significantly higher achievement than participants in either the "group processing" groups or the "no structure" groups. In addition, participants in the "positive interdependence" groups and the "group processing" groups interacted with each other to a greater extent than those in the "no structure" groups. This study also examined the relative effectiveness of positive interdependence and group processing on types of student interaction. The results indicated that "positive interdependence" strategies were relatively more effective than "group processing" strategies on "sharing and comparing of information" interactions, whereas "group processing" strategies were relatively more effective than "positive interdependence" strategies on "negotiation of meaning and co-construction of knowledge" interactions. Regarding student attitude towards the experiences of cooperative learning: participation, communication resources, and online activities, there was no significant difference among any of the three groups. The overall results of this study suggest that instructors would be advised to incorporate positive interdependence strategies in their online courses to help students perceive that they should actively contribute to their online group activities. In addition, instructors are recommended to inform groups of the individual progress of each member's activities periodically by employing group processing strategies.

DEDICATION

To my parents and my wife

ACKNOWLEDGMENTS

I am most indebted to my committee chair, Dr. Zellner for his support, guidance, and encouragement. I would also like to express my gratitude to my committee members, Dr. Ash, Dr. Rackley, and Dr. Willson for their advice and support.

I would like to thank Dr. Yusung Heo, Dr. Myoungsook Choi, Youngil Hong, Il Park, Eunsil Park, and Kohei Furuya for encouraging and supporting this study. Thanks also to my friend, Tachun Wang, Wanchi Yang, and Seungho Jung for their friendship while I have been in College Station.

Finally, I give my heartfelt thanks to my parents, parents-in-law, and siblings for their selfless love. I could not have accomplished the completion of this dissertation without my adorable wife, Eunju. I especially give all the glory to God for loving me.

TABLE OF CONTENTS

Page

Page

Page

LIST OF FIGURES

LIST OF TABLES

Page

CHAPTER I

INTRODUCTION

Background

Individual Contribution Problems in Cooperative Learning

Unbalanced participation, or the existence of free-loader's /free-rider's who escape from responsibility in group activities has been identified by some researchers as a significant potential problem in cooperative learning situations. Often learners in ineffective groups seem to be freeloaders who do not complete their group work equitably. (McWhaw, Schnackenberg, Sclater, & Abrami, 2003). Slavin (1995) presented a similar term, free-rider, to describe the problem that can arise when the individual members' responsibilities are not defined clearly.

Many college professors incorporate cooperative learning in their classes by simply giving team project assignments to their students. While the students are conducting the team projects, the free-rider problems may occur. Unlike in secondary level classes, in undergraduate classes, the students have diverse majors, have different schedules from each other, and often have not ever met before. In addition, their interests differ widely, adding to the lack of group identity. They also do not live near each other, making it more difficult to interact cooperatively. This leads to the use of electronic communication and solution.

This dissertation follows the style of the *American Educational Research Journal*.

When the students engage in cooperative learning in a course, some might not feel obligated to the group and create the free-rider problem by excusing their absence and negligence due to their conflicting schedules and interest: they do not care if they are ignored as long as they pass. This problem can lead to students' unwillingness to participate in cooperative learning activities and to negative influences on group productivity.

Solutions to the Free-loader/Free-rider Problem: Increasing Student Interactions

The problem can be addressed effectively by 1) investigating the essential components of cooperative learning and 2) utilizing computer and telecommunication technology which enables asynchronous student communication in online learning environments. First, there exist many published reports about cooperative learning's theoretical structure and essential related components such as positive interdependence and group processing (Johnson & Johnson, 1994; Slavin, 1986). However, there is little empirical evidence that documents how participants in group activities interact and how positive interdependence and group processing influence that interaction, group performance, or members' attitudes (Garibaldi, Johnson, Johnson, & Stanne, 1989; Jensen, Johnson, & Johnson, 2002). Some researchers addressed the influences of the interactions among group members on their achievement and the types of behaviors that hinder effective cooperative learning. Jensen et al. posited that promotive interaction may be one element that influences student achievement. Also, they suggested that some group members do not know effective collaborative skills or they use only irrelevant social interaction skills. Only a few studies have shown that the types of positive

interdependence (roles, rewards, roles-plus-rewards, and no structure) influence the interaction among participants (Brewer & Klein, 2006). Others have shown that group processing enhances learners' achievement in cooperative group activities (Garibaldi et al., 1989). Brewer and Klein (2006) stated that a teacher can promote role interdependence by providing students with interaction guidelines. Specifically, in terms of role interdependence, the guidelines can specify members' responsibilities and complementary roles for effective group acitivities. (Johnson & Johnson, 1994). Further, role interdependence is structured when group members have good relationships with other members by implementing their assigned roles and contributing their efforts to the common goals (Johnson & Johnson, 1992). Johnson, Johnson, and Holubec (1994) stated that giving appropriate rewards to group members can help students perceive reward interdependence when members complete joint activities. Although it is important for a teacher to know which components of cooperative learning enhance student interactions, achievement, or attitudes in group activities, there have been few empirical studies focused on how the components of cooperative learning differ from each other in relation to such final learning outcomes.

In a related topic, communication among members has been presented as an important factor in successful group performance. In addition, the development of computer and telecommunications technology has provided resources to help learners engage in cooperative learning through managed asynchronous communications among members. The main role of communication among individuals that come together as a group are the conferring of knowledge and the creating of meaning (Hinsz, Tindale, &

Vollrath, 1997; Weick & Roberts, 1993). Also, some researchers include the role of communication in cooperative learning in general. Hirokawa (1990) stated that the characteristics of tasks such as complex structure in group activities can increase the importance of communication.

Communication among teachers and learners in cooperative learning has an important role in creating educational interactions which may be important to obtaining group goals (Garrison, Anderson, & Archer, 1999). However, in order to maximize learning, effective communication in education needs a collaborative community of learners which promotes positive interdependence and high-order thinking (Garrison et al., 1999; Johnson & Johnson, 1994). Cooperation is also an essential element to promote interaction and effective instruction (Garrison et al., 1999).

The resources provided by online learning environments have the potential to offer a full range of interaction types: learner-instructor, learner-learner, learner-content (Moore, 1990) and learner-interface (Hillman, Willis, & Gunawardena, 1994). According to Johnson and Johnson (1994), the first three of these types of interactions are appropriate to cooperative learning. In terms of learner-instructor interaction, the instructor monitors group activities and provides appropriate feedback (Johnson & Johnson, 1994). In terms of learner-learner interaction, students helping each other provides a valuable resource in group activities (Johnson & Johnson, 1994; Moore, 1989). In learner-content interaction, the learners interact individually with the content presented (Moore, 1989). In this process, they collect their information and subsequently interpret it with other group members (Johnson & Johnson, 1994). In the fourth type of

interaction, learner-interface, the learners interact with high-technology devices necessary for online education, an interaction that is not required in face-to-face learning environments (Moore, 1989). This interaction is accomplished when a learner has Internet access and can use Internet software to communicate with other students and to work with a system (Hillman et al., 1994; Moore, 1989). This interaction becomes more and more important as technology increasingly becomes the means of communication utilized by the other types of interactions (Hillman et al., 1994).

Knowledge of the relationship between "positive interdependence and group processing" and "the four types of interactions" can help researchers and teachers use the components of cooperative learning effectively in order to increase appropriate types of interactions. Also, that knowledge can be applied to enhance student achievement and student attitude. While there are few reported empirical studies of the effectiveness of these components of cooperative learning on student interaction, achievement or attitude in online learning environments, some researchers have discussed the benefits of such interactions in online learning environments. Wagner (1997) stated that Moore's (1990) interaction types are based on the agents of these interactions, but they fail to explain the interaction's purpose and outcomes explicitly. Also, she suggested that student improvements are due to the results of the interactions rather than the interactions themselves. In this context, learners' motivation toward collaborative activities and joint goals can be increased by these meaningful interactions (Wagner, 1997).

Problems and Solutions in Cooperative Learning

In education, the importance of shared information and positive social relationships makes the incorporation of cooperative learning more and more desirable. Some studies support the use of cooperative learning by developing the trend toward classroom teamwork (Colbeck, Campbell, & Bjorklund, 2000). Cooperative learning is becoming a successful instructional method at all levels of education including postsecondary education (Johnson, Johnson, & Smith, 2007).

A number of meta-analyses have shown that cooperative learning can enhance learner achievement, interaction, motivation and productivity. Further, cooperative learning has been shown to be relatively more effective in promoting learner achievement and interaction than competitive and individual learning (Johnson & Johnson, 1989; Johnson, Maruyama, Johnson, Nelson, & Skon, 1981). Although there are many verified advantages of cooperative learning, some students are reluctant to actively participate in group work. Sometimes, only one or two willing students do almost all the work to complete the groups' assignment; the others are content to escape their responsibilities. In such cases it is difficult to evaluate individual student contributions to the group products. The inability to evaluate the individual members fairly can be a significant problem in applying cooperative learning activities to the classroom. This problem of assessing member participation can be addressed through the essential components of cooperative learning, particularly in relation to the incorporation of new technologies such as online discussion.

Components of Cooperative Learning

Cooperative learning is conducted through the collaboration among all members in a group activity. Although that collaboration can be a necessary condition for successful cooperative learning, it may not be a sufficient condition. Effective cooperative learning is comprised of several important components. According to some theorists and researchers have presented the essential components of 1) positive interdependence, 2) individual accountability, and 3) group processing as means of addressing the problems of equal individual contribution (Jensen et al., 2002; Kaufman, Sutow, & Dunn, 1997; McCafferty, Jacobs, & Iddings, 2006). According to Johnson and Johnson (1994), positive interdependence is achieved when learners perceive that the success of each individual is an important element of group success in completing the assigned activity. Consequently, in order to succeed, members should help all other members to succeed (Johnson & Johnson, 1994). The second component, individual accountability, occurs when the members' contribution to the group's success is shared fairly (Johnson & Johnson, 1994). They define group processing, the third component, as the members reflecting on a groups' activity to decide who performed well and what actions should be continued or discontinued. Specifically, group processing is focused on group members assessing individual contributions and making any adjustments necessary for succeeding (Johnson & Johnson, 1994).

The effectiveness of these components of cooperative learning on individual performance, achievement, interaction, and attitude have been investigated by many researchers. There is some evidence that positive interdependence (cooperation) is more

effective in learners' achievement and interaction than negative interdependence (competition) or no interdependence (individual efforts) (Jensen et al., 2002; Johnson & Johnson, 1989). On the other hand, because only a few researchers (Garibaldi et al., 1989) have presented models of cooperative learning addressing the group processing factor, there is very little empirical evidence that group processing increases individual achievement or group productivity.

In one of the few studies that did focus on this component, Garibaldi, Johnson, Johnson, and Stanne (1989) examined group processing as a means of explaining the relationship between cooperative learning and achievement. They incorporated four conditions in their study: 1) cooperative learning with no processing, 2) cooperative learning with teacher-led processing (the teacher specified what cooperative skills to use, observed, and gave whole-class feedback about how well students were using the skills), 3) cooperative learning with the combination of teacher- and student-led processing (the teacher specified what cooperative skills to use, observed, gave whole-class feedback about how well students were using the skills, and had groups discuss how well they interacted as a group), and 4) individual learning. They reported that students working in the three cooperative learning method groups performed better than those in the individual learning method group. Also, they concluded that students in the combination of teacher- and student-led processing learning method groups performed better in problem solving and achievement than students in the two cooperative learning method groups with no teacher or student-led processing strategies.

Cooperative Learning Using Technology

McWhaw et al (2003) stated that an important aspect of cooperative learning is the understanding and awareness of who is contributing to the group activity by each group member through ongoing discussion. They concluded that the use of bulletin board asynchronous communications is an effective method for equalizing individual student contribution (i.e. eliminating non-performance) if there is a record of each individual's contributions that can be judged by peers and the instructor. A group can succeed through ongoing discussion about how it is functioning, however, simply posting a group processing summary for all to see may not provide learners sufficient motivation to become contributing members of the group (McWhaw et al., 2003). Grading the learner's recorded activities either through peer-assessment or through instructor assessment provides tangible recognition for their contributions or penalty for not contributing (McWhaw et al., 2003). Knowing about this assessment in advance helps motivate individuals to perform throughout the learning period.

Providing additional support for the value of self/peer-assessment in cooperative learning, Nelson (1999) stated that periodically conducting formative evaluations of the current product should be added to the feedback received from the instructor and other groups. Further, students should conduct this formative evaluation as a form of self-evaluation to test out their activities and revise them as needed. Although a self/peer-assessment strategy is needed which should be formative, diagnostic and summative, many teachers and instructional designers have felt it difficult to achieve this ideal and it remains as an important and unresolved feedback and assessment issue (Gatfield, 1999;

Li, 2001; Raban & Litchfield, 2007). However, some researchers found that this problem can be overcome by the incorporation of communications technology. The use of technologies such as the Web-based resources enables the collection and storage of continuous student interaction data that supports assessment, providing greater adaptability and flexibility than traditional or objective assessment (McLoughlin & Luca, 2001).

What role does new technology have in existing instructional theories? Some researchers approach the uses of technology within the context of constructivism. Jonassen, Peck, and Willson (1999) stated that constructivist use of technologies helps students articulate and reflect on what they know and aids them in getting personally constructed knowledge organized. Also, they concluded that technologies help students engage in active learning, constructive learning, intentional learning, authentic learning, and cooperative learning.

Garrison (1997) described how new technologies such as the Web enable online discussion through computer conferencing and suggested that it leads to more effective peer assessment. Computer conferencing is a particular application of computer mediated communication; it is a flexible means for supporting an educational experience (Garrison, 1997; Garrison et al., 1999). Computer conferencing uses written communication as a dominant means although the Internet transforms computer conferencing from single-media (text) to a multi-media environment (audio and video) (Garrison, 1997). Learning activities in computer conferencing can be observed and recorded, and consequently it can help students conduct effective peer assessment.

CHAPTER II

REVIEW OF LITERATURE

Cooperative Learning in Online Learning Environments

Definition of Cooperative Learning

Various researchers have posited concepts of cooperative learning. Parker (1985) stated that cooperative learning is based in classroom learning environments in which learners perform on academic tasks in small, heterogeneous groups. Cohen (1994) defined the process of cooperative learning as a learning environment where every student participates collaboratively on a clearly assigned task. Johnson, Johnson, and Holubec (1994) stated that the pedagogical use of small groups is important in cooperative learning so that students work together and consequently improve their group learning.

Cooperative Learning and Collaborative Learning

The terms cooperative learning and collaborative learning tend to be used interchangeably, but some distinctions are discussed by some researchers and theorists. Springer, Stanne, and Donovan (1999) stated that the traditional procedures of incorporating cooperative learning include communicating a common goal, offering rewards, assigning interrelated roles, sharing team-building activities, elaborating on social skills, and discussing effective learning methods with group members. In contrast, they stated that the procedures of incorporating collaborative learning are involved with

relatively unstructured processes including negotiating goals, defining problems, developing procedures, and building socially constructed knowledge in small groups. Panitz (1997) stated that cooperative learning strategy is the most structured and teacher-centered approach to group activities while collaborative learning is a less structured and student-centered strategy. In this view, cooperative learning and collaborative learning differ in the degree of structure used by each.

Cooperative Learning and Social Interdependence Theory

The components of cooperative learning investigated in this study, positive interdependence and group processing, are originally drawn from social interdependence theory. Social interdependence theory is considered to be an essential element in understanding and applying components of cooperative learning (Johnson & Johnson, 2007). Social interdependence theory may also contribute to solving the problem of equitable contribution. Because social interdependence theory explains how people interact and suggests strategies to improve motivation and increase individual responsibility, problems such as lack of sufficient student responsibility toward group work can be addressed more effectively (Johnson & Johnson, 1998).

Several researchers and theorists have investigated the influence of social interdependence theory on cooperative learning. Johnson and Johnson (1998) stated that cooperative learning can be explained effectively with social interdependence theory and the related research is focused on dependence among students. They further stated that the effectiveness of cooperative learning on instructional conditions and environments such as achievement, interaction, ethnic integration, and online learning can be

explained by social interdependence theory. Through empirical research, Johnson, Johnson, and Anderson (1983) found that there is a positive correlation between positive attitudes toward cooperative learning and perceptions of positive interdependence. Also, they reported that the more positive the students' attitudes toward cooperative learning are, the more they believed that every member who tries to contribute to group activities has an equal chance to succeed in class. Accordingly, the perception that positive interdependence (such as positive goal interdependence and resource interdependence) is used in their classes is associated with the view that students get the rewards or grades they deserve, and that the rewarding or grading system is fair.

The idea that learning groups can be defined as dynamic wholes with the interdependence among group members was first proposed by Kurt Koffka, one of the founders the Gestalt School of Psychology (Koffka, 1922). His colleague, Kurt Lewin (1939) stated that thinking of a group as a dynamic whole should include a definition of group which is based on interdependence of the members. Also, he proposed that it is typical of functional groups having a high degree of unity to possess a variety of members who have different functions within the whole. In 1949, "Theory of cooperation and competition" was published by Morton Deutsch establishing the basis for social interdependence theory (Deutsch, 1949b). In the 1980s and 1990s, many discussions about social interdependence were conducted and elaborated on the components and effectiveness of cooperative learning. For example, from the 1990s to the present, researchers have focused on the role of online cooperative learning through computer-mediated communication as well as face-to-face communication. Through

empirical analyses, Jensen et al. (2002) concluded that online cooperative learning environments can enhance positive interdependence in social interdependence theory. McIsaac and Gunawardena (1996) found that online group work is facilitated by computer-mediated communication (CMC) because CMC enables two-way interactive communication. Also, Brewer and Klein (2006) found that to use positive interdependence in social interdependence theory increases the number of student interactions. Specifically, the results are that students in groups with role-plus-reward interdependence learning strategy had significantly more interactions than those in groups with reward interdependence or no structured interdependence learning strategy. Also, they reported that there is a significant positive correlation between achievement and number of interactions and that the students who interact more generally obtain higher achievement scores.

Johnson and Johnson (1998) stated that the basic premise of social interdependence theory is that the each type of interdependence structured in cooperative learning environments influences individual learners' interaction with the other group members and the outcome of the group product. Social interdependence is structured when the actions of others influence the achievement of each individual's goals (Johnson & Johnson, 1989). Positive interdependence as an important element of social interdependence occurs when individuals perceive that their goals are linked with the other individuals' goals and consequently they maximize each other's effort to succeed (Johnson & Johnson, 1994).

Components of Cooperative Learning

Many researchers have investigated the essential components of cooperative learning. Its structure has basic elements such as promotive interaction, positive interdependence, individual accountability, and group processing (Kagan, 1992). In addition, heterogeneous grouping of students is a key element in the application of cooperative learning (Slavin, 1981). Johnson and Johnson (1994) stated that students in heterogeneous learning groups perform better than those in homogenous learning groups in relation to academic ability and interests. The students in heterogeneous groups can think more elaborately and interact with each other more frequently because heterogeneity ensures the students' various learning experiences are available for the group activities (Johnson & Johnson, 1994).

Johnson, Maruyama, Johnson, Nelson, and Skon (1981) implemented meta-analyses of the relative effectiveness of cooperation, cooperation with intergroup competition, interpersonal competition, and individualistic efforts in promoting achievement and productivity by reviewing 122 studies which were conducted across all ages in North America. The results of the meta-analyses indicate that cooperation promotes higher achievement and productivity than does interpersonal competition and individual efforts. In addition, cooperation with intergroup competition promotes higher achievement and productivity than does interpersonal competition and individual efforts (Johnson et al., 1981). Similarly, Johnson and Johnson (1989) reported that studies of many different countries, as well as North America, have shown that cooperative

learning improves student achievement more than competitive and individualistic learning do.

Some researchers have studied the productivity of specific groups such as high-ability learners in terms of the effects of cooperative learning. Johnson, Johnson, and Talyor (1993) examined the effects of cooperative learning and individualistic learning on achievement and reported that high-ability learners participating in cooperative learning activities evidence higher performance on both recall and reasoning measures than those in individualistic activities. Widaman and Kagan (1987) investigated the impact of specific cooperative learning methods (Student Teams-Achievement Divisions (STAD) and Team-Games-Tournaments (TGT)) (Slavin, 1986) and a traditional learning method on students' spelling performance in relation to student characteristics of ethnicity, gender, and achievement level (grade) among second- through sixth-grade students in elementary school classrooms. They concluded that specific cooperative learning methods by ethnicity interaction have a highly significant effect on spelling performance. Specifically, Anglo-American students performed better in spelling in TGT than in the STAD and traditional, whereas Mexican-American students performed better in traditional than in STAD or classes. Also, they reported that females generally perform better in spelling than males.

Based on the results of such research and theories, two essential elements of cooperative learning can be identified: "positive interdependence" and "Individual accountability" (Jensen et al., 2002; McCafferty et al., 2006). Also, "group processing" can be added as one element to improve the effectiveness of cooperative learning

activities (Kaufman et al., 1997). Figure 2.1 illustrates the concepts of social interdependence theory: progress, categories, and sub-categories of interdependence.

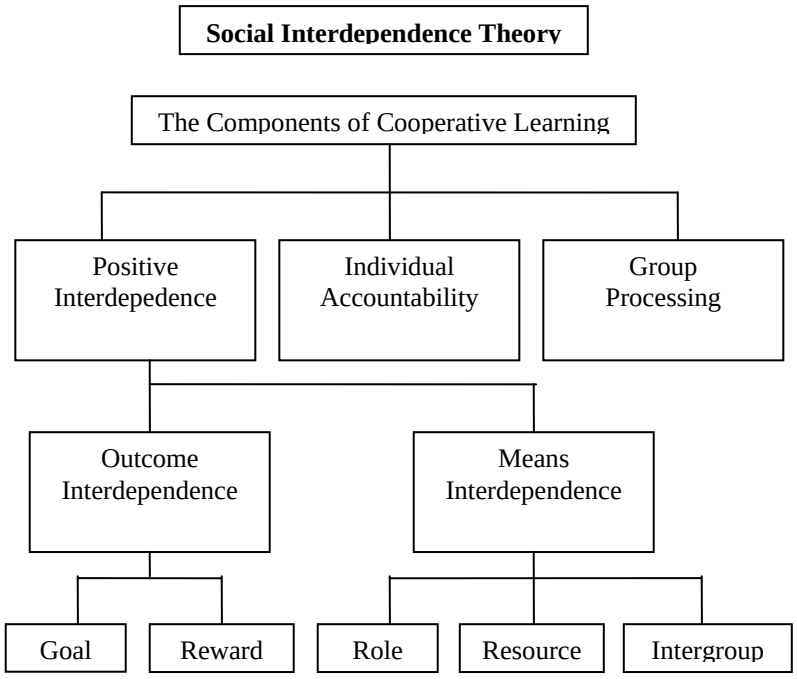

Figure 2.1. The concepts of social interdependence theory.

Positive Interdependence

Positive interdependence is identified as one of the key elements of cooperative learning by most researchers and theorists. Positive interdependence is achieved when group members perceive that what helps one member in a group helps all members in the group, and what hurts one member in a group hurts all members in the group (Deutsch, 1962). Earlier researchers concluded that there are two categories of interdependence: outcome and means (Deutsch, 1949a; Kelly, 1957). Similarly, Johnson

and Johnson (1989) recognized the same two categories: outcome interdependence and means interdependence.

Outcome interdependence includes two sub-interdependences: goal interdependence and reward interdependence (Johnson & Johnson, 1998). An individual who pursues a desired outcome in a cooperative or a competitive learning environment is oriented toward a desired goal or reward (Johnson & Johnson, 1998). Outcome interdependence (goal and reward interdependence) leads to actual cooperation or competition (Johnson & Johnson, 1998). Consequently, outcome interdependence is an essential element for successful cooperative learning.

Johnson and Johnson also presented the concept of means interdependence. Through means interdependence, which specifies the actions required on the part of group members, students can accomplish the mutual goals or rewards (Johnson & Johnson, 1992, 1998). Means interdependence includes some sub-categories: resources, role, and intergroup interdependence (Johnson & Johnson, 1998). Resources are partly taken by each member to implement and complete the mutual goals. Complementary roles are assigned to each member. Intergroup interdependence is created by the interaction among different groups. These three categories are not independent but are partly dependent on each other (Johnson et al., 2007).

Goal interdependence. Johnson, Johnson, and Holubec (1994) stated that the two steps of creating positive interdependence among members of a learning group are 1) to establish positive goal interdependence, and 2) to supplement positive goal interdependence by giving the whole group some motivators such as reward , celebration,

role, resource, and intergroup. Positive goal interdependence is an initial and primary element among all interdependences. Group members direct their efforts more to their common goals than to their individual goals if they have positive goal interdependence (Johnson & Johnson, 1998). A research team investigated the effectiveness of goal interdependence by comparing it with resource interdependence; they found that goal interdependence improves learners' achievement and productivity better than resource interdependence does (Johnson, Johnson, Ortiz, & Stanne, 1991). In this study, 30 undergraduate students participated in two sections of the U.S. military history course at a large Midwestern university. The experiments were carried out during the four class sessions. Student achievement was measured through three quizzes including short answer and total recall questions, which were given during the second, third, and fourth sessions. A final examination consisting of multiple-choice and short answer questions was also conducted. Attitude subscales were used to measure student perceptions of peer academic support, instructor academic support, and goal interdependence. The Verbal Interaction Measure was used to measure the verbal interaction among students (Johnson, Johnson, Roy, & Zaidman, 1986), and it was designed to record a continuous 2-min sequence of all group members' speech (Johnson et al., 1991). The achievement measures indicated that the students in the goal interdependence group scored higher on the second and fourth quizzes than those in the resource interdependence group. The attitude measures indicated that the students in the former group receive more peer academic support, more instructor academic support, and more cooperation than those in the latter. The verbal interaction results showed that the students in the former group

made more comments on task information, task elaboration, and management information than those in the latter (Johnson et al., 1991).

Reward/ celebration interdependence. Johnson and Johnson (1994) stated that reward/celebration interdependence occurs when the same reasonable and tangible reward is given to each member of a group for completing a joint task (e.g. if all the members in the group make 80 percent correct or better on the test, each member will receive 10 bonus points as a reward) or their success is jointly celebrated by the members. They also noticed that the quality of cooperation is influenced by regular celebrations of group efforts and successes. When students perceive that their efforts are appreciated and they are respected as individuals, they are willing to work in cooperative groups, and enjoy doing so (Johnson & Johnson, 1994). Wageman and Baker (1997) defined reward interdependence as the extent to which the rewards provided to an individual are based on the performance and productivity of the whole group.

Role interdependence. When each group member is assigned a specific and complementary role, role interdependence specifies each individual's expected responsibilities in a group's activities (Colbeck et al., 2000). Johnson and Johnson (1994) considered role interdependence to be effective when each member was assigned complementary and fair roles such as facilitator, reader, writer, editor, and organizer that clarify the set of responsibilities that is needed for the group to succeed. The role of instructors is very important to facilitate role interdependence effectively. If students are provided with specific instructions about interpersonal skills, cooperative learning will be more effective than individual learning (Johnson & Johnson, 1994; Slavin, 1995).

Resource interdependence. Resource interdependence is achieved when each member shares information and materials in order to complete the entire group goal cooperatively (Colbeck et al., 2000). Johnson and Johnson (1994) stated that resource interdependence increases when each member in a group has only limited information, materials, or resources, and all the members must combine the various resources to obtain their common goal. Fan and Gruenfeld (1998) stated that the advantages of resource interdependence provide justification for organizing a group in the first place. They added that when certain members ask each other for resources necessary to support their entire group's activities, the interaction among all members increases.

Role plus reward interdependence. Some researchers have studied not only the effects of single interdependence, but also those of combined interdependence. Brewer and Klein (2006) investigated the effect of the type of positive interdependence such as roles, rewards, roles-plus-rewards, or no structure in an asynchronous, cooperative learning environment. All of the 289 participants (104 males and 185 females) in the study were undergraduate business majors enrolled in a required course in Management at a private degree completion university for adult learners. Instruments used in the study were affiliation scale, attitude measure, and interaction checklist for categorizing student interactions in online groups during practice periods. The researchers developed a posttest to measure student achievement. The posttest was composed of 10 selected-response items for each of the three units, for a total of 30 items. Student attitude regarding the experienced practice method was measured with a 14-item survey which was developed by the researchers. The Cronbach's alpha internal consistency reliability

of the attitude survey was .75. An interaction checklist was adapted from instruments (Klein & Schnackenberg, 2000) previously used to observe group interactions in face-to-face settings (Brewer & Klein, 2006). The achievement results indicated that there was no main effect for the type of interdependence, affiliation motive, or any interaction effect ($p > .01$). The attitude measures showed that students in role-plus-reward interdependence groups had significantly higher agreements than those in no-structured-interdependence groups ($p < .01$). Students in all three interdependence groups—role, reward, and role-plus-reward— had significantly higher agreements than those in no-structured-interdependence groups ($p < .01$). The interaction results indicated that students in groups with role-plus-reward interdependence ($M = 18.34$ and $SD = .86$) had significantly more interactions than those in either the reward ($M = 13.57$ and $SD = .92$) or no interdependence ($M = 13.55$ and $SD = 1.02$) ($p < .01$) (Brewer & Klein, 2006).

Intergroup interdependence. Johnson, Johnson, and Holubec (1994) mentioned that establishing class goals or intergroup goals as well as individual and group goals to create intergroup interdependence leads to positive interdependence throughout a whole class or between-groups. Intergroup interdependence is achieved when a group finishes its work; its members find other groups who have not finished their work and then discuss the group products and help the others obtain their goals effectively (Johnson et al., 1994).

Individual Accountability

The concept of individual accountability overlaps with the concept of positive interdependence, since they both deal with shared responsibility among group members

(Johnson & Johnson, 1994). In other words, there is a reciprocal relationship between positive interdependence and individual accountability (McCafferty et al., 2006). A number of researchers have presented individual accountability as another essential element of cooperative learning. It is described as shared responsibility of one group member toward the whole group's goal (Johnson & Johnson, 1994).

If a cooperative learning activity does not evoke individual accountability, only a particular student who has more ability or who feels more responsibility than the others would actively conduct the cooperative learning activity, whereas the others would likely evoke the problem of free riders by making minimal effort (McCafferty et al., 2006). Johnson and Johnson (2007) stated that individual accountability can be defined as shared responsibility of conducting one's task in order to achieve the group's goal. Individual accountability is achieved when the individuals perceive the need and then participate in their group activities and share responsibility for the joint outcome (Johnson & Johnson, 1994). Also, if the group size is reduced, each member's individual accountability is increased (Brewer & Kramer, 1986).

Group Processing

Group processing means the reflection by a group about how helpful each member is in relation to the group's goal and about what actions they should continue or discontinue (Johnson & Johnson, 2007). The purpose of group processing is to help the group members contribute to the productivity and goals of the group (Garibaldi et al., 1989).

Johnson and Johnson (1994) mentioned that there are two levels of group processing: small group processing and whole class processing. In order to investigate whether small-group processing is achieved, a teacher gives some questions about how effectively group members worked together at the end of each class session. At that time, group members are required to describe who acted helpfully and who did not in relation to obtaining their goals and then decide what behaviors should be continued, discontinued or changed. (Johnson & Johnson, 2007). In terms of whole-class processing, a teacher makes systematic observations of each group and then gives appropriate feedback reverse on their cooperative learning activities (Johnson & Johnson, 2007). Also, the teacher can use a formal observation sheet to monitor and evaluate each group's activities; at the end of the class the teacher can conduct a whole-class processing session by announcing and sharing the results of the observation (Johnson & Johnson, 2007).

Garibaldi et al. (1989) investigated the impact of group processing (teacher-led processing, combined teacher- and student-led processing, no processing, and individual learning) on student achievement, interaction, and attitude in cooperative learning environments. The subjects were 49 African American students in a 4-week summer honors program in humanities. Twelve students were randomly assigned to each group. In all four conditions (teacher-led processing, combined teacher- and student-led processing, no processing, and individual learning), the students participated in a 3-hour instructional unit that connected a computer simulation with materials on the fundamental principles of map reading and navigation. The students' task was to master

the content of their reading and know how to decide what actions should be taken to solve the problems. The computer was used to record their decisions to give feedback on the actions they took. Student achievement was defined as 1) “the distance one’s ship traveled from the Old World to the New World and back again” and 2) “the amount of gold obtained.” Oral interaction was measured with the observation of teacher-student and student-student interactions, measured as interactions per minute. Also, student attitude was measured with a 5-point scale ranging from “strongly disagree” to “strongly agree” as the following: “We talked over what we were doing,” and “Everyone participated in the discussion” and so on. The attitude measures indicated that those in the three cooperative groups (teacher-led processing, combined teacher- and student-led processing, and no processing) talked over what they were doing and that everyone in the three cooperative groups participated in the discussion more actively than those in the individual learning group who interact only with their teacher. The combination of student- and teacher-led processing produced more progress in “the distance one’s ship traveled from the Old World to the New World and back again” than teacher-led processing and no processing. Also, teacher-led processing performed better than no processing. Students in all the three cooperative groups obtained significantly more in “the amount of gold obtained” than those in the individual group. In terms of interactions, more student-student interaction took place in the three cooperative groups than in the individual group, whereas more teacher-student interaction took place in the individual group (Garibaldi et al., 1989).

Cooperative Learning and Social Constructivism

According to some constructivists, technology provides some advantages that facilitate cooperative learning in online learning environments. Jonassen, Peck, and Willson (1999) stated that to observe others' skills and to share each other's knowledge allow learners to establish effective learning and knowledge-building communities. They added that cooperative learning often requires meaningful conversation among group members. Consequently, technologies for online cooperative learning can provide diverse opportunities for conversation and help learners develop their interactions (Jonassen et al., 1999). Some constructivists tend to connect the cooperative learning with a perspective of social constructivism. Merrill (2002) pointed out that cooperative learning is applied and emphasized by constructivist models, and that cooperative learning is a very important element to activate learners' prior experience and to integrate their new knowledge and skills into their everyday life. Also, social constructivists assume that cooperative learning is defined as a cooperative process to learn how to negotiate over different meanings from multiple perspectives (Merrill, 1992).

Cooperative Learning and Online Discussion

One way to enhance cooperative learning is through the use of online discussion. Online discussion utilizing bulletin boards is a common form of asynchronous communication; it allows cooperative group members to communicate interactively through message systems (McConnell, 2000). Jonassen (2000) stated that asynchronous communication, also referred to as delayed communication, occurs when only one

learner can communicate at a time. He added that asynchronous communication utilities are resources such as e-mail and bulletin boards. This asynchronous communication supports active online cooperation among learners, and learners can collaboratively construct documents, solve problems, and share information and perspectives (Jonassen, 2000). Garrison (1997) stated that web-based communication enables students to share references, learning resources, photographs, sound recordings, and even executable computer-assisted learning sequences using resources such as Java and other executable code. Further, online discussion can enhance social presence. Social presence is defined as the degree to which individuals project themselves into the community through the media (Garrison, 1997).

Cooperative Learning in Higher Education

Springer et al. (1999) conducted a meta-analysis of 39 studies from 1980 to 1997 on cooperative learning that applied small-group learning methods in undergraduate science, mathematics, engineering, and technology (SMET) courses and programs. They concluded that cooperative learning using small-group learning methods improves greater academic achievement, more favorable attitudes toward learning, and increases persistence through SMET courses and programs effectively. Of the 39 studies, 37 (94.9%) was about student achievement, 9 (23.1%) on persistence, and 11(28.2%) on attitudes. Some studies had more outcomes and the sum of these percentages is more than 100 (Springer et al., 1999). The main effect of small-group learning on achievement, persistence, and attitude among undergraduates in SMET was significant and positive ($p < .05$). The achievement result, based on 49 independent samples from 37 studies

encompassing 116 separate findings, indicated that students who learned in small groups demonstrated greater achievement than those who were in individual learning environments ($p < .05$). The persistence result showed that students who worked in small groups persisted through SMET courses or programs to a greater extent than those who were not in cooperative learning groups ($p < .05$). Finally, the attitude result indicated that students in small groups favored attitudes more than those who were not in small cooperative groups ($p < .05$).

Cooperative Learning and Interaction

Kreijns, Kirscher, and Jochems (2003) stated that although some variables such as group size, group composition, grouping of abilities, nature of task, group processing, and learning styles potentially influence the effectiveness of cooperative learning, all these factors are related in one way or another to an important component: interaction. Moore (2002) indicated that there is a relationship between cooperative learning—especially, social interdependence—and interaction as the following:

> Although ideas, rather than social interaction, are the focus of a mature online learning group, many researchers suggest that social interaction, especially in the form of learner-learner interaction, leading to social integration and social interdependence is an essential prerequisite for the development of such ideas (p. 63).

Johnson and Johnson (1998) stated that positive interdependence among the elements of cooperative learning creates promotive interaction whereas negative interdependence typically evokes oppositional interaction. They also concluded that

promotive interaction occurs when learners facilitate and maximize each other's efforts to obtain the entire group's goals in cooperative learning environments, whereas oppositional interaction occurs when learners discourage and obstruct each other's efforts in competitive learning environments and no interaction occurs when learners focus on their own learning independently without any interchange with each other. Sharan and Sharan (1994) stated that in terms of the method of cooperative learning, interaction is one of the four components of Group Investigation: investigation, interaction, interpretation, and intrinsic motivation. Group Investigation as one cooperative learning method helps students learn all the interpersonal discussion and teamwork skills and use them to establish appropriate learning goals (Sharan & Sharan, 1994).

Interaction in Online Learning Environments

Definition of Interaction

In online learning environments, the terms of interaction and interactivity are used interchangeably even though there are some distinctions between each other (Wagner, 1997). Wagner (1994) defined interaction as a reciprocal situation requiring two objects and two actions. Wagner (1997) stated that interaction is activated when learners and situations have a mutual relationship, whereas interactivity is activated to improve the technological capability of connecting a point with another point or multiple points. Also, Wagner (1997) added that interaction typically includes behaviors, whereas interactivity deals with the attributes of technology systems in online learning environments.

Importance of Interaction

Duffy and Jonassen (1992) stated that learners improve their knowledge construction by having dialogues with other learners in order to activate interactions. Learner interaction is also considered an essential element for building online learning communities through information exchange (Keegan, 1990).

The importance of interaction has been investigated in many instructional design studies. Instructional designers approach instructional technology by utilizing interaction as a critical element and suggest a strategy for how students should interact with each other efficiently (Dick & Carey, 1990). Leshin, Pollock, and Reigeluth (1992) also emphasized that well-structured interactive instructions and learning strategies offer the opportunities for mental experimentation and creative problem solving. Also, they suggested that the advantage of interaction is to encourage learners' positive participation and learning through the effective transfer of knowledge. They added that the methods to implement interactive instruction are needed: participatory instruction, role-play, demonstration, team quiz, cooperative instruction, and structured debates. Meaningful and effective interaction and cooperative learning are important ways of activating online learning communities (Wang & Kang, 2006). Also, they presented social discussion as a way to increase online interaction. Hannafin and Peck (1988) stated that interaction depends on the quantity and the quality of learner participation in Computer-Assisted Instruction (CAI) including online learning, and that CAI maximizes interaction.

The development of technology for online learning can support interaction. Romiszowski and de Haas (1989) pointed out that asynchronous communication such as computer conferencing enables learners to reflect on their thought more deeply than in real classroom interaction because they can reflect before responding. Wagner (1997) summarized the effects of interaction on learners: 1) interaction can help learner participate actively and share information in the instructional/training/performance improvement process, 2) interaction allows learners to individualize learning experiences according to their specific needs, 3) interaction motivates learner by focusing on the relevant relationship between the new information and specific circumstances.

Components for Enhancing Interaction

Kreijns et al.(2003) stated that building interaction in online cooperative learning environments does not mean that learners will interact with each other automatically; nor does just opening an online forum for group activities and labeling it “café” or “discussion room” necessarily make learners actively participate in online discussions. They added that an instructor must encourage the facilitators or agents (group member, instructors, and content) to be actively involved in interaction. They also mentioned that a complex of simultaneously applied instructional approaches can make online group members actively interact with each other by increasing elaboration, questioning, rehearsal, and elicitation.

Some researchers have focused on the advantage of technology to enhance interaction. Garrison and Cleveland-Innes (2005) stated that Internet technologies have

the potential and properties to support effective communication. Kreijns et al.(2003) stressed the ways to interpret the relationship between communication media and interaction as the following:

> Therefore, just providing members of a distributed learning group with more communication media than they already have (but possibly with characteristics that make these more appropriate for certain kinds of communication activities which require social interaction) neither necessarily fosters nor ensures social interaction. Although these media can contribute to a more suitable condition for the execution of the communication tasks, they do not guarantee that the desired social interaction will take place. In other words, availability of communication media is necessary, but not sufficient (p.341).

Online interaction can be activated and facilitated by online discussion. Swan (2001) summarized the available literature dealing with online interaction. According to her, when the instructor does not control learners in an asynchronous environment of online discussion, the participants in online discussions perceive that conversations are more equitable and more democratic than in face-to-face discussion in traditional classrooms. She also stated that learners can reflect on other's work and on one's own thoughts before posting them to asynchronous online discussion.

Interaction and Theory of Transactional Distance

Moore (1991) presented the theory of transactional distance as having two major components: dialogue and structure. According to him, dialogue is defined as the

interaction between instructor and learner, or learner and learner when one offers instruction and the other responds, whereas structure is described as the design which expresses the rigidity or flexibility of the program's instructional objectives, teaching methods, and evaluation models. Moore and Kearsley (2005) defined transactional distance as the physical distance that makes a communications gap, or a psychological space of potential misunderstandings between instructor and learner. Kanuka, Collett and Caswell (2002) interpreted the transactional distance as a theory to isolate those elements of instructional transactions that largely influence learners' activities in online learning environments. They explained that if the learner receives instruction and guidance from an instructor or other learner through both a high degree of structure of the course and a high degree of dialogue, a low level of transactional distance occurs in online learning environments; on the other hand, when the learners study alone and they decide their own learning strategy without any interaction or meaningful dialogue, a high level of transactional distance exists.

Moore and Kearsley (2005) explained that there is a potential gap in understanding between the behaviors and the thought of learners and instructor in online learning. Roblyer and Wiencke (2003) state that this potential is increased by the physical distance between instructor and learners but is decreased by dialogue, instructional activities, and technology uses.

Types of Interaction

In order to specify the discussion about interaction, Moore (1990) suggested the three types of interaction: learner-learner interaction, learner-instructor interaction, and

learner-content interaction. Some researchers suggested different types of online interaction: acknowledgement, agreement, apology, self-criticism, question, humor, invitation, and referential statement (Wang, Sierra, & Folger, 2003). Johnson and Johnson (1994) applied Moore's three types of interaction into their formula of cooperative learning, and explained how cooperation in learning can enhance each type of interactions. Table 2.1 presents the types of interactions and appropriate cooperation which is adapted from Johnson and Johnson (1994).

Table 2.1

The Types of Interactions (Johnson & Johnson, 1994)

The Types of Interactions	**Appropriate Cooperation**
Learner-Learner Interaction	Other students are perceived to be the major resources for assistance, feedback, reinforcement, and support.
Learner-Instructor Interaction	Instructor monitors and intervenes in learning groups to teach cooperative skills.
Learner-Contents (or Materials) Interaction	Contents (or materials) are arranged according to purpose of lesson.

Also, Hillman, Willis, & Gunawardena (1994) added a growth type of interaction, learner-interface interaction. Some controversies exist among researchers and theorists. Wagner (1997) summarized Moore's theory as the following:

> Moore's schema does not really describe the intended outcomes of these interaction categories. Instead it identifies the agents involved in or affected by a given interaction. In other words, it describes with whom—or with what—

> interactions will occur, within the context of a specific distance learning transaction (p. 21).

Wagner (1997) added that to concentrate on the outcomes of interaction rather than the agents of interaction helps learners take advantage of interaction more effectively as a means to achieve their goals. Wagner (1997) also suggested alternative types of interactions to be considered in building interaction into learning: interaction to increase participation, interaction to develop communication, interaction to receive feedback, interaction to enhance elaboration and retention, interaction to support learner control / self-regulation, interaction to increase motivation, interaction for negotiation of understanding, interaction for team building, interaction for discovery, interaction for exploration, interaction for clarification of understanding, and interaction for closure. Among them, interaction for closure is concerned with the ability to know "what expectations exist," or to decide "when learning activities are done with numerous resources" through dialogue (Wagner, 1997). In comparison with Moore's types of interaction, Wagner's types of interaction may be included in Moore's types, though the classification is not absolute. Interaction to enhance elaboration and retention, interaction to support learner control / self-regulation, interaction for discovery, and interaction for exploration are somewhat involved with learner-content interaction and learner-interface interaction, whereas the others are to some extent related with learner-learner interaction and learner-instructor interaction. Because Wagner's classification focuses on the outcome of interaction, it cannot be perfectly matched with Moore's which is concerned with the agents of interaction (Wagner, 1997).

Learner-learner interaction. Moore (1989) defined learner-learner interaction as inter-learner interaction among learners in group activity settings. Moore (1989) stated that learner-learner interaction among group members or inter-group members is a highly valuable and essential resource for learning. Chou (2003) stated that interpersonal communication functions such as email, Bulletin Board System (BBS) and chat rooms or discussion rooms can be designed in order to enhance learner-learner interaction in online learning environments.

Learner-instructor interaction. Moore (1989) defined learner-instructor interaction as the interaction between the learner and the expert who offers the subject. When interaction between learner and instructor exists through correspondence and teleconference, the learner can recognize the influence of the instructor and share knowledge by interacting with the content which is relevant to him / her (Moore, 1989). Giguere, Formica, and Harding (2004) explained that learner-instructor interaction occurs when the instructor engages the learners in group activities by using prior materials and by ascertaining how well students keep pace with the contents or instructors, and when students help instructors choose alternative strategies.

Learner-content interaction. Moore (1989) defined learner-content interaction as the interaction between the learner and the content or a subject of study. He also explained the oldest form of interaction as didactic text which is aimed at instructing, not only informing or entertaining. Giguere et al. (2004) listed the media for learner-content interaction as textbooks, Internet Web sites, simulations, guidebooks, audio, video, and television. Guguere et al. mentioned that even though this interaction tends to have self-

directed learning strategy, learner-content interaction is always related to other interactions such as learner-learner or learner-instructor interaction. In online learning environment, many learning programs have the characteristics of content-interactive structure, which enables learners to construct their self-directed study (Moore, 1989). This interaction can be related with resource interdependence in cooperative learning. Resource interdependence occurs when each member has only a portion of the resource needed to achieve the common goal (Johnson et al., 1991). When resources are divided, students seek to imagine the whole concept of a common work with partial and limited resources and to interact effectively with the contents of a portion of resources (Johnson & Johnson, 1994; Johnson et al., 1991).

Learner-interface interaction. Hillman et al. (1994) defined learner-interface interaction as the interaction between learners and technological media that is available for learners to efficiently interact with other learners, an instructor, or course contents efficiently. Chou (2003) noticed that diverse interactive technical functions such as "current grade status" and "assignment completion tracking" can be designed in the online system in order to enhance learner-interface interaction.

Some researchers described learner-interface interaction in terms of the interpretation of information. Wagner (1997) stated that it is more critical to be able to access, interpret, and apply information by using diverse learning technologies such as the Web and facilitating learner-interface interaction than to memorize a massive store of facts. When students conduct group activities in online cooperative learning environments, it is more important for the students to synthesize and extract the

important and appropriate resources from massive online information sources than to pile up unnecessary contents in online discussion rooms for the purpose of obtaining required learner-interface interaction.

Chapter Summary

The literature review in this chapter provides the fundamental basis of cooperative learning research. The review also offers the theoretical framework of 1) the basic components of cooperative learning: positive interdependence and group processing, and 2) the relationship between cooperative learning and student achievement, interaction, and attitude. The critical points in the literature review are as follows:

1. The important components of cooperative learning are summarized as positive interdependence and group processing. Positive interdependence and group processing promotes students' positive attitude, interaction, and achievement effectively in cooperative learning environments.

2. The use of the Web can support student interaction in cooperative learning activities. Also, researchers and instructors can get the specific information of group activities by investigating the types of online interaction, and they can help students improve their interaction and achievement.

CHAPTER III

METHODOLOGY

Introduction

The literature review presented above provided a summary of cooperative learning research and focused on the main components necessary for its effective implementation: positive interdependence, individual accountability and group processing (Johnson & Johnson, 1998). A series of research studies were presented to investigate the impact of positive interdependence on student achievement (Brewer & Klein, 2006; Jensen et al., 2002; Johnson & Johnson, 1998). A number of researchers have shown the positive effects of positive interdependence on student achievement. While most of the researches have investigated the effects of positive interdependence on student achievement in face-to-face and traditional learning environments, few studies have investigated them in online cooperative learning environments (Brewer & Klein, 2006). Consequently, this study was intended to extend the research to online cooperative learning environments. Among the basic components of cooperative learning, group processing has the potential to clarify and improve the effectiveness of the members to achieve the group's goals. Similarly, few empirical studies have examined the importance of group processing in cooperative learning (Garibaldi et al., 1989; Johnson & Johnson, 1998). This research intended to extend the examination of the effectiveness of group processing to online learning environments. It also compared the relative importance of positive interdependence with that of group processing.

Although there have been a few studies about the relative effectiveness of the two types of positive interdependence (goal interdependence and resource interdependence) (Johnson et al., 1991), few studies have examined the relative effectiveness of positive interdependence and group processing on group activities such as achievement, interaction, and attitude. Research on the relative effectiveness of positive interdependence and group processing on student achievement, interaction, and attitude in online cooperative learning environments should prove to be useful in helping educators develop more effective instructional practices.

Description of the Research Design

This study examined the relative effectiveness of positive interdependence and group processing on student achievement, interaction, and attitude. Specifically, the dependent variables were student interaction, achievement, and attitude. The elements of cooperative learning (positive interdependence and group processing, and no structured cooperative learning method) formed an independent variable:

Group 1: Positive Interdependence

Group 2: Group Processing

Group 3: No Structure

Group 1 received “positive interdependence” treatment (goal, reward, role, and resources) from their instructor. For example, they received academic rewards such as bonus points added to their scores if they posted at least two online messages in their

discussion rooms and they played active roles in their group activities (Johnson et al., 1994). Group 2 received "group processing" treatment from their instructor. For example, they wrote Processing Interim Report weekly to report the state of group processing (Johnson & Johnson, 1993; Johnson et al., 1994). Group 3 received specific treatment of the components of cooperative learning. However, they learned only the basic teamwork skills and general cooperative learning methods which were provided to all the three cooperative learning groups by their instructor.

While two of the basic components of cooperative learning, positive interdependence and group processing, each had distinct specific strategies and characteristics, individual accountability did not have too many specific strategies and the characteristics of it were inclined to be overlapped with positive interdependence in terms of the stress on group members' responsibility for positive participation in group activity. Because of the distinction and importance of positive interdependence and group processing, this research was focused on these two components of cooperative learning.

Research Questions

Research questions addressed by this study were:

1. Are there any differences in the relative effectiveness between positive interdependence, group processing, and no structure on student achievement in online cooperative learning environments?

2. Are there any differences in the relative effectiveness between positive interdependence, group processing, and no structure on student interaction in online cooperative learning environments?
3. Are there any differences in the relative effectiveness between positive interdependence, group processing, and no structure on student attitude in online cooperative learning environments?

In three research questions, student achievement was measured as a group report and the degree of participation in online discussion and contribution of the group report. Student interaction was measured as online written messages between student-student, student-instructor, student-content, or student-interface. Student attitude was measured as an attitude survey. The survey contained the items about student attitude about cooperative learning and technology such as the Web.

Also, to test these specific research questions, this study employed the method of planned orthogonal contrasts. Planned orthogonal contrasts are used when the contrasts are mathematically independent from each other, they enable a researcher to test specific research questions that are meaningful to the researcher (Cohen, 2003). Also, planned orthogonal contrasts tend to have greater power than post hoc comparisons (Glass & Hopkins, 1996). The above research questions are focused on whether the effects of positive interdependence (Group 1) and group processing (Group 2) are different from the effect of no structure (Group 3) and whether there is a relative effect between positive interdependence (Group 1) and group processing (Group 2). These focused research questions were tested with planned orthogonal contrasts in this study. Table 3.1

shows contrast coefficients for each group in this study. In balanced designs which have equal sample size in each condition, the contrasts are orthogonal when the products of the following contrast coefficients sum to zero (Cohen, 2003; Glass & Hopkins, 1996).

$$\sum C_{j1}C_{j2} = 0$$

For Contrast 1 and Contrast 2 in Table 3.1:

$$\sum C_{j1}C_{j2} = (1)*(1) + (1)*(-1) + (-2)*(0) = 0$$

Thus, Contrast 1 and Contrast 2 were orthogonal which means that the two contrasts are mathematically independent in this study.

Table 3.1

Contrast Coefficients for Each Group

	Group		
Contrast	1	2	3
1	1	1	-2
2	1	-1	0

Participants

Participants were 144 undergraduate students in the three universities in South Korea. The universities had their own online learning platforms that were available for the courses sampled for this study. In University A in Seoul, South Korea, participants were 24 undergraduate students who enrolled in the course, ‘Teaching Method and Educational Technology.’ In University B in Seoul, participants were 72 undergraduate students who enrolled in the course of ‘Human Resource Development.’ In University C

in Daegu, South Korea, participants were 48 undergraduate students who enrolled in the course, 'Teaching Method and Educational Technology.' Overall, participants ranged in age from 18 to 32 with mean 21, and median 21; 85 % were female and 15% male; and all of them were Asian. Participants had enrolled in a mean of 0.92 courses that contained online discussion before this study. In terms of the average hours of computer use per day, 8.3% reported less than 30 minutes, 24.3% from 30 minutes to 1 hour, 37.5% from 1 hour to 2 hours, 19.4% from 2 hours to 3 hours, and 10.4% more than 3 hours.

Participants were randomly assigned to one of three treatment groups: positive interdependence, group processing, and no structure. Johnson and Johnson (1994) stated that in cooperative learning, it is the easiest and most effective way to assign students to groups randomly in order to make each a heterogeneous group. Group sample sizes were about 48 in each treatment conditions.

Instruments

This study used the adaptation of the Interaction Analysis Model (Gunawardena, Lowe, & Anderson, 1997) to analyze characteristics of online interactions, the rubric to measure student achievement, or group report and the survey to measure student attitude. The Interaction Analysis Model was adapted from a model previously used to examine meaning negotiation and co-construction of knowledge (Gunawardena et al., 1997). In this study, the Interaction Analysis Model was used to measure students' online interactions; the model defines and describes five types of co-construction of knowledge and negotiation of meaning. The five types were: 1) the sharing and comparing of

information; 2) the discovery of dissonance and inconsistency among ideas, concepts, or statements; 3) the negotiation of meaning and co-construction of knowledge; 4) the testing and modification of proposed synthesis or co-construction; 5) the agreement statements and applications of newly-constructed meaning (see Appendix A for a complete description of the model.). Recent studies of online interactions have been conducted within the above types with adaptation to specific experimental environments and purpose of the study (Sing & Khine, 2006). The use of this Interaction Analysis Model contributed practical application to this study by providing the specific understanding of the process of knowledge co-construction and negotiation of meaning, and by providing a tool or standard for message analysis in online discussion using asynchronous and written communication. All messages in the online forum were categorized by the standard of the five types which were provided in the Interaction Analysis Model.

The Rubric for Assessing Learner Writing was adapted from the instrument used to measure five criteria for university writing (Barlow et al., 2006). In this study, the rubric was used to examine the differences in student achievement (writing a group report) as the results of positive interdependence, group processing, and no structure. The rubric contained five criteria such as purpose, evidence-based reasoning, management of flow, audience awareness, and language control to evaluate writing in higher education (see Appendix B). This study used only overall scores which were simply summarized from five criteria to evaluate the quality of each group's product. Instructor assigned any grade of group reports from A+ to F (A+ (100), A0 (95), A- (90),

B+ (85), B0 (80), B-(75), C+ (70), C0 (65), C-(60), D+ (55), D0 (50), D-(45), and F (0)) with only one reference of the rubric. However, the final grade (= the group product (60%) + group participation (40%)) was based on the knowledge of the course content as well as group participation.

The 14-item survey was administered after the online discussion period to measure student attitude about cooperative learning methods based on the experiences in the course activities. The survey included 14 items such as "When I perceived that I as one group member should contribute to my group activity, I participated in it actively and positively," "I was able to interact with other students more positively and often because I had a complementary and interconnected role in my group," and "In future, it will be helpful for my learning that each group member tells me whether I work together well or not during the activity." A five-point Likert-type scale was provided for the participants to respond to the items as "strongly agree," "agree," "undecided," "disagree," and "strongly disagree" (a copy of the summary is presented in Appendix C).

Common Training: Jigsaw 2

In order to provide the three groups with one set of common instructions and cooperative learning experiences, this study applied an adaptation of Jigsaw 2 (Aronson, Blaney, Stephan, Sikes, & Snapp, 1978; Slavin, 1986). This is a cooperative learning method, which was developed by Elliot Aronson and his colleagues in 1978 as a more practical and easier version of their Jigsaw 1. Jigsaw 2 is suitable for online discussion, as it is designed to incorporate asynchronous communication and written message. It is most effective in such subjects as social studies, literary studies, and part of science,

because Jigsaw 2 enables learners to formulate meta-cognitive concepts rather than to acquire simple skills (Slavin, 1995). Interdependence is essential to teaching with Jigsaw as it requires each member to exchange information with others in the group (Slavin, 1995). Its approach is focused on building a community of learners (Clarke, 1994).

Jigsaw 2 is composed of one expert group and several cooperative groups (Slavin, 1995). In the application of Jigsaw 2, each student is assigned to a cooperative group, and one student from each cooperative group becomes a member of the expert group. All members of the expert group read all the group materials and work together to learn how to facilitate online group discussions once they return to interacting with their own cooperative groups. Each member of the cooperative group takes a turn at instructing other members in his or her own group about his/her topic, which was previously discussed in the meetings of the expert group. In this study, Jigsaw 2 was applied as the model of training common to all of the three cooperative groups: Group 1, Group 2, and Group 3. Figure 3.1 represents the Jigsaw 2 structure and the relationship between the expert group and cooperative groups.

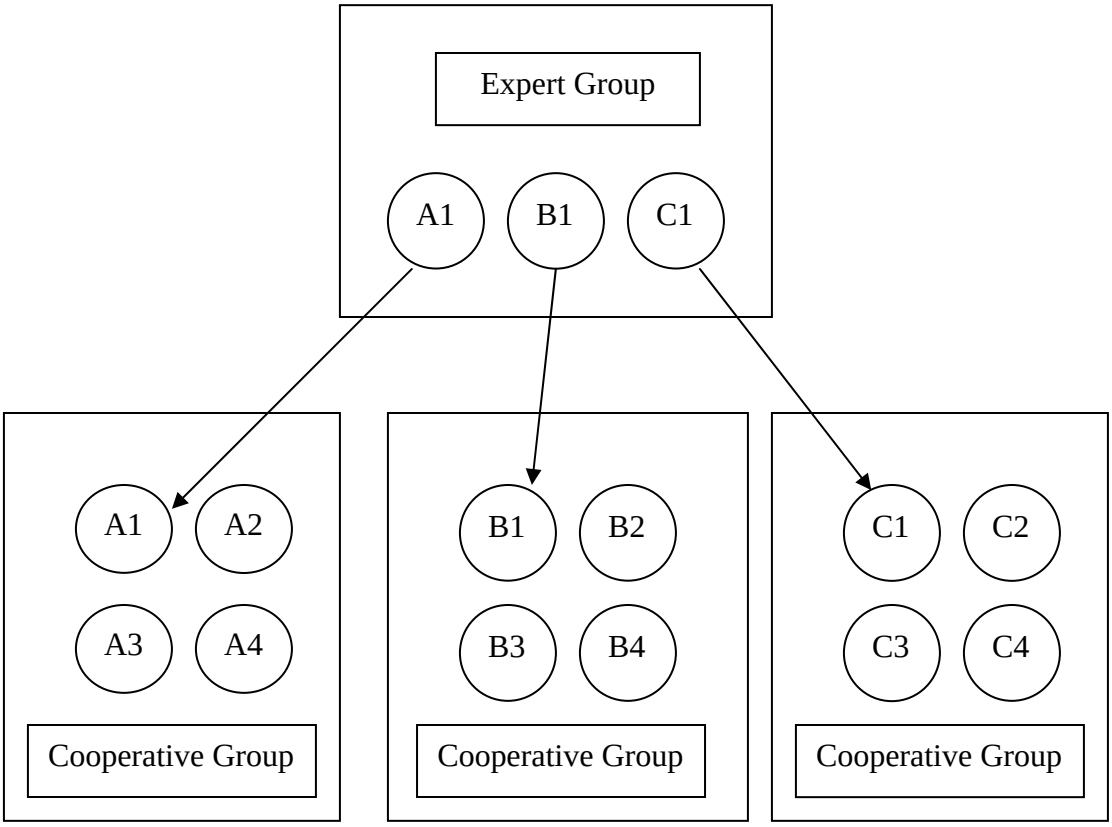

Figure 3.1. The structure of the Jigsaw 2 groups.

Method

In this study, learning activities took place through discussions held in online learning environments. The procedure was comprised of three phases: pre-experiment, experiment, and post-experiment. The pre-experimental phase consisted of two activities: to design the experiment and to obtain approval from Institutional Review Board (IRB). The experimental phase was composed of four major activities: 1) to conduct workshops to educate the instructors on the cooperative learning procedures, 2) to randomly assign students to the different treatment conditions, 3) to teach cooperative learning methods to all students within each of the three groups, and 4) to train the different cooperative learning strategies to each group. The post-experimental phase consisted of two activities: to obtain implementation fidelity and to analyze student interaction, achievement, and attitude. Figure 3.2 presents the steps containing major phases and research activities to conduct this study.

Pre-Experimental Phase

In this study, the pre-experimental phase was focused on opening online discussion room. The researcher and the instructors organized the online discussion rooms in the respective course management systems of the three universities.

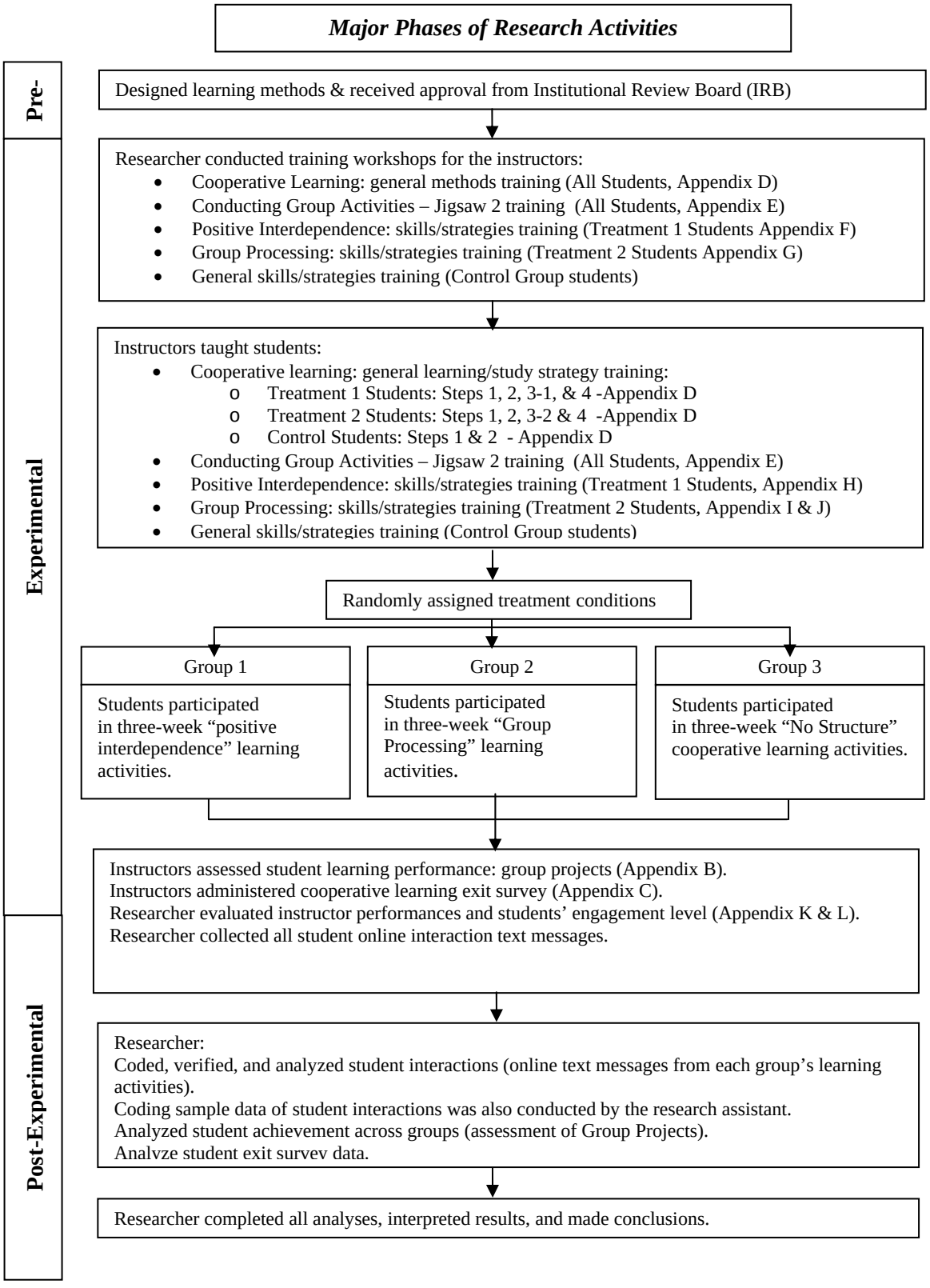

Figure 3.2. The steps which were implemented in this study.

Experimental Phase

The topics of online discussion. The topics of online discussion were provided for students by instructors in order for the students to complete their group reports. In University A in Seoul, each group discussed how to develop an instructional tool, WebQuest, as a group product. They also developed their own WebQuest that applied Web-editor softwares like Dreamweaver and FrontPage and, with them, submitted a group report, which included the contents of WebQuest, the self-evaluation of their group product, and the records of group activities during the online discussion and activities. In University B in Seoul, members of each group, playing the roles of Human Resource Development (HRD) specialists, discussed how to develop a 6-hour instructional program. They also submitted their group reports, which include the objects, contents, media, and locations for the program. In University C in Daegu, each group discussed the analysis of a class in employing learning theories. They also submitted their group reports on the analysis of one class, the application of learning theories into their own instruction, and some issues as a pre-service teacher.

Training resources for all instructors. The researcher conducted two workshops about teaching cooperative learning for each instructor of the courses. Each workshop lasted approximately two hours and provided instruction on the use of the instructional resources. Each workshop also included Q&A parts to help the instructor understand the whole process of this study. The Instructors' Guideline for Teaching Students Teamwork Skills and Cooperative Learning Methods was adapted from previous studies and presented specifications of desired student behaviors in cooperative learning (Johnson,

Holubec, & Johnson, 1993; Johnson et al., 1994). This guideline consisted of four steps to teach teamwork skills: 1) to establish the need for the skills, 2) to define the skills, 3) to guide practice of the skills, and 4) to repeat practice frequently (see Appendix D for a copy of the full document).

The instructors also received instruction on the use of the Instructors' Guideline for Teaching Students Jigsaw 2 Approach, which was an adaptation of Clarke's (1994) and Slavin's (1995) explanations of Jigsaw 2. This guideline presented four processes of teaching Jigsaw 2: 1) introduction and reading, 2) expert group discussion, 3) cooperative group report, and 4) integration and evaluation (see Appendix E).

Training resources for specific groups. Each instructor was provided with a set of guidelines appropriate to his/her experimental groups: Group 1 (Positive Interdependence), Group 2 (Group Processing), and Group 3 (No Structure). First, in order to help the members of Group 1 develop positive interdependence skills, those instructors were required to follow the Instructors' Guideline for Teaching Students Positive Interdependence, which was adapted from the steps in structuring positive interdependence suggested by Johnson, Johnson, and Holubec (1994). The guideline provided training for implementing four types of positive interdependence (goal, reward, role, and resource) and other expected activities (see Appendix F). Second, in order to help the members of Group 2 develop group processing skills, those instructors were required to follow the Instructors' Guideline for Teaching Students Group Processing, which was adapted from studies on the effectiveness of group processing (Johnson & Johnson, 1993; Johnson et al., 1994). The guideline included three steps in group

processing (encouraging and introducing, giving and receiving feedback, and executing and evaluating group processing) and expected activities (see Appendix G). Third, in Group 3, the instructors were trained in the use of the Instructors' Guideline for Teaching Students Teamwork Skills, which were commonly provided for all of the three groups without a unique strategy.

Random assignment into treatment conditions. 144 participants were randomly assigned to three treatment conditions (144 = 48 X 3). To facilitate active online discussion, the 48 members of each treatment group were also randomly assigned to 12 small discussion groups; each discussion group was composed of four students. Each discussion group had its own on-line discussion room, in which members posted their messages to discuss their group projects.

Teaching students cooperative learning methods within all three groups. Each instructor taught students the cooperative learning methods by using several guidelines, which were supplied in the one-hour face-to-face instruction training sessions before the courses started. Students in all three treatment groups learned how to employ teamwork skills and cooperative learning methods and how to apply Jigsaw 2 to their group activities. After all students had received several common instructions, they were divided into three groups and moved to three different classrooms, where members in each classroom were given further specific instructions about their group's specific cooperative learning technique. The group in the positive interdependence condition learned how to develop positive interdependence, the group in the group processing condition learned how to promote group processing, and the group in the no structured

condition did not receive any additional instructions and engaged in free dialogue during this period. This whole process was repeated at each of the three different universities.

Implementing group activities. During the interactive instruction period in the experimental phase students in individual group treatment exchanged asynchronous written communications by posting online message and discussed their learning with group members. This experimental phase lasted for 3 weeks. On Day 1st, each guideline for students was posted in each online discussion room by the instructors so that Group 1 (Positive Interdependence) members could see the Students' Guideline for Learning Positive Interdependence (see Appendix H) (Johnson et al., 1994) and follow it during the activity. They also rotated their complementary and interconnected roles every week. The instructors helped Group 1 members achieve positive interdependence by using techniques presented in the Instructors' Guideline for Teaching Students Positive Interdependence. In addition, students utilized the Students' Guideline for Learning Positive Interdependence. Group 2 (Group Processing) members received the Students' Guideline for Learning Students Group Processing (see Appendix I) (Johnson & Johnson, 1993; Johnson et al., 1994) and the Processing Interim Report (Weekly) (see Appendix J), which was developed by Johnson, Johnson, and Holubec (1994). Each member of Group 2 filled out the forms every week and submitted them in their online discussion rooms on the 2nd Sunday, 3rd Sunday and 4th Sunday. The instructors helped Group 2 members enhance their group processing by using the Instructors' Guideline for Teaching Students Group Processing. The instructors only answered Group 3 (No

Structure) members' questions and did not provide any extra directions for online discussion or specific methods of their cooperative learning.

Post-Experimental Phase

Obtaining implementation fidelity. To examine the treatment effects accurately during the three weeks of the experimental phase, this study needed to measure the level of implementation fidelity. Fidelity assessment identifies systematically the link between program or treatment implementation and outcomes. It also helps researcher understand the outcome whether the program or treatment succeeded or failed (Sanchez et al., 2007). The researcher informed the instructors at the beginning that they would be evaluated on how effectively they followed the guidelines. First, the researcher adopted the Researcher's Checklist for the Instruction of Positive Interdependence, which was adapted from Johnson and Johnson's (1994) study on the steps in students' achieving positive interdependence (see Appendix K). Second, the Researcher's Checklist for the Instruction of Group Processing adapted from the method for effective group processing explained by some researchers (Johnson & Johnson, 1993; Johnson et al., 1994) was used to evaluate the instructor's implementation of group processing skills (see Appendix L). To obtain inter-rater reliability for the overall fidelity on the two checklists, this study used Cohen's Kappa to examine the percentage of item agreement between the researcher and a research assistant. In addition, after online discussion activities for the three weeks, the researcher and the research assistant evaluated the progress of the participants with engagement level.

Data analysis. In the post-experimental phase, data analysis was conducted. On the last day of the 3rd week, each small discussion group in all the three conditions submitted a group report for the evaluation of the group products. The instructors employed the Rubric for Assessing Learner Writing (Barlow et al., 2006) which contained overall scores on five criteria for evaluating group reports. The researcher counted the total number of messages which were posted by each group member in each condition. The researcher also categorized all online messages into five types in the Interaction Analysis Models and counted the number of the messages in each type. Student attitudes toward cooperative learning activity were also evaluated by collecting and measuring the survey for cooperative learning activity. Participants submitted the survey of their experiences in the cooperative learning activity in the first class after the 3rd week. In the final analysis, the components of cooperative learning (positive interdependence and group processing, and no structure) were used as an independent variable, which has three levels. The dependent variables were the measures of online interaction, student achievement, and student attitudes toward cooperative learning activity.

Multivariate analysis of variance (MANOVA) with student interactions as the dependent variables was adopted to investigate the difference between Group 1, Group 2, and Group 3. In addition, planned orthogonal contrasts were applied to determine which group means between the three groups differed significantly from others with respect to the five types of student interaction.

The researcher investigated the student interactions in each condition by categorizing messages in the respective online discussion room. To obtain inter-rater reliability, the researcher and research assistant analyzed 288 sample data (approximately 10%) from the total of 2766 online messages, which were posted to the three-week online discussion. Also, this process used the operations as the specific standard of five categories in interaction analysis model. In this study, Cohen's Kappa was employed to examine the inter-rater reliability for the student interaction. In this study, the result of the inter-rater analysis was Kappa = .78, $p < .01$. It means that this measure was statistically significant and indicated a good level of inter-rater reliability.

One-way analysis of covariance (ANCOVA) with student achievement scores as the dependent variable was applied to investigate the differences between Group 1, Group 2, and Group 3. ANCOVA was used to increase power in a one-way ANOVA by adding participants' engagement level as a covariate. In addition, planned orthogonal contrasts were employed to determine which group means between the three groups differed significantly from others with respect to student achievement scores.

The instructors evaluated each group report from A+ ~ F (A+ (100), A0 (95), A-(90), B+ (85), B0 (80), B-(75), C+ (70), C0 (65), C-(60), D+ (55), D0 (50), D-(45), and F (0)). Although each member in the same condition received the same grade of the group reports, he or she received an independent final grade based on the different scores for participation in online discussions and contribution to the group product. The instructors evaluated students' the whole process of cooperative learning as their final

grades (final grade = group product (60%) + participation in online discussion and contribution to the group product (40%)).

To discover the pattern of relationships among the variables of student attitude, factor analysis was used. After some factors were found through the factor analysis, multivariate analysis of variance (MANOVA) with the factors as the dependent variable was employed to investigate the differences between Group 1, Group 2, and Group 3. In addition, planned orthogonal contrasts were applied to determine which group means between the three groups differed significantly from others with respect to the factors.

CHAPTER IV

RESULTS

Implementation Fidelity

To measure the level of implementation fidelity this study employed two checklists: the Researcher's Checklist for the Instruction of Positive Interdependence (Johnson & Johnson, 1994) and the Researcher's Checklist for the Instruction of Group Processing (Johnson & Johnson, 1993; Johnson et al., 1994). First, the Researcher's Checklist for the Instruction of Positive Interdependence contained eight checklist items and two response categories of "Yes" and "No." "Yes" was checked and coded by the researcher when the instructors conducted their instruction and followed the researcher's instruction effectively after the initial training workshops. "No" was checked and coded for any item when the instructors did not do so at all or they did, but not effectively. The overall fidelity measured by the percentage of "Yes" items among the total of 24 checklist items from all three instructors (24 = 3 X 8) was evaluated by the researcher. The results of the Researcher's Checklist for the Instruction of Positive Interdependence showed that its overall fidelity score was high, 95.83%. Second, the Researcher's Checklist for the Instruction of Group Processing contained nine checklist items and two response categories of "Yes" and "No." The overall fidelity by the percentage of items rated as "Yes" among the total of 27 checklist items from all three instructors (27 = 3 X 9) was evaluated by the researcher. The results of the Researcher's Checklist for the

Instruction of Group Processing showed that its overall fidelity score was also high, 96.30%.

To obtain inter-rater reliability for the overall fidelity with the two checklists, the percentage of agreement between the researcher and a research assistant was calculated. The total checklist items were 51 items which included the 24 items from the Checklist for the Instruction of Positive Interdependence and the 27 items from the Checklist for the Instruction of Group Processing. There were 48 items on which the two raters agreed. Then the percentage of agreement was 94.12 % (= (48 / 51) * 100). To examine inter-rater reliability further, Cohen's Kappa was used. Cohen's Kappa is a measure to examine the reliability of rating between two raters on the assignment of categories of a categorical variable (Cohen, 1960). Cohen's Kappa ranges from -1.00 to +1.00. The statistical measure from .40 to .59 is considered as moderate, .60 to .79 as substantial, and .80 to 1.00 as outstanding (Landis & Koch, 1977). The upper limit of 1.00 means perfect agreement between two raters (Cohen, 1960). In this study, the result of the inter-rater analysis was Kappa = .37, $p < .01$. It means that this measure was statistically significant and it was a good level (94.12 %) of inter-rater agreement even though the value of Kappa was not moderate. The value of Cohen's Kappa may be low even though there are high levels of agreement between two raters and even though individual ratings are accurate (Uebersax, 1987). Cohen's Kappa with only such a small sample size as in this study should be interpreted carefully.

After online discussion activities for the three weeks, the progress of the participants was evaluated with engagement level by the researcher and the research

assistant. Participants' engagement level dealt with the contents of the checklists to assess quality of implementation, and it ranged from 0 to 5 ("very poor implemented" to "very well implemented"). Its definition was based on and adapted from Sanchez et al (2007) as the following. A score of "3" indicated that a participant completed the instructions and the requirements satisfactorily. A score of "1 or 2" indicated that a participant did not complete them very well, and a score of "4 or 5" showed that a participant completed them exceptionally well. The average engagement level during online discussion was overall 3.18, SD = 1.16, which indicated that participants completed the instructions and the requirements effectively and they were moderately engaged in this study. Specifically, the average engagement level of Group 1 who received the treatment of positive interdependence was 4.06, SD = .76. The average engagement level of Group 2 who received the treatment of group processing was 3.19, SD = 1.02. The average engagement level of Group 3 who learned only basic teamwork skills and general cooperative learning methods was 2.29, SD = .92.

To measure the reliability of the data, the engagement level of each participant was evaluated by the researcher and the research assistant independently. To measure inter-rater reliability for these two raters, the Pearson correlation was used. The Pearson correlation obtained for the independent ratings was high, $r = .87$, $p < .01$. This result indicated that inter-rater reliability was high, and the reliable data of the engagement level was collected.

Student Achievement

Assumption of Homogeneity of Variance

As well as in the analysis of variance (ANOVA), the basic assumption underlying the analysis of covariance(ANCOVA) is that each group of the independent variable(s) has the same variance (Glass & Hopkins, 1996). To test this assumption, the Levene's test of homogeneity of variance was employed in this study.

Table 4.1

Levene's Test of Homogeneity of Variance for Student Achievement[a]

F	*df1*	*df2*	*p*
4.80	2	141	.010

Note. Dependent variable = student achievement; [a] Design: Intercept + group + fidelity + group * fidelity.

In Table 4.1, the Leven statistic was significant at the .05 level, $p < .05$, and it means that the null hypothesis that Group 1, Group 2, and Group 3 have equal variances was rejected. However, to violate the assumption of homogeneity of variance was not fatal to ANCOVA because Group 1, Group 2, and Group 3 were of equal sample size, n = 48.

Assumption of Equivalent Slopes

The ANCOVA model assumes that the slopes of the regression lines are the same for each group. That is, the slopes are assumed to be parallel (Glass & Hopkins, 1996; Howell, 2002).

Table 4.2 showed that the interaction effect between group and fidelity (students' engagement level) was not significant, F (2, 138) = .44, p > .05. This means that the covariate (fidelity) was linearly related to the dependent variable (student achievement) within all levels of the three groups.

Table 4.2

Tests of the Group by Fidelity Interaction for Student Achievement

Source	Type I *SS*	*df*	*MS*	*F*	*p*	Partial Eta Squared	Power
Corrected Model	10293.68	5	2,058.74	124.94	.00*	.82	1.00
Intercept	966,944.44	1	966,944.44	58,683.16	.00*	1.00	1.00
Group	6,409.39	2	3,204.69	194.49	.00*	.74	1.00
Fidelity	3,869.88	1	3,869.88	234.86	.00*	.63	1.00
Group X Fidelity	14.41	2	7.20	.44	.65	.01	.12
Error	2,273.88	138	16.48				
Total	979,512.00	144					
Corrected Total	12,567.56	143					

Note. Dependent variable = student achievement.

* $p < .05$

Figure 4.1 also contains scatterplots with the regression lines for each group. These results, which were computed by SPSS program, show that fidelity was linearly related to the achievement scores within all the levels of group, i. e., the assumption of equivalent slopes was met. Consequently, the researcher could proceed to conduct an ANCOVA.

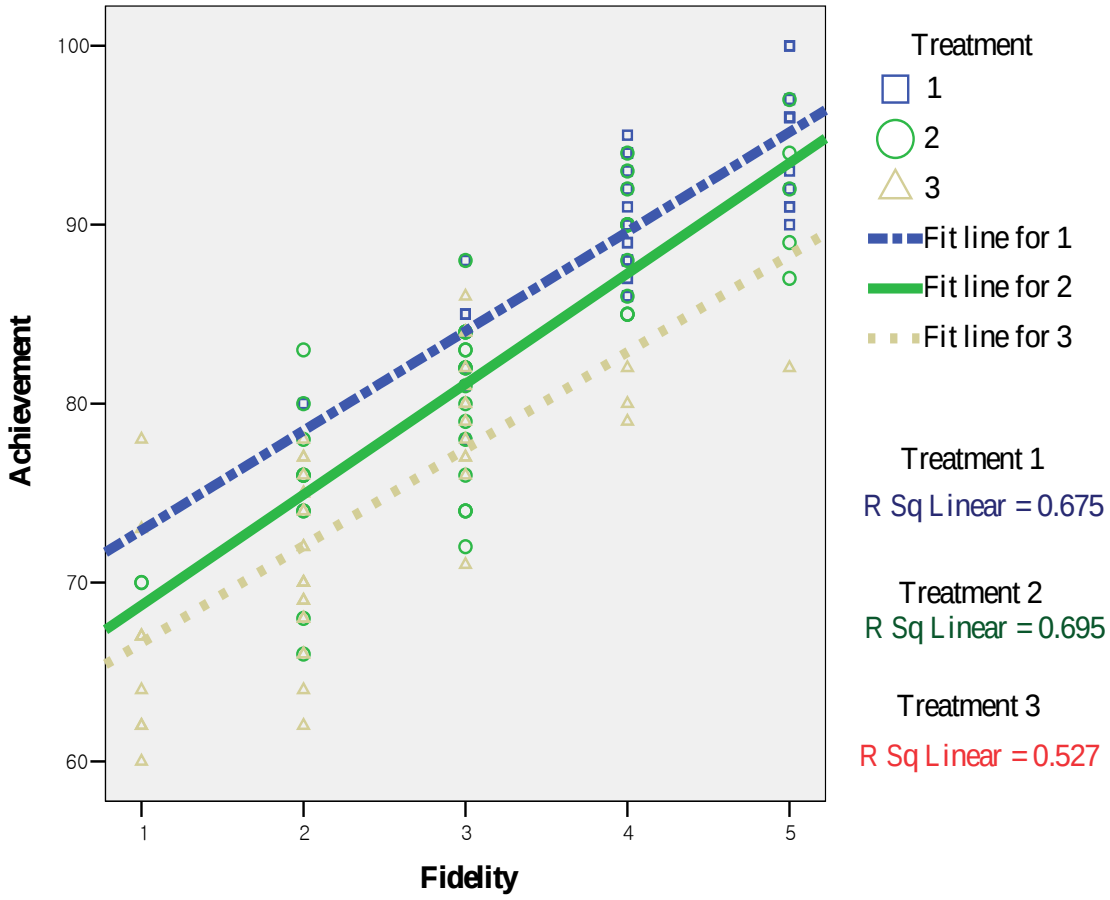

Figure 4.1. Scatterplots of treatments with regression lines.

Running ANCOVA for Student Achievement

Differences in student achievement scores were attributable not only to differences of group but also to the initial differences in fidelity, the measure of students' engagement level. As we see in Table 4.2, in order to control for this variability (fidelity) as the covariate variable, ANCOVA was used. ANCOVA could adjust student achievement scores based on fidelity scores (the covariate variable).

Table 4.3

Tests of the Difference in the Achievement Scores after Controlling the Covariate (Fidelity)

Source	Type I *SS*	*df*	*MS*	*F*	*p*	Partial Eta Squared	Power
Corrected Model	10279.27	3	3,426.42	209.63	.00*	.82	1.00
Intercept	966,944.44	1	966,944.44	59,158.81	.00*	1.00	1.00
Fidelity	9,731.60	1	9,731.60	595.39	.00*	.81	1.00
Group	547.67	2	273.84	16.75	.00*	.19	1.00
Error	2,288.29	140	16.34				
Total	979,512.00	144					
Corrected Total	12,567.56	143					

Note. Dependent variable = student achievement.
* $p < .05$

In Table 4.3, the result of the ANCOVA shows that there were significant differences between three adjusted means, F (2,140) = 16.75, p < .05, and the partial eta square of .19 suggested a relationship between student achievement scores and Group, controlling for fidelity scores. In other words, it indicates that 19% of the variation in student achievement could be attributable to the difference between groups after controlling for fidelity scores. Also, the adjusted means are shown in Table 4.4. The effects of student achievement scores in an ANCOVA were attributed to the difference in the adjusted means.

Table 4.4

The Adjusted Means of the Three Groups

			95% Confidence Interval	
Group	Mean	Std. Error	Lower Bound	Upper Bound
1	84.87[a]	0.67	83.54	86.19
2	82.21[a]	0.58	81.06	83.36
3	78.76[a]	0.67	77.43	80.09

Note. Dependent variable = student achievement.

[a] Covariates appearing in the model were evaluated at the following values: fidelity = 3.18.

This study employed the method of planned orthogonal contrasts, which allowed the researcher to test specific interests before the data were collected. Planned contrasts are used when a researchers has specific questions that include the comparison of means of combined groups, and especially when orthogonal contrasts are those in which all of the contrasts are mathematically independent (Cohen, 2003). The set of contrast coding is displayed in Table 4.5. Contrast 1 compared Groups 1 and 2 with Group 3 and Contrast 2 compared Group 1 and Group 2.

Table 4.5

Contrast Coefficients for Student Achievement

	Group		
Contrast	1	2	3
1	1	1	-2
2	1	-1	0

Table 4.6 shows that both of contrasts were significant. Since these planned contrasts were orthogonal in this study, which means that the two contrasts were mathematically independent from each other, the P-value did not need to be adjusted. The result of Contrast 1 showed significant differences in the adjusted means between Groups 1 and 2, and Group 3, $F (1, 140) = 30.01$, $p < .05$. Also, the result of Contrast 2 showed significant differences in the adjusted means between Group 1 and Group 2, $F (1, 140) = 8.94$, $p < .05$.

Table 4.6

Tests of Mean Differences with Contrast Coding

Source	*SS*	*df*	*MS*	*F*	*p*
Contrast 1	490.49	1	490.49	30.01	.00*
Contrast 2	146.09	1	146.09	8.94	.00*
Error	2,288.29	140	16.34		

Note. Dependent variable = student achievement.
* $p < .05$

Student Interaction

Measure of Student Interaction

Table 4.7 shows the descriptive statistics for student interaction. Student interactions were evaluated by the total number of online messages which each student posted in the discussion rooms during the online discussion period. The data shows that mean and standard deviations were 20.79, *SD* =13.72 for Group 1 who received the positive interdependence treatment, 22.58, *SD* = 13.75 for Group 2 who received the

group processing treatment, and 14.25, *SD* = 8.59 for Group 3 who learned only basic teamwork skills and general cooperative learning methods. Table 4.7 also shows that the 95% confidence limits for Group 1 overlapped those for Group 2. On the basis of these results, the researcher was not 95% confident that the mean of Group 1 differed from that of Group 2. However, the researcher was 95% confident that the means of Group 1 and Group 2 differed from the mean of Group 3.

Table 4.7

Descriptive Statistics for Student Interaction

					95% Confidence Interval for Mean	
	N	Mean	Std. Deviation	Std. Error	Lower Bound	Upper Bound
1	48	20.79	13.72	1.98	16.81	24.78
2	48	22.58	13.75	1.98	18.59	26.57
3	48	14.25	8.59	1.24	11.76	16.74
Total	144	19.21	12.70	1.06	17.12	21.30

Note. Dependent variable = the total number of online messages which each student posted.

To test the assumption of the analysis of variance (ANOVA) that each population has the same variance, this study used the Levene's test of homogeneity of variance. In Table 4.8, the Levene statistic was significant at the .05 level, $p < .05$, which means that the null hypothesis that Group 1, Group 2, and Group 3 have equal variances was rejected. However, the effect of inequality of variance was mitigated and the *F* test was fairly robust (Howell, 2002), because Group 1, Group 2, and Group 3 were of equal sample size, n = 48.

Table 4.8

Levene's Test of Homogeneity of Variance for Student Interaction

Levene Statistic	*df1*	*df2*	*p*
3.38	2	141	.04*

Note. Dependent variable = the total number of online messages which each student posted.
* $p < .05$

Table 4.9

Tests of Group Effect for Student Interaction

Source	Type III *SS*	*df*	*MS*	*F*	*p*	Partial Eta Squared	Power
Corrected Model	1847.17	2	923.58	6.14	.00*	.08	.88
Intercept	53,130.25	1	53,130.25	353.36	.00*	.71	1.00
group	1,847.17	2	923.58	6.14	.00*	.08	.88
Error	21,200.58	141	150.36				
Total	76,178.00	144					
Corrected Total	23,047.75	143					

Note. Dependent variable = the total number of online messages which each student posted.
* $p < .05$

In Table 4.9, the result of the ANOVA, which were computed by SPSS program, shows that there were significant differences among three adjusted means, F (2,141) = 6.14, $p < .05$. The partial eta square of .08 also suggested a relationship between the total number of online messages (dependent variable) and group, which means that 8% of the variation in the total number of online messages could be attributable to the difference between groups. Also, the power coefficient shows the probability that the F test statistic

is greater than the critical value (Howell, 2002). If Power > .80, it is considered as acceptable by rule of thumb. In this study, the observed power was .88, which attests to the existence of strong group effect.

Contrast coefficients for student interaction are displayed in Table 4.10. Contrast 1 indicates the comparison Groups 1 and 2 with Group 3 and Contrast 2 indicates the comparison between Group 1 and Group 2.

Table 4.10

Contrast Coefficients for Student Interaction

	Group		
Contrast	1	2	3
1	1	1	-2
2	1	-1	0

Table 4.11 shows the results of contrast tests for student interaction. For Contrast 1, each group mean of Group 1 and Group 2 was significantly different from that of Group 3 ($p < .05$). For Contrast 2, the group mean of Group 1 was not significantly different from that of Group 2 ($p > .05$). As in the analysis of student achievement above, the researcher did not need to adjust the P-value; these planned contrasts were orthogonal, indicating that the two contrasts were uncorrelated.

Table 4.11

Tests of Contrasts for Student Interaction

Contrast	Value of Contrast	Std. Error	*t*	*df*	*p*
1	14.88	4.34	3.43	141	.00*
2	-1.79	2.50	-0.72	141	.48

Note. Dependent variable = the total number of online messages which each student posted.
* $p < .05$

Multivariate Analysis of Variance for the Five Types of Student Interactions

Multivariate analysis of variance (MANOVA) with the five types of student interactions as the dependent variables was employed to examine the differences between Group 1, Group 2, and Group 3. In order to analyze characteristics of online interactions, the researcher categorized all 2766 online messages which were posted for the three-week online discussion into the five types of co-construction of knowledge and negotiation of meaning, which were employed in the adaptation of the Interaction Analysis Model (Gunawardena et al., 1997). These data were coded according to the following categories: Type 1— sharing and comparing of information, Type 2— discovery of dissonance and inconsistency among ideas, concepts, or statements, Type 3— negotiation of meaning and co-construction of knowledge, Type 4— testing and modification of proposed synthesis or co-construction, and Type 5— agreement statements and applications of newly-constructed meaning (see Appendix A for a complete description of the model.). Table 4.12 shows the descriptive statistics for the coding results of the student interactions.

Table 4.12

Descriptive Statistics for the Coding Results of the Student Interactions

Dependent Variable	Group	Mean	Std. Deviation	*N*
Type1	1	9.21	5.25	48
	2	5.96	4.50	48
	3	3.94	3.19	48
	Total	6.37	4.88	144
Type2	1	3.00	5.32	48
	2	3.98	6.44	48
	3	1.25	2.16	48
	Total	2.74	5.08	144
Type3	1	4.44	4.70	48
	2	6.85	4.72	48
	3	5.17	4.20	48
	Total	5.49	4.63	144
Type4	1	1.08	1.32	48
	2	1.65	2.17	48
	3	1.29	1.73	48
	Total	1.34	1.77	144
Type5	1	3.06	2.15	48
	2	4.15	3.90	48
	3	2.60	2.69	48
	Total	3.27	3.05	144

The assumption of homoscedasticity was examined as one part of MANOVA. Homoscedasticity refers to the homogeneity of variances and covariances, i. e., it indicates the circumstance in which the errors of each interval dependent variable for each group formed by the categorical independent variables have equal variance. The homogeneity of variances was investigated by using Levene's test and the homogeneity of covariances was also investigated by using Box's M. Table 4.13 presents the results

of the Levene's test of homogeneity of variance for the coding results of the student interactions.

Table 4.13

Levene's Test of Homogeneity of Variance for the Five Types of Student Interactions

Dependent Variable	*F*	*df1*	*df2*	*p*
Type1	4.86	2	141	.01*
Type2	6.13	2	141	.00*
Type3	.74	2	141	.48
Type4	2.43	2	141	.09
Type5	3.27	2	141	.04*

Note. Dependent variables = the number of online messages which were categorized into five types; Design: Intercept + group.
* $p < .05$

If Levene's test is significant at the .05 level, then the data fails the assumption of equal group variances (Glass & Hopkins, 1996). In the Table 4.13, the results, which were computed by SPSS program, shows that the assumption of homogeneity of variances was met for Type 3 and Type 4 categories ($p > .05$), but it was not met for Type 1, Type 2, and Type 5 categories ($p < .05$). However, the problem of unequal error variance was mitigated and the F test was robust (Howell, 2002), since Group 1, Group 2, and Group 3 were of equal sample size, $n = 48$.

Table 4.14

Box's M Test of Homogeneity of Covariance for the Five Types of Student Interactions

Box's M	*F*	*df1*	*df2*	*p*
118.52	3.75	30	62,997.01	.00*

Note. Dependent variables = the number of online messages which were categorized into five types; Design: Intercept + group.
* $p < .05$

In Table 4.14, Box's M tested the homogeneity of covariances as MANOVA's assumption of homoscedasticity using the F distribution. The result shows that the covariances were significantly different, $p < .05$, which means that the assumption of equal covariances among the five types of student interaction as the set of dependent variables was violated with respect to Group 1, Group 2, and Group 3. However, Box's M test is extremely conservative and sensitive to violation of the assumption of normality (Howell, 2002). The F test was quite robust, for the sample size was equal, n =48.

Table 4.15 shows the results of multivariate significance test with Wilks' Lambda for the coding results of the student interactions. Wilks' Lambda is commonly used for more than two groups formed by the independent variable (Bray & Maxwell, 1985). Table 4.15 also shows that the effect of group was significant ($p < .05$) in the Wilks' Lambda. Also, Partial Eta-Squared was .20, which means that 20.0% of the variation in the number of online messages that were categorized into the five types could be attributable to the differences between Group 1, Group 2, and Group 3.

Table 4.15

Multivariate Significance Test with Wilks' Lambda for the Five Types of Student Interactions

Effect	Wilks' Lambda	*F*	Hypothesis *df*	Error *df*	*p*	Partial Eta Squared
Intercept	.23	92.26	5	137	.00*	.77
Group	.64	6.78	10	274	.00*	.20

Note. Dependent variables = the number of online messages which were categorized into five types; Design: Intercept + group
* p <.05

Table 4.16 shows the results of tests of the univariate ANOVA effects for Group. Some univariate effects for Group were significant in Type 1 [F (2, 141) = 17.57, p < .05] , Type 2 [F (2, 141) = 3.70, p < .05], Type 3 [F (2, 141) = 3.57, p < .05], and Type 5 [F (2, 141) = 3.34, p < .05]. This means that the researcher succeeded to reject the null hypothesis that Group is unrelated to Type 1, Type 2, Type 3, and Type 5 categories; in other words, there were significant differences in the group means between Group 1, Group 2, and Group 3 with respect to Type 1, Type 2, Type 3, and Type 5 categories. The other univariate effect for Group was not significant in Type 4 [F (2, 141) = 1.24, p > .05]. This means that the researcher failed to reject the null hypothesis that group is unrelated to Type 4. However, in Type 4, the result of observed power was quite low (Power = .27). This means that the chance of Type II error, which was defined as not

rejecting a false hypothesis, was too high to be confident in this decision of the rejection in Type 4 (Howell, 2002).

Table 4.16

Tests of the Univariate ANOVA Effects for Group

Source	Dependent Variable	Type III *SS*	*df*	*MS*	*F*	*p*	Partial Eta Squared	Power
Corrected Model	Type1	678.85	2	339.42	17.57	.00*	.20	1.00
	Type2	183.51	2	91.76	3.70	.03*	.05	.67
	Type3	147.51	2	73.76	3.57	.03*	.05	.65
	Type4	7.76	2	3.88	1.24	.29	.02	.27
	Type5	60.17	2	30.08	3.34	.04*	.05	.62
Intercept	Type1	5,839.51	1	5,839.51	302.19	.00*	.68	1.00
	Type2	1,083.51	1	1,083.51	43.65	.00*	.24	1.00
	Type3	4,334.03	1	4,334.03	209.53	.00*	.60	1.00
	Type4	258.67	1	258.67	82.41	.00*	.37	1.00
	Type5	1,540.56	1	1,540.56	171.00	.00*	.55	1.00
Group	Type1	678.85	2	339.42	17.57	.00*	.20	1.00
	Type2	183.51	2	91.76	3.70	.03*	.05	.67
	Type3	147.51	2	73.76	3.57	.03*	.05	.65
	Type4	7.76	2	3.88	1.24	.29	.02	.27
	Type5	60.17	2	30.08	3.34	.04*	.05	.62
Error	Type1	2,724.65	141	19.32				
	Type2	3,499.98	141	24.82				
	Type3	2,916.46	141	20.68				
	Type4	442.56	141	3.14				
	Type5	1,270.27	141	9.01				
Total	Type1	9,243.00	144					
	Type2	4,767.00	144					
	Type3	7,398.00	144					
	Type4	709.00	144					
	Type5	2,871.00	144					
Corrected Total	Type1	3,403.49	143					
	Type2	3,683.49	143					
	Type3	3,063.97	143					
	Type4	450.33	143					
	Type5	1,330.44	143					

* $p < .05$

Table 4.17

Contrast Coefficients for the Five Types of Student Interactions

	Group		
Contrast	1	2	3
1	1	1	-2
2	1	-1	0

To conduct specific multiple comparisons of groups with respect to the five types of student interactions, this study used planned orthogonal contrasts. Contrast coefficients for the five types of student interactions are displayed in Table 4.17. Contrast 1 indicates the comparison Groups 1 and 2 with Group 3, and Contrast 2 indicates the comparison between Group 1 and Group 2.

Table 4.18 shows the results of contrast tests for the five types of student interactions. For Contrast 1, each group mean of Group 1 and Group 2 was significantly different from that of Group 3 with respect to Type 1 and Type 2 categories ($p < .05$). However, for Contrast 1, each group mean of Group 1 and Group 2 was not significantly different from that of Group 3 with respect to Type 3, Type 4, and Type 5 categories ($p > .05$).

For Contrast 2, the group mean of Group 1 was significantly different from that of Group 2 with respect to Type 1 and Type 3 categories ($p < .05$). However, for Contrast 2, the group mean of Group 1 was not significantly different from that of Group 2 with respect to Type 2, Type 4, and Type 5 categories ($p > .05$). Also, the researcher

did not need to adjust the P-value, for these planned contrasts are orthogonal, which means that the two contrasts were independent from each other.

Table 4.18

Tests of Contrasts for the Five Types of Student Interactions

Source	Dependent Variable	*SS*	*df*	*MS*	*F*	*p*	Partial Eta Squared	*Power*
Contrast 1	Type1	425.35	1	425.35	22.01	.00*	.14	1.00
	Type2	160.50	1	160.50	6.47	.01*	.04	.71
	Type3	7.35	1	7.35	0.36	.55	.00	.09
	Type4	0.17	1	0.17	0.05	.82	.00	.06
	Type5	32.00	1	32.00	3.55	.06	.02	.46
Contrast 2	Type1	253.50	1	253.50	13.12	.00*	.09	.95
	Type2	23.01	1	23.01	0.93	.34	.01	.16
	Type3	140.17	1	140.17	6.78	.01*	.05	.73
	Type4	7.59	1	7.59	2.42	.12	.02	.34
	Type5	28.17	1	28.17	3.13	.08	.02	.42
Error	Type1	2,724.65	141	19.32				
	Type2	3,499.98	141	24.82				
	Type3	2,916.46	141	20.68				
	Type4	442.56	141	3.14				
	Type5	1,270.27	141	9.01				

* p <.05

Student Attitude

Factor Analysis for Student Attitude

This study employed factor analysis to examine student attitude about online cooperative learning methods in this course and to explore the underlying structure of a set of 14 survey item variables. Factor analysis is usually used to summarize the interrelationships among the variables in a concise manner; in other words, to explore the underlying structure of a set of variables (Gorsuch, 1983). Table 14.19 shows the

descriptive statistics of 14 survey items for student attitude. The survey items were measured by a five-point Likert-type scale: “strongly disagree (1),” “disagree (2),” “undecided (3),” “agree (4),” and “strongly agree (5).”

Table 4.19

Descriptive Statistics for Student Attitude

Item Variables	Mean	Std. Deviation	*N*
1. I enjoyed this cooperative learning activity more than competition and individual learning.	3.03	1.10	144
2. To work with other students in online helps me enhance interactions with other students or the instructor.	3.26	1.04	144
3. To work with other students in online will help me enhance your academic performance.	2.97	1.01	144
4. Before I begin this cooperative learning activity, I have already experienced and known the activity.	3.14	1.13	144
5. When I perceived that I as one group member should contribute to my group activity, I participated in it actively and positively.	4.08	.77	144
6. I was able to interact with other students more positively and often because I had a complementary and interconnected role in my group.	3.55	.94	144
7. In future, it will be helpful for my learning that each group member tells me whether I work together well or not during the activity.	3.98	.74	144
8. In future, I would like to be satisfied if all group members including me get the same grade through the cooperative learning activity.	3.56	.99	144
9. I prefer online learning activities to face-to-face learning activities.	2.38	.98	144
10. I think that interactive environments using Internet are useful for my learning.	2.99	.99	144
11. I felt more comfortable with online discussion in this course than offline (face-to-face) discussion in other course.	3.00	1.21	144
12. To what extent did you use the communication resources to complete your assignment?	3.67	.89	144
13. To what extent did you participate in the required group activities?	3.90	.83	144
14. In addition to the course communications activities, did you or your group engage in external communication in relation to the assignment activities?	3.74	.93	144

Table 4.20 shows the results of the Kaiser-Meyer-Olkin measure of sampling adequacy (KMO) and Bartlett's Test applied to the student attitude scores. The KMO tests whether the partial correlations among survey item variables are small. It should be

around .5 or greater for a successful factor analysis to proceed(Child, 2006). Table 4.20 shows that the result was .84. The large value of .84 indicates that a factor analysis was an appropriate approach for the item variables. Bartlett's Test of Sphericity tests whether the correlation matrix is proportional to an identity matrix. If the correlation matrix is proportional to an identity matrix, it means that the factor model is inappropriate. In other words, Bartlett's Test of Sphericity is employed to test the null hypothesis that there are no correlations among the dependent variables in the population correlation matrix (Child, 2006). In this study, the observed significance level was .00, and consequently the null hypothesis was rejected, indicating that there was a strong relationship among the survey items.

Table 4.20

KMO and Bartlett's Test Applied to the Student Attitude Scores

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.84
Bartlett's Test of Sphericity	Approx. Chi-Square	636.61
	df	91
	p	.00*

* p <.05

Table 4.21 shows the total variance accounted for components in student attitude. This study employed Principal Component Analysis (PCA) as a method to extract the factors from a set of data. PCA enables the maximum variance to be extracted from the variables. After the maximum variance has been extracted, PCA removes this variance and accounts for the maximum proportion of the remaining variance (Child, 2006;

Gorsuch, 1983). In Table 4.21, the eigenvalues signify the variance that was accounted for by each component; in other words, they mean the variances accounted for the factors. Component 1 accounted for 34.36% of the variance, Component 2 for 11.41%, Component 3 for 8.33%, Component 4 for 7.48%, and so on.

Table 4.21

Total Variance Accounted for Components in Student Attitude

	Initial Eigenvalues		
Component	Total	% of Variance	Cumulative %
1	4.81	34.36	34.36
2	1.60	11.41	45.76
3	1.17	8.33	54.09
4	1.05	7.48	61.57
5	.87	6.19	67.77
6	.86	6.14	73.90
7	.63	4.52	78.42
8	.59	4.23	82.66
9	.54	3.87	86.52
10	.47	3.37	89.89
11	.44	3.12	93.01
12	.38	2.72	95.73
13	.34	2.43	98.16
14	.26	1.84	100.00

Note. Extraction Method: Principal Component Analysis.

Figure 4.2 shows the Scree Plot for student attitude. The Scree test as a graphical method was first proposed by Cattell (1966). All eigenvalues were plotted in this figure. Cattell (1966) suggested that researchers should examine the place where the smooth decrease of eigenvalues appears in the Scree Plot. He also suggested that the number of factors be taken as the number immediately before the smooth decrease begins.

According to this criterion, 2 or 3 factors would be retained in this study. However, this test involves subjective human judgments, and it is difficult to establish high reliability (Gorsuch, 1983).

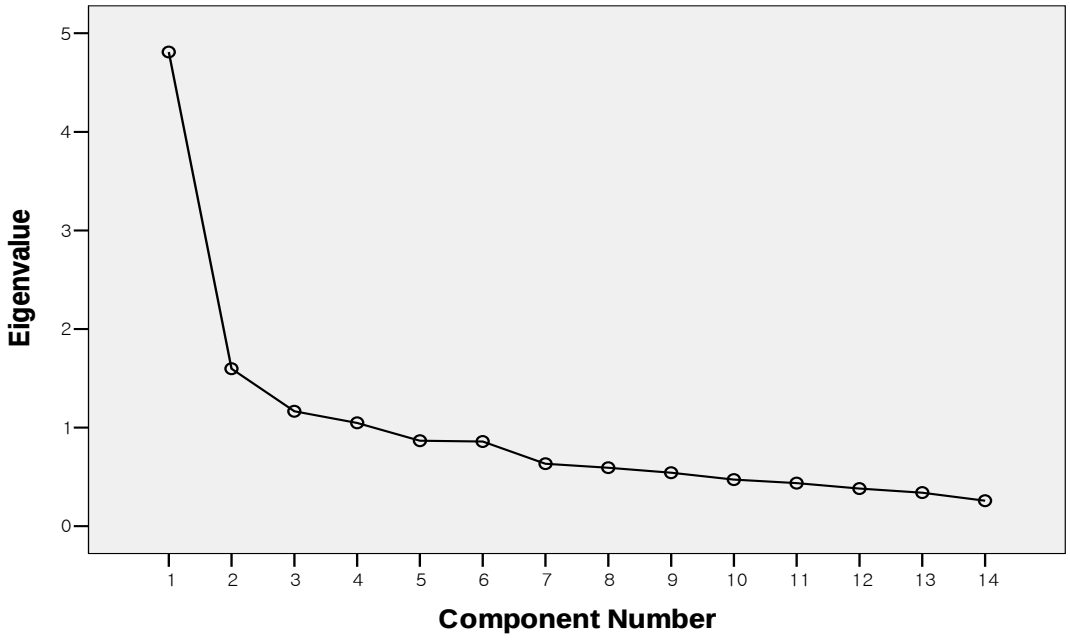

Figure 4.2. Scree plot for student attitude.

Table 4.22 shows unrotated component loadings for student attitude. Component loadings in PCA are also called factor loadings and they are the correlation coefficients between the variables that stands for survey items in this study and components (Gorsuch, 1983). The results, which were computed by SPSS program, show that four components were extracted by Kaiser-Guttman Criterion, which was proposed by

Guttman (1954) and adapted by Kaiser (1960). This method is appropriate for PCA. On the Kaiser-Guttman Criterion, only those factors which have eigenvalues greater than 1.0 are considered as common factors and all factors with eigenvalues under 1.0 are dropped (Child, 2006). However, it may overestimate the true number of factors when the number of variables is large and it may underestimate the true number of factors when the number of variables is small (Child, 2006). For these reasons, this study employed this method not as the sole cut-off criterion for estimating the number of factors, but as a mere tool of reference for judgment.

The data of Table 4.22 also shows that the first component (factor) was generally more highly correlated with survey item variables than the second component (factor). However, generally, the results of unrotated component loadings are hard to interpret, because variables tend to load on multiple factors (Gorsuch, 1983). To interpret component loading more accurately, the researcher employed a rotation method in this study.

The rotation method usually facilitates the interpretation of components (factors) and it creates a set of rules producing factors having greater meaning in a study (Child, 2006). In this study, Varimax rotation, which is the most commonly used among several rotation methods, was employed. Varimax rotation maximizes the variance across all components (factors) and the results with Varimax rotation make it easy to identify each variable with a single component (factor) (Gorsuch, 1983).

Table 4.22

Unrotated Component Loadings for Student Attitude

Item Variable	Component 1	2	3	4
6. I was able to interact with other students more positively and often because I had a complementary and interconnected role in my group.	.71	.29	.09	.00
2. To work with other students in online helps me enhance interactions with other students or the instructor.	.69	-.08	.24	.13
5. When I perceived that I as one group member should contribute to my group activity, I participated in it actively and positively.	.68	.41	.05	-.08
3. To work with other students in online will help me enhance your academic performance.	.68	-.28	.13	.23
13. To what extent did you participate in the required group activities?	.67	.48	-.32	-.01
1. I enjoyed this cooperative learning activity more than competition and individual learning.	.67	-.16	-.24	.22
12. To what extent did you use the communication resources to complete your assignment?	.65	.32	-.32	-.20
11. I felt more comfortable with online discussion in this course than offline (face-to-face) discussion in other course.	.64	-.35	.11	-.25
10. I think that interactive environments using Internet are useful for my learning.	.62	-.45	.26	-.03
9. I prefer online learning activities to face-to-face learning activities.	.54	-.51	.09	-.16
14. In addition to the course communications activities, did you or your group engage in external communication in relation to the assignment activities?	.38	.41	.26	.17
4. Before I begin this cooperative learning activity, I have already experienced and known the activity.	-.11	.39	.81	.01
8. In future, I would like to be satisfied if all group members including me get the same grade through the cooperative learning activity.	.37	-.03	-.12	.68
7. In future, it will be helpful for my learning that each group member tells me whether I work together well or not during the activity.	.44	.04	-.01	-.55

Note. Extraction Method: Principal Component Analysis.

Table 4.23 shows the results of rotated component loadings for student attitude. The results of Varimax rotation show that the first component (factor 1) was marked by high loadings on item 13, 12, 5, 6, and 14, and factor 1 was composed primarily of item variables that measure “Cooperative learning: participation and communication resources.” The second component (factor 2) was also marked by high loadings on item 10, 9, 11, 3, 2, and 1, and factor 2 was composed primarily of item variables that

measure “Online activities.” However, the third and the fourth components (factor 3 and factor 4) were not readily interpretable and were not taken into account in this study.

Table 4.23

Rotated Component Loadings for Student Attitude[a]

Item Variable	Component			
	1	2	3	4
13. To what extent did you participate in the required group activities?	.86	.05	-.09	.15
12. To what extent did you use the communication resources to complete your assignment?	.78	.17	-.18	-.03
5. When I perceived that I as one group member should contribute to my group activity, I participated in it actively and positively.	.74	.23	.21	.05
6. I was able to interact with other students more positively and often because I had a complementary and interconnected role in my group.	.65	.32	.20	.13
14. In addition to the course communications activities, did you or your group engage in external communication in relation to the assignment activities?	.43	.05	.42	.20
10. I think that interactive environments using Internet are useful for my learning.	.08	.80	.05	.08
9. I prefer online learning activities to face-to-face learning activities.	.05	.75	-.15	-.04
11. I felt more comfortable with online discussion in this course than offline (face-to-face) discussion in other course.	.24	.73	-.07	-.11
3. To work with other students in online will help me enhance your academic performance.	.22	.66	.03	.36
2. To work with other students in online helps me enhance interactions with other students or the instructor.	.34	.58	.20	.25
1. I enjoyed this cooperative learning activity more than competition and individual learning.	.40	.45	-.26	.38
4. Before I begin this cooperative learning activity, I have already experienced and known the activity.	-.05	-.09	.89	-.11
8. In future, I would like to be satisfied if all group members including me get the same grade through the cooperative learning activity.	.16	.15	-.04	.76
7. In future, it will be helpful for my learning that each group member tells me whether I work together well or not during the activity.	.43	.35	-.05	-.44

Note. Extraction Method: Principal Component Analysis; Rotation Method: Varimax with Kaiser Normalization.
[a] Rotation converged in 6 iterations

According to the results of the rotated component loadings for student attitude, component (factor) scores were computed by SPSS program. Factor scores are the scores

of each item on each component (factor). Factor scores can be obtained as the sums of the products of the case's standardized score on each variable and the corresponding factor loading of the variable for the given factor (Gorsuch, 1983). Factor scores for a sample are also used as variables in subsequent modeling to examine some questions about the differences among groups in the sample (Child, 2006). This study employed factor scores to investigate the differences between Group 1, Group 2, and Group 3 in terms of the first and the second factors.

Multivariate Analysis of Variance for the Factors of Student Attitude

Multivariate analysis of variance (MANOVA) with the factor scores of student attitude as the dependent variables was used to examine the difference between Group 1, Group 2, and Group 3. Table 4.24 shows the descriptive statistics for the factors of student attitude.

Table 4.24

Descriptive Statistics for the Factor Scores of Student Attitude

Dependent Variable	Group	Mean	Std. Deviation	*N*
Factor 1: Cooperative Learning: Participation and Communication Resources	1	0.04	1.03	48
	2	0.03	1.06	48
	3	-0.07	0.92	48
	Total	0.00	1.00	144
Factor 2: Online Activities	1	-0.03	1.12	48
	2	-0.05	0.84	48
	3	0.09	1.03	48
	Total	0.00	1.00	144

In Table 4.25, the results, which were computed by SPSS program, showed that the assumption of homogeneity of variances was met for Factor 1 scores and Factor 2 scores ($p > .05$), for Levene's test was not significant at the .05 level. Table 4.26 also shows that Box's M tests the homogeneity of covariances as MANOVA's assumption of homoscedasticity using the F distribution.

Table 4.25

Levene's Test of Homogeneity of Variance for the Two Factor Scores of Student Attitude

Dependent Variable	*F*	*df1*	*df2*	*p*
Factor 1: Cooperative Learning: Participation and Communication Resources	.50	2	141	.61
Factor 2: Online Activities	2.70	2	141	.07

Note. Dependent variables = Two Factor Scores of Student Attitude; Design: Intercept + group.
* $p < .05$

In Table 4.26, the results show that the covariances were not significantly different, $p > .05$. This means that the assumption of equal covariances between the two factor scores of student attitude as the set of dependent variables was met with respect to Group 1, Group 2, and Group 3.

Table 4.26

Box's M Test of Homogeneity of Covariance for the Two Factor Scores of Student Attitude

Box's M	*F*	*df1*	*df2*	*p*
8.48	1.38	6	495,495.69	.22

Note. Dependent variables = Two Factor Scores of Student Attitude; Design: Intercept + group.
* $p < .05$

Table 4.27 shows the results of multivariate significance test with Wilks' Lambda for the two factor scores of student attitude. The results indicate that the effect of group was not significant ($p > .05$) in the Wilks' Lambda. Also, Partial Eta-Squared was .00, which means that almost none (0%) of the variation in the two factor scores of student attitude could be attributable to the differences between Group 1, Group 2, and Group 3.

Table 4.27

Multivariate Significance Test with Wilks' Lambda for the Two Factor Scores of Student Attitude

Effect	Wilks' Lambda	*F*	Hypothesis *df*	Error *df*	*p*	Partial Eta Squared
Intercept	1.00	.00	2	140	1.00	.00
Group	.99	.22	4	280	.93	.00

Note. Dependent variables = Two Factor Scores of Student Attitude; Design: Intercept + group
* $p < .05$

Table 4.28

Tests of the Univariate ANOVA Effects for Group in Student Attitude

Source	Dependent Variable	Type III *SS*	*df*	*MS*	*F*	*p*	Partial Eta Squared	Power
Corrected Model	Factor 1	.34	2	.17	.17	.85	.00	.08
	Factor 2	.56	2	.28	.28	.76	.00	.09
Intercept	Factor 1	.00	1	.00	.00	1.00	.00	.05
	Factor 2	.00	1	.00	.00	1.00	.00	.05
Group	Factor 1	.34	2	.17	.17	.85	.00	.08
	Factor 2	.56	2	.28	.28	.76	.00	.09
Error	Factor 1	142.66	141	1.01				
	Factor 2	142.44	141	1.01				
Total	Factor 1	143.00	144					
	Factor 2	143.00	144					
Corrected Total	Factor 1	143.00	143					
	Factor 2	143.00	143					

* p <.05

Table 4.28 shows the results of tests of the univariate ANOVA effects for Group in student attitude. No univariate effect for Group was significant in Factor 1 scores [F (2, 141) = .17, p > .05] and Factor 2 scores [F (2, 141) = .28, p > .05]. This means that the researcher failed to reject the null hypothesis that group is unrelated to Factor 1 scores (Cooperative learning: participation and communication resources) and Factor 2 scores (Online activities); in other words, there were not significant differences in the group mean between Group 1, Group 2, and Group 3 with respect to Factor 1 scores and Factor 2 scores. However, in both of Factor 1 and Factor 2, the results of observed power were quite low (Power = .08 in Factor 1 scores; and Power = .09 in Factor 2 scores). It means that the chance of Type II error, which was defined as not rejecting a false

hypothesis, was too high to be confident in this decision of the rejection in Factor 1 scores and Factor 2 scores (Howell, 2002).

In this study, the researcher adopted planned orthogonal contrasts to conduct specific multiple comparisons of groups with respect to the two factor scores of student attitude. Contrast coefficients for the five types of student interactions are displayed in Table 4.29. Contrast 1 indicates the comparison Groups 1 and 2 with Group 3, and Contrast 2 indicates the comparison between Group 1 and Group 2.

Table 4.29

Contrast Coefficients for the Two Factor Scores of Student Attitude

	Group		
Contrast	1	2	3
1	1	1	-2
2	1	-1	0

Table 4.30 shows the results of contrast tests for the two factor scores of student attitude. For Contrast 1, each group mean of Group 1 and Group 2 was not significantly different from that of Group 3 with respect to Factor 1 scores and Factor 2 scores ($p > .05$). For Contrast 2, the group mean of Group 1 was not significantly different from that of Group 2 with respect to Factor 1 scores and Factor 2 scores ($p > .05$). The P-value did not need to be adjusted, because these planned contrasts are orthogonal, which indicates that the two contrasts were independent.

Table 4.30

Tests of Contrasts for the Two Factor Scores of Student Attitude

Source	Dependent Variable	*SS*	*df*	*MS*	*F*	*p*	Partial Eta Squared	Power
Contrast 1	Factor 1	.33	1	.33	.33	.57	.00	.09
	Factor 2	.55	1	.55	.55	.46	.00	.11
Contrast 2	Factor 1	.00	1	.00	.00	.96	.00	.05
	Factor 2	.01	1	.01	.01	.92	.00	.05
Error	Factor 1	142.66	141	1.01				
	Factor 2	142.44	141	1.01				

* $p < .05$

CHAPTER V

CONCLUSION

This study investigated the relative effectiveness of positive interdependence and group processing on student interaction, achievement, and attitude in online learning environments. The undergraduate students who participated in this study received instruction in cooperative learning methods, were then placed in small groups composed of four participants and the groups were assigned randomly to one of the three treatment conditions: positive interdependence, group processing, and no structured cooperative learning. Subsequently, they participated in instructional activities composed primarily of online discussions to complete their common group projects.

Student Achievement

Prior studies on cooperative learning have been limited, focusing on either the relative effectiveness of several types and structures of positive interdependence on student achievement (Brewer & Klein, 2006; Jensen et al., 2002; Johnson & Johnson, 1989) or on the relative effectiveness of some structures of group processing on such achievement (Garibaldi et al., 1989; Johnson & Johnson, 2006). The findings of this study supported those made from these prior studies. To expand on the limitation of the previous research, this study compared the relative effectiveness of positive interdependence strategies, group processing strategies, and no structured strategies on student achievement in online cooperative learning environments.

The overall results of this study showed that there were significant differences in the effectiveness between the cooperative learning strategies of positive interdependence, group processing, and no structure on student achievement in online cooperative learning environments. The ANCOVA results on student achievement scores revealed that there were significant differences in their adjusted means between positive interdependence, group processing, and no structure.

The results of planned orthogonal comparisons (Contrast 1) suggest that the application of positive interdependence strategies and group processing strategies affects undergraduate student achievement more positively in online cooperative learning environments than when no structured cooperative learning strategies are provided. The results (Contrast 2) also suggest that the application of positive interdependence strategies in online cooperative learning environments affects undergraduate student achievement more positively than does the use of group processing strategies.

Student Interaction

The overall results of this study showed that there were significant differences in the relative effectiveness of positive interdependence, group processing, and no structure on student interaction while completing assignments in online cooperative learning environments. The ANOVA results on student interaction, as measured by the total number of online messages posted, revealed that there were significant differences between the means of the positive interdependence, group processing, and no structure groups. While there were no indicated differences between the positive interdependence and group processing groups (Contrast 2), the results of planned orthogonal comparisons

(Contrast 1) provided the evidence that both groups were relatively more effective than no structure on student interaction in online cooperative learning environments. The results corroborate prior studies that examined the usefulness of positive interdependence on student interaction (Brewer & Klein, 2006; Jensen et al., 2002; Johnson & Johnson, 1989) and the usefulness of group processing on student interaction (Garibaldi et al., 1989). However, further study will be necessary to determine the relative advantages of these two strategies on student interaction.

To more closely examine the effects of these strategies on student interaction, five different types of student interactions were identified and compared. MANOVA was employed to examine the differences between positive interdependence, group processing, and no structure with respect to these five types of interactions (Gunawardena et al., 1997): Type 1— sharing and comparing of information, Type 2— discovery of dissonance and inconsistency among ideas, concepts, or statements, Type 3— negotiation of meaning and co-construction of knowledge, Type 4— testing and modification of proposed synthesis or co-construction, and Type 5— agreement statements and applications of newly-constructed meaning. The results of multivariate significance test with Wilks' Lambda showed that there were significant differences between the means of the positive interdependence, group processing, and no structure groups on the five types of student interactions. The results also suggest that the application of positive interdependence strategies and group processing strategies can positively affect the five types of student interactions. However, it is difficult to decide whether these results corroborate the results of prior studies as few studies have

examined the patterns or the types of interactions in online cooperative learning environments (Jonassen & Kwon, 2001).

To examine how the three strategies affect each of the individual types of student interactions, a univariate ANOVA analysis was also employed. The results of this analysis showed that there were significant differences in the effectiveness between positive interdependence, group processing, and no structure on Type 1, Type 2, Type 3, and Type 5 categories, but not on Type 4. Consequently, the results suggest that the application of positive interdependence strategies and group processing strategies can have a comprehensive influence, positively affecting most of the types of student interactions in online cooperative learning environments.

To examine more closely the differences among the influences on the specific types of interactions, planned orthogonal comparisons were employed. The results of these comparisons (Contrast 1) presented some evidence that the application of positive interdependence strategies and group processing strategies were particularly more effective in increasing both Type 1 and Type 2 interactions. Accordingly, these results also showed that there was no significant influence on the occurrence of Type 3, Type 4, or Type 5 entries. From these findings we may conclude that these strategies produce desired results with respect to Type 1 (sharing and comparing of information) and Type 2 (discovery of dissonance and inconsistency among ideas, concepts, or statements) interactions. While this indicates a desired effect on learning outcome, these types of interactions represent basic involvement with the course content and may not be as associated with higher levels of understanding as the remaining three types: Type 3

(negotiation of meaning and co-construction of knowledge), Type 4 (testing and modification of proposed synthesis or co-construction), and Type 5 (agreement statements and applications of newly-constructed meaning). Further research is recommended for to determine the relative desirability of each type of interactions in relation to overall instructional goals and the best way of increasing the occurrence of the desired interactions.

Additional results of these planned orthogonal comparisons (Contrast 2) provided evidence that positive interdependence was relatively more effective than group processing for fostering Type 1 interactions; and, conversely, group processing was relatively more effective than positive interdependence for increasing Type 3 interactions. Accordingly, they showed that there was no significant difference between positive interdependence and group processing on Type 2, Type 4, and Type 5 interactions. The results suggest that an instructor's decision to incorporate positive interdependence strategies or group processing strategies can be crucial to student performance, especially when the types of student interactions are associated with basic or lower levels of understanding as in Type 1 and Type 3 interactions.

Student Attitude

A factor analysis was utilized to explore the underlying structure of a set of survey items measuring student attitude. This analysis identified two underlying factors: Factor 1— "Cooperative learning: participation and communication resources" and Factor 2— "Online activities." Factor loadings and factor scores were computed and interpreted with the Principal Component Analysis (PCA) including Varimax rotation

method. MANOVA was adopted to examine the differences in the responses of the positive interdependence, group processing, and no structure groups with respect to these two factors. The results of multivariate significance test with Wilks' Lambda showed that there was no significant difference in the factor score means between the positive interdependence, group processing, and no structure groups. To examine more closely the differences among the influences on the two factors, planned orthogonal comparisons were employed. The results of these comparisons (Contrast 1) provided additional evidence that there was no significant difference between the positive interdependence and no structure groups or between the group processing and no structure groups on Factor 1 and Factor 2. These results (Contrast 2) also provided evidence that there was no significant difference between the positive interdependence and group processing groups on Factor 1 and Factor 2.

Previous research on cooperative learning has shown that some types and structures of positive interdependence (Brewer & Klein, 2006) and some structures of group processing (Garibaldi et al., 1989) increase positive student attitude toward cooperative learning. The results of this study do not corroborate these prior studies as positive interdependence and group processing activities did not show an improvement on student attitude when compared to the group with no such activities. However, this difference in findings may be due to the difference in the way student attitudes were measured. In addition, this study didn't employ as large a subject sample which might lead to higher statistical power (Howell, 2002). Consequently, these results do not necessarily suggest that neither application of positive interdependence strategies nor

group processing strategies affects student attitude in online cooperative learning environments as measured by the two factors in this study. However, further research would be suggested to investigate the additional factors of student attitude and determine the relative usefulness of these two strategies.

Specifically, the overall results of this study provided some evidence that positive interdependence and group processing can have positive effects on some part of student attitude although they did not have positive effects on the two factors: "Cooperative learning: participation and communication resources" and "Online activities." For example, the highest agreement (Mean = 4.08, *SD* = .77) across all the three groups occurred in the item, "When I perceived that I as one group member should contribute to my group activity, I participated in it actively and positively." This finding indicates that generally all of the participants perceived the importance of positive interdependence and this perception led to their positive participations in group activities. Also, the second highest agreement (Mean = 3.98, *SD* = .74) across all the three groups occurred in the item, "In future, it will be helpful for my learning that each group member tells me whether I work together well or not during the activity." This finding indicates that generally all of the participants perceived the importance of group processing and this perception led to the positive student attitude toward group activities and their learning. Accordingly, these findings suggest that the overall activity of cooperative learning with small online discussion groups itself affects student attitude positively to the extent that there is little room for finding measurable differences between the groups on such items. A meta-analysis of 11 studies presented some

evidence that cooperative learning with small online discussion groups had affected undergraduate positive student attitude significantly (Springer et al., 1999). Further research is suggested to develop more appropriate measures of student attitude and investigate the relationships between these two strategies and student attitude.

Implications

It is important for instructors and undergraduate students to select appropriate learning strategies for use in online cooperative learning environments in order to improve student achievement, interaction, and positive attitude during online cooperative learning. The findings of this study provide some implications for instructors who are willing to incorporate online cooperative learning activities and resources in their courses and for undergraduate students who want to know to the best ways to participate in online group activities and how to interact with their group members productively.

First, these results suggest that instructors would be advised to incorporate positive interdependence activities into their courses as it is one of the important components for fostering effective online group work. Further, they should be prepared to help their students conduct their group processing activities effectively by facilitating the students' online cooperative learning activities throughout the course (Johnson et al., 2007). In addition, instructors and undergraduate students should be encouraged to consider positive interdependence rather than group processing among the components of cooperative learning in order to improve student achievement in online cooperative learning environments. However, group processing might be desired when instructors

want to observe students' group activities systematically and obtain better information about how well the students work together (Johnson & Johnson, 1994).

Second, it is recommended that instructors apply both positive interdependence strategies and group processing strategies to increase and facilitate student interaction effectively; in other words, these structured learning strategies are essential for students to participate fully in online discussion activities. Specifically, the findings of student interaction in this study imply that positive interdependence and group processing are important components for instructors and students to define a problem and advance their arguments when group members begin and activate their online discussion participation. They also imply that instructors and undergraduate students should be recommended to choose between positive interdependence and group processing when they struggle to proceed to the next step for structured and active online discussion and to propose new statements to identify co-construction of knowledge (Gunawardena et al., 1997). Specifically, it can be more effective for instructors to choose positive interdependence strategies rather than group processing strategies in order to increase student interaction, especially when students do not know how to share information among their group members. However, it can be more effective for instructors to choose group processing strategies rather than positive interdependence strategies in situations where students do not know how to negotiate meaning and construct knowledge during their group activities.

Third, instructors who are interested in improving undergraduate positive student attitude toward online cooperative learning are advised to consider the use of some

components of positive interdependence strategies and group processing strategies in online group activities. Specifically, it is recommended that instructors help students perceive that they should actively contribute to, and be more aware of, their online group activities by utilizing positive interdependence strategies such as goal-, reward-, role-, and resource-interdependence strategies. In addition, they should be prepared to provide students with the information or evaluation about whether they cooperate with each other members effectively or not during their online discussion activities by employing group processing strategies by having the students submit their group processing reports and post them into their online discussion rooms.

Fourth, instructors are recommended to organize both positive interdependence strategies and group processing strategies, and prepare their instructional materials thoroughly before online group activities begin. If instructors fail to organize these two strategies or perceive specific methods for facilitating these two strategies in advance of the online group activities, they may feel frustrated when students are not willing to actively participate in their online discussions or when they cannot find the proper means or methods to participate. These situations can lead to decreasing student interaction and negative influences on student attitude toward online cooperative learning activities.

Finally, it is recommended that instructors inform groups of the individual progress of each member's activities periodically and provide students with regular, opportune feedback. If students perceive that they are evaluated fairly and regularly by other group members and by their instructors during their online group activities they may maintain positive attitudes about their activities and meaningfully interact with each

other to a greater extent. For example, instructors are advised to announce that students will be evaluated every week during their online group activities, and post the results of their activities in their online discussion rooms.

Further Research

Future research can build on these findings to refine the instructional resources and methods offered by positive interdependence and group processing strategies to enhance their effectiveness and extend the educational settings and academic areas to which they may be applied. This study did not investigate the relationships between individual student characteristics and their achievement, interaction, and attitude in online cooperative learning environments. Such individual differences in student characteristics may have had confounding effects strong enough to make the inference of treatment effects difficult to determine (Jonassen & Kwon, 2001; Wolins, 1982). Further research may provide insight on the role of such individual differences on these relationships and provide a means of modifying the activities to accommodate to the profiles and backgrounds of specific students. In addition, such studies would shed light on more efficient ways of selecting students to form student groups and providing specific skill training to particular students to help insure successful participation in the learning activities. Also, some findings related to student attitude in this study do not support the results of previous research that the use of positive interdependence strategies and group processing strategies can increase positive student attitude toward online cooperative learning activities (Brewer & Klein, 2006; Garibaldi et al., 1989; Jensen et al., 2002). By exploring this discrepancy in results between previous studies

and this study and whether there are additional factors related to measuring student attitude toward online cooperative learning, future studies can provide additional insights on the effective application of online cooperative learning.

This study did not investigate any instructor attributes, for example, the relationships: 1) between instructor's perception and student achievement, interaction, and attitude, 2) between instructor's self-efficacy and student achievement, interaction, and attitude, or 3) between instructor's attitude toward online cooperative learning and student achievement, interaction, and attitude. While these factors were controlled for in this study by having each instructor involved in applying all three conditions, considerations for real-world application would suggest that instructor attributes would need to be researched to fully understand the effective applicability of these strategies in the range of settings available in today's myriad of academic settings and content areas. Further research may provide some information on effective online cooperative learning by exploring: 1) whether or not there are some factors of instructor's perception, instructor's self-efficacy, and instructor's attitude toward online cooperative learning, and 2) what kind of relationships occur between instructor attributes and student achievement, interaction, and attitude.

This study did not investigate the effectiveness of combined positive interdependence-plus-group processing on student achievement, interaction, and attitude. Previous research on positive interdependence has shown that combined interdependence strategies such as roles-plus-rewards are often a more effective influence on student interaction than any single strategy (Brewer & Klein, 2006). Future

studies can provide additional insights on effective online cooperative learning by exploring how students interact with each other when they receive combined interdependence-plus-group processing treatment from their online group activities. In addition, research should explore the possibilities of building such activities directly into online discussion software in order to facilitate the use of these positive interdependence and/or group processing strategies in a manner that makes it easy for faculty to integrate them into their instructional practice and produce immediate benefits to student learning.

REFERENCES

Aronson, E., Blaney, N., Stephan, C., Sikes, J., & Snapp, M. (1978). *The Jigsaw classroom*. Beverly Hills, CA: Sage Publications.

Barlow, L., Chadwick, M., Fishman-Boyd, S., Herendeen, W., Liparulo, S., & Reynolds, D. (2006). *Undergraduate writing assessment: Spring 2006 report*. Houston, TX: University of Houston.

Bray, J. H., & Maxwell, S. E. (1985). *Multivariate analysis of variance*. Thousand Oaks, CA: Sage Publications.

Brewer, M., & Kramer, R. (1986). Choice behavior in social dilemmas: Effects of social identity, group size, and decision framing. *Journal of Personality and Social Psychology, 50*(3), 543-549.

Brewer, S., & Klein, J. D. (2006). Type of positive interdependence and affiliation motive in an asynchronous, collaborative learning environment. *Educational Technology Research and Development, 54*(4), 331-354.

Cattell, R. B. (1966). The Scree Test for the number of factors. *Multivariate Behavioral Research, 1*(2), 245-276.

Child, D. (2006). *The essentials of factor anlaysis* (3rd ed.). New York: Continuum International Publishing Group.

Chou, C. (2003). Interactivity and interactive functions in web-based learning systems: A technical framework for designers. *British Journal of Educational Technology, 34*(3), 265-279.

Clarke, J. (1994). Pieces of the puzzle: The Jigsaw method. In S. Sharan (Ed.), *Handbook of cooperative learning methods* (pp. 34-50). Westport, CT: Greenwood Press.

Cohen, E. G. (1994). Restructuring the classroom: Conditions for productive small groups. *Review of Educational Research, 64*(1), 1-35.

Cohen, J. (1960). A coefficient of agreement for nominal scales. *Educational and Psychological Measurement, 10*, 37-46.

Cohen, J. (2003). *Applied multiple regression/correlation analysis for the behavioral sciences* (3rd ed.). Mahwah, NJ: Lawrence Erlbaum Associates.

Colbeck, C. L., Campbell, S. E., & Bjorklund, S. A. (2000). Grouping in the dark: What college students learn from group projects. *The Journal of Higher Education, 71*(1), 60-83.

Deutsch, M. (1949a). An experimental study of the effects of cooperation and competition upon group process. *Human Relations, 2*, 199–232.

Deutsch, M. (1949b). A theory of cooperation and competition. *Human Relations, 2*(2), 129-152.

Deutsch, M. (1962). Cooperation and trust: Some theoretical notes. In M. R. Jones (Ed.), *Nebraska symposium on motivation* (pp. 275–319). Lincoln: University of Nebraska Press.

Dick, W., & Carey, L. (1990). *The sytematic design of instruction* (3rd ed.). Glennview, IL: Scott, Foresman and Company.

Duffy, T., & Jonassen, D. (Eds.). (1992). *Constructivism and the technology of instruction: A conversation*. Englewood, NJ: Lawrence Erlbaum and Associates.

Fan, E. T., & Gruenfeld, D. H. (1998). When needs outweigh desires: The effects of resource interdependence and reward interdependence on group problem solving. *Basic and Applied Social Psychology, 20*(1), 45-56.

Garibaldi, A., Johnson, D. W., Johnson, R. T., & Stanne, M. B. (1989). Impact of group processing on achievement in cooperative groups. *The Journal of Social Psychology, 130*(4), 507-516.

Garrison, D. R. (1997). Computer conferencing. *The Journal of Open and Distance Learning, 12*(2), 3-11.

Garrison, D. R., & Cleveland-Innes, M. (2005). Facilitating cognitive presence in online learning: Interaction is not enough. *American Journal of Distance Education, 19*(3), 133-148.

Garrison, D. R., Anderson, T., & Archer, W. (1999). Critical inquiry in a text-based environment: Computer conferencing in higher education. *The Internet and Higher Education, 2*(2-3), 87-105.

Gatfield, T. (1999). Examining student satisfaction with group projects and peer assessment. *Assessment & Evaluation in Higher Education, 24*(4), 365-377.

Giguere, P. J., Formica, S. W., & Harding, W. M. (2004). Large-scale interaction strategies for Web-based professional development. *American Journal of Distance Education, 18*(4), 207-223.

Glass, G. V., & Hopkins, K. D. (1996). *Statistical methods in education and psychology* (3rd ed.). Needham Heights, MA: A Simon & Schuster Company.

Gorsuch, R. L. (1983). *Factor analysis* (2nd ed.). Hillsdale, NJ: Lawrence Erlbaum Associates.

Gunawardena, C. N., Lowe, C. A., & Anderson, T. (1997). Analysis of a global online debate and the development of an interaction analysis model for examining social construction of knowledge in computer conferencing. *Journal of Educational Computing Research, 17*(4), 397-431.

Guttman, L. (1954). A new approach to factor analysis: The radex. In P. F. Lazarfield (Ed.), *Mathematical thinking in the social sicences* (pp. 258-348). Glencoe, MN: Free Press.

Hannafin, M. J., & Peck, K. L. (1988). *The design, development, and evaluation of instructional software*. New York: Macmillan Publishing Company.

Hillman, D. C. A., Willis, D. J., & Gunawardena, C. N. (1994). Learner–interface interaction in distance education: An extension of contemporary models and strategies for practitioners. *The American Journal of Distance Education, 8*(2), 30-42.

Hinsz, V. B., Tindale, R. S., & Vollrath, D. A. (1997). The emerging conceptualization of groups as information processors. *Psychological Bulletin, 121*(1), 43-64.

Hirokawa, R. Y. (1990). The role of communication in group decision-making efficacy: A task-contingency perspective. *Small Group Research, 21*(2), 190-204.

Howell, D. C. (2002). *Statistical methods for psychology* (5th ed.). Pacific Grove, CA: Duxbury Press.

Jensen, M., Johnson, D. W., & Johnson, R. T. (2002). Impact of positive interdependence during electronic quizzes on discourse and achievement. *Journal of Educational Research, 95*(3), 161-166.

Johnson, D. W., & Johnson, F. (2006). *Joining together: Group theory and group skills* (9th ed.). Boston, MA: Allyn & Bacon.

Johnson, D. W., & Johnson, R. T. (1989). *Cooperation and competition: Theory and research*. Edina, MN: Interaction Book Company.

Johnson, D. W., & Johnson, R. T. (1992). Positive interdependence: Key to effective cooperation. In N. Miller & R. Hertz-Lazarowitz (Eds.), *Interaction in cooperative groups: The theoretical anatomy of group learning* (pp. 174-199). New York: Cambridge University Press.

Johnson, D. W., & Johnson, R. T. (1993). *Leading the cooperative school* (2nd ed.). Edina, MN: Interaction Book Company.

Johnson, D. W., & Johnson, R. T. (1994). *Learning together and alone : Cooperative, competitive, and individualistic learning* (4th ed.). Boston, MA: Allyn and Bacon.

Johnson, D. W., & Johnson, R. T. (1998). Cooperative learning and social interdependence theory. In R. S. Tindale, L. Heath, J. Edwards, E. J. Posavac, F. B. Bryant, Y. Suarez-Balcazar, E. Henderson-King & J. Myers (Eds.), *Theory and research on small groups* (Vol. 4, pp. 9-36). New York: Plenum Press.

Johnson, D. W., & Johnson, R. T. (2007). Social interdependence theory and cooperative learning: The teacher's role. In R. M. Gillies, A. Ashman & J. Terwel (Eds.), *The teacher's role in implementing cooperative learning in the classroom*. New York: Springer.

Johnson, D. W., Holubec, E. J., & Johnson, R. T. (1993). *Circles of learning*. Edina, MN: Interaction Book Company.

Johnson, D. W., Johnson, R. T., & Anderson, D. (1983). Social interdependence and classroom climate. *The Journal of Psychology, 114*, 135-142.

Johnson, D. W., Johnson, R. T., & Holubec, E. (1994). *Cooperative learning in the classroom*. Alexandria, VA: Association for Supervision and Curriculum Development.

Johnson, D. W., Johnson, R. T., Ortiz, A., & Stanne, M. B. (1991). The impact of positive goal and resource interdependence on achievement, interaction, and attitudes. *The Journal of General Psychology, 118*(4), 341-347.

Johnson, D. W., Johnson, R. T., Roy, P., & Zaidman, B. (1986). Oral interaction in cooperative learning groups. *The Journal of Psychology, 119*(4), 303-321.

Johnson, D. W., Johnson, R. T., & Smith, K. (2007). The state of cooperative learning in postsecondary and professional settings. *Educational Psychology Review, 19*(1), 15-29.

Johnson, D. W., Johnson, R. T., & Taylor, B. (1993). Impact of cooperative and individualistic learning on high-ability students' achievement, self-esteem, and social acceptance. *The Journal of Social Psychology, 133*(6), 839-844.

Johnson, D. W., Maruyama, G., Johnson, R. T., Nelson, D., & Skon, L. (1981). Effects of cooperative, competitive, and individualistic goal structures on achievement: A meta-analysis. *Psychological Bulletin, 89*(1), 47-62.

Jonassen, D. (2000). *Computers as mindtools for schools: Engaging critical thinking* (2nd ed.). Columbus, OH: Prentice Hall.

Jonassen, D., & Kwon, H. (2001). Communication patterns in computer mediated versus face-to-face group problem solving. *Educational Technology Research and Development, 49*(1), 35-51.

Jonassen, D., Peck, K. L., & Willson, B. G. (1999). *Learning with technology*. Columbus, OH: Prentice Hall.

Kagan, S. (1992). *Cooperative learning*. San Juan Capistrano, CA: Resources for Teachers, Inc.

Kaiser, H. F. (1960). The application of electronic computers to factor analysis. *Educational and Psychological Measurement, 20*(1), 141-151.

Kanuka, H., Collett, D., & Caswell, C. (2002). University instructor perceptions of the use of asynchronous text-based discussion in distance courses. *The American Journal of Distance Education, 16*(3), 151-167.

Kaufman, D., Sutow, E., & Dunn, K. (1997). Three approaches to cooperative learning in higher education. *Canadian Journal of Higher Education, 27*(2-3), 37-66.

Keegan, D. (Ed.). (1990). *Foundations of distance education* (2nd ed.). New York: Routledge.

Kelly, T. (1957). *George Birkbeck: Pioneer of adult education*. Liverpool, England: Liverpool University Press.

Klein, J. D., & Schnackenberg, H. L. (2000). Effects of informal cooperative learning and the affiliation motive on achievement, attitude, and student interactions. *Contemporary Educational Psychology, 25*(3), 332-341.

Koffka, K. (1922). Perception: An introduction to the Gestalt-theorie. *Psychological Bulletin, 19*, 531-585.

Kreijns, K., Kirschner, P. A., & Jochems, W. (2003). Identifying the pitfalls for social interaction in computer-supported collaborative learning environments: A review of the research. *Computers in Human Behavior, 19*, 335-353.

Landis, J. R., & Koch, G. G. (1977). The measurement of observer agreement for categorical data. *Biometrics, 33*(1), 159-174.

Leshin, C. B., Pollock, J., & Reigeluth, M. (1992). *Instructional design strategies and tactics*. Englewood Cliffs, NJ: Educational Technology Publications.

Lewin, K. (1939). Field theory and experiment in social psychology: Concepts and methods. *The American Journal of Sociology, 44*(6), 868-896.

Li, L. K. Y. (2001). Some refinements on peer assessment of group projects. *Assessment & Evaluation in Higher Education, 26*(1), 5-18.

McCafferty, S. G., Jacobs, G. M., & Iddings, A. C. (2006). Cooperative learning and second language classrooms. In S. G. McCafferty, G. M. Jacobs & A. C. Iddings (Eds.), *Cooperative learning and second language teaching* (pp. 3-8). New York: Cambridge University Press.

McConnell, D. (2000). *Implementing computer supported cooperative learning* (2nd ed.). Sterling, VA: Routledge.

McIsaac, M. S., & Gunawardena, C. N. (1996). Distance education. In D. H. Jonassen (Ed.), *Handbook of research for educational communications and technology* (pp. 403-437). New York: Simon & Schuster Macmillan.

McLoughlin, C., & Luca, J. (2001). *Quality in online delivery: What does it mean for assessment in e-Learning environments.* Paper presented at the the annual meeting of the Australasian Society for Computers in Learning in Tertiary Education Melbourne, Australia.

McWhaw, K., Schnackenberg, H., Sclater, J., & Abrami, P. C. (2003). From cooperation to collaboration: Helping students become collaborative learners. In R. M. Gillies & A. F. Ashman (Eds.), *Cooperative learning: The social and intellectual outcomes of learning in groups* (pp. 69-86). New York: RoutledgeFalmer.

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

Merrill, M. D. (2002). First principles of instruction. *Educational Technology Research and Development, 50*(3), 43-59.

Moore, M. G. (1989). Editorial: Three types of interaction. *The American Journal of Distance Education, 3*(2), 1-6.

Moore, M. G. (1990). Recent contributions to the theory of distance education. *Open Learning, 5*(3), 10-15.

Moore, M. G. (1991). Editorial: Distance education theory. *The American Journal of Distance Education, 5*(3), 1-6.

Moore, M. G. (2002). Editorial: What does research say about the learners using computer-mediated communication in distance learning? *American Journal of Distance Education, 16*(2), 61-64.

Moore, M. G., & Kearsley, G. (2005). Distance education: A systems view. *Internationl Journal of Information and Communication Technology Education, 1*(4), 70-72.

Nelson, L. M. (1999). Collaborative problem solving. In C. M. Reigeluth (Ed.), *Instructional design theories and models: A new paradigm of instructional theory* (pp. 241-267). Mahwah, NJ: Lawrence Erlbaum.

Panitz, T. (1997). Collaborative versus cooperative learning: Comparing the two definitions helps understand the nature of interactive learning. *Cooperative Learning and College Teaching, 8*(2).

Parker, R. (1985). Small-group cooperative learning. *The Education Digest, 51*, 44-46.

Raban, R., & Litchfield, A. (2007). Supporting peer assessment of individual contributions in groupwork. *Australasian Journal of Educational Technology, 23*(1), 34-47.

Roblyer, M. D., & Wiencke, W. R. (2003). Design and use of a rubric to assess and encourage interactive qualities in distance courses. *The American Journal of Distance Education, 17*(2), 77-98.

Romiszowski, A. J., & de Haas, J. A. (1989). Computer-mediated communication for instruction: Using E-mail as a seminar. *Educational Technology, 29*(10), 7-14.

Sanchez, V., Steckler, A., Nitirat, P., Hallfors, D., Cho, H., & Brodish, P. (2007). Fidelity of implementation in a treatment effectiveness trial of reconnecting youth. *Health Education Research, 22*(1), 95.

Sharan, Y., & Sharan, S. (1994). Group investigation in the cooperative classroom. In S. Sharan (Ed.), *Handbook of cooperative learning methods* (pp. 97-114). Westport, CT: Greenwood Press.

Sing, C. C., & Khine, M. S. (2006). An analysis of interaction and participation patterns in online community. *Educational Technology & Society, 9*(1), 250-261.

Slavin, R. (1981). Synthesis of research on cooperative learning. *Educational Leadership, 38*(8), 655-660.

Slavin, R. (1986). *Using student team learning*. Baltimore, MD: Johns Hopkins University, Center for Research on Elementary and Middle Schools.

Slavin, R. (1995). *Cooperative learning* (2nd ed.). Needham Heights, MA: Allyn & Bacon.

Springer, L., Stanne, M. E., & Donovan, S. S. (1999). Effects of small-group learning on undergraduates in science, mathematics, engineering, and technology: A meta-analysis. *Review of Educational Research, 69*(1), 21.

Swan, K. (2001). Virtual interaction: Design factors affecting student satisfaction and perceived learning in asynchronous online courses. *Distance Education, 22*(2), 306-331.

Uebersax, J. S. (1987). Diversity of decision-making models and the measurement of interrater agreement. *Psychological Bulletin, 101*(1), 140-146.

Wageman, R., & Baker, G. (1997). Incentives and cooperation: The joint effects of task and reward interdependence on group performance. *Journal of Organizational Behavior, 18*(2), 139-158.

Wagner, E. D. (1994). In support of a functional definition of interaction. *The American Journal of Distance Education, 8*(2), 6-29.

Wagner, E. D. (1997). Interactivity: From agents to outcomes. *New Directions for Teaching and Learning, 71*, 19-26.

Wang, M., & Kang, M. (2006). Cybergogy for engaged learning: A framework for creating learner engagement through information and communication technology. In D. Hung & M. S. Khine (Eds.), *Engaged learning with emerging technologies* (pp. 225-254). Dordrecht, The Netherlands: Springer.

Wang, M., Sierra, C., & Folger, T. (2003). Building a dynamic online learning community among adult learners. *Educational Media (Special Issues: Computer-mediated communication), 40*(1/2), 49-61.

Weick, K. E., & Roberts, K. H. (1993). Collective mind in organizations: Heedful interrelating on flight decks. *Administrative Science Quarterly, 38*(3), 357-381.

Widaman, K. F., & Kagan, S. (1987). Cooperativeness and achievement: Interaction of student cooperativeness with cooperative versus competitive classroom organization. *Journal of School Psychology, 25*, 355-365.

Wolins, L. (1982). *Research mistakes in the social and behavioral sciences*. Ames, IA: Iowa State University Press.

APPENDIX A

Interaction Analysis Model (Gunawardena et al., 1997)

Type	Operation
Type I: Sharing/Comparing of Information	1. A statement of observation or opinion and agreement from one or more other participants 2. Corroborating examples provided by one or more participants 3. Definition, description, or identification of a problem
Type II: The Discovery and Exploration of Dissonance or Inconsistency among Ideas, Concepts, or Statements	1. Identifying areas of disagreement 2. Asking and answering questions to specify the source and extent of disagreement 3. Restating the participants' position, and possibly advancing arguments or considerations in its support by references to the participants' experience, literature, formal data collected, or proposal of relevant metaphor or analogy
Type III: Negotiation of Meaning/Co-Construction of Knowledge	1. Negotiation or clarification of 1) the meaning of terms and 2) the relative weight to be assigned to types of arguments 2. Identification of areas of agreement or overlap among conflicting concepts 3. Proposal and negotiation of 1) new statements embodying compromise and co-construction and 2) integrating or accommodating metaphors or analogies
Type IV: Testing and Modification of Proposed Synthesis or Co-Construction	1. Testing the proposed synthesis against "received fact" as shared by the participants and/or their culture 2. Testing against existing cognitive schema, personal experience, data collected, and contradictory testimony in the literature
Type V: Agreement Statement(s)/Applications of Newly-Constructed Meaning	1. Summarization of agreement 2. Applications of new knowledge 3. Metacognitive statements by the participants describing their understanding and that their knowledge or ways of thinking (cognitive schema) have changed as a result of the online conference

APPENDIX B

Rubric for Assessing Learner Writing (Barlow et al., 2006)

Criteria	Trait and Level
Purpose	Clarity of purpose (purpose may be argument or exposition and implicitly or explicitly stated) 1. Fails to establish purpose 2. Alternates between purposes 3. Clear purpose
Evidence-Based Reasoning	Demonstrates evidence-based reasoning 1. Makes generalizations without support or cites irrelevant evidence 2. Repeats evidence without drawing conclusion 3. Draws conclusion from evidence
Management of Flow	Manages flow in a manner appropriate to genre 1. Composed without sense of how sentences relate to each other 2. Uneven management of flow (i.e., not consistent) 3. Can be read without awareness of construction
Audience Awareness	Demonstrates audience awareness through appropriation of form, specialized language forms, or authoritative voice 1. Unclear who audience might be 2. Audience acknowledged in a token way but not consistently 3. Clear sense of audience whether general academic reader or other audience appropriate for task
Language Control	Demonstrates effective control of academic language conventions 1. Problems with grammar and syntax distract reader and detracts from overall presentation 2. Occasional problems with grammar and syntax but language does not otherwise stand out 3. Language usage impresses reader

Note. Levels within each trait essentially equate to not present (1), inconsistent (2), and consistent (3).

APPENDIX C

Survey

This survey concerns your thought and feeling about the cooperative learning activity during last three weeks. Feel free to answer these questions frankly. The result of this survey <u>does not</u> influence your grade about academic achievement at all. All contents you answer will be confidential. Record your responses by checking one blank that corresponds to your thought and feeling correctly.

1	**2**	**3**	**4**	**5**
Strongly agree	**Agree**	**Undecided**	**Disagree**	**Strongly disagree**

1.	I enjoyed this cooperative learning activity more than competition and individual learning.	**1**	**2**	**3**	**4**	**5**
2.	To work with other students in online helps me enhance interactions with other students or the instructor.	**1**	**2**	**3**	**4**	**5**
3.	To work with other students in online will help me enhance your academic performance.	**1**	**2**	**3**	**4**	**5**
4.	Before I begin this cooperative learning activity, I have already experienced and known the activity.	**1**	**2**	**3**	**4**	**5**
5.	When I perceived that I as one group member should contribute to my group activity, I participated in it actively and positively.	**1**	**2**	**3**	**4**	**5**
6.	I was able to interact with other students more positively and often because I had a complementary and interconnected role in my group.	**1**	**2**	**3**	**4**	**5**
7.	In future, it will be helpful for my learning that each group member tells me whether I work together well or not during the activity.	**1**	**2**	**3**	**4**	**5**
8.	In future, I would like to be satisfied if all group members including me get the same grade through the cooperative learning activity.	**1**	**2**	**3**	**4**	**5**

9.	I prefer online learning activities to face-to-face learning activities.	**1**	**2**	**3**	**4**	**5**
10.	I think that interactive environments using Internet are useful for my learning.	**1**	**2**	**3**	**4**	**5**
11.	I felt more comfortable with online discussion in this course than offline (face-to-face) discussion in other course.	**1**	**2**	**3**	**4**	**5**

1 **2** **3** **4** **5**

Not at all **Sometimes** **Often** **A lot** **To full extent**

12.	To what extent did you use the communication resources to complete your assignment?	**1**	**2**	**3**	**4**	**5**

1 **2** **3** **4** **5**

The minimum **Moderate** **Fullest possible**

13.	To what extent did you participate in the required group activities?	**1**	**2**	**3**	**4**	**5**

1 **2** **3** **4** **5**

Not at all **Occasionally** **Frequently**

14.	In addition to the course communications activities, did you or your group engage in external communication in relation to the assignment activities?	**1**	**2**	**3**	**4**	**5**

1 **2** **3**

E-mail **Telephone** **Face-to-face meetings**

* If you did engage in external communication, check those that apply:	**1**	**2**	**3**

APPENDIX D

The Instructors' Guideline for Teaching Students Teamwork Skills and Cooperative Learning Methods (Johnson et al., 1994)

Steps in Teaching Teamwork Skills	Teacher Actions
Step 1: Establish the need for the skills	Display in online bulletin board that the teacher considers the skills to be important. Communicate to students why mastering the skills is important.
Step 2: Define the skills	Teach students to use more effective encouraging questions such as "How would you explain the answer?" rather than "Do you agree?" to facilitate discussion actively.
Step 3-1: Guide practice of the skills (only for the "positive interdependence" Group)	Announce that the occurrence of the skills will be observed. Cue the Skills periodically. Assign specific roles to group members to ensure practice of the skills. A teacher, for example can assign the roles of reader, encourager, summarizer, and elaboration-seeker to the members of a cooperative group. The role could be rotated weekly.
Step 3-2: Guide feedback and reflection (only for the "group processing" Group)	Provide a regular time for processing. Provide a set of procedures for students to follow. Provide opportunities for positive feedback among group members.
Step 4: Repeat Step3-1 or 3-2 frequently	Emphasize continued improvement while proceeding through the stage of the skill development.

APPENDIX E

The Instructors' Guideline for Teaching Students Jigsaw 2 (Clarke, 1994; Slavin, 1995)

Stages in the Jigsaw 2 Approach	Activities
Stage 1: Introduction and Reading	1. The instructor organizes the class into cooperative groups. 2. Students receive expert topic and read assigned material to locate information.
Stage 2: Expert (facilitator) Group Discussion	1. The instructor may provide an expert room in online discussion room a set of questions to help students explore the idea in their assigned material. 2. Students with the same expert topics meet to discuss them in expert group.
Stage 3: Cooperative Group Report	1. Expert (facilitator) group members return to their teams to teach their topics to their cooperative group members. 2. During the reporting stage, cooperative group members post their questions and discuss ideas in online discussion room.
Stage 4: Integration and Evaluation	1. The instructor may ask questions to help the students reflect on how they worked together. 2. Each cooperative group submits students' achievement (writing assignment) covering topics.

APPENDIX F

The Instructors' Guideline for Teaching Students Positive Interdependence
(Johnson et al., 1994)

The Types of Positive Interdependence	Expected Activities
Goal Interdependence	Ensure that group members are responsible for: 1. All members scoring above a specified criterion when tested individually 2. The overall group score being above a specified criterion (determined by adding the individual scores of members together) 3. One product (or set of answers) successfully completed by the group
Reward/ Celebration Interdependence	Ensure that group members receive academic rewards such as bonus points added to their scores if the student achievement is scored above a specified criterion.
Role Interdependence	Ensure that group members take complementary and interconnected roles (for example, facilitator, reader, writer, editor, and organizer)
Resource Interdependence	Ensure that each group member receives only a portion of the information, materials, or other items necessary to complete a task so that the members should combine their resources to achieve their goals.

APPENDIX G

The Instructors' Guideline for Teaching Students Group Processing
(Johnson & Johnson, 1993; Johnson et al., 1994)

Steps in Group Processing	Expected Activities
Step 1: Encouraging and Introducing	Ensure that each group member gives and receives feedback on the effectiveness of taskwork and teamwork. Ensure that students and groups analyze and reflect on the feedback they receive. Help group members set a plan for improving their work. Encourage the celebration of members' hard work and the group's success.
Step 2: Giving and Receiving Feedback	Focus feedback on activities in online (not on personality traits). Be descriptive (not judgmental). Be specific and concrete (not general or abstract). Make feedback as soon as possible.
Step 3: Executing and Evaluating Group Processing	Ensure that group members submit one document, "Processing Interim Report" weekly for reporting the state of group processing. Ensure that group members are given a series of questions to discuss their effectiveness of skills as following: ("How did other group members encourage participation?" or "How did other group members check for understanding your topic?") Ensure that group members are given a group-processing question as the last question on an assignment. Ensure that group members tell one target member one thing he or she did that helped them learn or work together effectively through online discussion room. Ensure that group members write one paper about their group processing and post the paper in online discussion room one time at the end of the discussion. The paper should include the contents such as: A positive comment about each other's participation in online discussion room Summary about group processing Rating each member's performance on a series of dimension on a bar chart

APPENDIX H

The Students' Guideline for Learning Positive Interdependence
(Johnson et al., 1994)

The Types of Positive Interdependence	Expected Activities
Goal Interdependence	Group members are responsible for: 1. All members scoring above a specified criterion when tested individually 2. The overall group score being above a specified criterion (determined by adding the individual scores of members together) 3. One product (or set of answers) successfully completed by the group
Reward/ Celebration Interdependence	Group members receive academic rewards such as bonus points added to their scores if the student achievement is scored above a specified criterion.
Role Interdependence	Group members take complementary and interconnected roles (for example, facilitator, reader, writer, editor, and organizer)
Resource Interdependence	Each group member receives only a portion of the information, materials, or other items necessary to complete a task so that the members should combine their resources to achieve their goals.

APPENDIX I

The Students' Guideline for Learning Students Group Processing
(Johnson & Johnson, 1993; Johnson et al., 1994)

Steps in Group Processing	Expected Activities
Step 1: Encouraging and Introducing	1. Each group member gives and receives feedback on the effectiveness of taskwork and teamwork. 2. Students and groups analyze and reflect on the feedback they receive. 3. Group members set a plan for improving their work. 4. Encourage the celebration of others' hard work and the group's success.
Step 2: Giving and Receiving Feedback	1. Focus feedback on activities in online (not on personality traits). 2. Be descriptive (not judgmental). 3. Be specific and concrete (not general or abstract). 4. Make feedback as soon as possible.
Step 3: Executing and Evaluating Group Processing	1. Each Group should submit one document, "Processing Interim Report" weekly for reporting the state of group processing 2. Group members are given a series of questions to discuss their effectiveness of skills as following: ("How did other group members encourage participation?" or "How did other group members check for understanding your topic?") 3. Group members are given a group-processing question as the last question on an assignment. 4. Group members tell one target member one thing he or she did that helped them learn or work together effectively through online discussion room. 5. Group members write one paper about their group processing and post the paper in online discussion room one time at the end of the discussion. The paper should include the contents such as: 1) A positive comment about each other's participation in online discussion room 2) Summary about group processing 3) Rating each member's performance on a series of dimension on a bar chart

APPENDIX J

The Processing Interim Report (Johnson et al., 1994)

The Processing Interim Report (Weekly)

1. Name two things you group did well when learning together. Name one thing your group could do even better.
2. Think of something each group members did that helped the group activities be effective.
3. Write your group members how much you receive and appreciate their help about academic or social skills through this week.
4. Rate yourself from 1 (low) to 10 (high) on
    1) encouraging participation
    2) checking for understanding
    3) responding other members' questions actively
    4) facilitating interactions effectively

APPENDIX K

The Researcher's Checklist for the Instruction of Positive Interdependence
(Johnson & Johnson, 1994)

Checklist Item	Yes	No
Goal Interdependence		
1. Does the instructor inform group members that they are responsible for all members scoring above a specified criterion when tested individually?		
2. Does the instructor inform group members that they are responsible for the overall group score being above a specified criterion?		
3. Does the instructor inform group members that they are responsible for one product successfully completed by the group?		
Reward Interdependence		
4. Does the instructor provide academic rewards such as bonus points added to their scores when the student achievement is scored above a specific criterion?		
5. Does the instructor celebrate their joint success when all members reach criterion?		
6. Does the instructor inform group members that they receive a single group grade for the combined efforts of group members?		
Role Interdependence		
7. Does the instructor assign each member complementary and interconnected roles (such as reader, writer, checker of understanding, encourager of positive participation, and elaborator (facilitator) of knowledge)?		
Resource Interdependence		
8. Does the instructor limit the resource given to the group in order to combine a portion of the information or materials through the cooperation by group members?		

APPENDIX L

The Researcher's Checklist for the Instruction of Group Processing
(Johnson & Johnson, 1993; Johnson et al., 1994)

Checklist Item	Yes	No
Encouraging and Introducing		
1. Does the instructor inform each group member that they should give and receive feedback on the effectiveness of teamwork?		
2. Does the instructor inform each group member that students and groups should analyze and reflect on the feedback they receive?		
3. Does the instructor help group members set a plan for improving their work and encourage the celebration of members' hard work and the group's success?		
Giving and Receiving Feedback		
4. Does the feedback in online learning activities have the characteristics of being descriptive, specific, and concrete?		
5. Does the instructor give the feedback as soon as possible (not delayed)?		
Executing and Evaluating Group Processing		
6. Do group members submit "Processing Interim Report" weekly for reporting the state of group processing?		
7. Does the instructor give group members the questions about group-processing and their effectiveness of cooperative skills?		
8. Does the instructor have each group member tell (write in bulletin board) one target member one thing he or she did that helped them learn or work together effectively through online discussion room?		
9. Does the instructor have each group member write one paper about their group processing and post the paper in online discussion room one time at the end of the discussion?		

VITA

Name: Chang Woo Nam

Address: Department of Educational Psychology
College of Education & Human Development
Texas A&M University
704 Harrington Tower
MS 4225
College Station, TX 77843-4225

Email Address: ncw753@gmail.com

Education: Ph.D., Texas A&M University, 2008
M.A., Educational Technology, Seoul National University, 2001
B.A., Education, Seoul National University, 1999

Professional Experience: *Manager of Examination System (Lieutenant)*, Department of Human Resources, Headquarters, Republic of Korea Air Force, South Korea, 2003-2004

Instructor and Program Coordinator (*Lieutenant)*, Education & Training Command, Republic of Korea Air Force, South Korea, 2001-2003

Manager of Cyber University (Research Assistant), Sunsil Unversity, South Korea, 2000