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UNIVERSITY OF OKLAHOMA

GRADUATE COLLEGE

**THE RELATIONSHIP OF GROUP FUNCTIONS
TO ACHIEVEMENT IN COOPERATIVE LEARNING GROUPS
PERFORMING ILL-STRUCTURED PROBLEM SOLVING**

A Dissertation

SUBMITTED TO THE GRADUATE FACULTY

in partial fulfillment of the requirements for the

degree of

Doctor of Philosophy

By

**ROBERT L. WELP
Norman, Oklahoma
1997**

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A Dissertation APPROVED FOR THE
DEPARTMENT OF EDUCATIONAL PSYCHOLOGY

BY

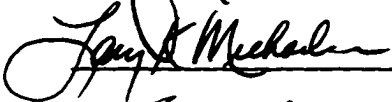
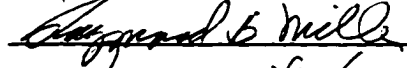
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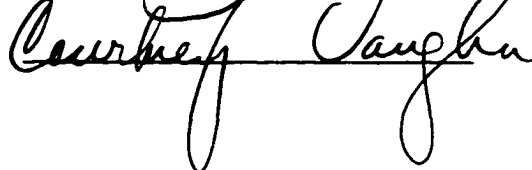
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**THE RELATIONSHIP OF GROUP FUNCTIONS TO ACHIEVEMENT IN
COOPERATIVE LEARNING GROUPS PERFORMING
ILL-STRUCTURED PROBLEM SOLVING**

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FUNCTIONS OF HIGH ACHIEVING
COOPERATIVE LEARNING GROUPS PERFORMING
ILL-STRUCTURED PROBLEM SOLVING

BY: ROBERT L. WELP

MAJOR PROFESSOR: JAY C. SMITH, Ph.D.

Cooperative learning groups have been the subject of study for nearly a century. The majority of the studies have focused primarily on either establishing the effectiveness of a particular method, or assessing the effectiveness of specific manipulations or methods within a general cooperative learning approach. No known research has sought to systematically identify the functions of effective cooperative learning groups and determine the relative contribution of these functions to achievement.

This study investigates the role goal setting, feedback, and decision making functions within cooperative learning groups play in contributing to high achievement in ill-structured problem solving. The performance of group functions of seventy-seven project groups solving ill-structured problems from within a large southwestern university were assessed at three points in time during the life of the group. Results indicate that goal setting for the overall project and for individual assignments and use of feedback increased over time. The number of personal goals decreased over time. Group functions were predictive of achievement late in the life of the group, at the third time period. Group goal setting for individual assignments, the number of personal goals in the group, and the group's decision making style were found to predict twelve percent of the variance in group achievement. Group goal setting was

positively related to achievement, while number of personal goals and a democratic decision making style were negatively related to achievement.

An analysis of the top twenty achieving groups indicates that approximately one third of these groups became somewhat more autocratic in the final time period. These groups were more likely to be polarized and less likely to have formal team leaders assigned specific responsibilities. The remaining two thirds had become more democratic, were not polarized, and were more likely to have a formal team leader.

THE RELATIONSHIP OF GROUP FUNCTIONS TO ACHIEVEMENT IN COOPERATIVE LEARNING GROUPS PERFORMING ILL-STRUCTURED PROBLEM SOLVING

CHAPTER I

INTRODUCTION

Cooperative learning groups have been the subject of study for nearly a century (Johnson & Johnson, 1989). A considerable body of research has focused on comparing achievement outcomes under cooperative versus individualistic or competitive conditions. Studies have been conducted to identify achievement differences resulting from different reward structures within cooperative conditions, various cooperative learning methods, the type of task being taught, and different group compositions (e.g., high versus low achievers, handicapped versus non-handicapped, and minority versus majority groups). Researchers have also conducted numerous studies to examine the effects of cooperative learning on student attitudes and motivation. In related research, ad hoc task groups and workplace groups have been the subject of investigation of social psychologists, industrial organizational psychologists, and communications specialists for a similar period of time and this research has contributed to a general understanding of how groups work.

As noted above, the majority of the studies conducted to date on cooperative learning have focused primarily on either establishing the effectiveness of the method, or assessing the effectiveness of specific manipulations or methods within a general cooperative learning approach. No known research has sought to systematically

identify the functions of effective cooperative learning groups and determine the relative contribution of these functions to achievement. This study examines this area and builds on two bodies of research: that which has been concerned with task performance of ad hoc and work groups, and that which has been concerned with achievement in cooperative learning groups. Specifically, the study will investigate those functions of cooperative learning groups that contribute to high achievement in ill-structured problem solving.

Research Problem

The purpose of this research is to examine the relationship between group functions and achievement for cooperative learning groups solving ill-structured problems.

Background of the Problem

The effectiveness of cooperative learning for most learning tasks has become a consistent research finding established through hundreds of empirical studies (Johnson & Johnson, 1989; Johnson, Maruyama, Johnson, Nelson, & Skon, 1981; Sharan, 1980; Slavin, 1980; and Slavin, 1983). Specifically, four meta-analyses and reviews of research studies examining the effects of cooperative learning have been reported since 1980 (Johnson & Johnson, 1989; Johnson et al., 1981; Slavin, 1980; and Slavin, 1983). Although there is considerable overlap of the studies included, these four reports represent a substantial body of research in the field of cooperative learning (41, 122, 28, and 521 experimental studies reviewed respectively). The collective findings of these four meta-analyses and reviews strongly support the conclusion that

cooperative learning conditions are generally superior to competitive or individualistic learning conditions in producing higher achievement across a range of topics, tasks, and student grade levels. Two meta-analyses (Johnson & Johnson, 1989; Johnson et al., 1981) examined the effects of cooperative learning on differing types of tasks and found that cooperative learning conditions consistently resulted in higher achievement for problem solving tasks. Although the research has been consistent in reporting higher achievement for cooperative learning groups performing problem solving, there has been limited research examining what it is that cooperative learning groups do that leads to higher achievement. Similarly, there has been little descriptive information that differentiates high achieving (i.e., successful) groups from low achieving (i.e., unsuccessful) groups.

Overview of the Research

A substantial body of research exists examining cooperative learning, ad hoc, and work groups. In reviewing the many studies related to this research, it became necessary and helpful to establish some broad categories of research variables. These are: goal setting, feedback, problem solving and decision making, decision styles (i.e., how decisions are made), and group member behaviors. Close examination of the empirical research and reviews of group member behaviors suggests the existence of a sixth category, general group functions.

Goal setting and feedback research has been conducted in both laboratory and field settings. These studies have investigated effects of goal setting, feedback, and combinations of the two treatments on both individuals and groups. When examining

groups, the studies have been concerned primarily with group performance, and particularly with group productivity as a dependent variable. Problem solving and decision making research has been conducted for several decades. There are primarily two kinds of investigations that have been conducted: quantitative studies, conducted primarily with ad hoc laboratory groups, and qualitative studies, conducted primarily through case study with intact teams. Problem solving and decision making research as it relates to this study can be characterized best by two broad lines of investigation: functions the group must perform, and methods for avoiding defensiveness and poor reasoning. Research on decision styles began in the 1960's. This research has been primarily concerned with comparing various styles of decision making to determine differences in outcomes such as the quality or correctness of the decision, the level of satisfaction expressed with the decision, and the degree of commitment to the decision expressed by subjects. Most of the studies have employed a ranking problem which does not have a clear procedure, but does have an identifiable correct answer. The various decision styles are designed to help groups more effectively share information and arrive at a correct (or at least logical) solution with which the group members are satisfied and will implement.

Based upon the studies included in the major reviews and empirical studies, research on group member behaviors has origins in the field of communications and social psychology. In recent years, military, education, and management researchers have been more predominant in exploring this area, presumably due to an increased interest in the use of groups or teams in these fields. While many of the variables

examined in this area are clearly individual behaviors, there are phenomena included (e.g., organizing time, reviewing progress, etc.) which appear to be group rather than individual functions. Thus, a sixth category of group functions captures these phenomena that have been identified, but do not clearly relate to the majority of the existing research. This category is general group functions.

Theoretical Orientation

This study is designed based upon certain theoretical assumptions and constructs which have been derived from the body of literature published on cooperative learning, ad hoc, and work place groups. Given the breadth of the research that is relevant to the study and the many perspectives possible, these assumptions and constructs are explicitly presented.

Conditions for Cooperation

Studies of cooperative learning suggest there is a great deal of variation in the conditions under which learning groups operate. Some methods are very structured, while others may simply involve assigning a task to students with the instructions to “work together.” The assumption of this study is that cooperative learning groups must meet some minimum necessary conditions in order to be considered “cooperative.” First, a portion of each student’s grade must be based on the common outcome and score of the group. Second, the group must be engaged in a task that clearly benefits from the additional resources (i.e., primarily idea, opinion, or information exchange) available from a group or could not be performed by individuals alone. Third, students must be able to discuss their task as a group.

Additional specific requirements unique to this study are provided in Chapter 3, Methodology. Social skills and group processing have not been included as a minimum condition as specified by Johnson and Johnson (1989). These latter two conditions are not fully supported by the research and do not reflect those conditions most frequently cited as necessary for cooperative work.

Group-to-Individual Transfer

Though not central to this study, the issue of group-to-individual transfer is important in cooperative learning. The question is whether or not students that work in cooperative groups master the material to the same degree as their counterparts who learn individually. In many cases, the use of a group score or grade makes it difficult to determine and compare individual achievement levels. Johnson and Johnson (1989), in a meta-analysis of 521 experimental studies, report mixed findings for group-to-individual transfer, but argue that it is more likely to occur for higher level learning tasks such as synthesis and evaluation or procedural rules and higher-order rule learning. The primary evidence in favor of group-to-individual transfer is indirect and also originates from this same meta-analysis. In the study, the authors compare 118 studies, 85 in which individual measures of achievement were used, to 33 in which group measures of achievement were used. They argue that if transfer were not occurring (i.e., only one or two members were learning), then the studies using group measures would outperform the studies using individual measures. From their comparison, the group measure studies were slightly but not significantly higher in achievement than the individual measure studies. The authors interpret this outcome

as evidence in favor of group-to-individual transfer. An assumption of this study is that given cooperative conditions are established, group-to-individual transfer will generally occur and achievement will therefore be measured based on group outcomes.

Cooperative Learning and Ill-structured Problem Solving Tasks

Related to the issue of group-to-individual transfer, is the question of which approach, cooperative or individualistic learning, is generally more effective in teaching students to solve ill-structured problems. Returning to the Johnson and Johnson (1989) meta-analysis (p. 45), the study compares mean effect sizes for cooperative, competitive, and individualistic learning conditions across a range of tasks. Task classifications are: verbal (concept attainment, verbal problem-solving, categorization, retention and memory, and composition), mathematical (spatial and analytical problem solving,), procedural (combining conceptual learning of a skill with performing the skill), and rote (decoding and correcting). The effect size comparisons are shown in Table 1. Based on these findings, cooperative learning appears to be a superior method over both competitive and individualistic learning for all except rote tasks, and the difference is of practical significance¹.

General Research Question

What functions do high achieving cooperative learning groups perform that support successful problem solving achievement and are there differences in the importance of these functions over time?

¹ Borg and Gall (1989, p. 7) state that an effect size of .33 or greater is considered to be of practical significance.

Table 1

Comparison of Mean Effect Sizes for Cooperative, Competitive, and Individualistic Learning Conditions

Type Task	Cooperative vs. Competitive	Cooperative vs. Individualistic
Verbal	0.60	0.65
Mathematical	0.60	0.65
Procedural	1.39	0.81
Rote/Decoding	0.38	-0.14

Specific Research Questions

The following specific questions, drawn from previous research on cooperative learning, ad hoc, or workplace groups, will be investigated.

1. Is there a significant relationship between goal setting and achievement for cooperative learning groups solving ill-structured problems?
2. Is there a significant relationship between the use of feedback and achievement for cooperative learning groups solving ill-structured problems?
3. Is there a significant relationship between decision making style (i.e., the method of reaching a decision) and achievement for cooperative learning groups solving ill-structured problems?
4. To what extent do goal setting, use of feedback, and decision making style predict a cooperative learning group's ability to solve ill-structured problems?

Definition of Terms

ad hoc group - a short term group (i.e., generally lasting no more than a few hours) created in a laboratory setting for the exclusive purpose of studying group behavior and/or performance.

cooperative learning - a learning situation in which a small group of students are given a learning task and in which the following conditions are met: there is a common outcome or reward for the group's outcome (e.g., common grade or score); group members must work together to achieve that outcome (i.e., the group must share resources or divide the work and the task could not reasonably be accomplished individually); and the group is provided time and the means to have face-to-face interaction (Johnson & Johnson, 1989).²

Delphi method - an idea generation and decision making process in which group members independently and anonymously generate ideas by questionnaire. Responses are summarized and fed back to the group to generate additional ideas or to evaluate the ideas. The process continues until a decision is reached (Van de Ven & Delbecq, 1974).

goal setting - the process used by a group to establish specific and challenging outcomes of their effort.

² Johnson and Johnson (1989) also include conditions specifying that the group members are taught or already possess certain social skills (e.g., leadership, communication, conflict management, etc.); and the group performs group processing. However, empirical evidence to support the requirement for these conditions is neither compelling nor extensive.

group processing - a process through which a group assesses the way it does its work to determine what it does well and what needs improvement. It generally focuses on individual behaviors that are creating conflict, causing uneven participation, or are reducing group effectiveness such as off task behavior.

group-to-individual transfer - occurs when individuals learning within a group demonstrate mastery of the material in subsequent, individual tasks. (Johnson & Johnson, 1989).

face-to-face promotive interaction - refers to providing the time and meeting facilities to permit whole group discussion of the learning task.

ill-structured problem - “. . . problems that are not clearly stated, where the needed information is not all available, there is no algorithm, and there may not be a single answer that can be demonstrated to be correct” (Frederiksen, 1984, p. 363).

nominal group technique - an idea generation and decision making process in which the following steps are used: ideas are generated individually without discussion; ideas are orally presented, clarified, and recorded without evaluation; ideas are ranked individually; and inconsistencies are resolved until a decision is reached.

performance feedback - information provided by the teacher or available to the student as a natural consequence of task performance that identifies what part of a learning task was performed correctly and completely (or to

teacher expectations) and that which was not performed correctly or completely.

process consultation - a method for diagnosing and improving group behaviors such as leadership, communication, and conflict management.

social loafing - a situation in which some group members do not exert effort on a task and instead rely on the knowledge or effort of others. The effect tends to appear and increase as group size increases and when group member contributions are not identifiable. Related to social loafing is *free riding*, in which a group member permits others to do the work, and *sucker effect*, in which a performing group member reduces effort when free riding occurs (Kerr, 1983).

Significance of the Study

While a great deal of research has been conducted on ad hoc laboratory groups and work groups, relatively little research has been conducted on the functions performed by either naturalistic or long-term cooperative learning groups. Also, no known research on cooperative learning has attempted to examine multiple functions of groups. In order for teachers to help cooperative learning groups perform effectively, researchers must explore and communicate what effective learning groups do. This knowledge can help teachers focus on establishing the right conditions and teaching the processes, skills, and behaviors that truly support achievement. Understanding what high achieving cooperative learning groups do will contribute to the development of tools to diagnose and correct problems in poor performing groups.

This study will also provide information that will help improve the understanding of what differences may exist between learning and work place groups.

In addition to the outcomes already mentioned above, there is a need for integrative research across multiple group functions. One of the issues that confounds the study of groups is the high degree of interdependence between group functions, but the general lack of integrative research. For example, the quality and usefulness of feedback to a group is in part dependent on the group's ability to set clear and specific goals (Mesch, Farh, & Podsakoff, 1994; Nadler, 1979; Nadler, Cammann & Mirvis, 1980). Goals are also thought to influence the problem solving strategies used by the group (Chesney & Locke, 1991; and Mitchell & Silver, 1990). Similarly, feedback has been reported to interact with decision style (Tindale, 1989), task performance and group coordination strategies (Mesch, Farh, & Podsakoff, 1994), and the type of task the group is performing (Conlon & Barr, 1989). Patterns of communication within groups have been found to vary dependent upon the decision making style being used. (Gouran & Geonetta, 1977; Kline & Hullinger, 1973; and Saine & Bock, 1973). It is also possible that some groups may emphasize or rely on certain functions and behaviors to compensate for lack of skill in other areas (Oser et al., 1989). Gersick (1988), Watson, Kumar and Michaelsen (1993), and Watson and Michaelsen (1988) have also observed that groups change their strategies, processes, and functions over time and at predictable points in their life. While it is not likely that the full complexity of group functioning can be illustrated or understood through a single study or even a group of studies, it is important that researchers examine multiple

functions. Examining multiple functions will help develop a more comprehensive understanding of both the unique and relative contributions of each.

Finally, to more effectively prepare students for later work experiences, educators must continue to expand their understanding of how groups effectively solve complex problems. Gibson, Ivancevich, and Donnelly (1991) believe that managers in organizations are continuously faced with solving novel problems that involve considerable uncertainty and they often must resolve these in group situations. They emphasize that, "In most organizations, decisions on such problems are rarely made by one individual on a regular basis" (p. 585). Cooperative learning offers students the opportunity to learn group problem solving and decision making skills that can improve both their immediate achievement and their performance later in work groups. As will be illustrated in the review of literature, much of the previous research on groups has been focused on lower order learning objectives such as recall, recognition, or psychomotor tasks. The intent of this study is to provide insights into the functions that contribute to higher order task performance, specifically problem solving.

The question of group functions remains an important one both for cooperative learning and workplace groups. Cooperative learning has demonstrated a great deal of potential to improve student achievement across a wide range of tasks, student populations and ages, and educational settings. These findings are likely to result in an increased use of cooperative learning. Yet, much remains to be understood in terms of how groups learn and achieve. This study examines the functions performed by

high achieving cooperative learning groups performing ill-structured problem solving tasks and seeks to identify the relative contribution of these functions to achievement.

Limitations of the Study

There are both methodological and content limitations to this study. Each area is discussed below.

Methodological Limitations

First, the population of subjects used are university students (graduate and undergraduate), and consequently, generalizations of the results to different populations or to non-university settings may not be appropriate. Second, because the study is being conducted with naturalistic groups, some potentially confounding variables were not be controlled. These include previous achievement (i.e., average grade point average of the group) and previous experience in cooperative learning groups, group size, and methods and problems associated with the different courses included in the study. Though uncontrolled, these four variables will be measured and included in the analysis to assess the amount of variance they may explain. Other uncontrolled factors such as the composition of the groups, differing amounts of help from instructors or others, and events that may occur during the course of the assignment will not be controlled and will not be measured. It is also possible that group behavior may change as a result repeated administration of the instrument to assess group functions (i.e., group functions questionnaire). Fourth, the tasks performed by the cooperative groups are ill-structured problem solving tasks requiring several weeks to complete. The results of the study should not be considered

reflective of results that might be obtained for short-term cooperative group efforts or for cooperative groups performing other types of learning tasks. Fifth, the data used in this study are self-reported observations collected through a questionnaire. While steps were taken to establish the generalizability and reliability of the questionnaire, the data are potentially subject to intentional or unintentional distortion.

Content Limitations

This study will focus on a functional approach to group problem solving and will therefore exclude many of the factors that have been reported to impact group performance. For example, group size has been investigated by many researchers and has at times been associated with differences in performance (Bettenhausen, 1991; Gist, Locke, & Taylor, 1987; Jablin & Sussman, 1983). Problem solving functions (Hirokawa, 1988; Larson, 1969; and Salazar, Hirokawa, Propp, Julian, & Leatham, 1994), discussion style (Argyris, 1993; Hirokawa & Pace, 1983; Janis, 1972), and other more general group functions (Campion, Medsker & Higgs, 1993; Watson & Michaelsen, 1988; Yager, Johnson, Johnson, & Snider, 1986) have been reported to affect group effectiveness. Researchers have also reported that group member behaviors can affect achievement or performance, and that these can change over time (Oser, McCallum, & Salas, 1989; Gersick, 1988; Watson & Michaelsen, 1988).

Group climate and cohesion are still other factors that may affect performance that will not be included, except in-so-far as they are related to goal setting, feedback, or decision making, though both have been associated with differences in performance. As described in the literature review, the preponderance of empirical

evidence on group functioning suggests that goal setting, feedback, and decision making style are most likely to have a significant impact on achievement and are likely to be related. Consequently, this study will examine only these three functions.

Finally, the body of literature published on groups originates from a wide range of disciplines and is quite extensive and diverse, and continues to grow. To obtain and review every relevant study would not only be impossible, but of limited value. Therefore, this study relied heavily on three processes for identifying relevant sources. The first was existing reviews of empirical research on groups (where available) and recent studies (also where available) as a point of departure for identifying relevant theoretical and empirical literature. Second source was discussions with researchers in the field to identify key studies and reviews. The third was focused literature searches. Given this approach, some individual studies and studies using unusual key words may have been overlooked.

CHAPTER II

REVIEW OF RELATED LITERATURE

Overview

This study will examine the relationship of goal setting, feedback, and decision making style to achievement in cooperative learning groups performing ill-structured problem solving tasks. Research related to this issue has been conducted with several populations to include cooperative learning groups, ad hoc groups, and work place groups. This review of the literature will attempt to synthesize the major findings and theories and relate these to ill-structured problem solving. Because the focus of this research is functional, this chapter is organized around the three functions noted above. The chapter concludes with a summary of the dimensions, characteristics, and behaviors related to each of these group functions.

Goal Setting

No studies could be located that specifically examined goal setting effects on cooperative learning groups. This is due in part to the fact that cooperative conditions usually involve providing groups with a common goal, often in the form of a product to produce or an assignment to complete. Therefore, the research findings presented and discussed below are based on ad hoc and work place groups.

Major Theories of Goal Setting

Three major theories of goal setting dominate the literature. The earliest of these is Locke's (1968) theory which postulates that goals are immediate regulators of human action and specific and difficult goals lead to higher performance than general

goals, given the goal is accepted. Campion and Lord (1982) propose a control systems model of goal setting in which the purpose of the system is, “to maintain congruence between the environment and the desired state of affairs” (p. 267). In the model, goals and feedback are compared to determine if a discrepancy exists. When feedback indicates the goal has been met or exceeded, goals, strategy, and effort remain relatively stable. If a discrepancy is sufficiently large, remedial action in the form of increased effort, a change in strategy, or a lowering of the goal is triggered.

Bandura (1989) integrates goal theory and research with the concept of self-efficacy to produce a model of self-regulation (see Figure 1). In the model, personal goals are established through a *feedforward control* by adopting performance standards that create a state of disequilibrium with the current status. Bandura reiterates the finding of a variety of studies that goals that are specific, difficult, and accepted all tend to enhance performance.

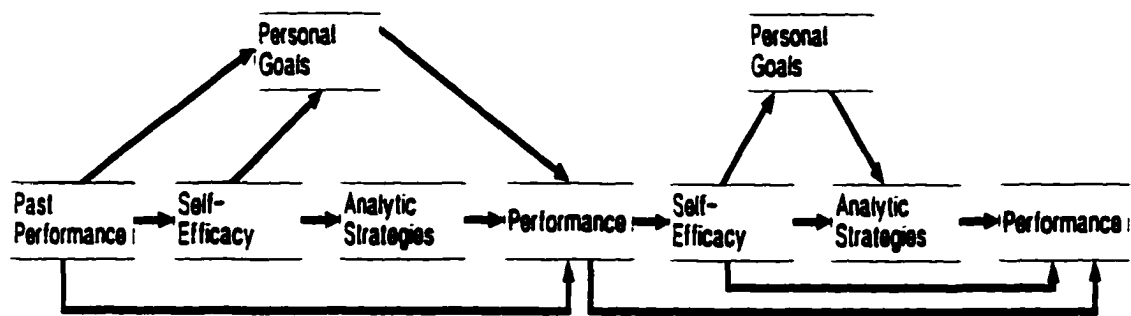


Figure 1. Model of goal setting causal structures

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In addition, Bandura asserts that proximal goals (or sub-goals) enhance performance and perceptions of efficacy by providing rising indicators of mastery; whereas distal goals are too far removed in time to serve as favorable markers.

In Bandura's model, goal setting is mediated by past performance and perceived self-efficacy. Generally, future goals will be slightly higher than previously achieved levels of performance unless feedback indicates repeated failure (note that this differs from the control systems model which asserts that when goals have been met, they remain relatively stable). A previous history of success will tend to raise perceived self-efficacy while a history of failure will tend to lower self-efficacy estimates. Self-efficacy (or inefficacy) also affects the personal goals selected as well as the level of effort and perseverance that will be exhibited. High self-efficacy leads to higher goals and greater perseverance in the face of failure.

Bandura also contends that goal orientation plays a part in goal setting. Goal orientation relates to the meaning that is given to the goal and its accomplishment. In a *learning goal orientation*, a student seeks challenging tasks to enable incremental improvement; and errors are regarded as natural while easy successes are considered boring. In a *performance goal orientation*, students tend to select very easy or very difficult tasks and avoid challenging tasks. Challenging tasks are avoided because the fear of failure and its related consequences (e.g., exposure of deficiencies, punishment, social evaluation of incompetence, etc.) overrides interest in the challenging aspects of the task. Bandura cites previous research that indicates a learning goal orientation enhances the student's ability to cope with failure over a performance goal orientation.

Overview of Empirical Research

No reviews or meta-analyses of the effects of goal setting on groups could be located. Latham (1990) provides a review of goal setting in human resource management, which includes both individual and group studies. Several studies have indicated that the effect of goal setting on groups is to improve performance (Becker, 1978; Latham & Yukl, 1975; Pritchard, Jones, Roth, Stuebing, & Ekeberg, 1988; Weingart & Weldon, 1991; Zander, 1968). Given the lack of reviews specifically focused on group goal setting, selected individual studies and secondary source reports of findings form the basis of the following review.

Dimensions of Goal Setting

Five dimensions of goal setting are reported in the empirical research. These are: goal difficulty, goal specificity, goal participation and acceptance, group and individual goals, and task complexity and proximal versus distal goals. Each is discussed below.

Goal Difficulty

Several studies have reported that difficult goals result in better group performance than easy goals (Latham & Yukl, 1975; Locke, Saari, Shaw, & Latham, 1981; Steers & Porter, 1974; Zander & Newcomb, 1967). For example, the Zander and Newcomb study indicated that when groups raised their goals over previous performance levels, the resulting performance was significantly higher than when they maintained their past goals or set lower goals, with one exception -- when groups had consistently failed to attain their previous goals, no relation was found between goal

level and performance. Similarly, Weingart (1992) created high and low goal conditions and found that goal difficulty had a positive effect on effort and effort in turn had a positive effect on group performance. Goal difficulty was also found to have a positive effect on the quality of planning for group coordination and the amount of in-process planning performed by the groups.

Weldon, Jehn, and Pradhan (1991) placed groups in high and low goal conditions (both with feedback) and examined the effects on performance and six mediating processes: effort, planning, performance monitoring, decreased quality (i.e., reducing quality to meet quantity goals), extrarole behavior (i.e., behaviors that facilitate the performance of others or facilitate coordination), and morale-building communication. The task given to the groups was to build abstract structures from various supplies. Each group first built one structure then performed one practice session and two performance sessions under their respective conditions. The correlation between goal level and performance was not significant for session two, but was significant in session three. The high goal groups built, on average, two structures more than the low goal groups.

In correlating group processes to performance, overall the authors were able to account for 55% of the variance with three process variables: increased effort with few adjustments (i.e., less concern for quality), group planning and strategy changes, and individual strategy changes. First, the high goal groups did more planning and made more changes in their strategies than the low goal groups in both sessions two and three, and these changes were significantly correlated with performance in session

three. Second, the high goal groups did not exhibit differences in effort or individual performance strategies in session two, but these were significantly higher in both for session three.

The authors assert that the high goal groups tested various performance plans during session two and, based on feedback, made the necessary adjustments to improve performance significantly in session three. This result is consistent with a control systems view of the effect of discrepancies, which are identified by the feedback). Another seemingly important implication is the time it took for the groups to develop and test strategies that created a performance effect. That is, had the groups simply been compared after one session, as are most ad hoc groups, no significant differences between them would have been evidenced. Interestingly, the groups were aware that they would be performing two structure building sessions and the high goal groups may have intentionally devoted the first session to testing strategies that might not have been used had they been performing only once. The implication of this finding is that goal setting effects on performance may be mediated by feedback and practice as well as strategy planning. Such an effect can only occur over multiple trials, suggesting that single event research on groups would be unable to detect such a relationship.

Goal Specificity

Several studies have reported that specific goals have led to better group performance than unspecified, vague goals (Cohen, 1959; Latham & Kinne, 1974; Steers & Porter, 1974; Ishida, 1980; Watson, 1983, as cited in Matsui, Kakuyama, and

Onglatco, 1987). In addition, several reviews and meta-analyses examining both individual and group goal setting have reported higher performance for specific goals (Latham & Yukl, 1975; Locke, Saari, Shaw, & Latham, 1981; Mento, Steel, & Karren, 1987; Tubbs, 1986). For example, in the Latham and Kinne study, 20 pulpwood logging crews were matched on performance and placed in goal setting versus control conditions over a 14 week period. The goal setting condition consisted primarily of training that focused on teaching the crews to set specific rather than general goals. Production measures, turnover, absenteeism, and injuries were dependent variables. Production was significantly higher for the crews trained in goal setting. Absenteeism was significantly higher in the control group. There were no differences between the groups in turnover rate or injuries. Latham (1990) reviewed twenty-four field experiments involving a wide range of settings and tasks (e.g., key punch operators, clerical workers, sales personnel, engineers and scientists, ship loaders, truck drivers, etc.), some of which included groups, and reported that “all found that individuals who are given specific, challenging goals either outperformed those trying to do their best or else surpassed their own previous performance when they were not trying for specific goals” (p. 186). Seven correlational studies also supported these results.

Despite fairly consistent reports of positive effects related to specific and difficult goals, it is not clear whether these effects can be generalized to ill-structured problem solving. Most of the tasks used in goal setting studies have been procedural. This reduces uncertainty in setting goals because the group has a history of task performance, their methods of performing the task are usually well understood, the

desired outcomes are known, and individual responsibilities are often clear cut. Also, many of the tasks involve pooled interdependence (outcomes are the sum of individual work) rather than reciprocal interdependence (individual effort is highly interactive and variable), which is more characteristic of problem solving. In short, goal setting for procedural tasks may have as a primary effect an increase in effort. Ill-structured problems are not procedural; in fact, part of the solution may include the search for or development of a procedure. Also, ill-structured problems, by their very nature, are reciprocally interdependent. It is not possible to pool outcomes since it is not clear at the outset what would be pooled.

Hirst (1988) conducted a study specifically to examine differences in intrinsic motivation as a result of goal setting under two conditions of the same task: pooled and reciprocal interdependence. Pooled interdependent tasks involve simple summing of individual contributions and are usually less complex to perform than reciprocal interdependent tasks. The outcome of reciprocal interdependent tasks cannot always be traced to individual efforts. The author found that specific and difficult goals increased intrinsic motivation for pooled interdependent tasks, but decreased intrinsic motivation for reciprocal interdependent tasks. Similarly, general “do your best” goals increased intrinsic motivation for reciprocal interdependent tasks, but decreased intrinsic motivation for pooled interdependent tasks. Task performance was not examined.

Specific goals appear to stimulate strategy planning and in-process strategy changes (Hackman & Morris, 1975; Shaw, 1981) which contribute to better problem

solving performance. However, the results of the Hirst study suggests that while setting specific and difficult goals may be effective for some tasks, its effectiveness for ill-structured problem solving, which is usually a reciprocal interdependent task, is not consistent. In fact, it may not be possible in many cases for groups to form specific goals when there is uncertainty about the nature of the problem. Establishing general "do your best" goals may be more effective.

Finally, if cooperative learning groups performing ill-structured problem solving do set specific and difficult goals for themselves, they may do so differently than work groups. It is possible that goals in a learning setting are oriented more around completing of a set of required products, learning how to solve problems or achieving a particular score, grade, or minimum performance on a set of criteria used to establish the score or grade rather than an outcome that is intrinsic to the task itself (i.e., actually solving the problem).

Goal Participation and Acceptance

Locke (1968) contends that participation effects motivation only to the extent that it influences a person's goals. Latham (1990) conducted a review of studies, most of which appear to be studies of individual goal setting, to attempt to isolate the differential effects of goal difficulty and participation in goal setting.³ In the studies reviewed, many of which were conducted by the reviewing author, various controls were used to isolate participation from goal difficulty effects. The primary method

³ Note that the author does not always specify if a study examined group or individual goal setting. However, it is clear that at least some of the studies involved groups.

used initially was to assign individuals or groups to participatively set versus assigned goal conditions. These studies suggested there was a participative effect since in several cases the participative groups outperformed the assigned goal groups. What was noticed however, was that participatively set goals were often more difficult than assigned goals. Therefore, a second round of studies were conducted which controlled for goal difficulty. In these studies no differences were found between participatively set goals and assigned goals. This lead Latham to concur with Locke and conclude that participation affects performance only to the extent that it affects goal difficulty. That is, participation in setting goals tends to result in higher goals, which increases effort, and in turn improves performance.

Acceptance (or agreement) is a second aspect of the goals that is related to participation. Cartwright and Zander (1968) contend that, "If a group goal is not accepted by a significant portion of the group we should expect to find relatively poor coordination of efforts and a relatively high incidence of self-oriented rather than group-oriented task behavior" (p. 410). This would suggest that acceptance of a goal can vary among group members and in some cases may be very low among some members. Similarly, Conlon and Barr (1989) point out that social influence can create minority/majority sub-group differences in acceptance of goals that introduces conflict, particularly for assigned goals. This phenomenon would be more likely to occur when social forces are acting on a group to polarize it, such as the existence of an adversarial labor-management relationship. This type of dynamic should be less of

a concern for cooperative learning groups, though occasionally it does occur.⁴ In addition, acceptance of a group goal may be more likely when the individual is in a learning environment where the consequences of performance, particularly failure, typically are not as significant as they might be in a work environment. Overall, it would appear that participation and goal acceptance are mediators of goal difficulty and effort respectively, and both could reasonably be expected to affect cooperative learning groups.

Group and Individual Goals

Gowen (1986) compared a no-goal condition with individual goals only, group goals only, and complimentary group and individual goals on a sentence construction task. Group goals alone increased productivity 12%; individual goals increased productivity 19%; the combination of individual and group goals increased productivity 31%. Using a tower building task, Mitchell and Silver (1990) compared no goal, group goal, individual goal, and group goal plus individual goal and found the individual goal condition performed worst, significantly poorer than the other three conditions. The individual plus group goal condition performed best, but was not significantly better than the group goal or no goal conditions. Of note in this study is the fact that the researchers imposed the individual goals and increased individual performance by one group member at times inhibited the performance of other group members.

⁴ Personal conversation with L. Michaelsen regarding an explanation for three cases out of 122 cooperative learning groups in which individuals outperformed their group as reported in Michaelsen et al., 1989.

Matsui, Kakuyama, and Onglatco (1987) propose that for a control systems model of goal setting to be applied effectively to groups, both group and individual goals must be formed. Then group and individual feedback is given so that a comparison process between performance and goals can occur at each level. In accordance with control systems theory, if there is a discrepancy attempts would be made to minimize it by increasing effort (with the exception of repeated failure that results in low group or individual self-efficacy). To test this hypothesis, two-person groups were given a group goal and were asked to establish individual goals for a numerical counting task (pooled interdependence). Groups were categorized into one of four possible conditions and were given feedback based on their performance: (1) individual and group performance were at or above goal; (2) individual and group performance were below goal; (3) individual performance was at or above goal, but group performance was below goal; and (4) individual performance was below goal, and group performance was at or above goal. The results indicated that groups in categories 2, 3, and 4, as expected, improved performance after feedback, while group 1 (which had no discrepancies between group or individual goals and performance) showed no change. The findings also add weight to the argument for both group and individual level performance feedback. One limitation of the study is that the task was one of pooled interdependence between group members, which typically requires little or no interaction. Thus, it is not clear if the effect would generalize to ill-structured problem solving.

As with specific and difficult goals, setting individual goals may not necessarily be associated with effective problem solving. The empirical research does not indicate how individual goals can be established before the group has determined the actions necessary to define and solve a problem. Under such circumstances, at least two alternative explanations are possible. It may be that individual goals are formed but they are related more to process than outcome (e.g., participate in discussions, follow-through on tasks, help the group succeed, etc.). Or, specific individual goals may be formed at various stages during the problem solving process as the group decides on a strategy, individual actions or roles, and the necessary outcomes required to successfully carry out that strategy.

Task Complexity and Proximal Versus Distal Goals

Only one study could be located that addressed the effects of task complexity for group goals. Weingart (1992) examined the interactive effects of goal difficulty and task component complexity on group performance, effort and amount, quality, and timing of group planning. The task was building a structure from various materials. Goal difficulty was varied by differences in the number of structures to be built. Task component complexity was varied through differences in the number of unique acts required to build the structures and by providing a greater variety of supplies. Weingart found that goal difficulty had a direct, positive effect on performance, which was mediated by increased effort. Goal difficulty also resulted less pre-planning and more in-process planning and higher quality planning for coordination. Task component complexity affected both the amount and quality of planning performed for

use of supplies, which were higher for more the more complex task. However, planning for group coordination was lower in quality for the more complex task. In essence, increasing task component complexity resulted in focusing the group's planning efforts on supply management at the expense of group coordination. Finally, higher task component complexity lead to less effort in performing the task, but the author indicates this finding may be due to the coding scheme used for effort.

A meta-analysis of the effects of task complexity as a moderator of individual goal effects was conducted by Wood, Mento, and Locke (1987). They found that generally goal setting effects were strongest for easy tasks and weakest for more complex tasks. This suggests again, at least for individuals, that setting specific and difficult goals may be less effective for complex tasks such as ill-structured problem solving than less complex tasks such as simple procedural or recognition tasks.

Based on research of individual goal setting, Bandura (1989) contends that goals which are more proximal in nature will result in higher levels of motivation and performance than those that are more distal. Bandura recommends that complex tasks be broken down into sub-goals that can be more readily achieved and therefore will raise self-efficacy perceptions. It appears there is some evidence that proximal goals, created by breaking larger or more complex tasks into smaller components, are more motivating than distal goals. However, the strength of this conclusion could be increased through additional research, particularly focused on groups. In cooperative learning groups it is likely that for ill-structured problems, the teacher has already broken down the task into component parts which may be associated with a domain-

specific problem solving process such as instructional design, engineering design, counseling steps, etc. It is possible for ill-structured problem solving that groups establish specific criteria for the solution or product they produce and/or further break the steps of the problem solving process down into sub-steps that can be assigned to individuals for completion.

Feedback

Major Theories of Feedback

In 1968, Cartwright and Zander reviewed the research on groups and theorized outcomes related to feedback based on two possible results: success and failure. For success, the members are expected to evaluate the group higher, be more attracted to the group, and set higher expectations for future performance. For failure, the members should experience frustration, decrease their evaluation of the group, be less attracted to the group, set lower expectations for future performance, and engage in coping behaviors designed to minimize the negative consequences of failure (e.g., shift responsibility to others, depreciate the value of the goal, and discredit the criteria used to evaluate the group).

Figure 2 graphically displays these relationships. This view of feedback implies a kind of “rich get richer - poor get poorer” phenomenon and does not, for example, postulate that groups receiving negative feedback might be cued to problem areas or might be motivated to try harder. Note that Cartwright and Zander link the effects of feedback to the goals (both explicit and implicit) formed by the group. That is, they argue that if a group has a clear operational goal that is accepted, the members

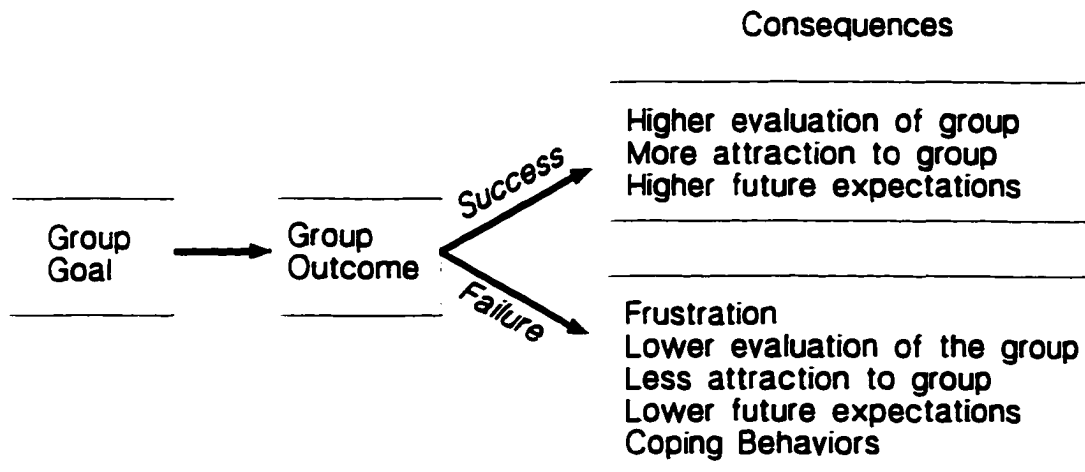


Figure 2. Cartwright/Zander model of group feedback effects

will tend to evaluate the group in relation to the degree to which the goal was met and will evaluate each other in relation to individual contributions to goal attainment. The model does not address individual feedback within the group.

In 1979, Nadler proposed a model for the effects of group feedback which was based on a previous model of group performance developed by and Hackman and Morris (1975) and a review of 34 studies on the effects of feedback (see Figure 3). In addition, Nadler drew several conclusions about the relationship of factors within the model. First, feedback has a direct effect on group behavior through cueing, and the most significant moderator of this effect is the interaction between aggregation level of the feedback and structure of roles within the group. Specifically, when individual performance is not clearly identifiable, group feedback may provide incorrect cues. Second, the motivational effects of feedback are much less clear and interact with the process of using feedback (i.e., goal setting), individual differences, group task

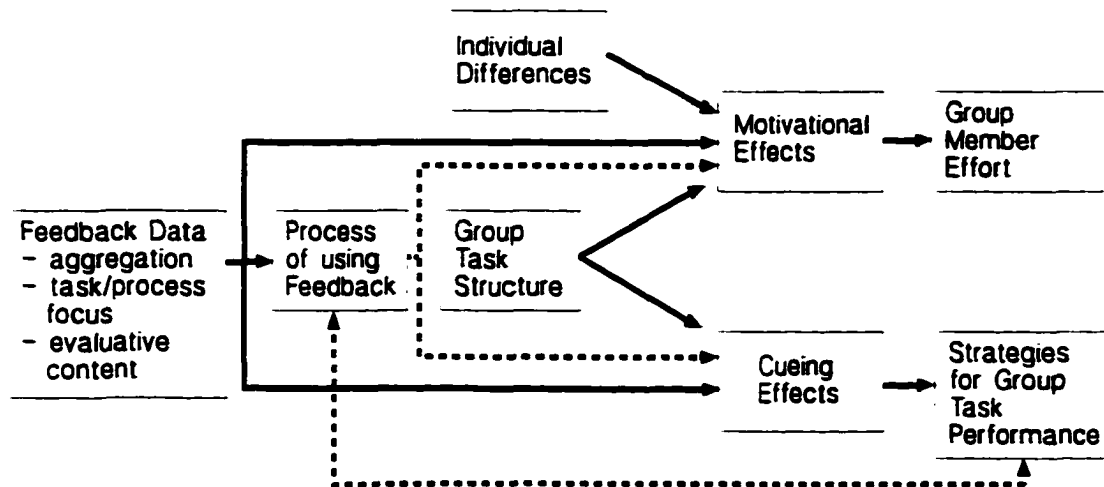


Figure 3. Nadler's Model of group feedback effects (© Copyright Academic Press)

structure, and the evaluative nature of the feedback. Outcomes that are affected by feedback include: level of attraction to the group, degree of task directed motivation, level of participation, task performance, coping behavior, and group structure.

Nadler reached several other specific conclusions about the effects of feedback. Group feedback is most effective when the task is more interdependent and roles are more differentiated. Process (i.e., primarily group social interaction) feedback tends to serve a cueing rather than motivational function and is more effective if it includes behavioral models or information. Evaluative feedback tends to have negative effects on group functioning and can induce defensive attributions. Individuals who are highly achievement oriented are less sensitive to "feeling" oriented group level feedback, more aware of individual level and task oriented feedback, and respond more favorably to negative feedback than others. This latter conclusion would appear to be related to Bandura's assertion that individuals with high self-efficacy (the belief

that one can learn and perform a task) and learning orientations cope better with failure (see discussion of Bandura under goal-setting theory).

Conlon and Barr (1989) used an experimental study of job switching in a mine to create a framework for examining the research on group feedback and identify the types and mediators of group feedback. Based on the authors' analysis of the job switching experiment, they concluded that three types of feedback are inherent in a group experience. The first is *intrinsic feedback*, that which originates from direct experience with performing the task. The second type is *aggregated feedback*, (i.e., group), which is performance data provided to the group(s). The third type of feedback is responses of other group members, or *socially mediated outcomes*, as the authors refer to them. The authors argue that this level of complexity of feedback exists in naturalistic settings but has not been captured in previous studies. From this foundation the authors reviewed the existing literature and identified five phenomena that mediate the relationship between feedback and subsequent performance and motivation. For the most part, these mediators decrease motivational effects associated with the feedback.

Confounding of Aggregation of Feedback

The first mediator is *confounding of aggregation of the feedback*. This phenomenon occurs when individuals receive only group feedback and incorrectly draw conclusions about individual performance from group performance. The phenomenon interacts with task structure in that tasks with low interdependence require group plus individual feedback to prevent distortions, while tasks with high

interdependence require group feedback and public individual feedback to prevent distortions.

Social Loafing

The second mediator is *social loafing* (group members letting other members do the work). This mediator also interacts with task type and the requirements the task places on the need for feedback. Aggregated feedback is adequate for all unitary tasks (i.e., non-divisible) except for two types. The first are tasks where group performance is determined by the highest performing member. In this case, low performers do not receive feedback and are therefore not motivated to improve, (e.g., simple math tasks). The second are additive tasks where the group size is so large that individual contributions get lost (e.g., tug of war). In both of these cases, individual, public feedback is required. Individual feedback is also required for divisible tasks and for promoting non-interdependent individual behaviors.

Social Influence

The third mediator is *social influence*. This occurs when individual feedback is available, particularly if the feedback is public, and individuals in the group form judgments about each other on the basis of that feedback. This can result in the formation of majority and minority groups, which exert influence (persuasion or punishment) on each other to adopt their position or level of effort (e.g., high or low performance). For example, when students can see the feedback given to all other students, it is easy to compare performance. Social influence would occur when the students receiving low scores would label students receiving high scores as “teacher’s

pets” and try to get them to work less. Or, conversely, the higher performing students might label the low performing students as “goof-offs” and try to get the lower performing students to improve. The relative size of the sub-groups is the primary determinant of the degree of influence exerted. For example, a single individual in the minority versus several in the majority should expect to experience a great deal of social influence or “peer pressure.”

Equity

The fourth mediator is social comparison or *equity*. This occurs when individual feedback is available, particularly if the feedback is public, and individuals in the group form judgments about the fairness of that feedback. Equity judgments may interact with social influence and may in turn be affected by the distribution or “mix” of feedback to the group. Essentially, when feedback to individuals in a group varies, the individuals compare this feedback and check for inequities. For low performance feedback, the feedback may be addressed by improving performance or by discounting or distorting the feedback. If there is high confidence in the feedback comparisons because they appear equitable, discounting and distortion should be used less frequently. While Conlon and Barr do not address the issue specifically, one could speculate that if there is low confidence in the feedback (i.e., the source is not credible), then the feedback might be distorted or discounted, thus blunting or misdirecting its cueing and motivational effects.

Cooperation Problems

The fifth interfering phenomenon is *cooperation problems*. This occurs when there are sub-tasks within the group that are interdependent and individuals performing these focus exclusively on optimizing the performance of the sub-tasks, lose sight of the group's overall performance, and fail to adequately cooperate in their efforts. The authors suggest that aggregate feedback can reduce cooperation problems.

From their review and analysis, Conlon and Barr drew several conclusions about group feedback. First, supplementing group feedback with individual feedback can improve performance by reducing effects of confounding and social loafing. However, individual feedback introduces social influence and equity effects that can reduce performance and cause conflict. Aggregate feedback can increase cooperation by reducing the effects of sub-goal optimization for interdependent sub-tasks. The implications of these mediators for cooperative learning approaches to ill-structured problem solving are that there may need to be increased emphasis on group feedback and group scoring. This would tend to focus individual efforts on coordinating their actions to maximize the group's performance over individual performance. If ill-structured problem solving were simply the sum of non-interdependent individual tasks, then emphasis on individual feedback and scores would be expected to maximize the group's effort.

Overview of Empirical Research

In 1968, Locke, Cartledge, and Koeppel wrote after reviewing 51 studies on individual feedback, "The facilitative effect of knowledge of results (KR) upon

learning and performance is one of the best established findings in the research literature” (p. 474). Research on the effects of feedback in groups is not quite so substantial, but is increasing as evidenced by recently published studies by Archer-Kath, Johnson, and Johnson (1994), Barr and Conlon (1994), and Mesch, Farh, and Podsakoff (1994). In reviewing the literature on feedback effects on groups, the most comprehensive study to date is that of Nadler’s (1979). However, reviews have also been conducted by Cartwright and Zander (1968), Conlon and Barr (1989), and Kaplan (1979). In addition, numerous experimental feedback studies have been published either as a part of the group feedback line of research or as a part of goal setting research.

In general, the experimental studies have focused on task (rather than learning) groups, though the distinction between the two is often difficult to pinpoint except in those situations where the study was conducted in a work site. The studies that have examined feedback effects on cooperative learning groups have focused primarily on the effects of process feedback (e.g., communication, participation, or helping behaviors). No studies could be located that examined the effects of performance feedback on cooperative learning groups. The lack of a research base in this area may be due to two reasons. First, there appears to be a considerable amount of research on individual feedback effects and effects of feedback on work groups, which when coupled with research on individual feedback for instructional purposes, may be blunting an interest in exploring feedback in learning groups. Second, the theoretical

differences between those that do and do not advocate process feedback for learning groups may have focused the interests of researchers in this direction.

Dimensions of Feedback

Seven dimensions of feedback are reported in the empirical research. These are: feedback sign, evaluative nature, feedback source and credibility, process feedback, group versus individual feedback, specificity, and delay. It may be important to note that the majority of the studies on feedback have involved short-term, ad hoc groups rather than long-term, intact groups. Thus, the feedback effects reported generally do not examine or illustrate how repeated applications of feedback might effect groups over time.

Feedback Sign

Feedback sign is information within the feedback that indicates whether or not the standards of performance were met. Feedback sign may be positive, indicating the goal or parts of it were achieved; or, it may be negative, indicating the goal or parts of it were not achieved. Sign information does not convey evaluative information such as “good,” or “poor.”

DeNisi, Randolph, and Blencoe (1982) examined aggregation, source, and sign of feedback on groups performing two truck routing tasks in a mock work setting. Using a 2x4 design, individuals received group and individual feedback (pos/pos, pos/neg, neg/pos, and neg/neg) from peers or the supervisor. Eighteen dependent variables included cohesion, motivation, attractiveness, interaction, objective performance, perceived performance, and group member perceived performance.

Main effects for feedback sign were obtained for all dependent variables except objective performance. While not significant, objective performance was best after mixed feedback and poorest after positive/positive or negative/negative feedback. Effects of feedback source and how it interacts with feedback sign is presented in a later section.

Mesch, Farh, and Podsakoff (1994) manipulated feedback to groups performing two trial periods for a word recognition task by telling them after the first trial that their performance was either above (i.e., positive sign feedback) or below (i.e., negative sign feedback) a fictitious average score. The feedback was given as descriptive in nature and did not include an evaluative element. The groups receiving negative sign feedback differed significantly from those receiving positive sign feedback in the following ways. First, negative sign feedback groups outperformed positive sign feedback groups on the second trial of their task. Negative sign feedback groups were significantly less satisfied with their performance and set higher goals than positive sign feedback groups. Negative sign feedback groups also spent more time discussing strategy and developed significantly more strategies for improving than positive sign feedback groups. Path analysis indicated that feedback sign and prior performance had a significant effect on subsequent performance through its impact on group goals.

In a test of equity theory, Barr and Conlon (1994) investigated the effects of positive and negative sign feedback at the group and individual level and the distribution of feedback on intentions to persist with job rotation in a simulation task.

Feedback was given to individuals in three-person groups in two ways. In the first, two group members (i.e., the majority) received positive sign feedback and one group member (i.e., the minority) received negative sign feedback. In the second, the majority of the group received negative sign feedback and the minority received positive sign feedback. Their findings, summarized below, suggest that how feedback is distributed interacts with sign of the feedback to affect group members intentions to persist. When group feedback was positive sign, group members expressed significantly higher intentions to persist with their decision than when group feedback was negative sign. Individual intentions to persist however, were affected only when group feedback was positive. When the feedback given to the group as a whole was positive, individuals in the minority feedback (regardless of sign) expressed significantly lower intentions to persist with their decision than those receiving majority feedback and those in the majority receiving positive feedback had higher intentions of persistence than their counterparts in the minority.

Snyder, Lassegard, and Ford (1986) examined the effects of positive and negative sign feedback and no feedback on group affiliation. The feedback given was norm referenced to a national standard (30th percentile for failure and 90% percentile for success) and to previous groups at the university. For example, failure groups were told their score was, "one of the lowest that any group tested at the University of Kansas had received." Success groups were told their score was, "one of the highest that any group tested at the University of Kansas had received" (p. 385). Self-report and behavioral measures of distancing from the group were collected. Those groups

receiving negative sign feedback scored significantly higher on distancing for both self-report measures and behavioral observations than those receiving positive sign feedback or no feedback.

In general, positive sign feedback appears to affect persistence, satisfaction, cohesion, and efficacy positively, but has little effect on goal difficulty or strategy formulation. Negative sign feedback appears to have a positive effect on strategy reformulation, and effort, and a negative effect on cohesion, efficacy estimates, and satisfaction. Generally, future goals will be the same or slightly higher than previously achieved levels of performance following success, but are unpredictable following failure. Repeated negative sign feedback generally reduces the group's estimate of efficacy, and may lead the group to set very high or very low goals, with the tendency being to set very low goals (Zander, 1968). For example, Zander (1974) summarizes a study of groups that had repeatedly met goals versus those that had not. The author reports that the members of the failing groups, "worked longer hours, enjoyed work less, had less pride in their organization and in their personal efforts, blamed others more, and generally did not accept their goals" p. 100. Similarly, Campion and Lord (1982) report that for individuals, initial failure to reach a performance standard leads to greater effort, but repeated failure leads to giving up the standards. Deci (1972) points out that when there is enough negative feedback to threaten an individual's sense of competence and self-determination, intrinsic motivation is reduced. These effects could provide an explanation for the positive effects of mixed sign feedback reported by DeNisi, Randolph, and Blencoe (1982).

Given the potential effects of repeated negative feedback on individual and group estimates of efficacy, cohesion, and satisfaction, the implications are that some positive feedback is required for a group to persist, set realistic goals that are accepted, remain cohesive, and for individuals to derive a sense of satisfaction from the group's efforts.

Evaluative Feedback

Evaluative feedback is information the group receives that indicates a judgment about the group's performance such as "good" or "poor," or may involve reward or punishment for certain outcomes. Nadler (1979) reviewed eleven studies examining evaluative feedback effects on a range of outcomes including performance, defensiveness, and group structure. Most of the research has focused on the effects of negative evaluations. Nadler concluded that the results of evaluative data (particularly when negative) were to create defensiveness and other coping behaviors, increase external attributions to other group members of causes outside the group, reduce the attractiveness of group members, and result in lower goals than groups receiving favorable feedback. Individuals may respond with less defensiveness to negative evaluations when the feedback is aggregated (i.e., given at the group level) rather than individual. In general, there was little support for any positive effects of evaluative feedback. One exception to this was a study finding by Berkowitz, Levy, and Harvey (1957) who reported that groups high in initial motivation responded with more task oriented behavior after an unfavorable evaluation than low motivation groups, who responded better to a positive evaluation.

Binning and Lord (1980) investigated the effect of fictitious performance ratings on cohesiveness, influence, communication, conflict, motivation, satisfaction, and other perceptions. Groups worked three tasks and then were given performance feedback on each. The feedback was manipulated in such a way that four possible types of evaluations could be received: poor, poor, poor; poor, good, poor; good, poor, good; or good, good, good. A group atmosphere and attributional questionnaire was administered. While none of the groups differed in actual performance (as predicted), significant differences were found for 14 of the 23 measures, with three at marginal significance ($p < .08$). These included cohesiveness, perceived influence, communication, perceived motivation of other group members, and self and other ratings of ability (i.e., efficacy).

A linear trend analysis relating the degree of positive feedback to the outcome measures indicated that in 18 cases the linear trend was significant. The authors concluded that evaluative feedback not only creates distortion in perceptions of the group, but that as the feedback becomes more favorable so do group member assessments. The authors caution that in a laboratory setting, feedback may take on heightened clarity and importance that is greater than in field settings.

In general, the effects of evaluative feedback on groups appear to be focused on the social dynamics and motivation of the group rather than directly on group performance. Positive evaluative feedback tends to have a positive effect on group perceptions, while negative evaluative feedback tends to have a negative effect. Group member attraction, efficacy estimates, perceptions of other group members'

motivation, performance attributions, and defensiveness are all reportedly affected by evaluative feedback; and, the effects are generally negative for negative evaluations. Nadler found an exception to this to exist when group members are very high in achievement motivation (versus affiliation or power motivation). These groups have been observed to respond to evaluative feedback with greater effort, at least initially. One question that remains unanswered is the long term effects of evaluative feedback.

The anticipated role of evaluative feedback in cooperative learning groups performing ill-structured problem solving would be minimal. First, teachers (as opposed to supervisors of groups) would be expected to be more cognizant of the effects of feedback and, when using evaluative feedback, would be expected to use primarily positive evaluations. Also, teachers would be expected to use scoring systems supplemented with descriptive comments to convey feedback, which would minimize the use of evaluative feedback.

Feedback Source and Credibility

Only one group study was found that addressed the source and/or credibility effects of feedback. DeNisi, Randolph, and Blencoe (1982) examined aggregation, source, and sign of feedback on groups performing two truck routing tasks in a mock work setting. Dependent variables included cohesion, motivation, attractiveness, interaction, objective performance, perceived performance, and group member perceived performance. Results indicated that peer feedback had a greater effect on all dependent variables except objective performance. Interestingly, the only conditions

that improved objective performance were negative sign individual feedback from peers and negative sign group level feedback from the supervisor.

In related research on the effects of individual feedback, Podsakoff and Farh (1989) found that subjects who received more credible negative feedback set higher goals and performed at higher levels than subjects who received less credible negative feedback. The same effect was not found for positive feedback. Greller and Herold (1975) found that individuals rely to a greater extent on intrinsic sources (i.e., those that are psychologically close) than those that are more extrinsic (i.e., those that are psychologically distant) for feedback information on the job. Johnson, Johnson, Stanne and Garibaldi (1989) found evidence that in cooperative learning groups negative sign process feedback is most effective when the individual feedback is delivered by group members and group feedback is delivered by a teacher. Ilgen, Fisher, and Taylor (1979) reviewed the research on individual feedback and concluded that interpersonal sources of feedback must be credible and trustworthy to be effective. The individual must also believe that the feedback is in response to his or her own actions, not that of technology or of others' efforts. Cusella (1982) found that sources judged high in expertise gave feedback that resulted in higher levels of intrinsic motivation than low expertise sources, regardless of feedback sign.

Though no definitive conclusions can be drawn, it appears that feedback given from sources considered credible, expert, and/or psychologically close can affect motivation and performance positively; and, this effect may be more pronounced when the feedback is negative sign.

Process Feedback

In general, the literature uses the term *process feedback* to refer to feedback on the way the group does its work. It typically focuses on a class of individual group member behaviors oriented around communication, participation, social skills, helping or supporting and/or affective elements, rather than problem solving processes. Studies examining the effects of process feedback have involved both task and learning groups.

In 1979, Kaplan reviewed 14 experiments on the effects of process consultation and observed, "Of the many studies reviewed, not one supports the hypothesis that process consultation promotes task effectiveness" (p. 354). Kaplan acknowledged that in some cases process consultation did result in higher group cohesiveness. The author concluded that, "Process intervention requires process problems in order to have the desired effect" (p. 355). "If there is a place for process consultation in apparently well functioning groups, it is for the purpose of diagnosing for the presence of underlying problems or for the purpose of accelerating the development of newly formed groups" (p. 358).

Johnson, Johnson, Stanne, and Garibaldi (1989) examined the effects of feedback with group discussion on selected process elements (i.e., summarizing, encouraging participation, and checking for consensus) for a cooperative learning group working on a computer simulated problem. A no feedback/no discussion control group was compared to: teacher-led group feedback and discussion, and teacher-led group feedback session followed by a student-led individual feedback and

discussion session. The dependent variables included two measures of problem-solving success, attitude variables (e.g., feelings of acceptance) and several observed interaction variables. The combination of teacher-provided group feedback and student-provided individual feedback and discussion was superior to the other conditions for five of the nine dependent variables including the two achievement variables and participation. The authors concluded that, "These findings indicate that group processing may have more impact when it occurs in small groups and members may make personalized, specific statements to each other rather than broad generalizations" (p. 514-515). Interestingly, this study combined process feedback with information describing effective models of interaction behavior as recommended by Nadler.

Yager, Johnson, Johnson, and Snider (1986) examined the effects of group processing (including identification of problematic and helpful behaviors) and goal setting for individual behaviors in third grade cooperative learning groups. A no-processing condition was used as a control. Students in the processing condition outperformed the control group on both immediate achievement tests and retention tests.

McLeod, Liker, and Lobel (1992) examined the effect of process feedback on intact undergraduate student groups (five weeks after group formation) performing two tasks: (1) an ordering task, and (2) an in-basket exercise in which actions for six items had to be completed. System Multiple Level Observation of Groups (SYMLOG) was used to guide observers in collecting and providing feedback on the

three SYMLOG bi-polar dimensions: dominance versus participation in the group, group orientation and friendly versus individual oriented and unfriendly, and emotional expression versus task-focused behavior. Performance feedback was also provided. The only significant finding reported was that the most dominant individuals tended to reduce their domineering behavior following feedback. There was no difference found between the groups in satisfaction or task performance.

Archer-Kath, Johnson, and Johnson (1994) examined individual versus group level feedback on the use of social skills in cooperative learning groups. Subjects were 56 eighth grade students studying beginning German. The authors reported that the feedback resulted in improved performance. However, close examination of the reported results suggest several problems. First, the data reported indicate that the group feedback condition actually outperformed the individual feedback condition on the final achievement test. Second, this result has a reported probability of .10 suggesting marginal significance at best. Third, a no feedback control group was not used for comparison.

After reviewing the literature, McLeod, Liker, and Lobel (1992) concluded that, generally, the literature on process interventions (e.g., feedback) finds that these interventions increase group cohesiveness and member satisfaction but have no measurable effect on task performance" (p. 17). The exception to this finding appears to be the use of process feedback or process feedback followed by discussion when used in elementary and middle school level cooperative learning groups (Johnson, Johnson, Stanne, & Garibaldi, 1989; and Yager, Johnson, Johnson, & Snider, 1986),

which has been reported to improve achievement. Individual behaviors that may be affecting group cohesiveness have been demonstrated to change as a result of process feedback and may be more likely to change when a behavior model is provided. Examples of this result are provided in a series of studies conducted on the use of videotape to provide feedback to groups (Walter, 1975; Walter & Miles, 1972; and Weber, 1971). The videotape studies have involved either viewing a videotape of a previous group discussion or, in some cases, viewing a previous discussion and a videotape of another group modeling appropriate behaviors.

Based on empirical research, the only condition under which process feedback has affected task performance has been in elementary or middle school cooperative learning groups. Process feedback has been demonstrated to affect cohesiveness and certain individual behaviors, particularly when information about or models of desired behavior are provided and individual level feedback is available.

Group Versus Individual Feedback

Nadler (1979) examined nine studies and concluded that group feedback generally impacts group attraction and group esteem rather than performance and individual feedback impacts individual behavior. Overall, the author concluded that a combination of individual and group feedback is most effective in improving group performance. For example, in a study reviewed by Nadler, Zajonc (1962) examined a pooled interdependence task involving individual reaction time to lights appearing on a console under a variety of group and individual feedback conditions. The author found that individual and group performances were best when individuals had

knowledge of the group's performance, their own performance, and the performance of other group members. Nadler also concluded that group feedback is more effective when the task is more interdependent and differentiated roles exist for group members. Individual feedback is more effective when the task involves pooled interdependence.

Conlon and Barr (1989) contend that individual feedback has the potential to introduce social influence and equity effects that reduce performance, but is nonetheless necessary for most tasks to prevent confounding and social loafing. Similarly, Weldon and Mustari (1988) examined individual performance in groups performing an additive task under conditions of monitoring individual performance (i.e., individual performance was known to the group) versus anonymity. Group members who made identifiable contributions contributed more than those contributing anonymously. Group feedback was most appropriate to prevent goal sub-optimization. Three additional studies (described below) were located that examined individual versus group feedback which were not included in these reviews.

Matsui, Kakuyama, and Onglatco (1987) conducted a study to examine the effects of feedback sign for group and individual feedback. Student pairs were given a goal for a visual perception task and were then asked to establish individual goals. Halfway through the task the subjects were given group and individual feedback on their performance relative to their individual and group goals. Subjects were then categorized into one of four groups dependent on the combination of feedback given: group positive, individual positive; group positive, individual negative; group negative, individual positive; and group negative, individual negative. The authors

found that performance improved in all cases where at least one element (i.e., group or individual) of the feedback was negative sign. A couple of the findings are worth emphasis. First, when feedback indicated that individual performance was below target, group performance improved even if the group feedback indicated they were at or above goal levels. Subjects who were at or above goal continued to improve even when they learned that their more capable partners had performed poorly. Finally, group performance improved when one individual performed below individual goal level even when group feedback was positive. The study indicates that both individual and group feedback can affect performance, and adds weight to the argument that negative sign feedback increases effort. The authors concluded that combining group and individual feedback was effective in eliminating both social loafing effects of *free-riding* (i.e., allowing others to do the work) and the *sucker effect* (i.e., reducing effort when others are thought to be free-riding, thus avoiding being a sucker). There are, however, at least two limitations in generalizing the findings of this study to cooperative learning groups solving ill-structured problems. One is its use of ad hoc groups, which cannot illustrate the effects of feedback or goal setting over time. The second is the use of a pooled interdependent task, in which member contributions are clearly identifiable.

The Archer-Kath, Johnson, and Johnson (1994) study described earlier also examined differences between individual and group feedback. The authors report that individual feedback conditions resulted in increased use of the targeted skills, higher levels of intrinsic motivation, greater liking of classmates, greater satisfaction with

cooperative learning and the subject matter, and higher achievement. However, the weaknesses of this study described earlier make the conclusions questionable.

DeNisi, Randolph, and Blencoe (1982) examined aggregation, source, and sign of feedback in a study described earlier. Individual level feedback generated more significant results than group feedback; however, objective performance of the group was not significantly different.

Based upon theory and empirical results, individual feedback appears to serve two main purposes in groups. First, it has a cueing effect by providing information about individual contributions in relation to other group members and to the overall group effort that permits the group to identify individual performance shortfalls. It also has a motivating effect to resolve discrepancies between anticipated and actual performance. From a control theory perspective, individuals will have increased motivation when their performance is below an accepted goal level. Social influence is a second motivating effect that occurs when group members exert influence on each other to minimize performance differences and achieve group goals. In many cases this results in pressure to improve.

A question that remains is whether or not individual feedback has the same effect for ill-structured problem solving. As discussed earlier regarding individual goal setting, individual feedback may be difficult to obtain and use for ill-structured problem solving. The effectiveness of individual feedback when solving problems very likely depends upon whether or not individual goals are established (in fact, if they can be established), the nature of those goals, and whether or not group members

provide feedback to each other, since it would be very difficult for an instructor to identify individual contributions.

Group feedback appears to have similar cueing and motivational effects. First, it has a cueing effect by providing information on the magnitude and nature of differences between anticipated and actual group outcomes, which provides a basis for changes in strategy or effort. This information, as Conlon and Barr (1989) report, can be used to identify and correct coordination problems that arise when divisible tasks are performed. Second, it affects motivation directly by indicating whether or not the goal has been met. Except in the case of repeated failure or negative evaluations, a performance shortfall will tend to motivate the group to exert more effort, increase its search for strategies, and it may even cause the group to raise its goals. However, a performance shortfall decrease task persistence, satisfaction, and cohesion. Achieving or exceeding the group goal will tend to increase the group's satisfaction, cohesion, efficacy estimates, and persistence on the task. Goal accomplishment may also result in a modest increase in goal level. Group feedback affects motivation indirectly through the social dynamics of the group. It can increase cooperation by emphasizing group outcomes and effort over individual outcomes and effort. Goal accomplishment generally affects these outcomes positively, and thus success tends to lead to increased cohesion and satisfaction within the group.

Feedback Specificity

Surprisingly, no studies could be located that examined the effects of feedback specificity for groups. Hypothesizing about the possible effects of feedback

specificity, it might be expected that it would be related to confounding and social loafing (provides more information on individual versus group effort), defensive reactions (specific cues reduce the possibility of distortion and the plausibility of attributing performance to alternate explanations), cueing (specific information more precisely pinpoints performance problems), equity (specifics are easier to test for credibility and fairness than generalities), and efficacy (specific feedback more precisely indicates how close the group is to achieving the goal). Given the potential for such widespread effects, this area would benefit from research.

Feedback Delay

One study was located that examined the effect of feedback delay on group performance. The task was a training simulation of a firefighting task and required receipt of feedback from subordinate units, assessment of the situation, and decision making/delegation of authority back to subordinate units (Brehmer and Allard, 1991). Feedback delay resulted in poorer performance than no delay. Since the task used is performed continuously over a period of time and feedback is required to perform effectively, this single study should not be generalized. It does not address situations in which the task is completed in its entirety and then feedback is received, the task must be broken down into discrete sub-tasks, or the task can be redone on the basis of feedback, as is often the case with ill-structured problem solving in learning settings. Additional research is required to understand the effects of feedback delay on group performance.

Decision Making Style

A variety of decision styles available to groups engaged in problem solving have been examined. These include voting, ranking, averaging, leader-decision, sub-group decision, best-member decision, Delphi method, nominal group technique, consensus, unanimity, and combinations of these. Outcomes that have been examined include quality, efficiency, satisfaction, and commitment. The decision styles vary along several dimensions, most notably the scope of the decision making or problem solving steps included (i.e., problem definition, idea generation, solution formation, evaluation, and selection). For example, voting can be used for selection of a solution, but not for idea generation; while nominal group technique can be used for virtually all steps. Figure 4 summarizes several studies examining group decision making style. For each study, the decision styles compared, and their absolute rank in terms of quality, is shown.

Beyond the variation in the number of problem solving steps supported, a review of decision making styles suggests they also differ on three important dimensions. The first is the number of group members required to agree in order to reach a final decision (e.g., everyone agrees on one solution; most agree with the solution; one person, the leader or selected group member, makes the decision; etc.). Second, is the approach to interaction that occurs prior to the decision (i.e., no interaction, structured interaction, guided interaction, or unstructured interaction). Third, is whether or not an individual decision (or expression of opinion) is made prior to the final group decision.

Author(s)	Type Task	Decision Style										
		Delphi method	Normal group technique with interaction	Normal group technique no interaction	Individual decision + group decision	Maj vote + consensus	Individual decision + consensus	Majority vote	Best member	Sub-group decision	Average	Leader decision
Barnlund	30 logic problems				1			2	3		4	
Hall & Williams	logic problem				2		1(•)					
Hall & Watson	ranking problem				2		1					
Nemiroff & King	ranking problem				2		1					
Holloman & Hendrick	logic problem					1	2	3		4	6	5
Miner	ranking problem						1		1		2	
Michaelsen, Watson & Black	84-101 intellectual skill problems				1				2		3	
Yetton & Bottger	ranking problem				2				1		3	
Erffmeyer & Lane	ranking problem	1	4		3		2					
Nemiroff, Passmore & Ford	ranking problem		2		3		1					
Herbert & Yost	ranking problem		1		3				2		4	
Burleson, Levine, & Samter	ranking problem			3	1				2		4	
Stumpf, Freedman & Zand	ill-structured problem		1		1							
Falk	ill-structured problem						2(••)	1				

(•) Consensus groups also received group dynamics training (••) Individual decision not made first.

Figure 4. Decision effectiveness rank for various decision styles

Number of Group Members Required to Agree in Order to Reach a Final Decision

In an early study by Barnlund (1959), four decision styles were compared on a test of 30 logic problems. The styles included individual average, best individual, majority vote, and discussion followed by group judgment (i.e., consensus). The consensus groups outperformed all other decision styles.

Holloman and Hendrick (1972) compared six decision styles on a well-structured problem. The styles included averaged decision, leader decision, two person sub-group decision, majority vote, consensus, and consensus after majority vote. Paired comparisons of means indicated that consensus after majority vote was superior to all other styles except consensus; consensus was superior to averaged decisions, leader decisions, and sub-group decisions.

Similarly, in an examination of group decision versus average individual and best member decision strategies, Michaelsen, Watson, and Black (1989) examined the performance of 222 learning teams on six multiple choice tests covering a range of organizational behavior and management concepts. The groups took each test first individually then as a group. The group was not given any particular instructions on how to interact or make the decision; however, in order to receive full credit for an item, they were required to respond as a group with a single response for each question. The authors found that groups significantly outperformed both the average individual and the best member. In fact, there were only three groups that failed to outperform the best individual member.

Burleson, Levine, and Samter (1984) also found that an uninstructed group decision, when preceded by individual decisions, was superior to the best member decision. Herbert and Yost (1979) found nominal group technique (a highly structured decision style designed to involve all group members in the decision) was superior to the group's best member performance. Miner (1984) found the group decision quality at least equal to the group's best member decision. On the other side of the argument, Yetton and Bottger (1982) reported the best member outperformed the group when the group could select the best member after group discussion and decision. Burleson, Levine, and Samter (1984) also reported higher performance for a best member decision over a group decision using nominal group technique; however, the nominal group technique used had been modified so that no interaction between group members was permitted. Though not without exception, in general, the studies suggest that the more group members that are required to agree on the decision the more likely the decision will be of higher quality.

Approach to Interaction

Some decision styles involve a normative approach to interaction in which no particular instructions are given or guidelines imposed beyond how to make the final decision. Majority vote, averaging, and group decision are examples of these. Some styles seek to control interaction primarily by limiting negative comments that might stifle idea generation and group member participation. Nominal group technique and Delphi method are examples of these. Consensus differs from these two extremes in that it includes instructions on how to approach differences of opinion and present

arguments and evaluations in order to reach agreement. It represents a guided approach to decision making. When comparing normative, controlled, and consensus approaches, consensus consistently results in better quality decisions than normative, and generally results in equal or better decisions than controlled approaches. For example, Hall and Watson (1971) compared 16 groups instructed in consensus decision making to 16 groups given no specific instructions on effectiveness in solving the NASA Moon Survival Problem (a well-structured ranking problem with a known solution, though the solution procedures are unclear). The consensus groups were given guidelines for their discussions and were told consensus was reached when all members accepted a solution; each member did not have to give complete approval. Consensus groups outperformed the control groups. A comparison of group to best member performance indicated that consensus groups were also far more likely to outperform their best member than the control groups. Nemiroff and King (1975) replicated the Hall and Watson (1971) study using 18 groups instructed in consensus and 18 uninstructed groups. The consensus groups outperformed the uninstructed groups and were found to take 30.39 minutes on the average to complete the problem versus 21.17 minutes for uninstructed groups.

In a study specifically designed to examine the effect of control on problem solving, Levine (1973) reports that, "The higher the total amount of control of the group members over decision making and the more equally the members share this control, the better the group's problem-solving performance and the higher the member's satisfaction" (p. 186). In addition to higher and equal control within the

group, consensus instructions to view differences as helpful may permit greater expression of minority views which in turn can promote higher quality outcomes. Nemeth and Kwan (1987) report that a series of studies of minority influence on group decision making indicate that exposure to minority viewpoints can increase the group's detection of errors, creativity, divergent thinking, and problem solving. Similar findings of the superiority of consensus over normative methods have been reported in other studies (Hall & Williams, 1970; Nemiroff, Pasmore, & Ford, 1976; Miner, 1984; and Erffmeyer & Lane, 1984)

The effectiveness of using a consensus decision style, or other decision style aimed at enhancing group communication, may be that it guides the group interaction and increases the opportunity for all group member information and ideas to be shared and considered prior to the selection of a solution. In particular, the instructions given for most of the studies that have employed consensus have specifically directed group members to view initial agreement as suspect and differences of opinion as helpful.

Individual Decision Precedes Group Decision

Miner (1984) compared various decision strategies and found that, "when individual decisions precede a group effort [i.e., group decision], group performance is significantly better than individual averages and the selected best individual decision and equal to the actual best individual decision" (p. 122). In the Holloman and Hendrick (1972) study described earlier, the highest level of performance was achieved by groups that conducted a majority vote followed by consensus. In addition, nearly all of the studies that employed consensus, included a step in which

individuals decisions were made first. No studies could be located that specifically compared group decisions with and without preceding individual decisions.

Consequently, one must conclude that this is likely a factor, but additional research is required. In considering this issue in relation to cooperative learning groups, it is not likely that many groups would automatically employ a two step decision process unless specifically instructed to do so; however, it is likely that group members would have or develop a preferred or at least possible solution. In this case, the method used to deal with differences of opinion may become the critical issue.

The empirical evidence supporting a decision style consisting of individual decision or expression, discussion, and consensus is compelling, yet it is neither unequivocal or easily generalized to ill-structured problem-solving. Nemiroff, Pasmore, and Ford (1976), for example found that on two of three performance measures, nominal group technique equaled consensus. Herbert and Yost (1979) report that when nominal group technique procedures were modified to include a discussion phase prior to final voting, groups using the technique outperformed interacting groups. Erffmeyer and Lane (1984) compared nominal group technique, consensus, interacting, and Delphi groups on the NASA Moon Exercise and found Delphi groups produced the highest quality decisions followed by consensus groups. And finally, Falk (1981) trained groups in majority vote and consensus and found the majority vote groups produced higher quality solutions.

Hirokawa (1982) reviewed previous studies of consensus and challenges the notion that it is consensus that increases decision quality, but rather the problem

solving functions often enabled by consensus. The author designed an experiment to examine the differential effects of consensus with and without a *vigilant* problem solving process. In this case vigilant meant to examine assumptions carefully and consider the pros and cons of each alternative solution. Hirokawa concluded there is a relationship between consensus and decision quality, but ". . . the existence of such a relationship depends on whether or not consensus is reached through the use of a 'vigilant' decision making strategy" (p. 413). Hirokawa's finding points out that it is possible for a group to achieve consensus without having performed very effectively. In fact there is a separate body of research that specifically examines how group's arrive at erroneous solutions due to defensive reasoning or a collection of conditions often referred to as *groupthink* (Argyris, 1993; and Janis, 1972).

Given the nature of the tasks used in the decision style research and the mixed findings, generalization of decision style research to ill-structured problem solving situations should be made with caution. The following comment on decision styles research by Michaelsen et al. (1989), typifies a limitation characteristic of most of the studies:

An additional limitation of our study is that in many organizational settings, the right answer is simply not known and it is impossible to provide the definitive feedback on either individual or group performance. Thus, caution should be used in generalizing the findings of this study beyond situations characterized by relatively focused problems and in which groups can obtain data on their problem-solving effectiveness within a reasonable length of time (p. 837).

As discussed earlier, it is doubtful that teacher-provided individual feedback is possible for cooperative learning groups solving ill-structured problems. Thus, despite

evidence that consensus, nominal group technique, and Delphi can improve the quality of some decisions, it is not clear that these styles would be equally effective for ill-structured problem solving.

In general, it would appear that the decision styles that require more group members to agree, enable open expression and consideration of all ideas, view differences constructively (or at least ensure differences and challenges can be expressed freely), and permit individual decisions to precede the group decision are more effective. These methods include consensus, Delphi method, and nominal group technique. Because the latter of these two require training, they are not likely to emerge in cooperative learning groups. However, consensus, majority vote, group-selected best member, sub-group decision, and leader decision would all appear possible in a cooperative learning group. Because cooperative learning groups typically do not have appointed leaders (as is the case in work settings), a leader decision would most likely occur in one of two forms: an individual that forces a decision onto the group, or an individual who claims to have unique information that qualifies him or her to make the decision for the group.

Summary of Group Functions

As presented and discussed in the preceding review of the literature, goal setting, feedback, and decision making style have been reported to influence the performance of groups across a range of tasks and settings. Each of these functions consists of more specific dimensions, characteristics, or behaviors that comprise the

function. A list of these, as they are expected to relate to higher performance for ill-structured problem solving, is provided in Table 2.

From the literature the specific relationship of each of these functions to group effectiveness for cooperative learning groups performing ill-structured problem solving can not be established. For example, most of the studies have used ad hoc groups to investigate group functions many of which have involved simple recall, recognition, or possible that groups establish minimum criteria for their products and/or break down the problem solving steps into smaller sub-steps that can be assigned to individuals.

A second issue is that most of the published studies have been experimental. In these studies the conditions have been controlled to ensure that the groups perform the functions of interest, often involving training, and usually requiring the function to psychomotor tasks. This leaves open the question of the role of these functions when groups operate over time and perform more complex tasks. This issue is probably best illustrated in the uncertainty that surrounds specific versus vague or general goals. It is likely that lower level tasks more readily lend themselves to specific goal setting, while complex problem solving may involve goal setting of a more successive approximation nature. Under such circumstances, goal setting functions would be performed more toward the end of the group task than the beginning and may in some cases only be stimulated by the receipt of feedback. Also, because learning settings often include a problem solving process that specifies tasks (e.g., proximal goals), it is performed before the group performs the task. Without such controls, it is not clear

Table 2

Group Functions and Characteristics Related to Effectiveness

Function	Characteristic
Goal Setting	Goals are specific versus general such as, "do your best." Goals are difficult. Goals are participatively set or accepted by group members. Individual goals compatible with group goals are set. The group breaks larger goals into smaller, proximal goals.
Feedback	Feedback indicates both areas of goal accomplishment and inadequacy. Individual feedback is provided. Group feedback is provided. Feedback is descriptive rather than evaluative. Feedback is credible. Process feedback (i.e., related to interpersonal functioning) is provided when the group has difficulties. Feedback is provided soon enough after group performance as to be useful.

table continues

Function	Characteristic
Decision Making Style	All members participate in decisions. Members share equal control over decision making. A decision is reached when all group members agree. Each group member can express a decision preference or opinion and explain the basis of the preference before the group makes a final decision. Differences among members are viewed as helpful. Discussion of differences in opinion precedes final decisions.

when or to what degree any of these functions will appear, if at all, in naturalistic groups.

A third issue is related to feedback and how groups actually benefit from it. The research related to feedback for groups is comprised to great extent of studies examining feedback sign and aggregation level. Yet, an important question remains unaddressed. How and to what extent do groups use the feedback they are given, and does this relate to achievement? In any given instructional setting, it is likely that a teacher will assume that if he or she provides students with feedback, their performance is likely to improve. However, to what extent must groups use this

feedback to be effective? This study will examine the extent to which student groups use feedback and how this ultimately relates to achievement.

CHAPTER III

METHOD

This study examines the functions of cooperative learning groups performing ill-structured problem solving. The remainder of this chapter describes the design and method of the study.

Participants

The participants in this study were groups drawn from a population of advanced students (both graduate and undergraduate) engaged in instructional design and various engineering courses within a large southwestern university. This population was selected for two reasons. First, and most importantly, this study seeks to understand the functions of groups and therefore, the individual subject or unit of analysis is the group. In order to ensure a sufficient sample size of groups was obtained (i.e., approximately 50 to 70 groups), the researcher decided to concentrate on groups in the university setting, and it was apparent that multiple courses from several different departments would need to be included. No single course could provide sufficient numbers of groups working on ill-structured problems in a timely manner nor could adequate numbers of groups be obtained from a business environment, where projects, products, group membership, and group life span are highly variable. Second, the population needed to include advanced students such as graduating seniors or masters level, since this is typically the level of course work that involves application of a broad range of subject matter expertise to specific, real world problems or tasks. It is at this level of course work that students are often given

assignments in which they are expected to apply information, concepts, principles, and procedural knowledge to problems or issues characteristic of their field of study.

Selection of the Sample

Groups were identified as candidates for inclusion in the study by contacting various departments within the university and first identifying those instructors who used groups. The instructor was then interviewed to determine whether or not the groups would qualify for inclusion in the study and to obtain instructor permission to conduct the study.

Courses were selected only if they met several criteria. These included the use of project teams of at least three group members, assignment of a project that encompassed half or more of the semester, and the requirement for at least four deliverable products from the groups that ranged in time from at or near the beginning of the project to at or near its conclusion. Information such as description of each group's project, length of the project, weight of the project grade in relation to the overall course grade, and the specific process to be used to complete the project was not systematically collected. However, numerous conversations with instructors indicated that these varied from course to course. Examples of projects include the design of a tray for fast food service, the development of a short lesson of instruction, and the development of a plan for the renovation of a local high school's football field bleachers. Deliverable products varied for the different courses as well. A common theme among all courses, regardless of the area of study, was that students submitted various design documents related to the overall product they were required to produce.

Students indicated their consent to participate in the study by completing a consent form prior to the start of the study (provided in Appendix A).

Groups were drawn from ten courses over a period of two consecutive semesters. Two courses each from aerospace and mechanical engineering, instructional development, and civil engineering areas of study were included. Four courses from the electrical and computer engineering were included. Of note, all of the engineering courses were senior level courses, while the instructional design courses were intended for masters and doctoral level students. A total of 77 groups consisting of 325 students participated in the study. A summary of numbers of groups and students from each course is provided in Table 3.

Group Demographics

Summary statistics for average age, average grade point average, and average previous experience of all groups is shown in Table 4. The size of the project groups ranged from three to seven members. Within any given course, groups tended to be of similar size, varying by one or two group members as necessary to assign all students to a group. The average group size was 4.2. Table 5 provides summary statistics on group size.

Table 3

Number of Groups and Students from each Area of Study and Course

Course	Groups	Students
Aerospace and mechanical engineering, course 1	14	44
Aerospace and mechanical engineering, course 2	9	43
Instructional development, course 1	8	32
Instructional development, course 2	3	10
Electical and computer engineering, course 1	14	59
Electical and computer engineering, course 2	8	28
Electical and computer engineering, course 3	9	44
Electical and computer engineering, course 4	2	8
Civil engineering, course 1	2	8
Civil engineering, course 2	8	51
Total	77	325

Table 4

Average Age, Grade Point Average, and Previous Group Experience of the Groups

Variable	Mean	Standard Deviation
Average age	25.6	4.54
Average grade point average	3.2	.29
Average previous group experience ⁵	2.9	.6

Table 5

Frequency and Percentage of Group Sizes

Group Size	Frequency	Percent	Cumulative Percent
3	21	27.3	27.3
4	29	37.7	64.9
5	20	26.0	90.9
6	3	3.9	94.8
7	4	5.2	100.0
Total	77	100.0	

⁵ This number reflects a scaled number (i.e., a mean of 2.9 equals three to five previous experiences), not the actual number of previous group experiences.

Individual Demographics

A total of 325 students participated in the study. Of these, 238 were males and 68 were females. The gender of nineteen students was unidentifiable either because they did not respond to the item or did not return the demographic data questionnaire. The majority of the students who participated were undergraduate seniors (261). One undergraduate junior, 39 masters, and 4 doctoral students participated. Twenty cases of class standing were missing. The average age of the students is 25.6 years. Appendix B provides the frequencies and percentage breakouts for ages of all group members.

Instrument Development

Two instruments were required to conduct this study. One instrument assesses the degree to which groups performed each of the functions of interest. A second instrument assesses group achievement in terms of the groups' ability to solve the problem they have been assigned.

For the first instrument, a questionnaire was used to collect self-assessment data on the group functions performed by each group. Development of the questionnaire consisted of five steps: develop item specifications; develop a test blueprint; develop the questionnaire and perform an expert review; conduct try outs of the instrument; and conduct a pilot test. Each of these steps and their results are presented below.

For the second instrument, an achievement measure enabled instructors to assess and rate each group's problem solving effectiveness and provided a standardized

scale for comparison of group performance across the various fields of study, courses, and problems. A description of the instrument development process and reliability data for this instrument is provided following presentation of the group functions questionnaire development below.

Group Functions Questionnaire Development

As described above, the instrument to assess group functions is a questionnaire. The questionnaire was used to collect group self-report data following the completion of various products associated with the groups' problem solving assignment, to include the proposed solution.

Item Specifications

Item form, response scale type, and response form. The items used to collect information on group functions consisted of a statement of a group function (e.g., setting goals) or behavior reflective of a particular group function (e.g., the group discussed the goals) and a response scale. The scale was designed so that respondents could indicate the degree to which the function occurred either in terms of pervasiveness (i.e., extent, such as, goals were discussed until we all agreed) or frequency (i.e., occurrence, such as, when I had a different opinion, some of the time I told them), whichever most appropriately fit the type of function being assessed. Respondents would indicate their selections by circling a letter that identifies each response option.

Characteristics of items. Items were constructed to be short and free of technical terminology. They included only one function or behavior.

Operational definition of group functions. The following operational definitions of each group function were used to guide the item development process. *Goal setting* is the process of establishing one or more desirable outcomes that an individual or group will expend effort to achieve. *Feedback* is the process of obtaining and using information that describes performance or progress relative to a goal or standard. *Decision making style* is the manner in which a group selects a single option from a set of alternatives and includes the number of participants involved in the final decision and related discussion, the degree of openness demonstrated through expression of opinion and disagreement, and the degree to which all participants must agree before a final decision is reached.

Instructions and sample items. Instructions and sample items are provided in Appendix C.

Group Functions Questionnaire Blueprint

The purpose of this instrument is to collect information on the degree to which certain functions are performed within a cooperative learning group performing ill-structured problem solving.

Number of forms required. Two forms of the questionnaire are required in order to address situations in which the group has not yet received feedback (i.e., after completion of the first product). Multiple versions of the items are not required because the instrument is measuring functions and behaviors rather than attitudes or beliefs and all functions and behaviors (rather than a sample) are of interest. Also,

since the instrument is not an achievement test and there are no correct responses.

prior knowledge of the items is not an issue. Consequently, an item pool is not used.

Item proportions. It is desirable that there be relatively equal numbers of items for each function. Although not adjusted specifically to ensure equality, the number of questions per function was relatively equivalent (three or four items) with the exception of one function, personal goals, which contained only one item.

Number of total items. The number of items in the questionnaires is limited by the time available to students to complete the questionnaires and by the amount of time one could reasonably expect the students to maintain attention sufficiently to provide accurate responses. While the latter time is not known, it is reasonable to expect students will be available for 5 to 15 minutes to complete the questionnaires. Based on sample administrations, the questionnaire should not exceed 20 items in order to meet these general time constraints. This number was used as a guide rather than an absolute upper limit.

Ordering and clustering of items. Because each function includes several items that are related, the items are clustered by function to enhance group member's recall of the group's performance.

Positive and negative wording. Items are written such that the respondents indicate the degree to which a function or behavior is present. In the cases where the presence of this action or behavior has been found to be negatively correlated with group effectiveness, the scoring was to be reversed rather than the wording of the item changed. Thus the number of items to be worded positively or negatively are not

prescribed. This decision was made to avoid confusion on items. Following first draft of the instrument it was determined that reverse scoring was not required.

Expert review

Two experts in each of the factor areas were identified and requested to review their respective sections and items of the draft version of the group functions questionnaire for face validity issues (e.g., accuracy, completeness, clarity, wording, and item form). Because expertise in these areas often overlaps, reviewers were instructed to review their areas first, and then the entire questionnaire if they so chose. All reviewers read the entire questionnaire and most did in fact provide feedback related to all items. Reviewer's comments are provided in Appendix D. Revisions based on the comments were incorporated into a revised version of the questionnaire for use during tryouts.

Questionnaire tryouts

Following expert review and revision of the questionnaire, it was administered to four individuals who are representative of the target audience. These students were asked to express any thoughts they had out loud while completing the questionnaire. Comments that indicated an item was confusing, could be worded better, or lacked a reasonable response option were recorded and these items were revised. Student comments are provided in Appendix E. The revised questionnaire, incorporating changes based on expert review and questionnaire tryouts is provided in Appendix F. Note that two items exploring the formation of individual goals were added to account for an oversight and to ensure this function could be examined during the pilot study.

Pilot study

A pilot study consisting of 54 individuals was conducted to assess the validity and reliability of the questionnaire. Students were drawn from undergraduate and graduate classes at a large university in the southwest United States. They are representative of the population that was used for the final study; that is, the students were working in groups solving an ill-structured problem and were participating in courses that ultimately were included in the study. The undergraduate student groups were drawn from a senior engineering design class, in which the groups were given an engineering problem to solve over the course of the semester. The problems were provided by private and public sector organizations outside of the university. The graduate student groups were drawn from an instructional design class, in which the groups were required to develop a short (approximately 30 minutes) module of instruction. Demographic data for all participants in the pilot study are provided in Appendix G.

Individuals in the pilot study completed the group functions questionnaire three times, with each administration corresponding to the submission of a product in the class. These three administrations were for purposes of establishing the reliability of the instrument. A total of 145 questionnaires were completed. For the third administration, samples of students from both classes were asked to complete the questionnaire twice; once at the beginning of their class session, and again after a delay of approximate one hour. This last administration was for purposes of establishing the test-retest reliability of the instrument. A total of 30 questionnaires

(i.e., 15 at each time interval) were completed. Factor analysis was conducted to determine if the group functions clustered into separate factors and to assist in determining what items, if any, needed to be deleted to improve the validity of the individual scales.

Also as a part of the pilot study, two groups (one from each class) were observed for ten discussion periods to determine if group self-ratings could be validated by independent observation. Each discussion period occurred between product delivery points for the groups and culminated in the delivery of a required product in the respective design processes. (Note that each discussion period ranged in duration from approximately one hour to several hours and is actually comprised of several meetings of the group.) A total of ten discussion periods were involved (five per group), corresponding to five product submissions. The first two discussion periods did not include observation of feedback related functions, since the groups had not yet turned in any products and therefore had not yet received any feedback. The observer attended all group discussions in which the full group met alone and used an interaction recording and scoring guide to determine the degree to which each group performed the group functions. The interaction recording and scoring guide is provided in Appendix H. The observer then completed the same questionnaire as the group members so that questionnaire scores based on independent observation could be compared to the groups' self-ratings. Bivariate product-moment correlations were calculated to determine the relationship between the observer and group scores. As a by-product of the observations, the observed groups could provide direct feedback on

any questionnaire items that were unclear, missing a particular response, or requiring editing.

Results of item reliability analysis. Nineteen items total comprised the questionnaire. Four questions each covered overall project goal setting, current assignment goal setting, and previous assignment feedback sub-scales. Five questions covered the decision making style sub-scale and one question each covered the total number of group goals and number of personal goals. Each item was scored on a four or five point scale depending on the number of responses possible. Items were scored on a scale of one to four or one to five, with "a." being the lowest score and "d." or "e." being the highest. Reliability analysis was conducted for the total instrument ($\alpha=.89$) and for each sub-scale (overall goals $\alpha=.74^6$, current assignment goals $\alpha=.89$, feedback $\alpha=.81$, and decision making style $\alpha=.80$). The inter-item correlations are provided in Appendix I⁷. Note that the majority of items are positively correlated, suggesting the potential for the presence of an underlying dimension to which all items are related. The item-total correlations for each sub-scale are provided in Appendix J.

Results of test-retest reliability analysis. A bivariate product-moment correlation was calculated for the first and second administration of the questionnaire to 15 individuals. The correlation coefficients are provided in Appendix K. Note that

⁶ Because the item covering the group's total number of goals (Goaln) clustered with the factor that included overall goals (see results of the factor analyses below and Appendix J), this item was included in the sub-scale covering overall goals.

⁷ To conserve space the variables are abbreviated followed by the number corresponding to the time interval in which the data was collected. Overall goal setting is Ogoal; current assignment goal setting is Cgoal; feedback is Fback, decision making is Dm; and number of personal goals is Pgoaln.

the lowest correlation is .75, suggesting that the instrument is relatively stable over short periods of time.

Results of the factor analyses. A factor analysis of all items was conducted to determine whether or not the items would cluster into factors related to the group functions. Given the high inter-item correlations, a rotation for an oblique solution was conducted to further refine and clarify the primary factors.⁸ The unrotated and rotated factor loadings and factor correlation matrix are provided in Appendix L. Note that when rotated for the oblique solution, the factors cluster as expected into overall goal setting, current assignment goal setting, feedback, decision making, and personal goals (see in particular the structure matrix) after ten iterations. The item related to the total number of goals set by the group clustered into the overall goal setting factor. The item related to the number of personal goals set by each group member formed a unique factor. No factor correlations were less than .30 for the primary factor to which the item was related. However, several items loaded on secondary factors with correlations greater than .30, again suggesting the items are related to a broader underlying dimension.

Following the factor analysis of all items, factor analysis for each sub-scale was conducted to determine item loadings, determine if any sub-factors were present, and thus provide additional information to assist in revising the instrument. Results of these analyses are provided in Appendix M. No sub-factors emerged with eigenvalues

⁸ Crocker and Algina (1986) suggest that, “the oblique solution simplifies a pattern that is already fairly evident in the orthogonal solution” (p. 300).

above one for any of the sub-scales; however, overall goal setting items did have a second factor near an eigenvalue of one (.92043).

Results of observations. Ten observations of the two groups were conducted. A bivariate product-moment correlation was calculated for the observer and group average rating for each of the nineteen items. The correlation coefficients are provided in Appendix N. Items with correlations of less than .5 were considered candidates to be dropped from the questionnaire. Note that neither item related to goal challenge (Ogoal4 and Cgoal4) achieved a high correlation (.1776 and .3573 respectively). Discussion of feedback (Fback1), expression of opinions (Dm2), expression of disagreement (Dm4), and total number of group goals (Goaln) were also low (.3983, .2995, -.0431, and -.1698 respectively). Discussion with group members regarding differences in how the group and the observer rated these items did not reveal any basis for the low correlations. It is clear, however, that these items were tracked and counted much more methodically by the observer than the group, which would call into question the basis of the group's rating on these items, since they did not track information on these functions nearly so carefully. It is also important to point out that goal clarity items (Ogoal3 and Cgoal3), goal challenge items (Ogoal4 and Cgoal4), expression of disagreement (Dm4), and number of personal goals (Pgoaln) could not be directly observed and consequently the observer/group score correlation was not expected to be high. Therefore, in reviewing the results of the observer and group's ratings, it seemed prudent to consider including unobservable items unless a reasonable basis for exclusion could be established and consider eliminating the

observable items with low correlations unless a reasonable basis for their inclusion could be established.

Regarding questionnaire revisions or edits, none were recommended by the groups who only filled out questionnaires (i.e., groups that were not observed) during the pilot study. In fact, all of the comments that were made (each item had a comment space) were related to the performance of the group rather than the questionnaire. A few recommended revisions to the questionnaire by the observed groups were made. These included adjusting the percentages in the item responses so that there was no overlap and using a response option that was anchored to percentages wherever possible. Two additional response options were suggested. One involved adding an option to Dm1 (participation in decision making) indicating “most or all participated, but unequally;” and the other was an addition to Dm5 (how the group makes final decisions) indicating “one or two group members blocked team decisions.”

During the course of the pilot study, the researcher noticed an inconsistency in the responses related to goal setting. Sometimes group members indicated a lack of discussion or agreement on group goals (either overall or current assignment) yet on the items related to goal clarity and goal challenge they indicated the goals were clear and/or challenging. Other times they indicated the group had not discussed or reached agreement on their goals on these same two items. As a result of these inconsistent responses, several group members were asked about their responses to the goal setting items. What group members said indicated that some of the group members were responding literally; that is, if the group didn't discuss goals, they consistently chose

response “a.” which indicates a lack of discussion. Others said that they felt there was enough structure and guidance to the overall project and assignments to have a sense of what the group needed to accomplish, even if the group didn't directly talk about it as a goal. It was through their group discussions about the project that their goals became more clear, and as they became clearer they could better assess the degree of challenge. In this latter approach, it was possible for some to respond to the clarity and challenge of the group's goals almost independent of group discussion. Group discussion could however, influence their responses on goal clarity and challenge in either direction, depending on the nature of the discussion. As a result of these interviews, the response options associated with option “a.” in goal clarity and goal challenge for overall goals and current assignment goals were changed to eliminate reference to group discussion and thus avoid creating two different response patterns.

The researcher also noted and made two changes in the questionnaire during its first administration. The first change was the need to instruct group members not to discuss their responses with other group members. The second change was the addition of two items that were not scored, but requested group members to write down those overall and current assignment goals that had been discussed and agreed upon by the group. These items were added to anchor the goal setting responses to specific goals that group members were asked to recall. Without such an item, it was possible to respond to the goal setting items without having to consider whether or not any goals had actually been discussed or set. A change was also made to response options “b.” and “c.” in the two goal challenge items by reversing the two items. This

was done to bring the scoring more in line with the research on the motivational effects of goal setting. That is, overly challenging goals are more likely to be motivating than goals that are too easy, except in the case of a group that has experienced repeated failure. Finally, a response option was added to the beginning of the feedback section which states, "If your group did not receive feedback on the last assignment, check this box and proceed to item 15 (skip items 12-14)." This response will be treated as a "0" score for all feedback items.

Group functions questionnaire revisions. As a result of the analyses conducted above, several revisions to the questionnaire were made. First, all revisions suggested by group members were reviewed, appeared to be valid and helpful, and consequently were made. Second, three items were deleted because they did not provide information central to the research questions. These items were related to strategy discussion, use of roles, and when personal goals were set. Finally, three items were deleted as a result of low correlations in the following: observer to group rating correlations, item-total correlations within their respective sub-scales, and correlations to their respective factors within the sub-scale factor analysis. These items were the total number of goals set by the group (Goaln), discussion of feedback, (Fback1), and expression of opinions (Dm2). Inspection of the observer/average group rating correlations in Appendix N for overall goal challenge (Ogoal4), current assignment goal challenge (Cgoal4), and expression of disagreement (Dm2) reveals that these items also had low correlations. However, they were not deleted for two reasons. First, they involved unobservable phenomenon and therefore the low correlation does

not necessarily reflect low validity of the item. Second, each of these items had relatively high item-total correlations to their respective sub-scale totals and high correlations to their respective factors.

Since the initial factor analysis for the overall goal setting sub-scale had revealed a second factor approaching an eigenvalue of one, the factor analysis was re-run following removal of the item referring to the number of goals set by the group (Goaln). The results are provided in Appendix O. Note there is greater distinction between the primary and secondary factors (eigenvalues of 2.37345 and .65101 respectively) with the removal of the item.

Following the revisions, reliability assessment was conducted for the overall instrument and each revised sub-scale. Results are shown in Table 6 below.

Item-total correlations were also calculated and are provided in Appendix P. As a final check, a factor analysis was conducted with the remaining items of the revised scale. Results of this analysis are provided in Appendix Q. As shown, the items clustered into five distinct factors consisting of four sub-scales (overall goal setting, current assignment goal setting, use of feedback, and decision making style) and the single item regarding personal goals. The revised group functions questionnaires are provided in Appendix R. Table 7 summarizes the scales.

Achievement Instrument Development

A draft achievement instrument was developed by integrating information available from course syllabi, interviews with course instructors, direct observations of student groups engaged in two courses in which ill-structured problems were assigned,

Table 6

Alpha Levels for Overall Instrument (Revised) and Individual Sub-scales

Scale	Alpha
Overall	.88
Overall Goal Setting	.76
Current Assignment Goal Setting	.89
Feedback	.85
Decision Making Style	.79

Table 7

Group Function Items per Scale and Scale Ranges

Scale	Number of Items	Scale Range
Overall Goal Setting	4	4 - 19
Current Assignment Goal Setting	4	4 - 19
Feedback	3	0 - 15
Decision Making Style	4	4 - 18
Number of Personal Goals	1	0 - unrestricted

and interviews with researchers who study groups. Three items were developed to capture the key dimensions on which groups were expected to perform: solving the problem, following a prescribed problem solving process, and the quality of the group's ideas. The actual items and their instructions for scoring are provided in Appendix S.

The instrument was provided to three instructors currently involved in teaching problem solving to undergraduate and graduate students using groups. A fourth individual knowledgeable in instrument development processes also reviewed the instrument. No revisions were suggested.

Reliability of the instrument was assessed using Cronbach's alpha. Factor analysis was conducted to determine if the items were unidimensional. Twenty-three groups total were assessed, eleven from the instructional design class and twelve from the senior engineering class. Because two instructors were teaching in the engineering design class, both were asked to assess each of the twelve groups and a correlation of the scores was calculated to examine the reliability between the two raters.

The alpha reliability coefficient (α) for the achievement instrument is .82. Inter-item correlations are provided in Appendix T. Bivariate product moment correlation coefficients between raters for each item are .2 (solved problem), .45 (followed problem solving process), and .44 (quality of ideas). Correlation between raters for the item sums is .51. These correlations were considerably lower than expected, and may have been attributable to a three month delay by one of the instructors in scoring the groups. Factor analysis using all scores (thirty-five total)

revealed a single factor (eigenvalue = 2.218). Factor analysis statistics are provided in Appendix U. As a result of the analyses above, no revisions were made to the achievement instrument.

Materials

Materials consist of a student participation consent form, a demographic questionnaire, a group functions questionnaire, an achievement instrument, pre-marked envelopes for group questionnaires, and pre-addressed and stamped envelopes for returning achievement instruments to the researcher.

Procedure

Data Collection

Four types of data were collected: course information, demographic information, group functions ratings, and problem solving achievement scores. The procedure for each is described below.

Course Information

An interview was conducted with the instructors of the course in which the groups were working. The following information was collected prior to administering the group questionnaires: general course content, a brief description of the class assignment to include product delivery schedules, the group size(s), number of groups formed, and a group number for each group. Course information was used to ensure the groups were working on an ill-structured problem which required at least four product submissions and consumed over half of the course length. Course information also enabled the researcher to coordinate the times and locations for data collection

with the instructor and select the product submissions to be used if more than four were required. Each group's number was used to code questionnaires so that individual group member responses and the achievement score could be linked to appropriate group.

Group Functions Assessment

Group functions were assessed when the groups completed a product related to their problem solving assignment. The number of intermediate plus final products varied; therefore, discussion with each instructor was required to ensure that at least four administrations were conducted and to establish the timing of each administration. Also, coordination with each instructor was necessary to ensure the following guidelines were met: questionnaires were administered at spaced intervals throughout the course of the project; each administration of the questionnaire had to have a corresponding product that was submitted previously by the group and for which they will have received feedback; and, the final administration of the group functions questionnaire in all cases must correspond to submission of the final product.

Questionnaires were distributed to each group either during class time or following individual group presentations. Groups were instructed to complete all items without discussion, insert their completed questionnaire into an envelope marked with their group number or letter, and return the questionnaire to the researcher. In a few cases, groups were required to meet at locations other than the classroom, such as the instructor's office or at the site of a company that was

sponsoring the group's work. In these instances, the instructor handed out and collected the envelopes with the questionnaires. The instructions to the students were placed in large type face on the envelope. When all groups had completed the questionnaire, the researcher collected the envelopes from the instructor.

Demographic Information

At the first administration the individuals completed the demographic questionnaire and completed a sample group functions questionnaire to familiarize them with the items.

Achievement score

At the end of the course, instructors were provided with the group problem solving effectiveness assessment form, instructions for completing the form, an example completed form and a pre-addressed and stamped envelope. Instructors were asked to fill out the form shortly after they had graded their groups, to ensure that scoring would occur after all group products had been carefully reviewed and while group performance was still fresh in each instructor's memory.

Research Design and Analysis

Statistical Procedures

This study uses a two-step design process. The first step is intended to identify any differences in the performance of functions over time and employs a repeated measures, multivariate ANOVA. The second step is to determine the relationship between group functions and achievement and employs a regression analysis. That is, are the performance of certain functions predictive of overall group achievement?

Treatment of Missing Data

Because this study involved the collection of data within an academic setting rather than one with experimental controls, the researcher was unable to ensure that all subjects would complete the questionnaire at each administration. In particular, absences from class during data collection represented the most likely reason for missing data, and were likely to occur with some regularity. In addition, during data collection it was noted that on occasion students would simply omit a response or two or fail to complete all items on the questionnaire. It was also considered possible that some students would receive the questionnaire but simply fail to complete it for one reason or another. From spot checks made on the number of group members present compared to questionnaires completed, these latter instances appear to have been rare. However, in anticipating the likelihood of missing data, a rule of thumb requiring that at least half of the questionnaires for a particular group be completed in order to be included was established. This rule was discussed with several researchers to determine its appropriateness. No references could be found that provided procedures for the treatment of missing data that are aggregated, as in the case of groups. Further, none of the researchers could establish a different procedure and in essence, all agreed that the rule was reasonable, if not verifiable as a procedure grounded in statistical theory. After the rule was applied, the number of missing cases (aggregated) was determined and is shown in Table 8 below. Examination of the data indicates that during time period one, two groups had less than half of their members present, which accounts for all missing cases for group function variables. Similarly, in time period

Table 8

Missing Data for Group Functions Variables at each Time Interval

Variable	Number of Missing Cases	Percent of Missing Cases
Overall Goal Setting, time 1	2	2.6
Overall Goal Setting, time 2	2	2.6
Overall Goal Setting, time 3	1	1.3
Current Assignment Goal Setting, time 1	2	2.6
Current Assignment Goal Setting, time 2	2	2.6
Current Assignment Goal Setting, time 3	1	1.3
Feedback, time 1	2	2.6
Feedback, time 2	2	2.6
Feedback, time 3	1	1.3
Decision Making Style, time 1	2	2.6
Decision Making Style, time 2	2	2.6
Decision Making Style, time 3	1	1.3
Number of Personal Goals, time 1	2	2.6
Number of Personal Goals, time 2	2	2.6
Number of Personal Goals, time 3	1	1.3

two, two groups had less than half of the group members respond. In time period three, one group had less than half of the group members respond, accounting for a single missing case for group function variables. Given the low percent of missing data, no additional analyses of missing data were conducted.

Assumptions for the Use of Multivariate Analysis

The unit of analysis for this study is the group. Consequently, group member scores on the group functions consist of the average score for each item in the respective group function sub-scale. The achievement score is the sum of the score (referred to as "total") of each achievement item for the group.

The instrument scales used in this study are treated as suggested in Crocker and Algina (1986), in that the data,

may be subjected to computations and statistical analyses as long as the data meet the assumptions required by the particular statistical method used . . . most parametric statistical tests do not require the data to be measured on an interval scale; rather such tests require assumptions about the distributions of the data (p. 62).

The distributions of scores on the group function and achievement instruments were examined prior to conduct of the repeated measures and regression analyses. The purpose of this examination is to determine if the data meet distribution assumptions for the use of parametric statistics for multivariate analyses. Appendix V provides descriptive statistics for the all variables collected for the groups. Note that the distributions for several of the group function variables are negatively skewed. For example, overall goal setting at time period three is -3.02. Harris (1985) was

consulted to determine if transformations might be required to adjust the data to more closely match normal distributions. Harris contends that,

. . . normal-curve-based F or t tests can be considered valid for even U-shaped population distributions so long as two-tailed tests are used; the ratio between the largest and smallest sample variance is no greater than about 20 to 1; the ratio between the largest and smallest sample size is no greater than about 4; and the total degrees of freedom for the error term (s_e^2 or MS_w) is 10 or more (p. 332).

Because all of these conditions could be met, no transformations were conducted.

Repeated Measures Analysis of Variance (ANOVA)

A repeated measures design is used to test differences in group functions across the three time periods selected. This type of analysis indicates whether or not the performance of group functions change significantly over time. If overall differences are detected, paired samples t-tests will be used to determine if differences between time periods one and two and two and three are significant. T-tests are used for post-hoc contrasts due to the limitation imposed by the repeated measures design when a between factor is not present, which does not permit comparison of all adjacent mean pairs. An alpha level of .05 will be used to determine statistical significance of both initial analyses and post hoc contrasts. The Bonferoni method will be used to adjust the level of significance to account for multiple tests. Consequently, a probability of .025 for each t-test will be required to achieve significance at an alpha of .05.

Regression Analysis

A regression analysis is used with group functions as predictor variables and the summed three-item achievement score as the criterion variable. Group average grade point average, previous experience in groups, group size, and average age will be loaded into the analysis first to determine the variance in achievement accounted for by these uncontrolled demographic variables. If the variance is significant, the individual predictor variable(s) of significance will be included in a comprehensive regression analysis that includes group functions as predictors. If not, they will be dropped from further analyses. Group functions will then be examined by time period. Group function predictor variables consist of the sum of the average item scores for each sub-scale. In order to ensure the assumptions associated with regression analysis are not violated, no more than one predictor factor will be used for each ten groups (with an upper limit of not more than one predictor for each five groups) in the study.”

As a last step, any significant demographic predictors will be loaded into each time period in which the regression analysis results are significant to determine what total variance in achievement can be accounted for by both group functions and demographic information.

⁹ Personal conversation with L. Toothaker, professor of psychology, Psychology Department, the University of Oklahoma, regarding guidelines for sample size when conducting multiple regression analysis.

CHAPTER IV

RESULTS

Introduction

This chapter presents the results of the two separate analyses of demographic and group functions data. The first set of results is from the repeated measures ANOVA's which were conducted to determine if the degree to which groups perform each function changes over the course of the three time periods measured. These analyses address part of the general research question, are there differences in the importance of group functions over time?

The second set of results is from the multiple regression analyses. These were conducted to determine if a relationship exists between group functions and achievement at each of the three time periods. Demographic characteristics of the group members including age, previous experience in groups, grade point average, and group size were included in the regression analyses to determine what role these might play in predicting group achievement. The results of this second set of analyses address each of the specific research questions, which are provided below.

1. Is there a significant relationship between goal setting and achievement for cooperative learning groups solving ill-structured problems?
2. Is there a significant relationship between the use of feedback and achievement for cooperative learning groups solving ill-structured problems?

3. Is there a significant relationship between decision making style (i.e., the method of reaching a decision) and achievement for cooperative learning groups solving ill-structured problems?
4. To what extent do goal setting, use of feedback, and decision making style predict a cooperative learning group's ability to solve ill-structured problems?

Changes in Group Functions Over Time

As a way of assessing the amount of importance groups place on performing functions such as goal setting, use of feedback, and decision making style, a repeated measures ANOVA was used to examine if any changes in these functions occurred over the three time periods. This would indicate, for example, if goal setting received emphasis during a particular time period, or if significant changes occurred in the way the groups made decisions. Further, analysis of changes in group functions over time was expected to illustrate any possible trends, such as the general increase or decrease in the degree to which the functions were performed or, in the case of decision making style, any trends toward or away from democratic decision making.

Results of the repeated measures ANOVA examining changes in group functions over time are provided in Table 9. Because a between-subjects factor was not employed, results are presented for within-subject effects only. Differences exist for overall goal setting, current assignment goal setting, and the use of feedback. The significance of the reported *F* value for personal goals (2.98) is .054, which is marginal. In light of the exploratory nature of this study and the lack of previous research known to examine the change in these particular types of group functions

Table 9

Repeated Measures ANOVA for Group Functions Over Time

Source	<i>df</i>	<i>MS</i>	<i>F</i>
Overall Goal Setting	2	11.04	5.77*
Within-group error	142	(1.91)	
Current Assignment Goal Setting	2	8.42	7.92*
Within-group error	142	(1.06)	
Feedback	2	128.12	9.22**
Within-group error	142	(13.90)	
Decision Making Style	2	1.91	1.40
Within-group error	142	(1.37)	
Number of Personal Goals	2	.65	2.98
Within-group error	142	(.22)	

Note. Values enclosed in parentheses represent mean square errors.

* $p < .01$. ** $p < .001$

over time, post-hoc contrasts are examined for personal goals to determine if significant differences exist between time one and time two or time two and time three.

Table 10 provides a summary of the paired samples t-test results of post-hoc contrasts. Significant differences exist in overall goal setting and current assignment goal setting between time two and time three, and both are due to an increase in these functions. Significant differences also exist for the number of personal goals present in the group, which decreases between time two and time three.

Relationship Between Group Functions and Achievement

Correlations between group function and achievement variables are provided in Appendix W. Outliers (i.e., extreme or unusual scores) can alter the results of a regression analysis and therefore should be examined prior to conducting such an analysis (Norusis, 1993).¹⁰ A brief discussion of the method and results of an analysis of outliers is provided below.

Analysis of Outlier and Extreme Scores

Predictor variables examined for the effect of outlier and extreme scores include the average age of group members, the average previous experience in groups of group members, the average grade point average of the group, group size, and all group function variables from each time period. The results of boxplots to identify

¹⁰ "If the point is incorrect due to coding or entry problems, you should correct it and rerun the analysis. If there is no apparent explanation for the outlier, consider interactions with other variables as a possible explanation" (p. 312).

Table 10

Paired Samples T-test Results for Post-hoc Contrasts

Variable Pair Contrast	Number of Pairs	Mean	<i>t</i>
Overall Goal Setting, Time 1	73	17.2	.45
Overall Goal Setting, Time 2		17.1	
Overall Goal Setting, Time 2	74	17.0	-3.3**
Overall Goal Setting, Time 3		17.8	
Current Assignment Goal Setting, Time 1	73	17.3	- .02
Current Assignment Goal Setting, Time 2		17.3	
Current Assignment Goal Setting, Time 2	74	17.4	-3.0**
Current Assignment Goal Setting, Time 3		17.9	
Feedback, Time 1	73	8.6	-2.13
Feedback, Time 2		10.1	
Feedback, Time 2	74	10.0	-2.14
Feedback, Time 3		11.2	
Number of Personal Goals, Time 1	73	.86	.17
Number of Personal Goals, Time 2		.84	
Number of Personal Goals, Time 2	74	.85	2.47*
Number of Personal Goals, Time 3		.69	

* $p < .05$. ** $p < .01$.

Note. Actual probability scores for Feedback contrasts are .037 for time 1 and 2 and .036 for time 2 and 3, but are not significant due to Bonferoni alpha adjustments.

outlier and extreme scores are provided in Table 11. As shown in the table, there were no outlier or extreme scores for group size or use of feedback. Table 12 provides a comparison of correlations between predictor variable scores and the achievement score with and without outlier and extreme scores included. All but three correlations are affected by less than .1. These are average age, overall goal setting at time three, and decision making style at time two. The greater change in these latter correlations is primarily in terms of sign rather than magnitude of the relationship. For example, $r = .0637$ for overall goal setting at time three with outliers and extreme scores included; $r = -.0748$ when outliers and extremes are removed. Given the minimal impact of outlier and extreme scores, no further adjustments were made prior to conducting the regression analysis.

Relationship Between Demographic Variables and Group Achievement

Group achievement was assessed by each group's instructor and is the sum of three scores: the group's effectiveness in solving the problem or producing the desired end product; the degree of competence demonstrated by the group in following the problem solving (or product development) process; and the quality of ideas developed by the group as a part of their solution or product. The best three regression models for one, two, three and four predictors of group achievement were calculated for the four demographic variables to determine if any of these variables could predict achievement and how much variance in achievement could be accounted for by these variables. The variance explained for each model and b weights associated with selected variables are shown in Table 13. Variable names are abbreviated.

Table 11

Outlier and Extreme Scores for Predictor Variables

Predictor Variable	Outlier Scores	Extreme Scores
Average Age	33.3	37.0
	33.5	38.0
	35.0	39.5
	35.5	42.5
Average Previous Group Experience	1.0	
Average Grade Point Average	3.99	
Overall Goal Setting, Time 1	13.5	8.7
	14.5*	
Overall Goal Setting, Time 2	12.0	9.0
	13.0	
Overall Goal Setting, Time 3	13.8*	
	15.0**	
	15.3	

table continues

Predictor Variable	Outlier Scores	Extreme Scores
Current Assignment Goal Setting, Time 1	13.7	
Current Assignment Goal Setting, Time 2	13.3	11.6
	14.0*	
Current Assignment Goal Setting, Time 3	14.0	12.3
	14.7	
Decision Making Style, Time 1	12.0*	
Decision Making Style, Time 2	10.0	
	11.4	
	11.5	
Decision Making Style, Time 3	10.3	
Number of Personal Goals, Time 1	3.0	

* indicates the score occurred twice. ** indicates the score occurred three times

Table 12

**Correlations Between Predictor Variables and Achievement with and without
Outlier and Extreme Scores**

Predictor Variable	With	Without
Average Age	-.0935	.0504
Average Previous Group Experience	-.0750	-.0215
Average Grade Point Average	.1196	.0822
Overall Goal Setting, Time 1	-.0727	-.0560
Overall Goal Setting, Time 2	-.0025	.0568
Overall Goal Setting, Time 3	.0637	-.0748
Current Assignment Goal Setting, Time 1	.0437	.0452
Current Assignment Goal Setting, Time 2	-.0208	-.0284
Current Assignment Goal Setting, Time 3	.0851	-.0049
Decision Making Style, Time 1	-.0604	-.0288
Decision Making Style, Time 2	.0411	-.0619
Decision Making Style, Time 3	-.1473	-.1337
Number of Personal Goals, Time 1	-.1511	-.1723

Table 13

Regression Model Results for Demographic Variables: Best Three Models for
One through Four Variables Predicting Achievement (i.e., Total)

Number in Model	R Square	b weight			
		Aveage	Avegpa	Aveexp	Size
1	.0145		3.63		
1	.0087	-.18			
1	.0055			-1.08	
2	.0414	-.35	6.05		
2	.0241		4.15	-1.44	
2	.0203		4.26		.64
3	.0490	-.34	6.44	-1.28	
3	.0478	-.35	6.75		.67
3	.0289		4.71	-1.36	.59
4	.0545	-.34	7.06	-1.3	.62

A stepwise regression was then calculated. The results of the stepwise regression analysis, in which all four demographic variables were forced into the equation, is provided in Table 14. The overall results were not significant and no individual variables achieved significance.

Table 14

Stepwise Regression Analysis for Demographic Predictors of Achievement

Source	<i>df</i>	<i>MS</i>	<i>F</i>
Regression	4	76.8748	1.04
Error	72	74.1430	
Total	76		

Relationship Between Group Functions and Group Achievement

The best three regression models for one, two, three, four and five predictors were calculated for each of the five group functions for each time period to determine if any of these variables could predict achievement and how much variance in achievement could be accounted for by these variables. The results of these analyses (the variance explained for each model and b weights associated with selected variables) are shown in Tables 15, 17, and 19. Results of subsequent stepwise regression analyses for the best model with three predictors for each time period is shown in Tables 16, 18, and 20.

Table 15

Regression Model Results for Group Function Variables at Time One: Best Three Models for One through Five Variables Predicting Achievement (i.e., Total)

Number in Model	R Square	b weight				
		Ogoal1	Cgoal1	Pgoal1	Dm1	Fback1
1	.0261					-.30
1	.0228			-1.94		
1	.0053	-.41				
2	.0546		.77	-2.18		-.34
2	.0311			-2.29		
2	.0283	-.27				-.29
3	.0643		.83	-2.57		-.34
3	.0550			-2.15	-.11	-.33
3	.0549	-.11		-2.14		-.33
4	.0754	-.80	1.57	-2.60		-.30
4	.0678		1.03	-2.56	-.37	-.33
4	.0551	-.08		-2.13	-.08	-.33
5	.0769	-.74	1.65	-2.59	-.25	-.30

Table 16

Stepwise Regression Analysis for Best Three Predictors: Group Function Variables
at Time One as Predictors of Achievement

Source	<i>df</i>	<i>MS</i>	<i>F</i>
Regression	3	115.1796	1.63
Error	71	70.7979	
Total	74		

Table 17

Regression Model Results for Group Function Variables at Time Two: Best Three Models for One through Five Variables Predicting Achievement (i.e., Total)

Number in Model	R Square	b weight				
		Ogoal2	Cgoal2	Pgoal2	Dm2	Fback2
1	.0260			-2.20		
1	.0238					-.32
1	.0017				.20	
2	.0552			-2.44		-.36
2	.0321				.48	-.38
2	.0266			-2.17	.12	
3	.0613			-2.35	.41	-.41
3	.0562	.13		-2.47		-.37
3	.0555		.09	-2.44		-.37
4	.0641		-.42	-2.26	.67	-.41
4	.0614	-.05		-2.33	.44	-.41
4	.0562	.14	-.03	-2.47		-.37
5	.0642	.07	-.46	-2.27	.65	-.41

Table 18

Stepwise Regression Analysis for Best Three Predictors: Group Function Variables at Time Two as Predictors of Achievement

Source	<i>df</i>	<i>MS</i>	<i>F</i>
Regression	3	104.3204	1.55
Error	71	67.4888	
Total	74		

Table 19

Regression Model Results for Group Function Variables at Time Three: Best Three Models for One through Five Variables Predicting Achievement (i.e., Total)

Number in Model	R Square	b weight				
		Ogoal3	Cgoal3	Pgoal3	Dm3	Fback3
1	.0399			-3.08		
1	.0217				-.78	
1	.0072		.56			
2	.0622		1.60		-1.49	
2	.0620			-3.10	-.79	
2	.0529		.76	-3.33		
3	.1192		1.93	-3.74	-1.65	
3	.0818	.79		-3.01	-1.17	
3	.0670	.43	1.34		-1.59	
4	.1208	.25	1.77	-3.66	-1.70	
4	.1199		1.92	-3.85	-1.60	-.07
4	.0825	.77		-3.13	-1.12	-.07
5	.1214	.24	1.77	-3.76	-1.66	-.06

Table 20

Stepwise Regression Analysis for Best Three Predictors: Group Function Variables at Time Three as Predictors of Achievement

Source	<i>df</i>	<i>MS</i>	<i>F</i>
Regression	3	213.6960	3.25*
Error	71	65.8014	
Total	74		
Pgoal3			4.66*
Cgoal3			4.67*
Dm3			5.42*

* $p < .05$.

As the results in Tables 16 and 18 illustrate, the relationship between the best three group function predictors at time one and time two are not significant, and no individual variables achieved significance. The results of the stepwise analysis for the best three group function predictor variables at time three are significant ($p < .05$). Current assignment goal setting ($\beta = .29$), decision making style ($\beta = -.31$), and number of personal goals ($\beta = -.24$) are all individually significant ($p < .05$). The amount of variance in group achievement that can be accounted for by these three functions is approximately twelve percent.

Combined Capability of Demographic and Time Three Group Function Variables to Predict Group Achievement

To determine if additional variance could be predicted in group achievement, a demographic variable was added as a predictor to the three significant predictor variables at time three. Though none of the demographic variables, when examined separately, were significant in predicting achievement, it remained possible that interaction between variables could affect both the overall prediction of group achievement and the significance of individual variables. Average grade point average was selected as the best candidate demographic variable because it had been the best single predictor of group achievement of the demographic variables and it had been included in each of the two, three, and four variable regression models (see Table 13).

The results of a stepwise regression analysis in which no variables were forced into the regression model is provided in Table 21. Including average grade point average increased the amount of variance explained by approximately one percent. Overall results were significant; average grade point average as an individual predictor was not significant. Thus, the addition of average grade point did not substantively improve the prediction of group achievement established by current assignment goal setting, number of personal goals, and decision making style at time three.

Best Predictors of Group Achievement Across All Time Periods

An additional regression analysis was conducted for all group function variables as predictors of group achievement. This analysis enabled the selection of any group function variable from any of the three time periods to be included in the

Table 21

Stepwise Regression Analysis for Best Three Group Function Predictors at Time
Three and Average Grade Point Average Predicting Achievement

Source	<i>df</i>	<i>MS</i>	<i>F</i>
Regression	4	176.3496	3.25*
Error	71	65.8224	
Total	75		
Pgoal3			5.34*
Cgoal3			2.98
Dm3			4.79*
Avegpa			.98

* $p < .05$.

regression model if it is one of the best predictors of group achievement. Again, when the variables are allowed to interact, some changes in the prediction of variance can be expected, and the individual variables that predict a significant amount of variance may change. Conducting this analysis can therefore provide additional supportive evidence for the significant predictors already identified at time three and insight into the way the variables may interact in predicting achievement. For the analysis, the best two regression models for one, two, three and four predictors were calculated for each of the five group functions for all three time periods.

The results of this analysis (the variance explained for each model and b weights associated with selected variables) are shown in Table 22. The results of a stepwise analysis with four predictors (personal goals at time three, use of feedback at time two, current assignment goal setting at time three, and overall goal setting at time three) in which no variables were forced into the model are provided in Table 23 and are significant ($p < .01$). The number of personal goals ($\beta = -.29$), current assignment goal setting ($\beta = .43$), and overall goal setting ($\beta = -.42$) are individually significant ($p < .05$). The results provide additional support for the predictive quality of personal goals and current assignment goal setting at time three. When the use of feedback at time two is included in the regression model, decision making style at time three is not a significant predictor; overall goal setting at time three is a significant predictor, is negatively correlated with achievement, and accounts for nearly eight percent of the variance in group achievement.

Table 22

Regression Model Results for all Group Function Variables:Best Two Models for One through Four Variables Predicting Achievement (i.e., Total)

Number in Model	R Square	b weight						
		Ogoal3	Cgoal3	Pgoal1	Pgoal2	Pgoal3	Fback1	Fback2
1	.0451					-3.05		
1	.0437			-2.50				
2	.0967					-4.05		-.47
2	.0737	-1.06				-2.91		
3	.1190					-4.18	-.26	-.47
3	.1155	-.87				-3.85		-.43
4	.1752	-2.13	1.76			-4.13		-.38
4	.1339			-1.60		-3.37	-.28	-.44

Table 23

Stepwise Regression Analysis for Best Four Group Function Predictors Across
All Times Predicting Achievement

Source	<i>df</i>	<i>MS</i>	<i>F</i>
Regression	4	211.2050	3.66**
Error	69	57.6567	
Total	73		
Pgoal3			4.06*
Fback2			2.33
Cgoal3			6.32*
Ogoal3			6.28*

* $p < .05$. ** $p < .01$.

Analysis of Decision Making Style Changes

In the regression analysis of group functions at time three, decision making style is a significant predictor and is negatively correlated with achievement. This is an unexpected result, generally counter to the research reviewed on decision making styles. Therefore, an analysis of the decision making style scores and other characteristics of the top twenty high achieving groups was conducted to determine if any patterns might emerge to explain this result. The top twenty performing groups were selected because they are most likely to reveal patterns directly associated with high achievement.

Table 24 shows the frequencies of decision making style scores for each item of the decision making style scale (i.e., participation, discussion of opinions, expression of disagreement, number of group members agreeing on final decisions). Table 24 also provides the average score for all decision making style items for each group. Cases are arranged from lowest to highest average decision making style score.

Visual inspection of the data reveals two patterns. First, and not surprisingly, there is a pattern of generally higher scores in the high ten decision making style groups. However, a second pattern of polarized scores (i.e., extreme) seems to occur in the low ten decision making style groups that is not present in the high ten groups. The most pronounced evidence of this pattern is in the frequency of extreme scores in the participation item. A low score on this item indicates that a group member felt the group discussions were being dominated by one or two group members. To test this difference statistically, first the groups were coded as "polarized" if the scores on one

Table 24

Item Frequencies and Average Overall Decision Making Style Score for Top Twenty Achieving Groups

Decision Making Scale Items																			
Case No.	Participation					Discussion of Opinions				Expression of Disagreement				No. Required for Agreement					Avg. Score
	a	b	c	d	e	a	b	c	d	a	b	c	d	a	b	c	d	e	
49	1			3	1	1		1	3		1	3	1			2		3	14
67	1			1	1		1	1	1			2	1		1			2	14
16	1			1	2			1	3			2	2			2		2	15
70	1			2	2				5		1	2	2	1			1	3	15
71	1	2		1	2		3		3			2	4					6	15
50				3	2			3	2			3	2			2		3	15.2
73		1			2			1	2				3			1		2	15.7
76				2	1			3			1	2				1		2	16
7				1	2			1	2			2	1				1	2	16.3
25					5				5		1	2	2	1				4	16.4

table continues

Decision Making Scale Items																			
Case No.	Participation					Discussion of Opinions				Expression of Disagreement				No. Required for Agreement					Avg. Score
	a	b	c	d	e	a	b	c	d	a	b	c	d	a	b	c	d	e	
45				1	3		1	1	2			1	3				1	3	16.5
23				2	2			2	2			1	3					4	16.8
60				1	2				3			1	2					3	17.3
59					2				2			1	1					2	17.5
58					3				3			1	2					3	17.7
51					3				3			1	2					3	17.7
54					4				4			1	3					4	17.8
38				1	3				4				4					4	17.8
47					4				4				4					4	18
69					6				6				6					6	18

or more item differed by three points or more. The remaining groups were coded as "not polarized." Seven of the low ten groups (roughly one third) were polarized, while none of the high ten were polarized. The high and low ten groups were then compared on number of polarized groups using Pearson's Chi Square with Fisher's Exact Test for expected cell frequencies of less than five, which revealed a significant difference; $\chi^2 (1, n = 20) = 10.77 p = .001$. Thus, one difference among high achieving groups is the number of groups that became polarized in their view of how decisions were made.

Table 25 shows, for these same groups, the average decision making style score for each time period, the direction of change between time two and time three, and whether or not the groups had a designated team leader. The first comparison made between the high and low ten decision making style groups was on the number of groups whose decision making style went down versus those that stayed the same or went up. Six of the low ten decision making style groups' scores went down while none of the high ten groups' scores went down. Pearson Chi Square with Fisher's Exact Test for expected cell frequencies of less than five revealed a significant difference between high ten and low ten decision making groups in this comparison; $\chi^2 (1, n = 20) = 8.57 p = .005$. Thus, a second difference among high achieving groups is that many of the low democratic groups became less democratic at time three, while nearly all of the high democratic groups became more democratic. Similar to polarization of scores, roughly one third of the top twenty high achieving groups (six total) evidenced a decline in democratic decision making at time three. Four of these six groups were also polarized.

Table 25

Average Overall Decision Making Style Score for All Time Periods, Direction of Decision Making Style Change Between Time One and Time Two, and Presence of a Team Leader for Top Twenty Achieving Groups

Case No.	Decision Making Score			Direction of Change	Team Leader
	Time 1	Time 2	Time 3		
49	15.4	15	14	Down	No
67	17.5	13	14	Up	No
16	13	15.5	15	Down	No
70	14.4	15.8	15	Down	No*
71	15.8	17.3	15	Down	No*
50	15.8	15.6	15.2	Down	No
73	15.7	14.5	15.7	Up	No*
76	15.3	17.7	16	Down	Yes
7	15.5	15.3	16.3	Up	No
25	16.7	15.6	16.4	Up	Yes

* indicates a team leader was assigned, but was given no specific responsibilities beyond returning peer evaluation forms when completed by the group.

table continues

Case No.	Decision Making Score			Direction of Change	Team Leader
	Time 1	Time 2	Time 3		
45	16.3	16	16.5	Up	Yes
23	15.5	16	16.8	Up	Yes
60	16.3	16	17.3	Up	Yes
59	16	15.7	17.5	Up	Yes
58	18	17.7	17.7	Same	Yes
51	12	16.8	17.7	Up	No
54	18	17.8	17.8	Same	No
38	17	16.8	17.8	Up	Yes
47	17.5	17.3	18	Up	Yes
69	16.8	17.5	18	Up	No*

* indicates a team leader was assigned, but was given no specific responsibilities beyond returning peer evaluation forms when completed by the group.

In examining the data for the top twenty achieving groups, the researcher noticed that most of the high ten decision making style groups had team leaders while most of the low ten groups did not (see Table 25)¹¹. These team leaders are given responsibility for such things as scheduling group meetings, communicating standards, coordinating technical work and presentations, and ensuring group products are completed on time. A Pearson Chi Square with Fisher's Exact Test for expected cell frequencies of less than five indicates a significant difference between high and low decision making style groups for presence of team leaders; $\chi^2 (1, n = 20) = 5.05$ $p = .03$. Consequently, a third difference among high achieving groups is that those operating more democratically are also more likely to have a team leader with specific responsibilities.

¹¹ While information about team leaders was not initially collected, it became available through contact with instructors and groups and was recorded.

CHAPTER V

DISCUSSION

Introduction

This chapter is organized into six sections. The first section discusses findings related to changes in group functions over time. The second section discusses the relationship between group demographics and group achievement. The third section discusses the relationship between group functions and group achievement. The fourth section presents limitations of the study. The fifth section presents implications of the findings of this study for academic problem solving groups. The sixth and final section presents implications for further research.

Changes in Group Functions Over Time

The results of the repeated measures analyses indicate that goal setting and feedback are functions that clearly change over the life of a group. As groups mature, they tend to more thoroughly set goals for their overall project and their current assignment. The results related to changes in the number of personal goals set by group members are marginal. An examination of differences among the means of each time period indicates that the number of personal goals decreases near the end of the groups' projects (between time two and time three). The decision making style of the group did not change over time.

Feedback results are somewhat problematic to interpret. Overall differences were significant at a very low probability level ($p < .001$). Post hoc analyses of means indicated that changes between time one and two, and time two and three were both

marginal and both involved increases in the function over time. As a result, logically the conclusion can be made that the difference between time one and time three is accounting for much of the overall significant result, although this post hoc contrast was not specifically made. It should also be noted that the Bonferoni adjustment may have increased the probability of a type II error by introducing an overly stringent alpha. Thus, while overall the means increased over time, individual differences between time one and time two and between time two and time three were statistically marginal. Given the results, it is reasonable to conclude that groups do tend to increase their use of feedback over time. However, there is no clear point in which their use of this function changes significantly.

When Change Occurs

The preponderance of change in all forms of goal setting occurs late in the life of the group, between the second and third time period. Post hoc analyses of paired means for overall goal setting, current assignment goal setting, and number of personal goals indicate that all significant changes occur between time two and time three. With the exception of personal goals, the changes are in a positive direction. That is, overall goal setting and current assignment goal setting increase while the number of personal goals decreases.

The direction and timing of the changes indicates that group goal setting is not being performed as thoroughly by the groups during the development of the early products as it is in the development of the final product. A possible explanation is that with time and other resources decreasing near the end of the project, it becomes

increasingly important to the groups to have both specificity and agreement on what needs to be done to complete the project. This need would naturally be reflected in more thorough goal setting for both the overall project and the current assignment, which at time three, may be very similar.

Personal Versus Group Goals

Between time period two and three, the number of personal goals decreases while the thoroughness of group goal setting increases; in essence, they change in opposite directions. This pattern of change suggests that for most groups personal goals are receding in importance as the group concentrates on completing its final product. There are several possible reasons why this may be occurring. Group members have individual responsibilities throughout the entire project, including those for completing the final product. Consequently, this change in personal goals is probably not indicative of a change in the way work is assigned to or within the group. Rather, it may be that at this point in the project the group members are perceiving themselves more as a group than a collection of individuals. As such, goals associated with the group would be more important than individual goals. It could also be argued that late in a project, the group members have consumed most of the time and other resources available to them. Essentially, the freedom they had during the early stages to explore a wide avenue of options has become limited. In this final stage of the project, group members may be discovering that they will not be able to accomplish some or all of their personal goals given the resources available without jeopardizing completion of the group's goals. Under these circumstances, group members may be

more willing to give up their personal goals in favor of group goals. Similarly, as the deadline for completion of the final product draws near, group members are likely to assess the possible outcomes associated with expending limited resources and effort on group goals versus individual goals and determine that group goal outcomes (usually these include the score of the product, the course grade, feedback from the instructor, and in some cases, a job recommendation) should take precedence.

Therefore, group goal setting may be increasing while personal goals decrease for several reasons: group members have a stronger affiliation with the group and its goals by time three; general limitations in resources restrict pursuit of individual goals; and group goals are associated with more meaningful outcomes than personal goals and therefore are more attractive.

Decision Making Style

Decision making style was measured using a four item scale that included group member participation in decision making, openness of expression of opinions, discussion of group member opinions, and number of group members required to agree in order to reach a decision. Low scores are associated with a more autocratic or directive style of decision making in which expression of opinions and discussion are suppressed and the number of group members participating in decision making is low. High scores reflect a more democratic style of decision making, which may include high levels of agreement (i.e., consensus) required to reach a decision.

Interestingly, decision making style does not change over the life of the group. One might reasonably expect that as group members build working relationships they

might become more democratic over time, but that is clearly not the case. As an explanation for the lack of change, it might be possible that some groups become more democratic, while others become more autocratic. This type of change would cause the variance of decision making style scores to increase but there would be no change in the level of the function. However, a decrease in variance of the scores at time three indicates this is not a reasonable explanation. Therefore, it appears that while other functions change naturally over time, decision making style, at least in the way it was measured in this study, does not.

It should be noted that during all three time periods, the groups tended to naturally operate far more democratically than autocratically¹² and, as will be discussed below, group decision making style was negatively correlated with achievement. This suggests that if very high levels of democratic style decision making is preferred or required for all groups solving ill-structured problems, then group organizers may need to take specific actions early to ensure this occurs. For example, instruction in consensus decision making (as reported in previous decision making research) or some other team building activity that illustrates or teaches the benefits of a more democratic style of decision making may be necessary. This approach is consistent with findings from Gersick (1988), who reported that groups are more open to influence at two key points: initial meeting, and midpoint.

¹² $M(\text{time } 1) = 15.9$; $M(\text{time } 2) = 15.8$; $M(\text{time } 3) = 16.2$. The decision making style scale is 0 to 18, with high scores reflecting democratic decision making.

Relationship Between Demographic Variables and Group Achievement

The relationship between four group demographic variables and group achievement was examined. These include the average age of group members, a measure of the average previous experience in work or learning groups, the average of group members individual grade point averages, and the number of group members. As the initial regression analysis revealed, none of the demographic variables individually or collectively were found to predict a significant amount of variance in achievement. It is somewhat surprising that neither previous academic success as represented by the group's average grade point average or previous experience would predict achievement. One possible reason for this result is lack of variability in most of the demographic scores. With the exception of previous group experience, the demographic score ranges were all somewhat narrow and the average age distribution was skewed. This type of distribution within predictors can at times suppress the identification of actual relationships between variables. A second possible explanation for this result is that both of these measures reflect *individual* characteristics rather than characteristics of the *group*. That is, grade point average is a measure of previous individual achievement just as previous group experience is a measure of individual experience. The lack of predictive power of these variables may be that they do not adequately characterize the *group's* capabilities. For example, grade point average arguably reflects qualities necessary to succeed individually rather than within a group. It may be that the groups' true performance capabilities emerge over time as a function of more dynamic variables such as the working relationships of the group

members or the extent to which they are able to use the individual resources available to the group. The lack of a relationship between previous group experience and achievement is somewhat puzzling. Two possible explanations are immediately recognizable. One is that previous group experiences do not provide transferable knowledge or skill to future group experiences. This does not seem plausible. A second, more reasonable explanation, is that the previous experiences of the group members failed to provide the conditions necessary to learn skills and knowledge that could be transferred effectively to ill-structured problem solving situations. This explanation is plausible given that many if not most group experiences in college involve writing a paper or serving in a short-term discussion group. None the less, these findings argue, in essence, that a group's potential should not be judged by group member grades or group member's previous experience in groups, and that groups do not gain an advantage over other groups by having individuals high in these characteristics.

Relationship Between Group Functions and Group Achievement

Some group functions are clearly related to achievement in ill-structured problem solving. However, this relationship does not emerge until late in the life of the group, and not all functions are related to achievement.

Personal Goals and Achievement

The consistent negative relationship between the number of personal goals established by group members late in their projects (i.e., time three) and achievement confirms what may be an intuitive assessment of groups: that when personal goals, or

agendas as they are often called, increase, achievement decreases.¹³ As discussed by Bandura earlier, goals serve to focus energy. Groups that have a larger number of personal goals are likely to be experiencing some form of conflict in terms of which direction to focus energy; or, group members may in fact be focusing more energy on achieving their individual goals rather than those of the group as a whole. What is not clear is whether or not personal goals are causing lower performance or if they are a symptom of some other underlying dynamic within the group. It is possible, for example, that previous poor performance, unresolved conflict, or poor working relationships among group members may stimulate the formation of individual goals.

Group Goals and Achievement

Group and current assignment goals were measured with two, parallel, four item scales. Each scale included the extent to which the group discussed goals; the percent of group members that expressed agreement with the goals; the clarity of the goals, and the difficulty (i.e., challenge) of the goals. Though not part of the scales, group members were also asked to write down the specific goals the group agreed upon. This item was included to improve the validity of their assessment.

Unlike personal goals, current assignment goal setting late in a group's project (i.e., goal setting for completing the final product) is positively related to achievement. Overall goal setting only predicts achievement at time three, is negatively correlated

¹³ This negative relationship was observed first in correlations with achievement, when personal goals were examined individually as a predictor, when personal goals were examined as part of time three, and in the analysis of predictors across all time periods.

with achievement, and only emerges when feedback at time two is included in the regression model as was identified in the regression analysis of group functions at all time periods (see Tables 22 and 23). Thus, the relationship of group goal setting to achievement appears to be present only late in the process of problem solving and is limited primarily to the immediate assignment at hand. These findings suggest that in general, the role of group goal setting is fairly limited, and in particular, is not related to achievement during early stages of group work in problem solving. As discussed earlier, Weingart (1992) reported that goal difficulty tends to suppress pre-planning and result in more in-process planning. The findings of this study as they relate to both overall and current assignment goal setting are consistent with this previous research, given the high level of complexity of the tasks given to the groups. It is also consistent with Bandura's (1989) assertion that proximal goals will result in higher levels of motivation and performance than those that are more distal (i.e., overall goals).

As is the case with personal goals, it is not clear if current assignment goal setting is causing changes in performance or if it is a mediating variable for some other function or dynamic of the group. However, it does seem reasonable to assume that some characteristics of the group may be affecting both group goals and individual goals. That is, there is evidence that something may be occurring within the groups that causes them to either place more emphasis on group goals while reducing the number of personal goals, or the opposite: reducing emphasis on group goals while increasing the number of personal goals. In understanding this choice point, previous

research suggests that feedback is pivotal in influencing the group's choices of and attitudes toward goals. Repeated negative feedback or evaluative feedback, if present, may be stimulating lower goals (Zander, 1968). Also, feedback provided on group products that is not public and clearly identifiable to individuals, may result in distortion of the feedback and social loafing (Conlon & Barr, 1989), which in turn could stimulate the formation of personal goals or lower group goals. The effect of feedback as a possible explanation gains support in light of the results of the regression analysis of group functions across all time periods. Feedback at time two, while not significant individually, was included in a four variable model that explained over 17 percent of the variance in achievement. The remaining three selected predictors were each of the goal setting variables from time three. Thus, feedback at the latter stage of a group's life may be exerting influence on the way the group approaches its goals at the end of a project, serving as a vector point at which the groups either focus on their current assignment goals or on the overall project goals, which are much broader. The latter may not only inhibit them from finishing successfully, but may also be suppressing attention on current assignment goals and stimulating the formation of personal goals.

Group Decision Making Style and Achievement

Group decision making style is also predictive of group achievement and the relationship is negative. This result modifies previous research on decision making discussed earlier (see page 57 for a summary of decision making research) that indicates that high levels of democratic decision making results in higher quality group

decisions. As reported earlier, the groups in this study tended to operate more democratically than autocratically at all time periods. However, it appears that some groups became somewhat more autocratic at the end of their projects, and were still successful.

While it is not clear why these high achievement groups become more autocratic, the analysis of the top twenty achieving groups suggests it could be a response to a lack of formal team leadership. The absence of a team leader to rally the group and provide direction in an otherwise high performing group may result in one or two members “taking over” and both dominating the discussion and suppressing opposing views in order to get the project done on time. Under such circumstances, the dominance of a team member who is not formally endowed with leadership from the instructor may be viewed as more autocratic than the same behaviors exhibited by a formal team leader. In understanding why these groups were successful, the reported domination of the group may be reflecting actions or decisions taken unilaterally to ensure the project was completed on time successfully rather than to simply exert the will of one or two group members on the entire group for personal reasons. This is probably the case for several reasons: it is likely that most of the key decisions related to the group’s solution have already been made by the time the group is preparing its final product; time is likely to be running short and groups’ without leaders may be struggling; and the item reflecting the number of group members required for a final decision did not go down substantially for these groups (this indicates they were still

basically in agreement with the decisions made despite being dominated and not expressing concerns).

Finally, high levels of agreed upon group goals coupled with low levels of personal goals were probably already developed in these groups. Specifically, at time three, decision making style is highly correlated with both overall goal setting ($r = .46$, $p < .001$) and current assignment goal setting ($r = .56$, $p < .001$) and unrelated to the number of personal goals ($r = -.01$, $p = .95$). This indicates that in general, democratic groups tend to be more effective at setting group goals. Since the decision making style scores of all groups were relatively high, the adjustment at time three in decision making style for the more autocratic groups that were successful appears to be relatively minor. In this light, again clear and agreed upon goals and the absence of personal goals may provide the primary conditions necessary for success, even if a somewhat less democratic decision making style is necessary to finish the project. In any case, the shift of some high performing groups to more autocratic decision making styles was not counterproductive for these groups, was relatively small in nature, and was restricted to a small number of groups (approximately one third of the highest performing groups).

Limitations

Groups in this study had the benefit of a fairly prescribed process to follow with clear milestones that required the delivery of specific interim products. The results should be generalized with caution to situations in which groups do not have such a structured process provided. The study also involved learning groups, which

differ from work groups or volunteer social groups that may be engaged in ill-structured problem solving. Finally, the population of groups in the study was restricted to those available for study in the university setting. As a result, the sample of group members is heavily represented by students between the ages of 19 and 30. The range of the grade point average of group members is also fairly narrow and may not be representative of the total university student population.

Implications for Application

The results of this study suggest several possible applications to learning groups involved in ill-structured problem solving projects. First, formation of goals for completing the final product is related to group achievement or success. To facilitate this goal setting, instructors may want to alert their groups to the importance of establishing these goals. To this end, advice and/or reminders to the group may be helpful; or, providing a checklist of the various requirements or standards necessary for accomplishment of the project may be useful. Goal setting may also be stimulated by making project performance public or by creating a situation in which the results of the groups' work can be compared to stimulate competition. The latter can be created by using common, public scores for all groups or by assigning more than one group to work on a particular problem and ensuring the results are public.

Second, recalling the effects of feedback on goal setting, instructors may also want to ensure groups receive detailed, public feedback that is identifiable to both the group and individual level. This can be accomplished through public presentations and the use of a panel of evaluators that provide an assessment of all aspects of the

work. Groups should also have ample opportunity to successfully complete each assignment prior to beginning the final project in order to address all areas of corrective feedback. As reported by Zander (1968 & 1974), repeated failure can result in lower goals and goals that are not accepted by the group.

Third, because groups that use a somewhat more authoritarian decision style at the end of a project also tend to be successful, instructors should not force groups to use consensus decision making, but they may want to consider using team leaders. While it is not clear precisely how the decision making style works for all successful groups, it is reasonable to assume that the majority of the decisions related to the problem solving process have been made by the time the group is preparing its final product. This leaves open primarily those decisions related to specific assignments for preparing the final products and the schedule for their completion. Instructors could encourage a more directive decision making style by encouraging or authorizing a group member to unilaterally ensure steps are taken to complete the project. This could be accomplished by assigning a group or team leader and giving this individual a "take charge" role for completing various products associated with the project. Interestingly, high performing groups with team leaders also demonstrated highly democratic decision making styles.

Finally, as Conlon and Barr (1989) point out and the findings of this study illustrate, personal goals can be very counterproductive to group achievement. However, it is not clear how to prevent these from emerging in a way that does not lower the group's success. It may be that for many groups, advising them about the

potential negative effect of personal goals is sufficient. For other groups however, more direct methods may be necessary. Four possible methods are presented below.

First, if team leaders are used, they can be assigned the responsibility for addressing the conflicts within the group and ensuring they are resolved. Specifically, team leaders can be responsible for addressing situations in which a group member fails to attend meetings, contributes very little in discussions, or fails to complete work to adequate standards. Similarly, the team leader can be assigned responsibility for ensuring that different points of view are resolved and that decisions made by the group are in fact accepted and supported by all group members. In this capacity, the team leader does not force solutions or decisions on the group, but ensures that situations that are often uncomfortable but important are not avoided by the group.

Another method frequently observed in the engineering groups is the use of individual feedback forms or *peer assessments* completed by group members on various dimensions of group member behaviors at several points during the projects. This feedback permits group members to score each other on behaviors only they as a group are likely to observe such as completion of work, attendance at meetings, cooperation, quality of work, and the like. The score is a percent of the overall grade and consequently low scores from several group members could result in a lower grade.

As many of the instructors pointed out, even with team leaders and peer assessments it may be necessary to counsel the groups when conflict emerges and continues for a period of time without resolution. This *process consultation* is

consistent with the research on feedback and may become necessary when peer assessment or team leader intervention is ineffective. Process consultation may do no more than validate the existence of a problem the group wishes to avoid, or it may serve to identify problems not known to the group. Process consultation may be given initially by the instructor to the team leader alone, if one is used. However, if the problem persists, it may be most effective to provide the feedback the entire group, so that it is not distorted.

Finally, during the pilot study for instrument development, one instructor demonstrated a novel approach to dealing with persistent unresolved conflict associated with personal goals that appeared to be effective. Each of the groups had a team leader who periodically reported to the instructor on the progress of the group. Peer assessment was used regularly. When conflict did emerge, the team leader was initially advised to attempt to resolve the conflict without instructor intervention. When a conflict persisted following process consultation, each group member engaged in the conflict received “negative team points,” which effectively could lower their grade, but did not affect other group members’ scores. The points could be recovered only when the conflict was resolved. As the instructor noted, this method was used only when all others had proven unsuccessful.

Implications for Future Research

Future research should focus on natural groups, since to date much of the research on groups has tended to focus on short-term, ad hoc, laboratory groups that may or may not provide results that can be generalized to real world instructional or

work settings. The relationship between personal and group goals needs to be explored further to address several questions this study cannot answer. First, how do group members determine the weight or importance of group versus individual goals? What role does feedback play in this determination? What other mechanisms can influence how group and personal goals are formed? Finally, the nature of the specific changes associated with increased autocratic decision making need to be understood. For example, why do some successful groups tend to use relatively high levels of democratic decision making until the final stages of a project and what specific changes occur within the group when they become less democratic?

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APPENDIX A
CONSENT FORM

CONSENT FOR PARTICIPATION IN A RESEARCH PROJECT

You are being asked to participate in a study to examine the functions that are performed by learning groups involved in solving ill-structured problems. The study is being conducted by Robert Welp, a doctoral student in the Department of Educational Psychology.

Your involvement requires you to fill out four questionnaires. The first will provide some background information that will later help describe, in general, the kinds of people who participated in the study along with some sample items. The other three ask for your observations about what functions your learning group performs while completing its assignments.

There are no known risks to this study and your responses will be kept confidential. To help ensure confidentiality, your name will not appear on the questionnaires you fill out.

Your participation in this study is voluntary. You may stop at any time and you will not be penalized in any way.

Should you have any further questions about this research, please contact Robert Welp at (405) 954-6914.

Should you have any questions about your rights as a research subject, you may contact the Office of Research Administration, University of Oklahoma at (405) 325-4757.

I agree to participate in this study and I understand all of the statements above.	
_____	_____
Name (Signature)	Date

APPENDIX B

FREQUENCY AND PERCENTAGE OF GROUP MEMBER AGE

Age	Frequency	Percent	Cumulative Percent
19	1	0.3	0.3
20	5	1.5	1.8
21	31	9.5	11.3
22	63	19.3	30.7
23	57	17.5	48.2
24	33	10.1	58.3
25	21	6.4	64.7
26	20	6.1	70.9
27	17	5.2	76.1
28	6	1.8	77.9
29	4	1.2	79.1
30	1	0.3	79.4
31	2	0.6	80.1
32	5	1.5	81.6
33	3	0.9	82.5
34	3	0.9	83.4

table continues

Age	Frequency	Percent	Cumulative Percent
35	3	0.9	84.4
36	2	0.6	85.0
37	0	0.0	85.0
38	6	1.8	86.8
39	3	0.9	87.7
40	1	0.3	88.0
41	1	0.3	88.3
42	3	0.9	89.3
43	2	0.6	89.9
44	1	0.3	90.2
45	0	0.0	90.2
46	2	0.6	90.8
47	2	0.6	91.4
48	1	0.3	91.7
49	1	0.3	92.0
50	1	0.3	92.3
Missing	24	6.8	100.0
Total	326	100.0	

APPENDIX C

GROUP QUESTIONNAIRE INSTRUCTIONS AND SAMPLE ITEMS

Demographic Information

Please provide the following background information:

1. Age: _____

2. Sex:: M F (circle one)

3. Class standing (circle one):

Fresh Soph Jr. Sr. Masters Doctoral Not enrolled in a degree program

4. Grade point average: _____

5. Previous experience in learning or work groups (check the item that best describes you):

_____ I have never been in a learning or work group.

_____ I have had a couple (1 or 2) of experiences in a learning or work group.

_____ I have had a few (3 -5) experiences in a learning or work group.

_____ I have had numerous (5 or more) experiences in a learning or work group.

Group Questionnaire

Instructions: The items below relate to actions your group took while completing your most recent assignment. For each item, select the one statement that best describes your group.

Goal Setting

1. Discussion of goals for the overall project
 - a. The group did not discuss goals.
 - b. The group discussed goals, but did not reach a final decision.
 - c. The group discussed goals and reached a final decision.
2. Agreement with the group's goals for the overall project.
 - a. Not applicable - the group did not discuss goals.
 - b. There is disagreement among group members about the group's goals.
 - c. Some of the group members agree on group's goals, most disagree or do not express an opinion.
 - d. Most of the group members agree on group's goals, some disagree or do not express an opinion.
 - e. All of the group members openly agree on group's goals.
3. Difficulty of the group's goals for the overall project.
 - a. Not applicable - the group did not discuss goals or there is no agreement on the goals.
 - b. I think the group's goals are too difficult.
 - c. I think the group's goals are too easy.
 - d. The group's goals are difficult, but possible if group members work hard.
4. Goals for the current assignment.
 - a. The group did not discuss goals.
 - b. The group discussed goals, but did not reach a final decision.
 - c. The group discussed goals and reached a final decision.

Feedback

Complete this section only if your group has received an assignment back from the instructor which has been scored. Select the statement that best describes your group's actions in relation to the feedback received on that assignment. If your group has not yet received a scored assignment, skip to next set of questions on decision making.

1. Discussion of feedback on the previous assignment
 - a. The group did not discuss the feedback.
 - b. The group discussed some of the feedback.
 - c. The group discussed most of the feedback.
 - d. The group discussed all of the feedback.
2. Identification of low performance areas in the last assignment
 - a. Not applicable - the group did not discuss the feedback.
 - b. The group discussed the feedback, but did not identify low performance areas.
 - c. The group identified some of the low performance areas.
 - d. The group identified most of the low performance areas.
 - e. The group identified all of the low performance areas.
3. Discussion of required changes for the next assignment
 - a. Not applicable - the group did not discuss the feedback or identify areas of low performance.
 - b. The group did not discuss changes necessary to improve their performance.
 - c. The group discussed changes necessary to improve their performance in some areas of low performance.
 - d. The group discussed changes necessary to improve their performance in most areas of low performance.
 - e. The group discussed changes necessary to improve their performance in all areas of low performance.
4. Making changes on the next assignment
 - a. Not applicable - the group did not discuss the feedback or identify any changes.
 - b. The group did not make changes aimed at improving their performance.
 - c. The group made changes aimed at improving some areas of low performance.
 - d. The group made changes aimed at improving most areas of low performance.
 - e. The group made changes aimed at improving all areas of low performance.

Decision Making

For the following questions on decision making, consider how your group makes major decisions such as: how you plan to complete the assignment, your strategy for solving the problem, who will do what work, how you reach resolution on differences of opinion on your solution.

1. Participation in the group's decision making discussion
 - a. The discussion is dominated by a one or two group members.
 - b. Most group members participate.
 - c. All group members participate.

2. Expressing preferences prior to a final decision
 - a. Only one or two group members express their preferences.
 - b. Most group members express their preferences.
 - c. All group members express their preferences, but there is little or no exploration of why group members hold these preferences.
 - d. All group members express their preferences, and there is discussion of why group members hold these preferences.
3. Willingness to disagree with another group member
 - a. When I disagree with someone in the group, I usually keep it to myself.
 - a. When I disagree with someone in the group, sometimes I let them know.
 - c. When I disagree with someone in the group, I almost always let them know.
4. Number of members that must agree before a final decision is reached
 - a. We let one group member make the decision for the entire group.
 - b. There is one group member that kind of bullies the group into a decision.
 - c. There are two group members who, when they agree, a decision is reached the rest of the group tends to listen to their discussion.
 - d. We take a vote and the majority rules.
 - e. The group checks to make sure all group members are in agreement before making a final decision.

APPENDIX D

RESULTS OF EXPERT REVIEW

Below are the comments provided by each of the six reviewers.

Reviewer 1: Goal Setting

1. Recommended adding an item asking about the number of goals set by the group as an indirect measure of the group setting proximal and specific goals.
2. Suggested considering adding an item asking for group member's opinions of how clear the group's goals are as a check on group agreement.

Reviewer 2: Goal Setting

1. Goal setting item 2 (agreement with group goals). Found response option b. vague and redundant. Suggested it be deleted.
2. Goal setting item 3 (difficulty of goals). Found the word "hard" to be open to different interpretations. Suggested the word "together."
3. Feedback items 2 through 4. Wondered how group members would respond if there were no low performance areas.
4. Decision making item 4. Suggested the words "that kind of" be replaced with "who" in response option b. Found response option c. to be vague.

Reviewer 3: Feedback

1. Consider defining learning vs. work groups.
2. Leave room for comments "Comments:" In directions say "If you would like to clarify your response or if you found the item confusing."
3. Feedback item 2 delete response option d (most identified) because it will be very hard to distinguish most from all, particularly if there were only a couple of low areas of feedback.

4. Check for past tense on all items and ensure consistency.
5. Use a parallel structure to ask about overall project goals (i.e., distal goals) and current assignment goals (i.e., proximal goals).
6. Let respondents report on process/strategy discussion so they have a way to report what they've done and not distort their goal setting responses. - check with Larry. Explain in goal setting about strategy.

Reviewer 4: Feedback

Reviewer 4 was unable to review the questionnaire at the time of the other reviews and therefore received a version that reflected changes based on other reviewer comments.

1. Expressed concern that questions were added about strategy discussions. The concern was that by asking about strategy, students might use these questions to respond about goals or some other aspect of the questionnaire. After discussion, the conclusion was to leave the items in.

Reviewer 5: Decision Making Style

1. Found the length and number of qualifiers in the response options confusing.
Recommended the behaviors in the options be moved into the stem of the item and then simplify the options to something like, "none, some, most, and all" wherever possible.
2. Recommended item 2 in decision making about expressing preferences or opinions be split into two items. One item should cover the number of group members expressing preferences; the other should cover the amount of discussion of preferences.
3. Recommended a "global" item be included to ask about the amount of participation in decision making overall.

Reviewer 6: Decision Making Style

1. Swap items 5 and 6 in goal setting so that clarity of the goals is asked about before number of goals.
2. Ask the group members to write down the goals to keep them from underestimating or overestimating and as a check that what they are reporting really are goals. (This comment was directed at the final questionnaire, not for the pilot study.) After further discussion, it was concluded that asking respondents to write down their goals would constitute a form of goal setting exercise because it would potentially require students who had implicit goals to make them explicit. On this basis, asking respondents to write down goals would probably influence the outcome of the questionnaire.

APPENDIX E

RESULTS OF QUESTIONNAIRE TRYOUTS

Below are the comments provided by each of the four respondents.

Respondent 1

A single tryout was conducted initially to ensure that edits from the expert review had not lead to grammar or meaning problems. In essence, the single walk through was conducted to catch editorial and gross meaning errors. Three additional tryouts were conducted once these errors were corrected. The first tryout was conducted with an 18 year female old high school graduate who had had numerous cooperative group experiences. She was instructed to think back on her group experiences and select one that most closely resembled a situation in which several assignments were completed as a part of a larger project. She was also told that clarity of the items and response options was of primary concern and was asked to express any thoughts she had while completing the questionnaire. Comments are summarized below. Revisions to the comments were made before the remaining tryouts. Note that due to the change of some but not all response options to percentages, this was confusing for the student, and she recommended that, where possible, percentages be used in lieu of “some, most, all” because they seemed less confusing.

1. Felt that item 2 and item 6 (goal agreement) response options of some, most, and all would be confusing for small groups and suggested using percentages because they can be used no matter what the group size might be.
2. Feedback item 3 (identifying changes) response options a and b are the same. Need to delete or rewrite one.

3. Decision making item 1 doesn't have a response option for participation by less than half of the group. The student felt this could occur and there wouldn't necessarily be any domination by one or two group members.
4. Decision making item 2 response options would seem to work better if they were percentages.

Respondents 2, 3 and 4

The remaining tryouts were conducted with a revisions made based on the first respondent's comments. Three students from the College of Education were selected primarily on the basis on their availability, willingness to assist, and extensive experience working in groups as a part of their undergraduate classes. Respondent 2 is a 25 year old male graduate student (masters) who has yet to declare a major. Respondent 3 is a 20 year old female undergraduate student (junior) in the teacher education program. Respondent 4 is a 19 year old female undergraduate student (sophomore) in the teacher education program. As a check against having selected students with a limited range of group experiences, each student was asked if he or she had had both "good" and "bad" group experiences, by what ever standards they used. They all indicated that they had had both good and bad experiences and "several in-between." The respondents were then given the same instructions as those given in the first tryout.

Comments are summarized below. Revisions to the comments were incorporated into a final version of the questionnaire to be used during the pilot study. Note that the comments were neither extensive nor of a substantive nature. Because of the limited comments, the decision was made to freeze the questionnaire following these edits for the pilot study.

Respondent 2

1. Felt that response options for item 1 and 5 of goal setting (discussion) did not clearly indicate that resolution (i.e., final decision) of the possible goals was only reached in option e. Suggested that wording such as “but did not reach resolution” be added to response options b, c, and d. The researcher asked if the phrase, “but did not reach a final decision” would effectively serve the same purpose since this phrasing would be parallel to the phrasing in response option e. and the student agreed that it would work.
2. In items 4 and 8 of goal setting, felt that the word, “difficult” carried a negative connotation (i.e., the goal is unpleasant or the work to achieve the goal is not enjoyable) and suggested the word, “challenging” be substituted. The literature on goal setting tends to use the word, “difficult” as in “specific and difficult goals.” However, a review of goal setting articles indicates that the word, “challenging” is also used.

Respondent 3

Student 2 had no comments or recommended changes other than to say, “It is real clear. I had no problem answering.”

Respondent 4

Student 3 had no comments or recommended changes other than to say, “It made sense to me. I could answer all the questions easily. The bad groups I’ve been in have usually been dominated by one person.”

APPENDIX F

REVISED QUESTIONNAIRE FOR PILOT STUDY

Questionnaire: Demographic Information

Please provide the following background information:

1. Age: _____
2. Sex:: M F (circle one)
3. Class standing (circle one):

Fresh Soph Jr. Sr. Masters Doctoral Not enrolled in a degree program
4. Grade point average: _____
5. Previous experience in learning groups (groups formed to complete class assignments in school) or work groups (groups formed to complete a task or solve a particular problem in a work environment). Check the item that best describes your experience:

____ I have never been in a learning or work group.

____ I have had a couple (1 or 2) of experiences in a learning or work group.

____ I have had a few (3 -5) experiences in a learning or work group.

____ I have had numerous (5 or more) experiences in a learning or work group.

Questionnaire: Group Functions

Directions: The items below relate to actions your group took while completing your most recent assignment. For each item, select the one statement (circle the letter) that best describes your group. Feel free to write comments on any item where you would like to clarify or elaborate on your answer or comment on an item.

1. Considering your discussion for both the overall project and the current assignment, what percentage of time did the group spend on strategy such as: work assignments, meeting time and location, product formats, etc?
- a. Less than 25%
 - b. 25-50%
 - c. 50-75%
 - d. 75-100%

Comments:

2. To what extent did your group use roles like "editor," "writer," "coordinator," or other such roles?
- a. Roles not used.
 - b. Roles used for some but not all work.
 - c. Roles used for most of the work.
 - d. All work was assigned and performed based on roles.

Comments:

The following 13 (3 - 15) questions items relate to goals. Goals are desirable outcomes that a person or group strives for. Goals can be a certain grade or score, the completion of the project, something to be learned, specific parts or milestones to be achieved, or other outcomes. You will be asked about overall project, the current assignment, and personal goals.

3. To what extent did the group discuss goals for the overall project?
- a. There was no discussion of goals.
 - b. The group identified possible goals, but did not reach a decision.
 - c. The group discussed the pros and cons of some of the possible goals, but did not reach a decision.
 - d. The group discussed the pros and cons of most or all of the possible goals, but did not reach a decision.
 - e. The group discussed the possible goals until a final decision was reached.

Comments:

5. What percentage of group members openly expressed agreement with the group's goals for the overall project?
- a. Not applicable - the group did not discuss goals.
 - b. Less than 25%
 - c. 25-50%
 - d. 50-75%
 - e. 75-100%

Comments:

6. How clear to you are your group's goal (or goals) for the overall project?
- a. Not applicable (The group did not discuss goals or there is no agreement on the goals.)
 - b. Very unclear
 - c. Somewhat clear
 - d. Fairly clear
 - e. Very clear

Comments:

7. How challenging are the group's goals for the overall project?
- a. Not applicable (The group did not discuss goals or there is no agreement on the goals.)
 - b. I think the group's goals are too challenging.
 - c. I think the group's goals are too easy.
 - d. The group's goals are challenging, but can be achieved.

Comments:

8. To what extent did the group discuss goals for the current assignment?
- a. There was no discussion of goals.
 - b. The group identified possible goals, but did not reach a decision.
 - c. The group discussed the pros and cons of some of the possible goals, but did not reach a decision.
 - d. The group discussed the pros and cons of most or all of the possible goals, but didn't reach a decision.
 - e. The group discussed the possible goals until a final decision was reached.

Comments:

10. What percentage of group members expressed open agreement with the group's goals for the current assignment?

- a. Not applicable - the group did not discuss goals.
- b. Less than 25%
- c. 25-50%
- d. 50-75%
- e. 75-100%

Comments:

11. How clear to you were your group's goal (or goals) for the current assignment?

- a. Not applicable (The group did not discuss goals or there is no agreement on the goals.)
- b. Very unclear
- c. Somewhat clear
- d. Fairly clear
- e. Very clear

Comments:

12. How challenging were the group's goals for the current assignment?

- a. Not applicable (The group did not discuss goals or there is no agreement on the goals.)
- b. I think the group's goals are too challenging.
- c. I think the group's goals are too easy.
- d. The group's goals are challenging, but can be achieved.

Comments:

13. Considering both the overall project and the current assignment, how many goals did your group set?

- a. None
- b. 1 to 2
- c. 3 to 4
- d. 5 to 6
- e. 7 or more

Comments:

14. If you set any personal goals for yourself (overall or for the current assignment) please note them below. If you did not set any personal goals, go to question 16.

- 1) _____
- 2) _____
- 3) _____

15. At what point did you form your individual goal(s)?

- a. Formed prior to group discussion
- b. Formed during group discussion
- c. Formed after group discussion

Comments:

The next 4 questions refer to the feedback your group was given by the instructor(s) on the previous assignment.

16. What percentage of the feedback on the previous assignment was discussed?

- a. Less than 25%
- b. 25-50%
- c. 50-75%
- d. 75-100%

Comments:

17. To what extent did the group attempt to determine why they performed low in some areas on the previous assignment?

- a. Not applicable (The group had no areas of low performance.)
- b. Low areas were not discussed.
- c. Some low areas were discussed.
- d. Most or all low areas were discussed.

Comments:

18. To what extent did the group use the feedback to identify changes required for the assignment you just turned in?

- a. No changes identified because the group had no areas of low performance or the identified changes were not directed at the current assignment.
- b. No changes were identified.
- c. Changes identified for some areas of low performance.
- d. Changes identified for most areas of low performance.
- e. Changes identified for all areas of low performance.

Comments:

19. To what extent did the group make the identified changes to the assignment just turned in?

- a. No changes made because the group had no areas of low performance or the identified changes were not directed at the current assignment.
- b. No changes were made.
- c. Changes were made for some areas of low performance.
- d. Changes were made for most areas of low performance.
- e. Changes were made for all areas of low performance.

Comments:

For the following questions on decision making, consider how your group makes major decisions such as: how you plan to complete the assignment, your strategy for solving the problem, who will do what work, or how you reach resolution on differences of opinion on your project.

20. Overall, to what extent did group members all participate in decision making?

- a. One or two group members dominated the discussion and decision making.
- b. Less than half participated.
- c. More than half participated.
- d. All participated fairly equally.

Comments:

21. What percentage of group members expressed an opinion or preferences prior to a final decision?

- a. Less than 25%
- b. 25-50%
- c. 50-75%
- d. 75-100%

Comments:

22. To what extent did the group discuss group member opinions or preferences?

- a. No discussion of opinions
- b. Discussed some of the opinions
- c. Discussed most of the opinions.
- d. Discussed all of the opinions.

Comments:

23. To what extent were you willing to openly express a disagreement with another group member?

- a. I usually kept it to myself.
- b. Some of the time I told them.
- c. Most of the time I told them.
- d. I always told them.

Comments:

24. How were final decisions made in the group?

- a. One group member forced their opinion on the group.
- b. We let one group member make the decision for the entire group.
- c. Two group members conferred and they decided for the group.
- d. We took a vote and the majority ruled.
- e. The group checked to make sure all group members agreed.

Comments:

APPENDIX G

PILOT STUDY DEMOGRAPHIC DATA

Tables G1 and G2 present demographic data for the two classes involved in the pilot study. The frequency (#), percent (%), mean, standard deviation (SD), and minimum and maximum scores (Min/Max) are provided, as appropriate.

Table G1

Instructional Design Class Pilot Study Demographic Data (10 cases)

Variable	#	%	Mean	SD	Min/Max
Age			35.7	11.5	22/53
Grade Point Avg.			3.9	.1	3.8/4.0
Sex					
Males	1	10			
Females	9	90			
Class Standing					
Masters	6	60			
Doctoral	4				
Group Experience					
None	0	0			
Couple (1-2)	1	10			
Few (3-5)	6	60			
Numerous (6+)	3	30			

Table G2

Senior Engineering Design Class Pilot Study Demographic Data (44 cases)

Variable	#	%	Mean	SD	Min/Max
Age	--	--	24.7	4.4	21/38
Grade Point Ave.	--	--	3.3	.4	2.1/4.0
Sex					
Males	40	91			
Females	3	7			
Missing	1	2			
Class Standing					
Senior	44	100			
Group Experience					
None	2	4.5			
Couple (1-2)	19	43.0			
Few (3-5)	14	32.0			
Numerous (6+)	9	20.5			

Table G3 provides demographic data for all pilot study cases combined. The frequency (#), percent (%), mean, standard deviation (SD), and minimum and maximum scores (MIN/MAX) are provided, as appropriate.

Table G3

Total Pilot Study Demographic Data (54 cases)

Variable	#	%	Mean	SD	Min/Max
Age			26.6	7.4	21/53
Grade Point Ave.			3.4	.5	2.1/4.0
Males	41	76			
Females	12	22			
Missing	1	2			
Class Standing					
Senior	44	82			
Masters	6	11			
Doctoral	4	7			
Group Experience					
None	2	4			
Couple (1-2)	20	37			
Few (3-5)	20	37			
Numerous (6+)	12	22			

APPENDIX H

INTERACTION RECORDING AND SCORING GUIDE

Interaction Recording and Scoring Guide

Notes should be taken as directed below during each discussion period. Following the last discussion period prior to the group's submission of their product, review all notes taken and complete the group functions questionnaire. The item to which the notes refer has been coded as follows:

S1 - S2 = Strategy items 1 and 2
G1 - G4 = Goal setting items for the overall project
G5 - G9 = Goal setting for the current assignment
F1-F4 = Feedback items 1 through 4
D1-D5 = Decision making items 1 through 5

Complete the following before the discussion period begins

- 1) Review the feedback given to the groups and fill out the feedback table with the items or areas in which points were deducted or performance was considered low.
- 2) Fill out group member identifiers (e.g., initials, or GM-1, GM-2, etc.) in the decision tables on page 3.

Complete pages 2-4 during the discussion period

Notes on discussion topics/decisions for each 15 period:

Strategy

(S1) At the end of each 15 minute block of discussion, note below the approximate percent of time spent in strategy discussion *who will do what work, when you will meet outside of class, how the work will be completed, how editing or review will be done*. If the reported time period is less than or slightly over 15 minutes, note the actual time. When the group product is submitted, determine an overall percent.

P1 - % =	P2 - % =	P3 - % =	P4 - % =	P5 - % =	P6 - % =
P7 - % =	P8 - % =	P9 - % =	P10 - % =	Overall (average)% =	

Goals

(G1, G2, G5 & G6) Note below any goals mentioned during the discussion and indicate whether or not they referred to the overall project (O) or the current assignment (CA). Consider goals to be desirable outcomes that the group expresses. Examples include: certain grade or score, the completion of the project, something to be learned, specific parts or milestones to be achieved, or other outcomes. Underline any goals where 2 or members agreed and note what % of the group expressed agreement. If the group changes a decision on a goal, put an editorial mark through the old goal (e.g., when recording or combining data from multiple sessions).

(G1-G4) **Overall Project Goals:**

(G5 - G8) **Current Assignment Goals:**

Feedback

(F1-F4) Under item/area, note any feedback the group was given on their previous assignment. This may be oral or written feedback. Note what action the group was told to take (e.g., respond to a question; correct an error; provide additional information; etc.) Place a $\checkmark$ in the blanks under the appropriate column as follows (Note that the actual product of the group must be reviewed in order to deter if changes were actually made):

D = Discussed

LI = Low areas examined to determine why points were lost

CI = Changes identified for next assignment as a result of the feedback

CM = Changes were made to the next assignment as related to the feedback

D LI CI CM

Item/Area

[illegible]

Decision Making

(D1-D5) For each decision matrix used, write the first initial of each group member under "identifier." When a proposal for a particular course of action or goal is presented, name the decision and place a check next to each group member that speaks during the discussion until either a decision is reached or the topic is dropped. If the topic is dropped temporarily and discussion later resumes, place a wavy line at the point the discussion stopped/restarted, and continue checking. Write "yes," "no," "dropped," or the actual outcome after "result" below to indicate the outcome of the decision. If yes, write the number of group members that openly expressed agreement and if one, note whether or not that group member was asked (i.e., permission) to make the decision. Check for all utterances including such remarks as "uh huh," "yeah," "OK," "what?" etc. Circle the check if the utterance reflects an opinion. Place a "D" after the check if the utterance is an examination of an opinion and draw a line connecting it to the appropriate circle. Place an "I" after the check for interrupts.

Identifier	Decision:										Result:	#:	If 1, Permission?			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

Identifier	Decision:										Result:	#:	If 1, Permission?			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

Identifier	Decision:										Result:	#:	If 1, Permission?			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

Identifier	Decision:										Result:	#:	If 1, Permission?			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

Identifier	Decision:								Result:			#:	If 1. Permission?			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

Identifier	Decision:								Result:			#:	If 1. Permission?			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

Identifier	Decision:								Result:			#:	If 1. Permission?			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

Identifier	Decision:								Result:			#:	If 1. Permission?			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

Identifier	Decision:								Result:			#:	If 1. Permission?			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

Complete the Following at the End of Each Observation Period

(S2) Note, by function, any roles established by the group or required by the instructor. If there are no roles established, write "none" below. If roles were established, note any work that is assigned or performed outside the established role and an estimate of the % of that work to the total. When the group product is submitted, review the notes and establish an overall percent of work performed in roles.

(G3, G4, G7, & G8) Review the underlined goals in the G1, G2, G5, & G6 notes and make an assessment of the clarity (very unclear, somewhat clear, fairly clear, or very clear) and difficulty (too challenging, too easy, challenging) of 1) the overall goals, and 2) the current assignment goals. Write N/A if no goals were discussed by the group.

(G3) Overall goal clarity:

(G4) Overall goal difficulty:

(G7) Current assignment goal clarity:

(G8) Current assignment difficulty:

(G9) Review the notes taken in G1, G2, G5, & G6 and write down the total number of goals where open agreement was at least 50%. Total:

(F1) Determine % of areas discussed (Divide "D" by total of "items/area"):

(F2) Determine % of low items examined (Divide "LA" by total of "items/area"):

Use the following to guide completion of the questionnaire:

>1 - <50% = some ≥50 - < 100% = most or all

(F3) Determine % of items for which changes were identified (Divide "CI" by total of "items/area"):

Use the following to guide completion of the questionnaire:

>1 - <50% = some ≥50 - < 90% = most ≥90% - 100% = all

(F4) Determine % of items for which changes were made (Divide "CM" by total of "items/area"):

Use the following to guide completion of the questionnaire:

>1 - <50% = some ≥50 - < 90% = most ≥90% - 100% = all

(D1) Review all group member utterance frequencies for each decision and look for the presence of extreme differences in frequency and the presence of a pattern of interrupts. Consider the typical length of utterances for each group member (i.e., lengthy explanation or argument vs. short statement of opinion or idea). First, look for a pattern of dominance by one or two members through lengthy utterances, high frequency of utterances relative to others, and the presence of interrupts. Place a "D" in front of any group member identifier judged to be dominating the discussion of a particular decision based on these behaviors. Second, look for a pattern of low participation by one or more members through short

utterances and low frequency of utterances relative to others. Place an "LP" in front of any group member identifier judged to be low in participation. Review all decision tables before selecting a response option in D1.

(D2) Determine the % of group members that expressed an opinion :

(D3) Determine the % of opinions discussed:

Use the following to guide completion of the questionnaire:

>1 - <50% = some ≥ 50 - < 90% = most $\geq 90\%$ - 100% = all

(D4) Use your judgment and consider the patterns of decision discussion to select a response option.

(D5) Review “#” and “If 1. Permission?” notes for all decisions and select the style most frequently used by the group.

APPENDIX I
INTER-ITEM CORRELATIONS FOR ALL ITEMS

Variable	Ogoal1	Ogoal2	Ogoal3	Ogoal4	Cgoal1
Ogoal1	1.0000				
Ogoal2	.3908	1.0000			
Ogoal3	.4676	.6700	1.0000		
Ogoal4	.4697	.5273	.6417	1.0000	
Cgoal1	.6098	.4099	.4121	.5281	1.0000
Cgoal2	.4127	.6273	.3769	.3876	.7413
Cgoal3	.4188	.4544	.5399	.4933	.7520
Cgoal4	.4518	.3566	.3384	.5044	.7218
Fback1	.2895	.3524	.2628	.1731	.3990
Fback2	.2237	.1718	.1240	.0588	.2754
Fback3	.3390	.2505	.2267	.1187	.2776
Fback4	.2399	.1970	.1974	.1048	.2792
Dm1	.3585	.3591	.2950	.4098	.4242
Dm2	.2335	.4111	.2868	.3063	.3541
Dm3	.3296	.3645	.3003	.3306	.4213
Dm4	.2473	.2723	.1973	.3339	.3360
Dm5	.5181	.3646	.3684	.5055	.3608
Goaln	.3084	.2770	.3385	.2886	.3227
Pgoaln	.0445	.2139	.0320	.1030	.0666

table continues

Variable	Cgoal2	Cgoal3	Cgoal4	Fback1	Fback2
Cgoal2	1.0000				
Cgoal3	.8001	1.0000			
Cgoal4	.7058	.7883	1.0000		
Fback1	.4125	.2616	.1597	1.0000	
Fback2	.2576	.1514	.1545	.4118	1.0000
Fback3	.2838	.2660	.1339	.3599	.6359
Fback4	.3123	.3087	.1297	.3417	.5523
Dm1	.4601	.3914	.3503	.3081	.2635
Dm2	.4699	.3260	.2973	.2636	.0832
Dm3	.4740	.3468	.2380	.3675	.1617
Dm4	.3832	.3841	.3750	.2413	.1414
Dm5	.3143	.3051	.2822	.1229	.0267
Goaln	.3471	.3015	.2290	.2305	-.0210
Pgoaln	.0776	-.0595	.0571	-.0139	-.0339

table continues

Variable	Fback3	Fback4	Dm1	Dm2	Dm3
Fback3	1.0000				
Fback4	.8161	1.0000			
Dm1	.2049	.1761	1.0000		
Dm2	.0439	.1277	.4715	1.0000	
Dm3	.1420	.1697	.7058	.5972	1.0000
Dm4	.1272	.0910	.4635	.3005	.5451
Dm5	.1492	.0955	.4943	.3332	.4919
Goaln	.1579	.1876	.1691	.0446	.1918
Pgoaln	-.0247	-.0878	-.1416	.1328	-.0325

table continues

Variable	Dm4	Dm5	Goaln	Pgoaln
Dm4	1.0000			
Dm5	.3974	1.0000		
Goaln	.0967	.1748	1.0000	
Pgoaln	.2012	.1472	-.0464	1.0000

APPENDIX J

ITEM-TOTAL CORRELATIONS FOR EACH SUB-SCALE

Sub-scale	Item	Item-total Correlation
Overall Goal Setting	Ogoal1	.7514
	Ogoal2	.7077
	Ogoal3	.8232
	Ogoal4	.6706
	Goaln	.5544
Current Assignment Goal Setting	Cgoal1	.8703
	Cgoal2	.8776
	Cgoal3	.9067
	Cgoal4	.8266
Use of Feedback	Fback1	.6126
	Fback2	.7943
	Fback3	.9017
	Fback4	.8650

table continues

Sub-scale	Item	Item-total Correlation
Decision Making Style	Dm1	.8312
	Dm2	.6604
	Dm3	.8025
	Dm4	.6592
	Dm5	.7488

APPENDIX K
TEST-RETEST ITEM CORRELATIONS FOR ALL ITEMS

Sub-scale	Item	Correlation
Overall Goal Setting	Ogoal1	.7485
	Ogoal2	.8103
	Ogoal3	.9880
	Ogoal4	1.0000
	Goaln	1.0000
Current Assignment Goal Setting	Cgoal1	.8335
	Cgoal2	.8046
	Cgoal3	.9518
	Cgoal4	.9835
Use of Feedback	Fback1	.9421
	Fback2	.9751
	Fback3	.8745
	Fback4	.9868
Decision Making Style	Dm1	.9349
	Dm2	.9095
	Dm3	.9221
	Dm4	.8270
	Dm5	1.0000
Personal Goal Setting	Pgoaln	.9085

APPENDIX L

FACTOR ANALYSIS FOR ALL ITEMS

Table L1

Initial Statistics for Factor Analysis of All Group Function Variables

Variable	Communality	Factor	Eigenvalue	% Variance	Cum % Variance
Ogoal1	1.00000	1	6.97519	36.7	36.7
Ogoal2	1.00000	2	2.23198	11.7	48.5
Ogoal3	1.00000	3	1.58389	8.3	56.8
Ogoal4	1.00000	4	1.26164	6.6	63.4
Cgoal1	1.00000	5	1.15866	6.1	69.5
Cgoal2	1.00000	6	.98312	5.2	74.7
Cgoal3	1.00000	7	.83569	4.4	79.1
Cgoal4	1.00000	8	.69479	3.7	82.8
Fback1	1.00000	9	.66743	3.5	86.3
Fback2	1.00000	10	.45958	2.4	88.7
Fback3	1.00000	11	.44731	2.4	91.0
Fback4	1.00000	12	.38508	2.0	93.1
Dm1	1.00000	13	.29543	1.6	94.6
Dm2	1.00000	14	.28719	1.5	96.1
Dm3	1.00000	15	.24673	1.3	97.4
Dm4	1.00000	16	.16287	.9	98.3

table continues

Variable	Communality	Factor	Eigenvalue	% Variance	Cum % Variance
Dm5	1.00000	17	.14759	.8	99.1
Pgoaln	1.00000	18	.11576	.6	99.7
Goaln	1.00000	19	.06007	.3	100.0

Table L2

Factor Matrix for Factor Analysis of All Group Function Variables

Variable	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Cgoal2	.82161	-.01173	-.13793	-.30665	.18307
Cgoal1	.81036	-.01527	-.23522	-.25596	.09370
Cgoal3	.78645	-.06182	-.34078	-.34828	.04479
Cgoal4	.69657	-.17737	-.35624	-.40727	.19631
Ogoal2	.69163	-.10097	-.09677	.36111	.10627
Ogoal4	.67678	-.29721	-.19119	.28176	-.11240
Ogoal1	.66837	.01298	-.15322	.20946	-.13317
Dm1	.66354	-.09034	.47780	-.13794	-.26686
Dm3	.65192	-.15693	.58675	-.07849	-.17058
Ogoal3	.65042	-.11059	-.26963	.42143	-.19685
Dm5	.58160	-.28818	.23969	.32652	-.12478
Dm2	.55148	-.22761	.41445	-.05471	.12382
Dm4	.54236	-.19774	.37923	-.09729	.23059
Fback1	.50888	.35944	.18436	.01383	.00196
Goaln	.40617	.00314	-.34023	.12914	-.38558
Fback3	.43811	.78147	.00456	.18163	.04993
Fback4	.42125	.76144	.00170	.07203	.00628
Fback2	.36458	.71390	.17020	-.00895	.16623
Pgoaln	.07458	-.22208	.00813	.42926	.79510

Table L3

Final Statistics for Factor Analysis of All Group Function Variables

Variable	Communality	Factor	Eigenvalue	% Variance	Cum % Variance
Ogoal1	.53198	1	6.97519	36.7	36.7
Ogoal2	.63960	2	2.23198	11.7	48.5
Ogoal3	.72433	3	1.58389	8.3	56.8
Ogoal4	.67494	4	1.26164	6.6	63.4
Cgoal1	.78653	5	1.15866	6.1	69.5
Cgoal2	.82175				
Cgoal3	.86176				
Cgoal4	.84798				
Fback1	.42234				
Fback2	.69925				
Fback3	.83814				
Fback4	.76247				
Dm1	.76698				
Dm2	.54603				
Dm3	.82916				
Dm4	.53971				

table continues

Variable	Communality	Factor	Eigenvalue	% Variance	Cum % Variance
Dm5	.60093				
Pgoaln	.87140				
Goaln	.44609				

Table L4

Pattern Matrix for Factor Analysis: Oblique Rotation of All Group Function Variables

Variable	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Cgoal4	.96523	-.11215	-.04546	-.01284	.02894
Cgoal3	.87345	.01454	-.00935	.11146	-.09128
Cgoal2	.78026	.13132	.15591	.00469	.04630
Cgoal1	.75615	.10709	.06879	.12529	-.00952
Fback3	-.05834	.91766	-.10424	.12469	.02972
Fback4	.01533	.86584	-.08526	.05015	-.05845
Fback2	.02693	.83883	.05288	-.17157	.05134
Fback1	.05791	.50633	.25278	.04733	-.02587
Dm3	-.01755	.04909	.89913	.05252	-.13798
Dm1	.05540	.07535	.80227	.07959	-.26171
Dm2	.13612	-.02250	.65250	-.01965	.13982
Dm4	.22329	.00695	.58928	-.10243	.20927
Ogoal3	.03795	.05796	-.01551	.82097	.06179
Ogoal4	.18213	-.12235	.12615	.67923	.09967
Goaln	.12859	.01677	-.13216	.57322	-.26958
Ogoal2	.11802	.13638	.11324	.57129	.30318
Ogoal1	.16272	.16996	.08170	.54316	.00115
Dm5	-.15415	-.06432	.51290	.51804	.10854
Pgoaln	-.00668	.00040	-.11080	.06574	.94317

Table L5

Structure Matrix for Factor Analysis, Oblique Rotation of All Group Function Variables

Variable	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Cgoal3	.91803	.28568	.34831	.50037	-.03453
Cgoal4	.91233	.14727	.30291	.38306	.08919
Cgoal2	.88209	.38036	.48876	.42946	.11487
Cgoal1	.86814	.35929	.41636	.50624	.04776
Fback3	.21821	.90472	.09448	.25167	-.02985
Fback4	.24548	.86643	.09494	.20360	-.10956
Fback2	.21024	.81978	.18071	.02674	.01876
Fback1	.31697	.58239	.38375	.25272	-.00540
Dm3	.35518	.23541	.89683	.32953	-.00116
Dm1	.40256	.27462	.82222	.36188	-.13579
Dm2	.37987	.13197	.71581	.24150	.25015
Dm4	.41858	.15387	.67683	.18562	.31229
Dm5	.26292	.09088	.61835	.59706	.19217
Ogoal3	.41969	.22800	.27363	.84616	.07705
Ogoal4	.50629	.08553	.39758	.77727	.15141
Ogoal2	.47505	.29256	.40838	.69315	.33446
Ogoal1	.48504	.34093	.34506	.67545	.02828
Goaln	.32177	.15521	.05585	.58739	-.27000
Pgoaln	.04137	.05331	.05292	.04912	.92701

Table L6

Factor Matrix for Factor Analysis. Oblique Rotation of All Group Function Variables

Variable	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Factor 1	1.00000				
Factor 2	.28196	1.00000			
Factor 3	.38292	.19387	1.00000		
Factor 4	.44744	.20122	.30916	1.00000	
Factor 5	.06462	-.04620	.15467	.02179	1.00000

APPENDIX M

FACTOR ANALYSES FOR INSTRUMENT SUB-SCALES

Table M1

Initial Statistics for Factor Analysis of Overall Goal Setting

Variable	Communality	Factor	Eigenvalue	% Variance	Cum % Variance
Ogoal1	1.00000	1	2.52367	50.5	50.5
Ogoal2	1.00000	2	.92043	18.4	68.9
Ogoal3	1.00000	3	.61191	12.2	81.1
Ogoal4	1.00000	4	.60344	12.1	93.2
Goaln	1.00000	5	.34055	6.8	100.0

Table M2

Factor Matrix for Factor Analysis of Overall Goal Setting

Variable	Factor 1
Ogoal1	.86063
Ogoal2	.73570
Ogoal3	.71263
Ogoal4	.71113
Goaln	.47769

Table M3

Final Statistics for Factor Analysis of Overall Goal Setting

Variable	Communality	Factor	Eigenvalue	% Variance	Cum % Variance
Ogoal1	.50571	1	2.52367	50.5	50.5
Ogoal2	.54125	2			
Ogoal3	.74068	3			
Ogoal4	.50784	4			
Goaln	.22819	5			

Table M4

Initial Statistics for Factor Analysis of Current Assignment Goal Setting

Variable	Communality	Factor	Eigenvalue	% Variance	Cum % Variance
Cgoal1	1.00000	1	3.03638	75.9	75.9
Cgoal2	1.00000	2	.38683	9.7	85.6
Cgoal3	1.00000	3	.35326	8.8	94.4
Cgoal4	1.00000	4	.22353	5.6	100.0

Table M5

Factor Matrix for Factor Analysis of Current Assignment Goal Setting

Variable	Factor 1
Cgoal1	.86063
Cgoal2	.73570
Cgoal3	.71263
Cgoal4	.71113

Table M6

Final Statistics for Factor Analysis of Current Assignment Goal Setting

Variable	Communality	Factor	Eigenvalue	% Variance	Cum % Variance
Cgoal1	.73158	1	3.03638	75.9	75.9
Cgoal2	.76859				
Cgoal3	.82774				
Cgoal4	.70847				

Table M7

Initial Statistics for Factor Analysis of Feedback

Variable	Communality	Factor	Eigenvalue	% Variance	Cum % Variance
Fback1	1.00000	1	2.56928	64.2	64.2
Fback2	1.00000	2	.77695	19.4	83.7
Fback3	1.00000	3	.47984	12.0	95.7
Fback4	1.00000	4	.17392	4.3	100.0

Table M8

Factor Matrix for Factor Analysis of Feedback

Variable	Factor 1
Fback1	.90406
Fback2	.86733
Fback3	.80566
Fback4	.59212

Table M9

Final Statistics for Factor Analysis of Feedback

Variable	Communality	Factor	Eigenvalue	% Variance	Cum % Variance
Fback1	.35061	1	2.56928	64.2	64.2
Fback2	.64909				
Fback3	.81733				
Fback4	.75225				

Table M10

Initial Statistics for Factor Analysis of Decision Making Style

Variable	Communality	Factor	Eigenvalue	% Variance	Cum % Variance
Dm1	1.00000	1	2.76825	55.4	55.4
Dm2	1.00000	2	.84465	16.9	72.3
Dm3	1.00000	3	.59033	11.8	84.1
Dm4	1.00000	4	.45272	9.1	93.1
Dm5	1.00000	5	.34405	6.9	100.0

Table M11

Factor Matrix for Factor Analysis of Decision Making Style

Variable	Factor 1
Dm1	.83302
Dm2	.81859
Dm3	.73744
Dm4	.66072
Dm5	.65106

Table M12

Final Statistics for Factor Analysis of Decision Making Style

Variable	Communality	Factor	Eigenvalue	% Variance	Cum % Variance
Dm1	.69393	1	2.76825	55.4	55.4
Dm2	.42388				
Dm3	.67008				
Dm4	.43655				
Dm5	.54381				

APPENDIX N
ITEM OBSERVER TO AVERAGE GROUP RATING CORRELATIONS¹⁴

Sub-scale	Item	Correlation	Probability	Number of Observations
Overall Goal Setting	Ogoal1	.6957	.025	10
	Ogoal2	.5222	.122	10
	Ogoal3	.6118	.060	10
	Ogoal4	.1776	.623	10
	Goaln	-.1698	.639	10
Current Assignment				
Goal Setting	Cgoal1	.5417	.106	10
	Cgoal2	.7021	.024	10
	Cgoal3	.6755	.032	10
	Cgoal4	.3573	.311	10
Use of Feedback	Fback1	.3983	.328	8
	Fback2	.6176	.103	8
	Fback3	.7228	.043	8
	Fback4	.6241	.098	8

table continues

¹⁴ Note that while observer scores are provided for all items, some items are arguably not directly observable and must be rated on the basis of observer opinion, e.g., goal clarity and challenge (Ogoal3, Ogoal4, Cgoal3, and Cgoal4), expression of disagreement (Dm 4), and number of personal goals (Pgoaln). The number of individual goals (Pgoaln) was not rated.

Sub-scale	Item	Correlation	Probability	Number of Observations
Decision Making Style	Dm1	.7658	.010	10
	Dm2	.2995	.400	10
	Dm3	.7081	.022	10
	Dm4	-.0431	.906	10
	Dm5	.8768	.011	10

APPENDIX O

OVERALL GOAL SETTING FACTOR ANALYSIS FOLLOWING REVISIONS

Table O1

Initial Statistics for Factor Analysis of Overall Goal Setting Following Revisions

Variable	Communality	Factor	Eigenvalue	% Variance	Cum % Variance
Ogoal1	1.00000	1	2.37345	59.3	59.3
Ogoal2	1.00000	2	.65101	16.3	75.6
Ogoal3	1.00000	3	.61016	15.3	90.9
Ogoal4	1.00000	4	.36539	9.1	100.0

Table O2

Factor Matrix for Factor Analysis of Overall Goal Setting Following Revisions

Variable	Factor 1
Ogoal1	.86005
Ogoal2	.77177
Ogoal3	.74089
Ogoal4	.69945

Table O3

Final Statistics for Factor Analysis of Overall Goal Setting Following Revisions

Variable	Communality	Factor	Eigenvalue	% Variance	Cum % Variance
Ogoal1	.48922	1	2.37345	59.3	59.3
Ogoal2	.59563				
Ogoal3	.73968				
Ogoal4	.54891				

APPENDIX P

ITEM-TOTAL CORRELATIONS FOR REVISED SUB-SCALES

Sub-scale	Item	Item-total Correlation
Overall Goal Setting	Ogoal1	.7597
	Ogoal2	.7623
	Ogoal3	.8318
	Ogoal4	.7130
Current Assignment		
Goal Setting	Cgoal1	.8703
	Cgoal2	.8776
	Cgoal3	.9067
	Cgoal4	.8266
Use of Feedback	Fback2	.7962
	Fback3	.9367
	Fback4	.9000
Decision Making Style	Dm1	.8384
	Dm3	.8181
	Dm4	.7107
	Dm5	.7555

APPENDIX Q

FACTOR ANALYSIS FOR ALL ITEMS OF THE REVISED GROUP FUNCTIONS
INSTRUMENT

Table Q1

Initial Statistics for Factor Analysis of Revised Group Function Variables

Variable	Communality	Factor	Eigenvalue	% Variance	Cum % Variance
Ogoal1	1.00000	1	6.26794	39.2	39.2
Ogoal2	1.00000	2	2.10017	13.1	52.3
Ogoal3	1.00000	3	1.42666	8.9	61.2
Cgoal1	1.00000	4	1.24559	7.8	69.0
Cgoal2	1.00000	5	1.08961	6.8	75.8
Cgoal3	1.00000	6	.83598	5.2	81.0
Fback2	1.00000	7	.59456	3.7	84.8
Fback3	1.00000	8	.55656	3.5	88.2
Fback4	1.00000	9	.42547	2.7	90.9
Dm1	1.00000	10	.36500	2.3	93.2
Dm3	1.00000	11	.29648	1.9	95.0
Dm4	1.00000	12	.27157	1.7	96.7
Pgoaln	1.00000	13	.18687	1.2	97.9
Cgoal4	1.00000	14	.15224	1.0	98.8
Ogoal4	1.00000	15	.11820	.7	99.6
Dm5	1.00000	16	.06710	.4	100.0

Table Q2

Factor Matrix for Factor Analysis of Revised Group Function Variables

Variable	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Cgoal1	.81449	-.03238	-.26582	-.21185	.07972
Cgoal2	.81103	-.00005	-.20687	-.21435	.25736
Cgoal3	.80162	-.04917	-.35840	-.26347	.06137
Cgoal4	.71252	-.17777	-.40925	-.31893	.14919
Ogoal4	.68415	-.30284	-.10142	.24278	-.26817
Ogoal2	.68093	-.09326	-.08576	.42053	-.00113
Ogoal1	.67744	-.00224	-.04956	.15838	-.22608
Ogoal3	.65435	-.11870	-.18215	.41203	-.37604
Dm1	.65378	-.06305	.52217	-.24221	-.12440
Dm3	.62637	-.13768	.58729	-.18575	-.01092
Dm5	.59367	-.25814	.39797	.25012	-.10866
Dm4	.55001	-.19523	.41476	-.11833	.39035
Fback3	.44047	.80320	.05331	.17642	.01197
Fback4	.41376	.79370	.01504	.06987	-.00196
Fback2	.36447	.71695	.11316	-.00377	.09923
Pgoaln	.07051	-.18387	-.01179	.58927	.73266

Table Q3

Final Statistics for Factor Analysis of Revised Group Function Variables

Variable	Communality	Factor	Eigenvalue	% Variance	Cum % Variance
Ogoal1	.53758	1	6.26794	39.2	39.2
Ogoal2	.65657	2	2.10017	13.1	52.3
Ogoal3	.78661	3	1.42666	8.9	61.2
Cgoal1	.78635	4	1.24559	7.8	69.0
Cgoal2	.81275	5	1.08961	6.8	75.8
Cgoal3	.84664				
Fback2	.66952				
Fback3	.87325				
Fback4	.80620				
Dm1	.77820				
Dm3	.79083				
Dm4	.67903				
Pgoaln	.92295				
Cgoal4	.83075				
Ogoal4	.70091				
Dm5	.65183				

Table Q4

Pattern Matrix for Factor Analysis. Oblique Rotation of Revised Group Function Variables.

Variable	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Cgoal4	.94578	-.11848	-.04578	.01415	-.01957
Cgoal3	.86248	.03747	-.01572	.11371	-.07127
Cgoal2	.79193	.12984	.12623	-.01071	.11112
Cgoal1	.77145	.07844	.06377	.12915	-.02818
Fback3	-.05541	.93056	-.03096	.10502	.03265
Fback4	.02613	.89066	-.04604	.02752	-.04024
Fback2	.02962	.80988	.08054	-.11559	.00646
Dm3	.01890	.03135	.86861	.03337	-.08368
Dm1	.06246	.08485	.80518	.06825	-.21658
Dm4	.22601	-.01946	.68918	-.17271	.28762
Dm5	-.16761	-.04629	.56392	.49182	.10370
Ogoal3	.05476	.04598	-.09075	.88211	-.03232
Ogoal4	.19202	-.14333	.09441	.71488	-.02079
Ogoal2	.13247	.11839	.02903	.62468	.27581
Ogoal1	.17782	.14781	.10591	.53987	-.07080
Pgoaln	-.03756	-.00668	-.07400	.04509	.96348

Table Q5

Structure Matrix for Factor Analysis, Oblique Rotation of Revised Group Function Variables.

Variable	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Cgoal4	.91117	.27781	.35033	.49101	-.00066
Cgoal3	.90282	.11920	.29731	.39456	.04986
Cgoal2	.87673	.34892	.45718	.41549	.17877
Cgoal1	.87092	.31031	.41179	.50425	.04423
Fback3	.22010	.92904	.14200	.23783	.01010
Fback4	.24596	.89563	.11709	.17818	-.06368
Fback2	.21703	.81015	.18735	.06955	-.01316
Dm3	.36611	.18855	.88370	.33854	.01063
Dm1	.40483	.25227	.84378	.36951	-.12420
Dm4	.42816	.11487	.74281	.18409	.36283
Dm5	.26061	.08915	.67209	.61145	.10198
Ogoal3	.42019	.20244	.23709	.88072	.03360
Ogoal4	.50624	.04905	.38686	.80514	.06578
Ogoal2	.47087	.26104	.34240	.73701	.33700
Ogoal1	.48980	.30866	.37601	.67539	-.00593
Pgoaln	.02386	-.04527	.02697	.08110	.95683

Table Q6

Factor Correlation Matrix for Factor Analysis, Oblique Rotation of Revised Group Function

Variables

Variable	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Factor 1	1.00000				
Factor 2	.25616	1.00000			
Factor 3	.38061	.16612	1.00000		
Factor 4	.44279	.17762	.34321	1.00000	
Factor 5	.07405	-.02561	.10473	.08224	1.00000

APPENDIX R

REVISED GROUP FUNCTIONS QUESTIONNAIRES

Questionnaire: Demographic Information

Please provide the following background information:

1. Age: _____
2. Sex:: M F (circle one)
3. Class standing (circle one):

Fresh Soph Jr. Sr. Masters Doctoral Not enrolled in a degree program
4. Grade point average: _____
5. Previous experience in learning groups (groups formed to complete class assignments in school) or work groups (groups formed to complete a task or solve a particular problem in a work environment). Check the item that best describes your experience:

____ I have never been in a learning or work group.

____ I have had a couple (1 or 2) of experiences in a learning or work group.

____ I have had a few (3 -5) experiences in a learning or work group.

____ I have had numerous (5 or more) experiences in a learning or work group.

Questionnaire: Group Functions

Directions: The items below relate to actions your group took while completing your most recent assignment. For each item, select the one statement (circle the letter) that best describes your group. Please complete the questionnaire without discussion with other group or class members.

Questions 1-11 relate to goals. Goals are desirable outcomes that a person or group strives for. Goals can be a certain grade or score, the completion of the project, something to be learned, specific accomplishments, or other outcomes. You will be asked about the overall project, the current assignment, and personal goals.

1. To what extent did the group discuss goals for the overall project?

- a. There was no discussion of goals.
- b. The group identified possible goals, but did not reach a decision.
- c. The group discussed the pros and cons of some of the possible goals, but did not reach a decision.
- d. The group discussed the pros and cons of most or all of the possible goals, but did not reach a decision.
- e. The group discussed the possible goals until a final decision was reached.

2. Please write below only those overall project goals your group actually discussed and agreed upon.

- 1) _____
- 2) _____
- 3) _____

3. What percentage of group members openly expressed agreement with the group's goals for the overall project?

- a. Not applicable - the group did not discuss goals.
- b. Less than 25%
- c. 26-50%
- d. 51-75%
- e. 76-100%

4. How clear to you are your group's goal (or goals) for the overall project?

- a. Very unclear
- b. Unclear
- c. Somewhat clear
- d. Clear
- e. Very clear

5. How challenging are the group's goals for the overall project?

- a. Goals are too unclear to say how challenging they are.
- b. I think the group's goals are too easy.
- c. I think the group's goals are too challenging.
- d. The group's goals are challenging, but can be achieved.

6. To what extent did the group discuss goals for the current assignment?

- a. There was no discussion of goals.
- b. The group identified possible goals, but did not reach a decision.
- c. The group discussed the pros and cons of some of the possible goals, but did not reach a decision.
- d. The group discussed the pros and cons of most or all of the possible goals, but didn't reach a decision.
- e. The group discussed the possible goals until a final decision was reached.

7. Please write below only those current assignment goals your group actually discussed and agreed upon

- 1) _____
- 2) _____
- 3) _____

8. What percentage of group members openly expressed agreement with the group's goals for the current assignment?

- a. Not applicable - the group did not discuss goals.
- b. Less than 25%
- c. 26-50%
- d. 51-75%
- e. 76-100%

9. How clear to you were your group's goal (or goals) for the current assignment?

- a. Very unclear
- b. Unclear
- c. Somewhat clear
- d. Clear
- e. Very clear

10. How challenging were the group's goals for the current assignment?

- a. Goals are too unclear to say how challenging they are.
- b. I think the group's goals are too easy.
- c. I think the group's goals are too challenging.
- d. The group's goals are challenging, but can be achieved.

11. If you set any personal goals for yourself (overall or for the current assignment) please note them below. If you did not set any personal goals, go to question 12.

- 1) _____
- 2) _____
- 3) _____

Questions 12-15 on decision making, refer to how your group makes major decisions such as: how you plan to complete the assignment, your strategy for solving the problem, who will do what work, or how you reach resolution on differences of opinion on your project.

12. Overall, to what extent did group members all participate in decision making?

- a. One or two group members dominated the discussion.
- b. Less than half participated.
- c. More than half participated.
- d. All or most participated, but participation was unequal among members.
- e. All participated fairly equally.

13. What percentage of group member opinions or preferences were discussed?

- a. Less than 25%
- b. 26-50%
- c. 51-75%
- d. 76-100%

14. When you had a different opinion or idea than another group member, to what extent were you willing to openly express disagreement?

- a. I usually kept it to myself.
- b. Some of the time I told them.
- c. Most of the time I told them.
- d. I always told them.

15. How were final decisions made in the group?

- a. One or two group members forced their opinion on the group or blocked the group from making decisions.
- b. We let one group member make the decision for the entire group.
- c. Two group members conferred and they decided for the group.
- d. We took a vote and the majority ruled.
- e. The group checked to make sure all group members agreed.

Questionnaire: Group Functions

Directions: The items below relate to actions your group took while completing your most recent assignment. For each item, select the one statement (circle the letter) that best describes your group. Please complete the questionnaire without discussion with other group or class members.

Questions 1-11 relate to goals. Goals are desirable outcomes that a person or group strives for. Goals can be a certain grade or score, the completion of the project, something to be learned, specific accomplishments, or other outcomes. You will be asked about the overall project, the current assignment, and personal goals.

1. To what extent did the group discuss goals for the overall project?

- a. There was no discussion of goals.
- b. The group identified possible goals, but did not reach a decision.
- c. The group discussed the pros and cons of some of the possible goals, but did not reach a decision.
- d. The group discussed the pros and cons of most or all of the possible goals, but did not reach a decision.
- e. The group discussed the possible goals until a final decision was reached.

2. Please write below only those overall project goals your group actually discussed and agreed upon.

- 1) _____
- 2) _____
- 3) _____

3. What percentage of group members openly expressed agreement with the group's goals for the overall project?

- a. Not applicable - the group did not discuss goals.
- b. Less than 25%
- c. 26-50%
- d. 51-75%
- e. 76-100%

4. How clear to you are your group's goal (or goals) for the overall project?

- a. Very unclear
- b. Unclear
- c. Somewhat clear
- d. Clear
- e. Very clear

5. **How challenging are the group's goals for the overall project?**
- Goals are too unclear to say how challenging they are.
 - I think the group's goals are too easy.
 - I think the group's goals are too challenging.
 - The group's goals are challenging, but can be achieved.
6. **To what extent did the group discuss goals for the current assignment?**
- There was no discussion of goals.
 - The group identified possible goals, but did not reach a decision.
 - The group discussed the pros and cons of some of the possible goals, but did not reach a decision.
 - The group discussed the pros and cons of most or all of the possible goals, but didn't reach a decision.
 - The group discussed the possible goals until a final decision was reached.
7. **Please write below only those current assignment goals your group actually discussed and agreed upon**
- 1) _____
 - 2) _____
 - 3) _____
8. **What percentage of group members expressed open agreement with the group's goals for the current assignment?**
- Not applicable - the group did not discuss goals.
 - Less than 25%
 - 26-50%
 - 51-75%
 - 76-100%
9. **How clear to you were your group's goal (or goals) for the current assignment?**
- Very unclear
 - Unclear
 - Somewhat clear
 - Clear
 - Very clear

10. How challenging were the group's goals for the current assignment?

- a. Goals are too unclear to say how challenging they are.
- b. I think the group's goals are too easy.
- c. I think the group's goals are too challenging.
- d. The group's goals are challenging, but can be achieved.

11. If you set any personal goals for yourself (overall or for the current assignment) please note them below. If you did not set any personal goals, go to question 12.

- 1) _____
- 2) _____
- 3) _____

Questions 12-14 relate to the feedback your group was given by the instructor(s) on the previous assignment.

☐ *If your group did not receive feedback on the last assignment, check this box and proceed to item 15 (skip items 12-14).*

12. To what extent did the group attempt to determine why they performed low in some areas on the previous assignment?

- a. Not applicable (The group had no areas of low performance.)
- b. 25% or less of the low areas were discussed.
- c. 26-50% of the low areas were discussed.
- d. 51-75% of the low areas were discussed.
- e. 76-100% of the low areas were discussed.

13. To what extent did the group use the feedback to identify changes required for the assignment you just turned in?

- a. No changes identified because the group had no areas of low performance or the identified changes were not directed at the current assignment.
- b. Changes were identified for 25% or less of the low areas.
- c. Changes were identified for 26-50% of the low areas.
- d. Changes were identified for 51-75% of the low areas.
- e. Changes were identified for 76-100% of the low areas.

14. To what extent did the group make the identified changes to the assignment just turned in?

- a. No changes made because the group had no areas of low performance or the identified changes were not directed at the current assignment.
- b. Changes were made for 25% or less of the low areas.
- c. Changes were made for 26-50% of the low areas.
- d. Changes were made for 51-75% of the low areas.
- e. Changes were made for 76-100% of the low areas.

Questions 15-18 on decision making, refer to how your group makes major decisions such as: how you plan to complete the assignment, your strategy for solving the problem, who will do what work, or how you reach resolution on differences of opinion on your project.

15. Overall, to what extent did group members all participate in decision making?

- a. One or two group members dominated the discussion.
- b. Less than half participated.
- c. More than half participated.
- d. All or most participated, but participation was unequal among members.
- e. All participated fairly equally.

16. What percentage of group member opinions or preferences were discussed?

- a. Less than 25%
- b. 26-50%
- c. 51-75%
- d. 76-100%

17. When you had a different opinion or idea than another group member, to what extent were you willing to openly express disagreement?

- a. I usually kept it to myself.
- b. Some of the time I told them.
- c. Most of the time I told them.
- d. I always told them.

18. How were final decisions made in the group?

- a. One or two group members forced their opinion on the group or blocked the group from making decisions.
- b. We let one group member make the decision for the entire group.
- c. Two group members conferred and they decided for the group.
- d. We took a vote and the majority ruled.
- e. The group checked to make sure all group members agreed.

APPENDIX S

GROUP PROBLEM SOLVING EFFECTIVENESS ASSESSMENT INSTRUMENT

Group Problem Solving Effectiveness Assessment

For each item, please identify the highest performing group (of all groups) and place their group number in the blank that has the pre-circled 10. Identify the lowest scoring group and place their group number in the blank that has the pre-circled 1. Score all remaining groups by placing their number in the blank and circling a score that reflects their performance relative to the highest and lowest scoring groups.

Item 1: The degree to which the group solved the problem they were given or produced the desired end product.

	Lowest Group									Highest Group
Group # _____	1	2	3	4	5	6	7	8	9	(10)
Group # _____	1	2	3	4	5	6	7	8	9	10
Group # _____	1	2	3	4	5	6	7	8	9	10
Group # _____	1	2	3	4	5	6	7	8	9	10
Group # _____	1	2	3	4	5	6	7	8	9	10
Group # _____	1	2	3	4	5	6	7	8	9	10
Group # _____	1	2	3	4	5	6	7	8	9	10
Group # _____	1	2	3	4	5	6	7	8	9	10
Group # _____	1	2	3	4	5	6	7	8	9	10
Group # _____	1	2	3	4	5	6	7	8	9	10
Group # _____	1	2	3	4	5	6	7	8	9	10
Group # _____	1	2	3	4	5	6	7	8	9	10
Group # _____	1	2	3	4	5	6	7	8	9	10
Group # _____	1	2	3	4	5	6	7	8	9	10
Group # _____	1	2	3	4	5	6	7	8	9	10
Group # _____	1	2	3	4	5	6	7	8	9	10
Group # _____	(1)	2	3	4	5	6	7	8	9	10

Item 2: The degree of competence demonstrated by the group in following the problem solving (or product development) process.

	Lowest Group									Highest Group
Group # _____	1	2	3	4	5	6	7	8	9	⑩
Group # _____	1	2	3	4	5	6	7	8	9	10
Group # _____	1	2	3	4	5	6	7	8	9	10
Group # _____	1	2	3	4	5	6	7	8	9	10
Group # _____	1	2	3	4	5	6	7	8	9	10
Group # _____	1	2	3	4	5	6	7	8	9	10
Group # _____	1	2	3	4	5	6	7	8	9	10
Group # _____	1	2	3	4	5	6	7	8	9	10
Group # _____	1	2	3	4	5	6	7	8	9	10
Group # _____	1	2	3	4	5	6	7	8	9	10
Group # _____	1	2	3	4	5	6	7	8	9	10
Group # _____	1	2	3	4	5	6	7	8	9	10
Group # _____	1	2	3	4	5	6	7	8	9	10
Group # _____	1	2	3	4	5	6	7	8	9	10
Group # _____	1	2	3	4	5	6	7	8	9	10
Group # _____	1	2	3	4	5	6	7	8	9	10
Group # _____	1	2	3	4	5	6	7	8	9	10
Group # _____	①	2	3	4	5	6	7	8	9	10

Item 3: The quality of ideas developed by the group as a part of their solution or product.

	Lowest Group									Highest Group
Group # _____	1	2	3	4	5	6	7	8	9	⑩
Group # _____	1	2	3	4	5	6	7	8	9	10
Group # _____	1	2	3	4	5	6	7	8	9	10
Group # _____	1	2	3	4	5	6	7	8	9	10
Group # _____	1	2	3	4	5	6	7	8	9	10
Group # _____	1	2	3	4	5	6	7	8	9	10
Group # _____	1	2	3	4	5	6	7	8	9	10
Group # _____	1	2	3	4	5	6	7	8	9	10
Group # _____	1	2	3	4	5	6	7	8	9	10
Group # _____	1	2	3	4	5	6	7	8	9	10
Group # _____	1	2	3	4	5	6	7	8	9	10
Group # _____	1	2	3	4	5	6	7	8	9	10
Group # _____	1	2	3	4	5	6	7	8	9	10
Group # _____	1	2	3	4	5	6	7	8	9	10
Group # _____	1	2	3	4	5	6	7	8	9	10
Group # _____	1	2	3	4	5	6	7	8	9	10
Group # _____	1	2	3	4	5	6	7	8	9	10
Group # _____	①	2	3	4	5	6	7	8	9	10

APPENDIX T
INTER-ITEM CORRELATIONS FOR ACHIEVEMENT ASSESSMENT ITEMS

Item	Item		
	Solved problem	Followed process	Quality of ideas
Solved the problem	1.0000		
Followed the process	.5958	1.0000	
Quality of ideas	.3886	.8176	1.0000

APPENDIX U
FACTOR ANALYSIS FOR ACHIEVEMENT ASSESSMENT ITEMS

Table U1

Initial Statistics for Factor Analysis of Achievement Assessment Items

Variable	Communality	Factor	Eigenvalue	% Variance	Cum % Variance
Solved problem	1.00000	1	2.21860	74.0	74.0
Followed process	1.00000	2	.63687	21.2	95.2
Quality of ideas	1.00000	3	.14453	4.8	100.0

Table U2

Factor Matrix for Factor Analysis of Achievement Assessment Items

Variable	Factor 1
Solved problem	.87420
Followed process	.74313
Quality of ideas	.94981

Table U3

Final Statistics for Factor Analysis of All Group Function Variables

Variable	Communality	Factor	Eigenvalue	% Variance	Cum % Variance
Solved problem	.76423	1	2.21860	74.0	74.0
Followed process	.55225				
Quality of ideas	.90213				

APPENDIX V
DESCRIPTIVE STATISTICS FOR DISTRIBUTION CHARACTERISTICS OF
GROUP VARIABLES

Variable	Mean	Variance	Skewness	Minimum	Maximum
Ogoal1	17.2	2.25	-2.75	8.7	19.0
Ogoal2	17.0	3.91	-1.61	9.0	19.0
Ogoal3	17.6	2.91	-3.02	7.8	19.0
Cgoal1	17.4	1.11	-.55	13.7	19.0
Cgoal2	17.3	2.11	-1.48	11.6	19.0
Cgoal3	17.9	1.64	-1.90	12.3	19.0
Fback1	8.6	20.57	-.37	0.0	15.0
Fback2	10.1	15.81	-.74	0.0	15.0
Fback3	11.3	13.28	-1.05	1.0	15.0
Dm1	15.9	2.25	-.72	10.0	18.0
Dm2	15.8	2.8	-1.2	10.0	18.0
Dm3	16.2	2.56	-1.04	10.3	18.0
Pgoaln1	.85	.44	.74	0.0	3.0
Pgoaln2	.85	.37	.54	0.0	2.5
Pgoaln3	.69	.30	.53	0.0	2.0

table continues

Variable	Mean	Variance	Skewness	Minimum	Maximum
Size ¹⁵	4.2	1.12	.84	3	7
Aveexp	3.0	.36	-.54	1	4
Avegpa	3.3	.08	.18	2.61	2.99
Aveage	25.7	20.61	1.84	20.7	42.5
Total	19.23	74.29	-.62	3	30

¹⁵ Note that variables are abbreviated. Size is the number of group members. Aveexp is average previous experience in groups. Avegpa is the average grade point average of the group. Aveage is the average age of the group members. Total is the sum of the three achievement variables.

APPENDIX W
INTER-ITEM CORRELATIONS FOR ALL ITEMS

Variable	Ogoal1	Ogoal2	Ogoal3	Cgoal1	Cgoal2
Ogoal1	1.0000				
Ogoal2	.1619	1.0000			
Ogoal3	.3088	.3195	1.0000		
Cgoal1	.6451	.2560	.3102	1.0000	
Cgoal2	.2101	.6056	.3420	.2450	1.0000
Cgoal3	.1524	.3456	.5680	.3134	.3806
Fback1	.1598	.0699	.0694	.0092	-.0262
Fback2	.1213	.1348	.1191	.1115	.1838
Fback3	.3069	.1927	.0625	.1863	.0138
Dm1	.4054	.0741	.3068	.3880	.3049
Dm2	.2005	.5086	.4392	.2950	.6909
Dm3	.2925	.2081	.4604	.3619	.3417
Pgoal1	.1553	.1282	.1190	.2881	.1037
Pgoal2	.0868	.0560	-.0587	.0039	.0219
Pgoal3	.0463	.1555	-.0372	.1449	.1449
Total	-.0727	-.0025	.0637	-.0208	-.0208

table continues

Variable	Cgoal3	Fback1	Fback2	Fback3	Dm1
Cgoal3	1.0000				
Fback1	.0997	1.0000			
Fback2	-.0047	.0219	1.0000		
Fback3	.0800	.3462	.2189	1.0000	
Dm1	.4638	.1355	.0395	.0923	1.0000
Dm2	.4658	.0068	.3002	.2060	.4102
Dm3	.5567	.1545	.1279	.2782	.4427
Pgoal1	.2163	-.1053	-.0133	-.2091	.1065
Pgoal2	.0278	.0020	-.0991	-.1257	.0959
Pgoal3	.1381	-.0712	-.2948	-.2600	.2665
Total	.0851	-.1614	-.1543	-.0258	-.0604

table continues

Variable	Dm2	Dm3	Pgoal1	Pgoal2	Pgoal3
Dm2	1.0000				
Dm3	.5090	1.0000			
Pgoal1	-.1115	.1260	1.0000		
Pgoal2	-.1050	.0932	.3888	1.0000	
Pgoal3	-.0681	-.0069	.3988	.4983	1.0000
Total	.0411	-.1473	-.1511	-.1612	-.1999

table continues

Variable	Total
Total	1.0000