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THE EFFECTS OF GOAL-ORIENTED CONTEXTS AND PEER GROUP COMPOSITION ON INTRINSIC MOTIVATION AND PROBLEM SOLVING

A Thesis in

Instructional Systems

by

Hae-Deok Song

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The thesis of Hae-Deok Song was reviewed and approved* by the following:

Barbara L. Grabowski
Associate Professor of Education
Thesis Advisor
Chair of Committee

Susan M. Land
Assistant Professor of Education

Kyle L. Peck
Professor of Education

Edgar P. Yoder
Professor of Agricultural and Extension Education

Alison A. Carr-Chellman
Associate Professor of Education
In Charge of Graduate Program in Instructional Systems

*Signatures are on file in the Graduate School

ABSTRACT

The main purpose of this study is to examine a more effective learning environment in terms of goal orientation that increases a learner's intrinsic motivation and problem solving skills. Goal orientation is important in problem solving because it guides students' intrinsic motivation in solving problems. Recently, some researchers have suggested that a person's goal orientation can be modified by contextual attributes that influence goal orientation. A common limitation of previous studies failed to take into account a combination of contextual attributes that affect goal orientation. This study predicts that providing a specific type of goal-oriented context including a combination of essential contextual attributes will develop the intended goal orientation.

Working in a peer group also has been shown to facilitate intrinsic motivation and problem solving skills. Typically, peer group learning advocates recommend that students are grouped heterogeneously. In this study, self-efficacy was chosen to form more effective peer groups because it mediates the relationship between goal orientation and performance.

This study, therefore, examined 1) the effect of types of goal-oriented contexts and 2) the effect of types of peer group composition by self-efficacy levels on intrinsic motivation and problem solving skills. Interaction effects between these two factors were also investigated first for all students participating in the study and then for students with low-levels of self-efficacy only.

Ninety sixth-grade students from four classrooms at one rural middle school located in the northeastern United States participated in this study. A 2 x 2 randomized factorial design was used. The independent variables in this study were types of goal-oriented contexts (learning, performance) and types of peer group composition (heterogeneous, homogeneous). Two different versions of a Web-based PBL treatment were developed for this study, providing either a learning-oriented context or a performance-oriented context. Each treatment included three essential contextual attributes promoting goal orientation: a) tasks design, b) distribution of authority, and c) evaluation practice. Dependent variables were intrinsic motivation and three components

of problem solving skills (problem representation, solution development, and monitoring and evaluation).

The results showed some significant findings. First, for intrinsic motivation, the factorial ANCOVA showed a significant main effect for the types of goal-oriented contexts, F (1, 85) = 3.95, $p < .05$. Students working in the learning-oriented-context (M = 3.49, SD =.69) had a significantly higher intrinsic motivation score than the students working in the performance-oriented context (M = 3.16, SD =.66). Second, for problem solving skills, the factorial ANOVA showed a significant main effect for types of peer group composition on one component of problem solving skills, *monitoring and evaluation*, F (1, 86) = 5.57, p <.05. Students working in the heterogeneous groups had an overall average of .57 (SD = .96) on *monitoring and evaluation*, while students working in the homogeneous groups had an overall average of .18 (SD = .50). Third, for the relationship between goal orientation, intrinsic motivation, and problem solving skills, different patterns of correlations were found according to the treatment group. A significant positive correlation was found between the learning-goal orientation and solution development (r = .491, p <. 05,. n = 23) for the students who participated in the learning-oriented context in heterogeneous peer groups, while no significant correlation was found for the students who participated in the performance-oriented context in homogeneous peer groups.

The findings of this study have important implications for the design of problem solving learning environments. First, given that intrinsic motivation is increased by a learning-oriented context, instructional designers should provide a context that stresses the intrinsic value of learning, allows students to choose learning activities of their interests, and provides self-referenced evaluation. Second, given that the heterogeneous peer groups had significantly higher scores on monitoring and evaluation, instructional designers should provide opportunities for students to work in heterogeneous peer groups to promote higher levels of cognitive skills. Third, the positive correlation between the learning goal orientation and solution development implies that instructional designers should employ the contextual attributes in problem solving environments resulting in increasing students' learning goal orientation.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

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Chapter 1

INTRODUCTION

Background

Researchers have recognized that one of the main elements required for successful problem solving is motivation (Albanese & Mitchell, 1993; Berkel & Schmidt, 2000; MacKinnon, 1999; Schmidt & Moust, 2000). When students are highly motivated, they are likely to expend more effort and be more effective problem solvers. Despite the importance of motivation's effect on problem solving, little research has been conducted comparing which type of motivation has more influence on problem solving skills (Mayer, 1998).

One such type of motivation, goal orientation, is currently receiving much attention in the field of motivation research. Goal orientation, also called "achievement goal orientation," refers to an individual's desire or purpose when pursuing competence in achievement situations (Harackiewicz, Barron, & Elliot, 1998; Pintrich, 2000b). According to (achievement) goal orientation theory, there are two primary, contrasting goal orientations: a learning goal orientation and a performance goal orientation. A learning goal orientation focuses on learning and understanding, whereas a performance goal orientation focuses on a student's efforts to demonstrate his/her ability or competence, often in relation to others (Linnenbrink & Pintrich, 2002).

Research on goal orientation demonstrates contrasting effects of these two types of goal orientations on affective, cognitive, and behavioral outcomes (Ames, 1992; Dweck & Leggett, 1988; Pintrich & Schunk, 2002). Generally, positive outcomes are associated with a learning goal orientation, and less positive outcomes are associated with a performance goal orientation (Dweck, 1986; Elliot & Dweck, 1988; Meece, 1991; Pintrich, 2000b). For example, students with a learning goal orientation exhibit higher levels of intrinsic motivation, prefer challenging work, tend to use higher quality learning strategies, and are actively engaged in classroom activities (Ames & Archer, 1988; Gabriele & Montectinos, 2001; Nicholls, 1989). Students with a performance goal orientation, on the other hand, demonstrate lower levels of intrinsic motivation, avoid challenging tasks, use superficial and effort-minimizing learning strategies, and demonstrate lower-levels of problem-solving skills (Meece, Blumenfeld, & Hoyle, 1988).

However, recent studies have questioned the maladaptive description of performance goal orientation (Barron *et al*., 2003; Harackiewicz, Barron, & Elliot, 1998; Linnenbrink, 2003; Midgley, Kaplan, & Middleton, 2001). They have suggested that some aspects of performance goal orientation such as a desire toward demonstrating high abilities can be positively related to the use of deeper cognitive strategies. These conflicting views surrounding the effects of goal orientation on problem solving highlight a need for continued research examining which type of goal orientation may be most effective for increasing students' intrinsic motivation for problem solving.

Problem Statement

One important consideration for predicting the effects of goal orientations is whether students' goal orientation is modifiable. Previous researchers tended to view goal orientation as a stable personal disposition. Recently, however, researchers have suggested that goal orientation may be influenced by contextual and situational factors (Ames, 1992; Meece, 1991; Pintrich & Schunck, 2002). Grounded in this view of goals as a personal state, several researchers have investigated the effects of contextual variables on students' goal orientation (Elliot & Dweck, 1988; Gabriele & Montectinos, 2001; McNeil & Alibali, 2000; McWhaw & Abrami, 2001; Schunk, 1996). For instance, Elliot and Dweck (1998) studied contextual variables by placing students in one of two goal conditions: learning or performance. Students were given a specific task instruction message highlighting either a learning or performance goal orientation. Students in the learning goal condition were told that they should focus on the value of learning, whereas students in the performance goal condition were told that their performance would be filmed and tested based on normative evaluation. They found that when the learning goal condition was highlighted, students opted for challenging tasks and tried to learn new skills, even when they made mistakes. On the other hand, when the value of performance goals was highlighted, students gave up attempts to find more effective solutions and attributed the mistakes to their lack of ability. In a similar study, Gabriele & Montectinos (2001) used modified task instruction messages at three different times during the experimental procedure to increase the establishment of the students' goal orientation.

They reported that students given learning goal instruction performed better on mathematical word problems than students given performance goal instruction.

However, a combination of contextual goal orienting variables may have more influential effects on goal orientation and intrinsic motivation. As Pintrich (2000b) has discussed, goals, in goal orientation theory, are assumed to be "representations of knowledge structures (p. 102)" that encompass a number of related beliefs about purposes, competence, success, abilities, efforts, and standards. Since a student's goal orientation integrates a number of related beliefs, it may be difficult to develop or change it by merely manipulating one contextual variable. To fully develop students' goal orientation, it may be necessary to provide them with a learning environment that includes a combination of contextual variables influencing their goal orientation (Ames, 1992; Fuchs et al., 1997). Given that there are two types of students' goal orientation (learning, performance), two types of goal-oriented contexts may be needed to orient students toward either a learning goal orientation or a performance goal orientation. If a students' goal orientation can be modified, then the question remains regarding which type of goal-oriented context (learning, performance) may be most effective in facilitating intrinsic motivation in order to uncover factors that may lead to higher intrinsic motivation and problem solving.

Another aspect to be considered in motivating students is the role of group composition in peer group learning. Many researchers have reported that students are more motivated when they have different perspectives from their peers during peer group learning (Slavin, 1996; Nichols & Miller, 1994). Thus, grouping students by an individual difference variable may also influence goal orientation.

Supporting goal orientation is especially important for younger students. Unlike older students, such as college and graduate students, elementary and secondary students often have not developed self-directed learning skills which enable them to plan, decide, critique, and self-assess their behaviors during the learning process (Gallagher, 1997). Accordingly, it is expected that when a learning environment has overt goal-oriented contexts and effective peer grouping are provided, younger students will be more intrinsically motivated, and it will lead them to improve their problem solving skills. Testing this hypothesis is the purpose of this study.

Background: Strategies for Enhancing Goal Orientation

Goal-Oriented Contexts

To design a goal-oriented context that helps students develop specific goal orientation, it is necessary to identify essential contextual attributes that influence students' goal orientations; either a learning goal orientation or a performance goal orientation. Several studies have identified key contextual attributes of an environment that can influence a learning goal orientation (Ames, 1992; Epstein, 1989; Maehr & Midgley, 1991; Meece, 1991). Epstein (1989) identified six contextual attributes of a family environment that promote a learning goal orientation: (a) task design, (b) distribution of authority, (c) recognizing students, (d) grouping arrangements, (e) evaluation practices, and (f) time allocation. Based on these previous studies, Ames (1992) emphasized three main contextual attributes that are important in designing a learning-oriented context: (a) task design, (b) distribution of authority, and (c) recognizing students and evaluation practice. Strategies to increase the learning goal orientation include: (a) providing task messages stressing the importance of challenging work with various tasks in the area of task, (b) providing students with choice control in the area of authority, and (c) providing self-reference evaluation information in the area of evaluation.

The contextual attributes and strategies that foster a performance goal orientation have been examined in conjunction with those that foster a learning goal orientation (Elliot & Dweck, 1998; Gabriele & Montectinos, 2001). Thus, it is expected that the same three contextual attributes that encourage a learning goal orientation, but structured differently, also enhance a performance goal orientation: (a) task, (b) authority, and (c) evaluation. Strategies to increase the performance goal orientation include: (a) providing messages stressing the importance of performance in the area of task, (b) setting classroom rules by teachers or instructional designers in order to help students to focus on performance goals, and (c) providing social comparison information and using norm-referenced evaluation standard in the area of evaluation.

Little research has compared the effects of using different goal-oriented contexts on intrinsic motivation and problem-solving skills, and those studies that have compared different goal-oriented contexts have mixed results. While most researchers have claimed that only a learning-oriented context helps students focus their interest on learning and thus enhance intrinsic motivation, some researchers recently have reported that a performance-oriented context can equally increase intrinsic motivation (Butler, 1992; Harackiewicz, Barron, & Elliot, 1998). Thus, it is still not clear which type of goal-oriented context may be more effective for increasing intrinsic motivation. In addition, studies on goal orientation have mainly examined the effects on lower-level cognitive tasks such as memory tasks. The lack of research on higher-level cognitive tasks such as problem solving tasks suggests a need for studying the effects of goal-oriented contexts on problem-solving skills (Pintrich & Schunk, 2002).

Peer Group Composition

As previously mentioned researchers have found that peer group learning is related to goal orientation and as a result, increases motivation (Ames, 1992; Epstein, 1989; Maehr & Midgley, 1991; Meece, 1991; Pintrich & Schunk, 2002). However, what is not clear is how to engage students in a peer group environment that increases goal orientation and intrinsic motivation (Slavin, 1996). Typically, advocates of peer group learning recommend that students be grouped heterogeneously according to ability level; this benefits students of both high and low ability levels (Johnson & Johnson, 1994). However, other possible learner characteristics could be considered in order to form more effective heterogeneous peer groups. Various leaner characteristics have been suggested for more effective learning and instruction (Jonassen & Grabowski, 1993). For instance, Hooper, Temiyakarn, and Williams (1993) suggest gender and personality characteristics variables.

One personality factor related to intrinsic motivation is self-efficacy. Self-efficacy refers to a person's beliefs of his or her own effectiveness or confidence in his or her ability to perform an academic task successfully (Lent & Brown, 1986). According to Schunk (1996), when students see themselves as efficient learners, they are highly motivated, work harder on learning tasks, expend more effort, and display more self-regulatory behaviors. Thus, the level of self-efficacy that learners possess may affect their intrinsic motivation toward a learning task and their overall problem solving skills (Hagen & Weinstein, 1995).

Since heterogeneous peer grouping by ability has been shown to be effective in increasing intrinsic motivation, it is expected that heterogeneous peer grouping by self-efficacy will be also effective because high self-efficacy students may increase their confidence when leading group work, while low self-efficacy students may adopt more confident attitudes from their partners with high levels of self-efficacy. This hypothesis is supported by two main benefits of heterogeneous peer group: active information processing and modeling (Hooper & Hannafin, 1991). High self-efficacy students with higher self-regulated learning strategies can experience deep information processing during the explanation to their peers, while low self-efficacy students can benefit from cross modeling by observing learning attitudes expressed by high self-efficacy students (Bandura, 1977). To test this hypothesis, this study investigates the effects of peer group composition in terms of self-efficacy level in problem solving environments.

Goal-Oriented Contexts and Peer Group Composition

Although the main effects of goal-oriented contexts and peer group composition have been partially examined in the past, how these two strategies interact is still unclear. Therefore, this study will examine the interaction between the type of goal-oriented contexts and the type of peer group composition. It is expected that students working in a learning-oriented context and heterogeneous peer group will work better than other groups because they will receive more contextual attributes that affect a learning goal orientation, and as a result, be more motivated and perform better.

Another interaction to be considered in this study is between the type of goal-oriented contexts and the type of peer group composition for students with low levels of self-efficacy. Students with high levels of self-efficacy are highly motivated and thus, are expected to perform well regardless of the type of goal-oriented contexts (Harackiewicz, Barron, & Elliot, 1998). However, students with low levels of self-efficacy are not highly motivated and thus, are expected to perform well in a condition that the learning goal orientations are supported because the learning (goal)-oriented context encourages them to focus on aspects of tasks critical to learning. This notion is supported by Gabriele & Montecinos (2001) who reported that low achieving students given task instruction messages that emphasized learning goal orientation performed better on posttests when they worked with high achieving peers than students given task instruction messages that emphasized performance goal orientation. They reported that the learning-oriented context provided students with a more comfortable environment where they could attempt various trials without fear of making errors thereby enhancing their performance.

Along with the effect of a learning-oriented context, it is expected that students with low levels of self-efficacy will gain more social and cognitive benefits from heterogeneous peer grouping than homogeneous peer grouping (Gabriele & Montectinos, 2003). Thus, this study investigated the interaction between type of goal-oriented contexts and type of peer group composition for students with low-levels of self-efficacy.

Purpose of the Study

The main purpose of this study is to design a more effective learning environment in terms of goal orientation that increases a learner's intrinsic motivation and problem solving skills. The development of this learning environment for enhancing goal orientation is based on several assumptions (see Figure 1-1). First, goal orientation can be changed by providing external supports such as contextual and situational variables. This view of goal orientation as a state has been suggested by some researchers (Ames, 1992; Elliot & Dweck, 1998; McNeil & Alibali, 2000). According to these researchers, goals are not stable personal characteristics but rather are influenced by contextual features. Grounded in this view of goals as a state, educational interventions should be able to be devised to enhance goal orientation.

Second, in order to fully develop goal orientation, the learning environment should include essential orienting contextual attributes that affect a student's goal orientation. It is widely believed that task design, distribution of authority, evaluation practice, and heterogeneous peer grouping influence students' goal orientations (Ames, 1992; Fuch et al., 1997). Previous studies have investigated the effects of an individual contextual variable such as a task instruction message designed to induce a goal orientation (Elliot & Dweck, 1988; Gabriele & Montectinos, 2001; McNeil & Alibali, 2002).

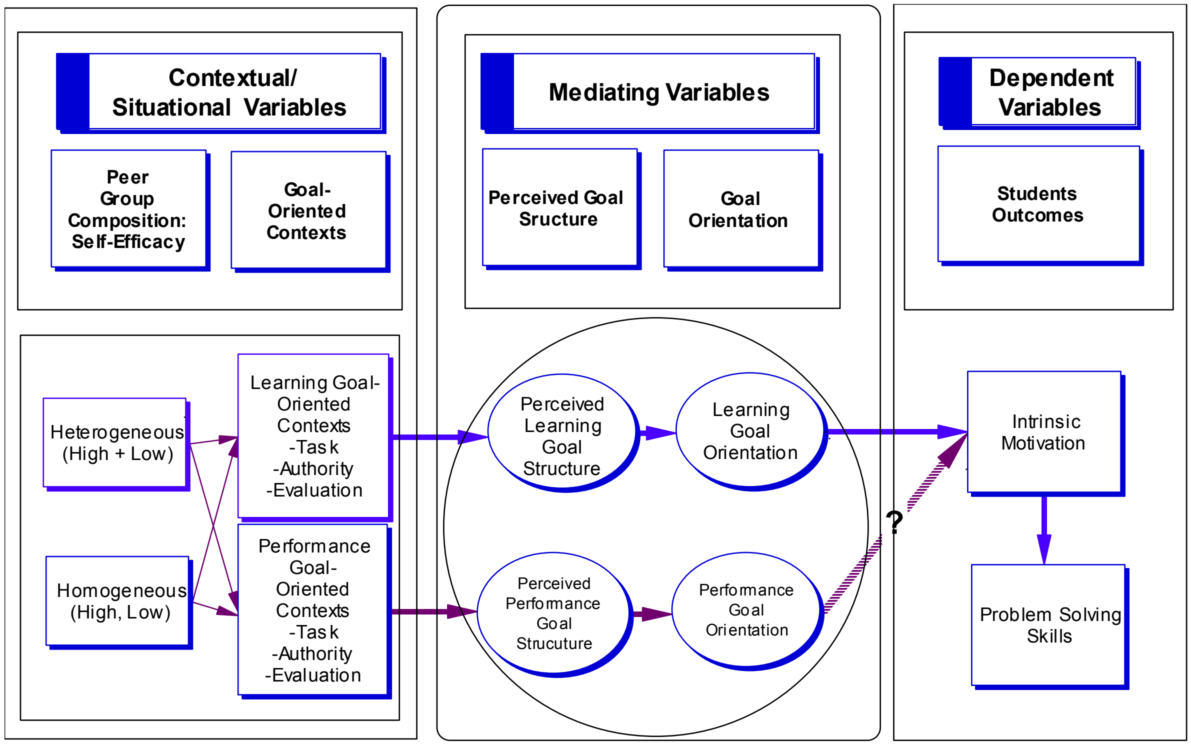

Figure 1-1. The framework of goal-oriented contexts

This study extends previous studies by investigating the effects of a combination of contextual attributes that foster students' goal orientations. Given the mixed results of the effects of two types of goal orientations, it is also necessary to determine which type of goal-oriented context (learning, performance) may be more effective. Thus, this study will test the effects of types of goal-oriented contexts on intrinsic motivation and problem solving skills.

Third, students' goal orientations will play a mediating role between the treatment variables (goal-oriented context, peer group composition) and outcome variables (intrinsic motivation and problem solving skills). Once a goal-oriented context is provided in a problem solving environment, it should have an effect on students' perceived learning or performance goal structure of peer group environments, which in turn, will relate to a learning or a performance goal orientation. It is expected that students' learning goal orientation will mediate the effectiveness of intrinsic motivation and problem solving skills because it helps students focus on interest in learning. However, some studies of goal orientation have shown mixed relationships between the types of goal orientations and intrinsic motivation, and between the types of goal orientation and problem solving skills. That is, the relationships among performance goal orientation, intrinsic motivation, and problem solving skills have not been as robust as have been shown in studies of learning goal orientation.

Therefore, the purpose of this study was to examine; (1) the effect of type of goal-oriented contexts, and (2) the effect of type of peer group composition according to self-efficacy levels on intrinsic motivation and problem solving skills. It was expected that the learning (goal)-oriented context would create a learning goal climate in a peer group learning environment, prompt a student's learning goal orientation, result in higher levels of intrinsic motivation, and, as a result, facilitate better problem solving skills. A performance (goal)-oriented context, on the other hand, was expected to create a performance goal climate in a peer group learning environment and promote a student's performance goal orientation, but it was not expected to result in higher levels of intrinsic motivation and better problem solving skills. It was expected that students in heterogeneous peer groups would demonstrate higher intrinsic motivation scores and better problem solving skills than students in homogeneous peer groups. Interaction effects between type of goal-oriented contexts and type of group composition were also expected for all students and students with low-levels of self-efficacy. The assumption of correlations among types of perceived learning goal structure, types of goal orientations, intrinsic motivation, and problem solving skills was also examined.

Research Questions

The main research question leading this study was whether or not there were significant differences between types of goal-oriented contexts and types of peer group composition on intrinsic motivation and problem solving skills. To further investigate this question, the following specific research questions were formed:

Intrinsic motivation

1. Is there a difference between two types of goal-oriented contexts on intrinsic motivation?
2. Is there a difference between two types of peer group composition on intrinsic motivation?
3. Is there an interaction between types of goal-oriented contexts and types of peer group composition on intrinsic motivation?
4. Is there an interaction between types of goal-oriented contexts and types of peer group composition on intrinsic motivation for students with low levels of self-efficacy?

Problem solving

5. Is there a difference between two types of goal-oriented contexts on problem solving skills?
6. Is there a difference between two types of peer group composition on problem solving skills?
7. Is there an interaction between types of goal-oriented context and types of peer group composition on problem solving skills?
8. Is there an interaction among types of goal-oriented contexts and types of peer group composition on problem solving skills for students with low levels of self-efficacy?

Relation between goal orientation and dependent variables

9. Is there a positive correlation among types of perceived goal structure, types of goal orientation, intrinsic motivation, and problem solving skills?

Research Hypotheses

The following outcomes were hypothesized:

Intrinsic motivation

H_{o1}: There will be no significant difference between students working in the learning-oriented context and students working in the performance-oriented context in terms of intrinsic motivation scores.

H_{a1}: Students working in the learning-oriented context will demonstrate higher intrinsic motivation scores than students working in the performance-oriented context.

H_{o2}: There will be no significant difference between students working in a heterogeneous peer group and students working in a homogeneous peer group in terms of intrinsic motivation.

H_{a2}: Students working in a heterogeneous peer group will demonstrate higher intrinsic motivation scores than students working in a homogeneous peer group.

H_{o3}: There will be no significant interaction between type of goal-oriented contexts and type of group composition for all students.

H_{a3}: All students working in the learning-oriented context/heterogeneous peer group will demonstrate higher intrinsic motivation scores than all other students in a combination of goal-oriented context and peer group composition treatment groups.

H_{o4}: There will be no significant interaction between type of goal-oriented contexts and type of group composition for students with low levels of self-efficacy.

H_{a4}: Students with low levels of self-efficacy working in the learning-oriented context/heterogeneous peer group will demonstrate higher intrinsic motivation scores than other students with low levels of self-efficacy in a combination of goal-oriented context and peer group composition treatment groups.

Problem solving

H_{o5}: There will be no significant difference between students working in the learning-oriented context and students working in the performance-oriented context in terms of problem solving skills.

H_{a5}: Students working in the learning-oriented context will demonstrate better problem solving skills than students working in the performance-oriented context.

H_{o6}: There will be no significant difference between students working in a heterogeneous peer group and students working in a homogeneous peer group in terms of problem solving skills.

H_{a6}: Students working in a heterogeneous peer group will demonstrate better problem solving skills than students working in a homogeneous cooperative peer group.

H_{o7}: There will be no significant difference between type of goal-oriented contexts and type of group composition for all students.

H_{a7}: All students working in the learning-oriented context/ heterogeneous peer group will demonstrate better problem solving skills than all other students in a combination of goal-oriented context and peer group composition treatment groups.

H_{o8}: There will be no significant interaction between type of goal-oriented contexts and type of group composition for students with low levels of self-efficacy.

H_{a8}: Students with low levels of self-efficacy working in the learning-oriented context/ heterogeneous peer group will demonstrate better problem solving skills than other students with low levels of self-efficacy in a combination of goal-oriented context and peer group composition treatment groups.

Relation between goal orientation and dependent variables

H_9: There will be a significant positive correlation among perceived learning goal structure, learning goal orientations, intrinsic motivation, and problem solving skills.

H_{10}: There will be no significant positive correlation among perceived performance goal structure, performance goal orientations, intrinsic motivation, and problem solving skills.

Definition of Terms

Achievement Motivation: One type of motivation that refers to one's need for achievement. It includes two types of goals in the area of achievement goal orientation theory: learning goal orientation and performance goal orientation.

Goal Orientation: It is one of the constructs that explains achievement motivation. It is often called *achievement goal orientation* in the literature. Goal orientation refers to the purposes or reasons why an individual is pursuing an achievement task, especially an academic learning task (Harackiewicz, Barron, & Elliot, 1998; Pintrich, 2000a). There are thought to be two main types: a learning goal orientation and a performance goal orientation.

- *A Learning Goal Orientation* refers to goals of students that orient them to focus on the task in terms of learning or mastering how to do the tasks. Different labels such as "mastery," "task," and "task-involved" goals have also been used by different researchers.
- *A Performance Goal Orientation* refers to goals of students that orient them to focus on the performance related to others, ability, and self. Different labels such as "relative ability" and "ego-involved goals" have also been used.

Goal-Oriented Contexts: Goal-oriented contexts refer to the learning situation in which instructional strategies have been deigned to orient a student toward a goal orientation.

- *Learning-Oriented Context*: This refers to a learning situation in which instructional strategies have been designed to orient students toward a learning goal orientation. It is achieved by designing three contextual attributes toward a learning goal orientation: (a) task design- providing messages stressing the importance of challenging work and intrinsic value of learning with various tasks, (b) the distribution of authority- providing choice control such as allowing students to set priorities, and (c) evaluation practice- reporting evaluation information privately and providing self-referenced evaluation.
- *Performance-Oriented Context*: This refers to a learning situation in which instructional strategies have been designed to orient students toward a performance goal orientation. It is achieved by designing three contextual attributes toward a performance goal orientation: (a) task design- providing

simple and plain tasks and messages stressing the importance of performance with simple and plain tasks, (b) distribution of authority- setting choice or controls by an instructor/ designer, and (c) evaluation practice- reporting evaluation information publicly, providing norm-referenced evaluation standard and social comparison information.

Intrinsic Motivation: It is defined as enjoyment of school learning characterized by an orientation toward mastery, curiosity, persistence, and the learning of challenging, difficult, and novel tasks (Gottfried, 1985).

Motivation: An overall construct that explains internal state or condition (sometimes described as a need, desire, or want) that serves to activate or energize behavior and give it direction (Kleinginna & Kleinginna, 1981).

Peer Group Composition: It refers to how to compose a peer group. Peer group composition includes two main types: heterogeneous peer group and homogeneous peer group. A heterogeneous peer group consists of different levels of students, whereas a homogeneous peer group consists of same levels of students in terms of ability, gender, or other personal characteristics.

Perceived Goal Structure of Peer Group Environments: This refers to students' perceptions of the purposes for engaging in academic work that are emphasized in the peer group learning environment. Students are expected to perceive one of two goal structures about the peer group environment where they are engaging in academic work: perceived learning goal structure or perceived performance goal structure.

Problem Solving Skills: It refers to skills required to perform a problem solving task successfully. Those skills include problem representation, strategies of developing solutions, monitoring and evaluation of solutions (Fortunato et al, 1991).

Self-Efficacy: It refers to a person's beliefs of his or her own effectiveness or confidence in his or her ability to perform an academic task successfully (Lent & Brown, 1986). It is particularly important in the overall construct of motivation because it mediates the relationship between a student's goal orientation and his or her performance.

Chapter 2

LITERATURE REVIEW

Introduction

This chapter provides the theoretical framework which undergirds the research questions and hypotheses on the effect of different types of goal-oriented contexts and peer group composition on intrinsic motivation and problem solving skills. The chapter addresses three main issues: a) the role of a student's goal orientation on motivation and problem solving, b) learning environments that affect goal orientation, and c) the effects of peer group composition on intrinsic motivation and problem-solving skills. First, the role of goal orientation on problem solving, definition of goal orientation, and the relationship of goal orientation to outcome variables will be reviewed. Second, based on goal orientation theory, the contextual attributes for enhancing goal orientation will be reviewed in the areas of task design, the distribution of authority, and evaluation practice. Third, along with the review of contextual attributes stated above, the theoretical framework for peer group composition by self-efficacy will be reviewed including the role of peer group in problem solving, peer group learning and goal orientation, peer group composition, and peer group composition by self-efficacy.

Goals, Intrinsic Motivation, and Problem-Solving

The Role of Goal-Orientation in Academic Achievement

Many researchers have emphasized the importance of motivation in helping students to achieve academic tasks. For example, Dewey (1913) has claimed that "education only comes through willing attention and participation in school activities" (p. ix). In fact, students come to understand material more deeply when they are more motivated to learn (Mayer, 1998). According to Ford (1992), achievement is determined by the interaction of the following elements: motivation, skills, biology, and a responsive environment. He formulated the function as follows:

Achievement = (Motivation * Skills) * Biology * Responsive Environment

This formula indicates the importance of motivation in academic achievement. In other words, if students are not motivated, even if they possess the prerequisite cognitive skills and physical abilities and a responsive environment is provided, they may not be able to achieve the desired outcome. Ford (1992) suggests further that motivation is determined by the interaction of three elements: goals, emotions, and personal agency beliefs (self-efficacy).

Motivation= Goals * Emotions * Personal Agency Beliefs (Self-Efficacy)

The formula outlined above indicates that goals are one of the essential elements that determine motivation. Because goals provide direction for behavior, individuals are likely to be more motivated when they have clearer goals. There are many goal theories, but goal-orientation theory is particularly important because it explains why individuals engage in achievement behavior.

Definition of Goal Orientation

Why is goal orientation important in carrying out academic tasks? What role does goal orientation play in increasing motivation and problem-solving skills? How are goals in goal-orientation theory different from the goals in other goal theories? The following section defines goal orientation and discusses the types of goal orientation that exist.

Goals and goal orientation

Goal-orientation theories were developed to explain achievement behavior in academic tasks. A *goal* is a cognitive representation that provides “the engine to move an organism to act” (Pintrich & Schunk, 2002, p.192). A goal can guide an individual to pursue certain objectives in order to satisfy particular needs within a given environment. More specifically, a goal may be regarded as an integrated pattern of belief that leads to specific ways of engaging, acting, and responding to achievement situations. Goals explain not only why we pursue achievement tasks but also what type of standards we use to judge our performance.

It is necessary to make it clear that goals in goal-orientation theory are different from goals in goal-content theory and goal-setting theory. First, goal-orientation theory focuses on the reasons behind achievement motivation. *Goal-content* theory, on the other hand, is concerned with the substance of the goals that individuals work toward in different academic situations. It examines the desired or undesired consequences of a particular goal. Thus, goal content can be classified according to a taxonomy made up of many general categories. For instance, Ford (1992) has classified goal content into two main categories: *desired within-person consequences* and *desired person-environment consequences*. Desired within-person consequences include affective goals, cognitive goals, and subjective-organization goals. Desired person-environment consequences include self-assertive social-relationship goals, integrative social-relation goals, and task goals.

Second, goal-orientation theory focuses on specific, proximal goals, being concerned with why individuals want to perform particular tasks and how they approach or engage in those tasks. In contrast to goal orientation, *goal setting* is concerned with establishing a standard of performance (Locke & Latham, 1990). Goal setting encourages students to get involved in learning processes, because students who set goals are apt to expand their efforts with a high sense of self-efficacy. Since individuals use different methods to conceptualize goals, various goal-setting strategies may be employed. Researchers report that two factors determine the effectiveness of goal-setting strategies: goal commitment and goal properties such as proximity, difficulty, and specificity. They suggest that students' motivation will be greater when they are fully committed to learning and when they perceive their goals as close-at-hand, moderately difficult, and specific, rather than when they have a clearer reason to engage in achievement behaviors.

Types of goal orientation

Although many goal orientations such as social goals have been mentioned in the literature (Urdan & Maehr, 1995), researchers in goal-orientation theory have agreed that two types are important. They have labeled these two types differently, calling them *learning and performance goals* (Dweck & Leggett, 1988; Elliot & Dweck, 1988), *mastery and performance goals* (Ames & Archer, 1988), *task-involved and ego-involved goals* (Nicholls, 1984), or *task-focused and ability-focused goals* (Maehr & Midgley, 1991), but agree that they involve a great deal of conceptual overlap. In this study, the two different types of goal orientation are called "learning and performance goals" because these are the terms found most often in the literature and they make very clear the different nature of the two types.

A learning-goal orientation involves a focus on learning, mastering tasks, trying to gain understanding, and improving competence according to self-imposed standards. A performance-goal orientation, on the other hand, is characterized by a focus on demonstrating ability, trying to surpass normative performance standards, striving to be the best in a group, seeking public recognition for high-level performance, and avoiding judgment for low ability. Researchers studying goal orientation have suggested that these two types of goals are related to different outcomes. The relationship of these two types of goal orientations to motivation and problem-solving skills will be reviewed.

Goal Orientation and its Relation to Outcomes

How are different goal orientations linked to various outcomes? Many researchers have investigated the relationships between learning and performance goals and outcomes such as attribution, self-efficacy, level of cognitive engagement, self-regulation, affect, interest, persistence, information seeking, task engagement, and performance. Most have agreed that generally adaptive outcomes are linked to learning goals, whereas generally less adaptive outcomes are linked to performance goals (Ames, 1992; Dweck & Leggett, 1988; Pintrich & Schunk, 2002). Recently, however, some researchers have reported that performance goals are also positively associated with learning outcomes. Accordingly, Midgley, Kaplan, and Middleton (2001) have pointed out the need for research into the people and conditions for which performance goals are effective. Below, the researcher reviews the relationships of learning- and performance-goal orientations to outcomes, with an emphasis on intrinsic motivation and problem-solving outcomes.

Goals and their links to intrinsic motivation

Studies have found that goal orientation plays an important role in increasing intrinsic motivation. Which type of goal then, best stimulates students' intrinsic motivation? Most theorists on goal orientation and motivation contend that learning and performance goals produce distinct consequences. Learning goals are thought to facilitate challenge appraisal, task absorption, self-determination, and a feeling of autonomy, all essential elements in intrinsic interest and enjoyment (Butler, 1987;

Rawsthorne & Elliot 1999). Performance goals, on the other hand, are thought to increase evaluative pressure and anxiety, which work against intrinsic interest. Thus, most researchers who believe in the effects of learning goals on intrinsic motivation have claimed that performance goals undermine intrinsic motivation by leading students to focus on demonstrating superior ability rather than on getting involved in the task itself (Deci & Ryan, 1990; Nicholls, 1989).

However, some researchers have reported that performance goals do not always lead to less interest, intrinsic motivation, or task involvement. For example, Harackiewicz, Barron, and Elliot (1998) suggest that the effects of both learning and performance goals depend on students' personal characteristics and on the context of the activity, and that both types of goals can increase intrinsic motivation. In fact, as long as there are clear reasons for becoming engaged in an activity, performance goals may promote intrinsic motivation just as well as learning goals (Butler, 1992). This positive side of a performance-goal orientation is also supported by more recent research on goal-orientation theory, which has distinguished between performance-approach goals and performance-avoidance goals, within the performance-goal orientation (Elliot & Harckiewicz, 1996). Researchers have suggested that performance-approach goals enable students to focus on positive attitudes while performance-avoidance goals encourage them to focus on avoiding failure and inferiority (Elliot, 1997; Harackiewicz et *al*., 1998). According to the findings of a meta-analysis of studies on the effects of goal orientation and intrinsic motivation carried out by Rawsthorne and Elliot (1999), the negative effects of performance goals differed depending on whether students perceive performance-approach or performance-avoidance goals in the experimental procedures involved. Since researchers have obtained mixed results in identifying relationships between learning- and performance-goal orientations and intrinsic motivation, further studies on these relationships is needed in order to determine what type of goals may be most effective.

Goals and their links to problem-solving

Experimental research on learning goals has shown that they are related to quality of performance. For example, in terms of cognitive outcomes, researchers have found that students with learning goals reported the use of deep cognitive-processing strategies such as elaboration and organization strategies (Ames & Archer, 1988). In addition, students with learning goals reported that they were more likely to use self-monitoring and self-regulatory strategies, seeking various ways to understand a task. However, the research on the relationships between performance goals and cognitive outcomes has had mixed results. Most researchers have reported that a performance-goal orientation is negatively related to perceived use of deeper cognitive strategies by students (Meece et *al*., 1988). Some, however, have suggested that performance goals may have positive effects on cognitive outcomes. For example, Wolters, Yu, and Pintrich et al. (1996) reports that performance goals that lead students to focus on doing better in relation to others are positively related to use of cognitive and self-regulatory strategies. Therefore, the relationships between different goal orientations and cognitive outcomes need to be further examined in order to determine what type of goal is most effective.

One of the important areas to examine in identifying the relationship between goal orientation and cognitive outcome is problem solving strategies. Although goal-orientation theorists have extensively reviewed the relationships between goals and various cognitive strategies (Ames & Archer, 1988; Meece et al., 1988), limited research has been conducted, to date, on how goals are linked to the use of problem-solving strategies. According to Pintrich and Schunk (2002), this is an area on which future research should focus in order to define the effects of goal orientation. Previous research has indicated that students who place greater emphasis on learning goals report more active cognitive engagement and use deeper cognitive and metacognitive strategies than other students. In contrast, students oriented toward performance goals report lower levels of cognitive engagement, using only surface cognitive and metacognitive strategies (Meece et *al*., 1988). Considering that the main components of problem-solving include the ability to represent a problem, the ability to develop a solution, and the ability to evaluate or monitor that solution, one can assume that a learning-goal orientation is also positively related to problem-solving strategies, because the strategies required for problem-solving are closely related to the use of the cognitive strategies discussed above: deep processing of cognitive strategies, self-monitoring strategies, and self-regulatory strategies.

The role of goal orientation in ill-structured problem solving

Many educational researchers agreed that problem-solving skill is one of the most important learning outcomes in education. The most commonly encountered problems, especially in everyday practice, are ill-structured problems with vaguely defined goals and unstated constraints that have multiple solutions and present uncertainty about which concepts, rules, and principles should be used in finding those solutions (Jonassen, 1997). Researchers on ill-structured problem solving have generally agreed that problem solving process of the ill-structured tasks involved three sub-component skills: a) problem representation, b) solution development, and c) monitoring and evaluation of solutions (Ge, 2001; Hong 1998; Voss and Post, 1988). However, ill-structured problem tasks provide students with many cognitive challenges. Students are challenged to understand a problem situation, identify the cause of the problem, generate hypotheses for a solution, and monitor their solutions (Song, Grabowski, Koszalka, and Harkness, 2003). Thus, finding effective strategies to develop their goal orientation is expected to help students to engage in the process of ill-structured problem solving.

Learning Environments to Foster Goal Orientation

Researchers have suggested that the goal orientation an individual adopts may be influenced by contextual information or situational variables (Ames, 1992; Elliot & Dweck, 1988). They have claimed that goals are not stable personal characteristics but rather are very sensitive to contextual features. Accordingly, they have suggested that goals can be changed through contextual features. Given the role of motivation in achievement stated above, when a responsive learning environment that supports a learning goal orientation is provided, students' learning-goal orientations will be reinforced, and as a result their motivation and achievement will also increase (see Figure

2-1, below). Since goals have the potential to increase students' motivation, ways of helping students develop appropriate goals should be studied.

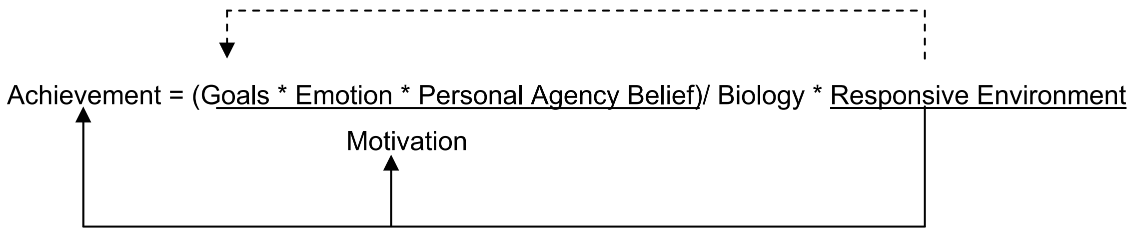

Figure 2-1. Relationship between goals and a responsive environment

Grounded in the view of goals as states, several studies have examined the effects of contextual variables. One typical contextual variable used in these studies has involved the provision of task-instruction messages highlighting the value of either learning or performance goals (Elliot & Dweck, 1988; Gabriele & Montectinos, 2001; McNeil & Alibali, 2000; Newman & Schwager, 1995). Students working under learning-goal instruction conditions received task messages that provoked them to focus on understanding answers by seeking challenges, whereas students working under performance-goal instruction conditions received task messages that provoked them to focus on getting answers. However, since a goal is an integrated cognitive representation, the development of a goal orientation can be most effectively supported by considering the various contextual attributes that affect it rather than by providing an individual contextual variable. Thus, providing a learning context that supports a particular goal orientation can be effective in fostering a goal orientation and intrinsic motivation because it takes into account various elements influencing that orientation.

What attributes, then, lead to the adoption of a goal orientation? Given the positive motivational and cognitive outcomes associated with learning goals, goal theorists have mainly investigated the structures of the classroom environment that help students to adopt learning goals. TARGET is an acronym representing such elements. Epstein (1989) identified six elements of family structure that influence children's motivation systems at home: (1) Tasks, (2) Authority, (3) Recognition, (4) Grouping, (5) Evaluation, and (6) Time. Noting the scarcity of systemic analyses of the classroom structures that can contribute to the adoption of learning goals, Ames (1992) used three elements of TARGET to develop classroom-environment structures that would lead to learning goals. These structures included (1) the design of tasks and learning activities, (2) the distribution of authority or responsibility, and (3) evaluation practices and use of rewards. Like Ames, many researchers have emphasized tasks, authority, and evaluation over the other elements. For example, Fuchs et *al*. (1997) used these three elements to structure classroom environments that would lead to a learning-goal orientation and found that students in an environment structured to facilitate learning goals chose more challenging learning topics and increased their efforts better than students in a control group.

Based on these previous findings, three attributes are necessary to design goal-oriented contexts that facilitate a goal orientation: task design, authority, and evaluation practices (Song, 2004). These three main attributes are thought to be important in promoting both learning- and performance-goal orientations. Strategies for enhancing different goal orientations are presented in Table 2-1.

Table 2-1

Framework of Strategies for Enhancing Different Goal Orientations

Areas	Focus	Learning Goals	Performance Goals
Task Design	Task Characteristics	• Provide variety and diversity in tasks	• Provide simple and plain tasks
	Task Provision Methods	• Provide tasks with messages that emphasize the intrinsic value of learning	• Provide tasks with messages that stress the importance of performance
Distribution of Authority	Provision of Control and Choice	• Provide opportunities for decision making in terms of (a) establishing rules, (b) setting priorities for when work will be done, (c) setting the pace of learning, and (d) determining how tasks will be accomplished	• Provide learning activities structured by designer or teacher to achieve the desired outcomes efficiently
Evaluation Practice	Evaluation Criteria	• Provide information about individual improvement, progress, and mastery based on self-reference evaluation	• Provide information about social comparison based on standardized and multiple choice test
	Evaluation Report Procedure	• Provide evaluation results privately	• Display evaluation results publicly
	Evaluation Methods	• Use various methods (e.g., portfolios)	• Use standardized multiple tests

Task Design

Task design refers to the patterns of the learning activities in which students will be involved. Researchers have focused on how to design tasks in order to facilitate learning goals. These strategies have included (1) designing tasks for novelty, variety, and diversity, (2) presenting reasonable challenges to students, (3) helping students to establish short-term goals, and (4) stressing goals and purposes in learning (Pintrich & Schunk, 2002). They can be categorized under two major design principles: (1) task characteristics and (2) task-provision methods (Becker, 1995).

First, task characteristics should be considered, as they can help students to develop a different goal orientation. Researchers have agreed that the degree of variety and diversity of tasks affects goal orientation: offering students diverse and challenging tasks has been found to stimulate their interest, whereas giving them simple and plain tasks has been found to contribute to a one-dimensional learning environment. Varying tasks will help students to develop learning goals, while assigning uni-dimensional tasks will lead students to focus on performance goals, due to the limited opportunities provided by these materials.

Second, the methods used to present tasks are important in influencing a person's goal orientation. Providing students with messages that emphasize the intrinsic value of learning will help them to adopt learning goals. In contrast, providing them with messages that stress the importance of performance will lead them to focus on performance.

Distribution of Authority

The way in which authority is distributed in a learning environment can also encourage students to develop a specific goal orientation. *Authority* refers to the degree of opportunity that students have to determine or control their own responsibilities in their learning activities (Ames, 1992; Brophy, 1998).

Authority is a broad construct that is related to other variables such as autonomy and learner control. What is the definition of authority and how is it different from these other variables? Authority is the locus of responsibility in the classroom; Ames (1992) operationally defines it as the "autonomy orientation of the classroom environment" (p. 266). *Autonomy* is a causality orientation. According to Deci and Ryan (1987), people have two types of causality orientation: *autonomy* and *control*; individuals with an autonomy orientation are inclined to base their regulations on internal awareness of interests, whereas individuals with a control orientation are prone to regulate behaviors by looking outward or by evaluating environmental contingencies. The term *learner control* is often used interchangeably with autonomy. Learner control, however, is a concept that is often introduced in relation to computer-based instruction. A major issue in learner-control research has been how much or what type of control should be given to the learner during the learning process in order to increase learner involvement, mental investment, and achievement (Williams, 1996). Some main variables controlled for in studies of learner control have included the pacing of information presented and the choice of learning activities that suit individual preferences and needs.

Researchers agree that an essential dimension of authority is allowing the student to participate in decision-making processes or in establishing rules (Ames, 1992). However, teachers often determine classroom rules and make unilateral decisions in traditional classroom settings. Students' learning opportunities are very restricted by those rules, which may lead them to focus on performance goals. When authority is shared with students, on the other hand, their interest in learning tasks will be increased. Therefore, distribution of authority is an important dimension affecting goal orientation.

Because of the common characteristics shared by authority, autonomy, and learner control, the strategies used in learner-control research have also been taken into consideration in developing both learning- and performance goal-oriented contexts. The optimal distribution of authority can be achieved by providing students with choices in the classroom setting (Maehr & Midgley, 1991), fostering responsibility and independence, improving self-monitoring skills (Fuchs et *al*., 1997), and generally allowing students to set the pace and procedures for learning (Martin, 2001).

Evaluation Practice

The way in which one assesses student learning is closely related to the development of a goal orientation. Researchers suggest that three main dimensions of evaluation affect one's goal orientation: (1) evaluation criteria, (2) evaluation report procedures, and (3) evaluation methods (Becker, 1995; Pintrich & Schunk, 2002) .

First, evaluation criteria influence one's goal orientation. When evaluation is based on self-referenced information and emphasizes individual improvement, it will help students to develop learning goals. However, when evaluation information is based on normative standards and emphasizes social comparison, students will be more likely to focus on performance goals. According to Harackiewicz et al. (1987), evaluation under a normative focus reduces intrinsic motivation while evaluation under a task focus does not reduce interest in a task.

Second, the way in which evaluation results are reported influences students' goal orientations. Reporting evaluations privately favors learning goals by creating a focus on self-referenced information, whereas reporting evaluations publicly favors performance goals by emphasizing social comparison. Examples of public evaluation include displaying grades on a bulletin board, displaying a selected group paper, and calling out test grades. Shih and Alexander (2000) report that students who receive self-referenced feedback demonstrate significantly higher performance skills and levels of self-efficacy than students in social-reference groups.

Third, evaluation methods influence one's goal orientation. Using a variety of evaluation methods, including not only tests but also other methods, will facilitate the development of learning goals over the development of performance goals. Counting exclusively on multiple tests for assessment leads to an emphasis on performance because it leads students to focus on attaining high scores.

Peer Group Learning, Intrinsic Motivation, and Problem Solving

The Role of Peer Group Learning in Problem Solving

Researchers have suggested that peer-group work can help students to improve their problem-solving skills in several ways (Albanese & Mitchell, 1993; Hmelo & Ferrairi, 1997; Torp & Sage, 1998) and can have positive effects on students' achievement (Slavin, 1996). One explanation for the effectiveness of peer groups is distributed cognition. Peer-group learning allows group members to take advantage of distributed expertise (Pea, 1993). For example, students become experts on particular topics while they divide, investigate, and share learning issues during problem-solving tasks (Hmelo & Ferrairi, 1997). Sharing constructed knowledge during the course of peer-group discussions enables students to encounter various points of view. The experience of coordinating different perspectives can help them to develop higher level of thinking and problem-solving skills. Another benefit of group work is that peer groups help learners to prepare for learning tasks. According to Flynn and Klein (2001), peer-group work can deal with a variety of perspectives faster than individual work, so collective efforts help students to prepare more efficiently than they could as individuals.

Peer-Group Learning and Goal Orientation

Peer-group learning is a type of cooperative learning that focuses on highly structured groups and emphasizes individual and group accountability (Flynn & Klein, 2001). Research on peer-group learning has shown it to be effective in increasing students' levels of achievement (Johnson & Johnson, 1984; Slavin, 1991, 1996).

One major view of the effects of peer-group learning on achievement is the motivational perspective. Research on peer-group learning has reported that it increases not only achievement but also motivation-related variables such as intrinsic interest and self-efficacy (Nichols, 1996; Nichols & Miller, 1994). Slavin (1996) explains these effects of peer-group learning on achievement from the perspective of extrinsic motivation, rewarding groups according to group performance. According to the author, the use of group rewards motivates students to interact with each other productively by creating an interpersonal reward structure within each group. However, some researchers have criticized the use of group goals, claiming that since they act as external rewards, they run against academic efforts and thus create a negative effect, a competitive classroom environment.

In contrast to group rewards, the development of a learning-goal orientation motivates students intrinsically because it helps them become aware of the reason why they are engaged in learning and to focus on achieving tasks. Working in a peer group can foster a learning-goal orientation. According to Nichols and Miller (1994), peers can provide students with emotional and tutorial learning support, which is likely to reinforce their goal orientation and intrinsic motivation. They found that students working in peer groups demonstrated significantly stronger learning-goal orientations and intrinsic motivation in carrying out learning tasks than individual students did. They reported that the peer group structure played important roles in producing the positive effects of peer group learning. Therefore, further research is needed to find an effective structure of peer group learning that fosters goal orientation, if we are to find better ways of motivating students to learn.

Peer-Group Composition

One important variable in the peer group structure is how to compose a peer group. For instance, flexible group arrangements provide students with an opportunity to increase participation, interact with their peers, and establish learning goals (Becker, 1995). To provide an atmosphere in which students can share diverse experiences and multiple viewpoints as they work to solve problems, it has been recommended that students be grouped heterogeneously (Brophy, 1998). According to Johnson and Johnson (1994), heterogeneous peer-group learning provides both affective and cognitive benefits to students of both high and low ability. First, less able students can benefit from emulating more able students' learning behavior, such as how they represent problems or come up with solutions. More able students, on the other hand, can benefit from explaining their knowledge structures to less able students. Second, heterogeneous groups can provide students with higher interpersonal attention because these groups are, by definition, composed of students with different backgrounds. In addition, less able students are likely to receive more attention in a heterogeneous peer group than in a homogeneous peer group (Hooper & Hannafin, 1988).

Despite the alleged benefits of heterogeneous peer grouping, research on this type of grouping has had mixed results. Some researchers have reported that only students of low ability learn in heterogeneous peer groups, because these groups fail to challenge high-ability students and because the latter perform well in any type of group. For instance, Hooper and Hannafin (1988) have reported that heterogeneous peer groups only significantly improved the achievement levels of students with low ability only and did not improve the achievement levels of students with high ability. Webb et al. (1989) also report that heterogeneous peer groups provide greater benefits to students of low ability. Others, however, have claimed that heterogeneous peer groups increase the achievement of more able students at the expense of those who are less able (Hooper, Temiyakarn, & Williams, 1993). Therefore, the effects of group composition will be investigated in this study.

Peer-Group Composition by Self-Efficacy

To test the effectiveness of heterogeneous peer grouping in various contexts, some researchers have suggested that factors other than ability level should be considered in forming effective peer groups. These factors may include gender, age, and other personal characteristics (Hooper, Temiyakarn, & Williams, 1993). Of these factors, it is especially important to take personal characteristics into account, since learner characteristic variables should be considered to provide a more meaningful learning. Given the interest in intrinsic motivation in this study, a related personal characteristic factor should be considered.

One personal characteristic to consider is self-efficacy. Self-efficacy refers to a person's beliefs of his or her own effectiveness or confidence in his or her ability to perform a skill successfully (Lent & Brown, 1986). It is particularly important as a type of motivation construct because it mediates the relationship between goals and performance. For example, research on goal orientation has demonstrated that students with learning goals also rate themselves high on self-efficacy and intrinsic motivation (Pintrich, 2000b; Schunk, 1996). In fact, learning goals help students to focus on understanding learning tasks, accepting challenges, and acquiring or improving capabilities. Like students who adopt learning goals, students with high levels of self-efficacy tend to participate actively in learning tasks and demonstrate greater effort and persistence in completing challenging tasks. Therefore, many researchers assume that students with learning goals feel efficient as they work on tasks and assess their own progress (Hagen & Weinstein, 1995). Given this correlation between goals and self-efficacy, it is also believed that self-efficacy affects intrinsic motivation and performance. Thus, self-efficacy would appear to be an appropriate personal characteristic to take into account in forming effective peer groups.

However, limited research has been done on the effects of peer-group composition by self-efficacy. If we compose peer groups according to self-efficacy, which type of peer group will be most effective in terms of intrinsic motivation and problem-solving skill?

Researchers have examined the relationship of self-efficacy to achievement. These studies have shown that there is a significant positive correlation between self-efficacy and skillful performance (Mayer, 1998; Pintrich & Schunk, 2002). These findings imply that peer-group composition by self-efficacy would produce the same results as peer-group composition by ability level. Given this positive relationship between self-efficacy and performance, it is expected that heterogeneous peer grouping will be more effective than homogeneous peer grouping because it will provide greater benefits to students of both high and low self-efficacy. In other words, as in heterogeneous peer groupings according to ability level, students with high levels of self-efficacy will be more likely to develop confidence in their ability by showing their learning behaviors to their partners with low self-efficacy, while students with low levels of self-efficacy will have the opportunity to observe their partners' confidence in learning. This hypothesis is partially supported by a previous study that investigated the effects of peer-group composition by communication efficacy, one type of self-efficacy (Kim & Kim, 2003). The study indicated that heterogeneous peer groups had significantly higher satisfaction scores on learning tasks than homogeneous peer groups. Interestingly, students with higher levels of communication efficacy earned significantly higher satisfaction scores within heterogeneous peer groups than within homogeneous peer groups, because they had more opportunities to explain things to their peers.

However, the effects of peer-group composition by self-efficacy on intrinsic motivation and problem-solving skills have not empirically tested, to date. Given the relationship between high self-efficacy and high levels of ability, it is expected that heterogeneous peer grouping by self-efficacy will also lead to higher intrinsic motivation scores and better problem-solving skills than homogeneous peer grouping. Thus, this study investigated the effects of peer group composition by self-efficacy.

Summary

Research on goal orientation and peer group learning by self-efficacy provided support for the hypotheses predicted in this study. Goal orientation is important in problem-solving because it can guide students' intrinsic motivation to pursue problem solving tasks. Many researchers agree that learning goal orientations are more associated with intrinsic motivation and problem solving skills because they focus students on learning the tasks, while performance goal orientations are less associated with intrinsic motivation and problem solving skills by leading them to demonstrate their abilities and avoid challenging tasks. Recently, some researchers suggested that providing goal-oriented contexts is helpful for increasing intrinsic motivation and problem solving. Given the positive relationships among learning goal orientation, intrinsic motivation, and problem solving, a learning goal-oriented context should be more effective in increasing intrinsic motivation and problem solving skills than a performance-oriented context.

Along with the design of learning environments that affect goal orientation, peer group composition is also important in increasing intrinsic motivation and problem solving skills. Previous studies mainly investigated the effect of peer group composition by ability levels. They reported that heterogeneous peer groups are more effective than homogeneous peer groups. Heterogeneous peer groups provide both affective and cognitive benefits to high- and low- achieving students. However, limited research has examined the effects of peer group composition by other factors such as personal characteristics. Self-efficacy is such a factor because it mediates the relationship between goal orientation and performance. Given the relationships between self-efficacy and ability levels, it is expected that heterogeneous peer group by self efficacy would be more effective in increasing intrinsic motivation and problem solving skills than homogeneous peer group by self efficacy.

Chapter 3

METHOD

Introduction

This study investigated the effects of types of goal-oriented context and types of peer-group composition by self-efficacy on intrinsic motivation and problem-solving skills in a web-based PBL environment. This chapter describes specific methodology including participants, research design, materials, treatments, assessment instruments, experimentation procedure, and data analysis methods.

Participants

The participants were 90 sixth-grade students from four classrooms in one rural middle school located in the northeastern United States. A total of 96 students participated at the beginning of the study. Of these, only 90 participants were included in the final analyses, due to missing data. There were 47 boys and 43 girls.

The study was conducted during science classes in the classrooms. Classrooms were of the same size, and equipped with the same types of laptop computers, desks, and other facilities. All classrooms were equipped with the Internet-connected laptops. One laptop was provided to each group consisting of two students. Peer groups were given a web site in which they could access to their assigned treatment materials. Peer groups were separately seated at one of four areas in the classrooms according to their treatment groups: (a) learning-oriented context and heterogeneous peer group, (b) learning-oriented context and homogeneous peer group, (c) performance-oriented and heterogeneous peer group, and (d) performance-oriented and homogeneous peer group. These seat assignments were used to control the influence from other treatment groups within a classroom.

Research Design

Independent Variables

This study employed a "posttest-only control group design." A 2 X 2 randomized factorial design (Type of Goal-Oriented Contexts X Type of Peer-Group Composition) was used. The primary independent variables in the study were type of goal-oriented contexts (learning or performance) and type of peer-group composition (heterogeneous peer group or homogeneous peer group). The research design is illustrated in Table 3-1. The researcher used block randomization to assign high and low self-efficacy students to one of the two goal-oriented contexts. Students were assigned to one of four treatment groups by a crossing of two factors: type of goal-oriented contexts and type of peer-group composition: (a) learning-oriented / heterogeneous peer group, (b) learning-oriented / homogeneous peer group, (c) performance-oriented / heterogeneous peer group, and (d) performance-oriented / homogeneous peer group.

Table 3-1

Research Design with Two Factors for All students

		Peer-Group Composition	
		Heterogeneous Group	Homogeneous Group
Goal-Oriented Contexts	Learning-Oriented	(a)	(b)
	Performance-Oriented	(c)	(d)

A second analysis of the 2 X 2 randomized factorial design (Type of Goal-Oriented Contexts x Type of Peer Group Composition) was run only for students with low levels of self-efficacy, in order to test the main and interaction effects between type of goal-oriented contexts and type of peer-group composition. The research design for students with low levels of self-efficacy is illustrated in Table 3-2.

Table 3-2

Research Design with Two Factors for Students with Low Self-Efficacy

		Peer-Group Composition	
		Heterogeneous Group	Homogeneous Group
Goal-Oriented Contexts	Learning-Oriented	(a)	(b)
	Performance-Oriented	(c)	(d)

Dependent Variables

Dependent variables were intrinsic motivation and three components of problem-solving skill (problem representation, solution development, and monitoring and evaluation of solutions).

Materials

A web-based PBL tutorial, KaAMS for Kids, was adapted and developed from one of the lesson plans in a supplementary web-enhanced PBL science curriculum, Kids as Airborne Mission Scientists (KaAMS) (see Figure 3-1).

Figure 3-1. A sample screen showing a main home page

The lesson selected was *Developing the Mission Flight Plan*. Two different versions of the web-based PBL tutorials, KaAMS for Kids (*Learning-Oriented KaAMS for Kids* and *Performance-Oriented KaAMS for Kids*), supporting two different goal orientations, were developed by the researcher in this study. Each version consisted of five main steps, following the main phases of PBL: reviewing the problem scenario, defining the problem, investigating the problem, proposing a group solution, and presenting an individual solution. These five main learning activities were divided into three sessions according to a sequence of learning activities, in order to facilitate the implementation of the study: (1) reviewing the problem scenario and defining the problem, (2) investigating the problem and proposing solutions at a group level, and (3) writing individual problem-solution papers.

The main problem of the lesson was, "What is the best flight plan for investigating the active lava flows on Kilauea volcano at Hawaii?" A problem scenario, the mission request letter was provided to the students (see Figure 3-2). Students in the peer groups were then asked to develop the best flight plan for the situation in question. The word 'best' was used to denote the optional flight plan taking into account any factors that might affect the mission. Those factors included the purpose of the flight, selection of the most suitable aircraft from available NASA research aircrafts, the characteristics of remote sensing instruments, and other factors that might influence the flight mission such as airport information and weather.

The Mission Request Letter

Dear Kids as Airborne Mission Scientists,

We are planning an airborne remote sensing mission. The purpose of this mission is to locate active lava flows on Kilauea at Hawaii. We are considering to use an NASA aircraft, ER-2 from NASA Dryden Flight Research Center at Southern California. The NASA aircraft will load a remote sensing instrument, AVIRIS to locate where the active lava flows on the Kilauea volcano are.

To prepare for the flying mission, we need a flight plan. The best flight plan includes consideration of so many factors that may affect the success of the mission. Those factors include the purpose of flight, selection of the best aircraft, the characteristics of the remote sensing instrument, airport information, or other conditions that may affect the flying mission such as weather. Investigating these questions will guide us in creating the most appropriate flight plan. However, since we have to take into account many factors, we are having a difficulty in developing the best flight plan.

We, Division of Airborne Mission Science at NASA, knowing that you are a bright and capable Airborne Mission Scientist, would like to request your help in developing the best flight plan for this mission.

We look forward to receiving your report after completing your study and data analysis. Thank you for your time and cooperation in this important matter.

Sincerely,
M. McCarthy
Director of Airborne Mission Science Division at NASA

Figure 3-2. A sample screen showing a problem scenario

Treatments

Two different versions of the KaAMS for Kids web-based PBL treatment materials, structured differently to emphasize either learning goals or performance goals, were used in this study. Each version was structured in terms of the three contextual attributes influencing goal orientations: a) task design, b) distribution of authority, and c) evaluation practice (Ames, 1992; Fuchs et *al*., 1997) (see Table 3-3).

Table 3-3

Strategies Employed in the Construction of Learning/ Performance-Oriented Contexts

Area	Focus	Learning-Oriented Context	Performance-Oriented Context
Task Design	Presentation Methods	• The instructor provides messages that stress the importance of challenging work and the intrinsic value of learning. E.g.: "The most important thing will be for you to think about the problems and try to understand them. These problems are important because if you try your best to understand them, you will know about science, and you will be one step closer to learning science."	• The instructor provides messages that stress the importance of performance or results. E.g.: "The most important thing will be for you to try your best to select answers correctly. These problems are important because if you try your best to select the best aircraft without failure, you will be able to show me how well you can do compared to the other students in the classroom."
Distribution of Authority	Provision of control and choice leading to autonomy	• The instructor allows students to set priorities and provides opportunities to select particular choices. E.g.: "Please click on the NASA resource below that seems to match your group's interests." • The instructor allows students to establish rule to explore resources. E.g.: "Please also be aware that your group should decide on an investigation plan and set up a time plan before the investigation."	• The instructor sets the choices and controls of learning activities to improve performance. E.g.: "The first step is to select the best research aircraft for this mission. The next step in creating a flight plan is to take into account a remote sensing instrument." • The instructor sets rules to improve performance. E.g.: "You will not be allowed to investigate a factor for over 10 minutes due to time limitations."
Evaluation Practice	Evaluation report procedure	• The instructor reports evaluations privately. E.g.: Distributing an evaluation report privately.	• The instructor displays evaluations publicly. E.g.: Displaying a selected group paper on the web bulletin board.
	Type of feedback according to evaluation criteria	• The instructor provides self-referenced information. E.g.: "While solving problems, you will do more problems, so you can see how much you've learned."	• The instructor provides social-comparison information. E.g.: "While solving problems, you will be tested on more problems, so I can see how well you are doing in relation to others."

In an effort to ensure content validity, the researcher asked two faculty with expertise in the fields of motivation and learning from a major university in a northeastern state to review the tutorials. All agreed that the tutorial incorporated essential areas that were important to the development of a goal orientation. As shown in Table 3-3, learning and performance-oriented contexts are different in terms of strategies employed. Task characteristics, one of foci in the area of *task design* discussed in the literature review was not considered in designing goal-oriented contexts in this study because the use of different tasks would become an uncontrolled factor in the design.

Learning-Oriented Context

The purpose of the learning-oriented context was to promote a learning-oriented climate in the peer group. It was achieved by providing the three contextual attributes according to a learning-goal orientation: task design, distribution of authority, and evaluation practice.

First, in the task design for each phase of the PBL situation, the researcher included task-instruction messages stressing the importance of challenging work and the intrinsic value of learning (see Figure 3-3).

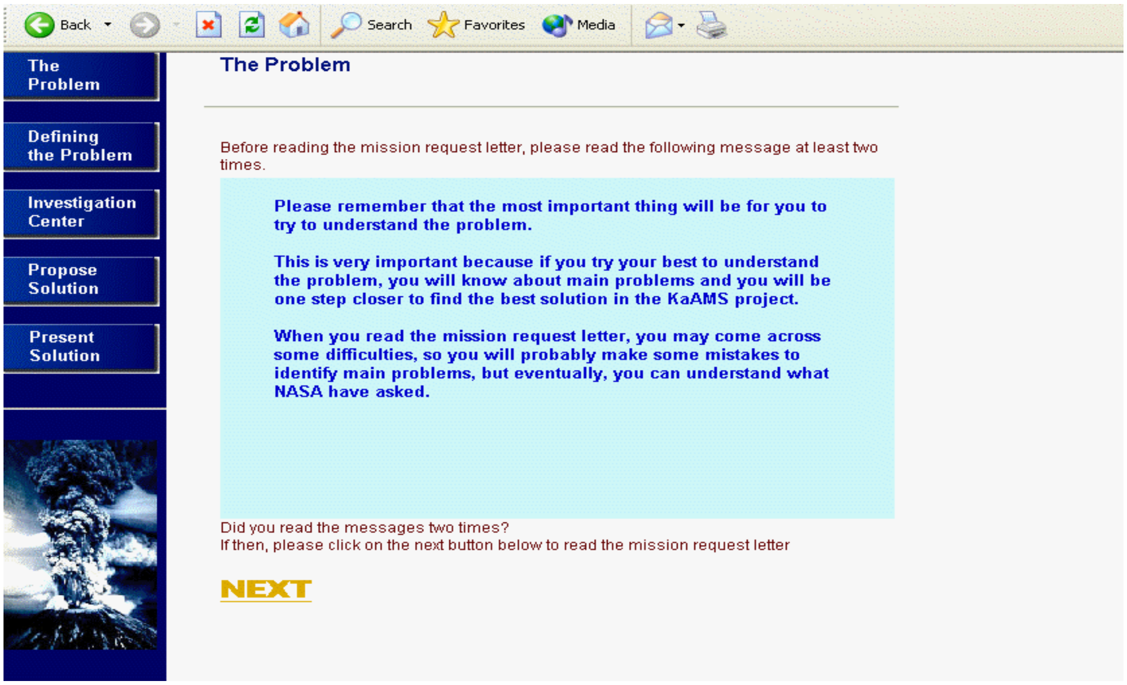

Figure 3-3. A sample screen showing a task-instruction message used in the learning-oriented context

A total of six task-instruction messages were used according to the sequence of learning activities during PBL: One message for reviewing the problem scenario, two messages for defining the problem, one message for investigating the problem, one message for proposing a group solution, and one message for presenting an individual solution. The participating students were asked to read the messages individually at least twice in order to facilitate the adoption of learning goals (see Table 3-4).

Table 3-4

Comparison of the Task-Instruction Messages Used in the Learning/ Performance-Oriented Contexts

PBL process	Learning-oriented Context	Performance-Oriented Context
Problem Scenario	1. Please remember that the most important thing will be for you to try to understand the problem. This is very important because if you try your best to understand the problem, you will know about the main problems and you will be one step closer to finding the best solution. When you read the mission request letter, you may come across some difficulties, so you will probably make some mistakes in identifying the main problems, but eventually, you will be able to figure out what NASA is asking.	1. Remember that the most important thing will be for you to try your best to plan the flying mission correctly. This is very important because if you try your best to develop a mission flight plan without failure making any mistakes, you will be able to show how well you can do compared to others in your classroom. While developing your flight mission, you will be tested on key problems. If you do your best to plan the flying mission correctly, then the test probably won't be as difficult. Your performance will show how well you can do in relation to others.
Problem Definition	<u>Defining the Problem</u> 2. Identifying the main problems is going to be a bit more challenging. However, if you and your group enjoy working on it, you will probably continue to get better at identifying problems. Please remember that the most important thing will be for you to try to understand the problem. This is very important because if you try your best to understand the problem, you will know about the main problems and you will be one step closer to developing the best flight plan. When you identify the main problems, you may come across some difficulties, so you will probably make some mistakes in identify them, but eventually, you will be able to define the main problems. <u>Writing the Problem Statement</u> 3. Writing the problem statement report is going to be a bit more challenging. However, if you and your group enjoy working on it, you will probably continue to get better at it. Please remember that the most important thing will be for you to try to understand the problem. This is very important because if you try your best to understand the problem, you will know about the main issues involved in the flight mission and you will be one step closer to developing the best flight plan. While writing a problem statement report, you may come across some more problems, so you will probably make some mistakes, but eventually you will be able to see how much you've studied.	<u>Defining the Problem</u> 2. Identifying the main problems will show how good or bad your group is at defining the main problems for the flight plan compared to your classmates. Remember that the most important thing will be for you to try your best to define the main problems correctly. This is very important because if you try your best to define the main problems involved in the flight mission without failure making any mistakes, you will be able to show how well you can do compared to others in your classroom. While defining the main problems involved in the flight mission, you will be tested on key problems. If you do your best to define the main problems, then it probably won't be as difficult. Your performance will show how well you can do in relation to others. <u>Writing the Problem Statement</u> 3. Your group's problem statement report will show how good or bad your group is at identifying the main problems compared to your classmates. Remember that the most important thing will be for you to try your best to correctly identify the main issues involved in the flight mission. This is very important because if you try your best to define the main problems involved in the flight mission without failure making any mistakes, you will be able to show how well you can do on the problems compared to others in your classroom. While identifying the main issues mentioned in the mission request letter, you will be tested on key problems. If you do your best to define the main problems correctly, then it probably won't be as difficult. Your performance will show how well you can do in relation to others.

Investiga-ting Problems	4. Investigating the problems with NASA web resources is going to be a bit more challenging. However, if you and your group enjoy working on it, you will probably continue to get better at investigating problems. Remember that the most important thing in your investigation will be for you to think about the problems and try to understand them. This is important because if you try your best to understand the problems, you will know more about the KaAMS problem and you will be one step closer to developing the best flight plan. It is strongly recommended that you and your partner spend a few minutes to set up an investigation plan. Since you will have only one class period to investigate the NASA web resources and find group solutions, it is also recommended that you set a time plan before starting your investigations.	4. Investigation of NASA web resources will show how good or bad your group is at collecting and analyzing data for the flight mission compared to your classmates. Remember that the most important thing will be for you to try your best to investigate the NASA web resources correctly. This is very important because if you try your best to collect and analyze the data for the flight plan without failure, you will be able to show how well you can do compared to others in your classroom. While working in this investigation center, you will be tested on key problems. If you do your best to investigate the NASA web resources correctly, then it probably won't be as difficult. Your performance will show how well you can do in relation to others. Since your group must finish all the investigations for this session and write down all possible solutions, we recommend that you and your partner not spend more than 10 minutes on each activity. Please finish each investigation within 10 minutes so that your group can submit a solution paper by the end of this session.
Propose Solution	5. O. K. you two worked nicely together, and we can tell that you are trying hard and getting better at developing the best flight plan. The next task, writing a group solution report, is going to be a bit more challenging. However, if you enjoy working on it, you will probably continue to get better at finding all the possible solutions for the flight mission. Remember that the most important thing will be for you to think about the problems and try to understand them. While writing a group solution report, you and your partner may come across some difficulties, so you will probably make some mistakes, but eventually you will be able to see how much you've studied.	5. O. K. you two worked nicely together. Based on how well you investigated these NASA web resources, we can tell how good you are at investigating problems compared to the other groups in your classroom. The next task, writing a group solution report, will also show how good or bad your group is at finding all the possible solutions for the flight mission compared to your classmates. While writing a group solution report, you will be tested on key problems. If you do your best to find all the possible solutions correctly, then it probably won't be as difficult. Your performance will show how well you can do in relation to others. Remember that the most important thing will be for you to try your best to identify the main issues for the flight mission correctly.
Present Solution	6. Your group worked nicely together, and I can tell that you two are trying hard and getting better at understanding these problems. The next task, writing your own solution report, is going to be a bit more challenging. However, if you enjoy working on it, you will probably continue to get better at developing the best flight plans for KaAMS flight missions. While developing your solutions, you will participate in many processes: reviewing and evaluating possible solutions, so you will probably make some mistakes, but eventually, you will be able to see how much you've learned.	6. O. K. you two worked nicely together. Based on how well you performed on these problems, we can tell how good your group is good at these types of problems compared to the other groups in your classroom. The next task, writing your own solution report, will show how good or bad you are at presenting solutions for the flight mission compared to your classmates. While writing your solution report, you will be tested on key problems. If you try to your best to develop the best flight plan correctly, then it probably won't be as difficult. Your performance will show how well you can do in relation to others.

Second, for *distribution of authority*, control over choice was provided to students. Students in the learning-oriented context were allowed to set priorities and choose activities that interested them (see Figure 3-4).

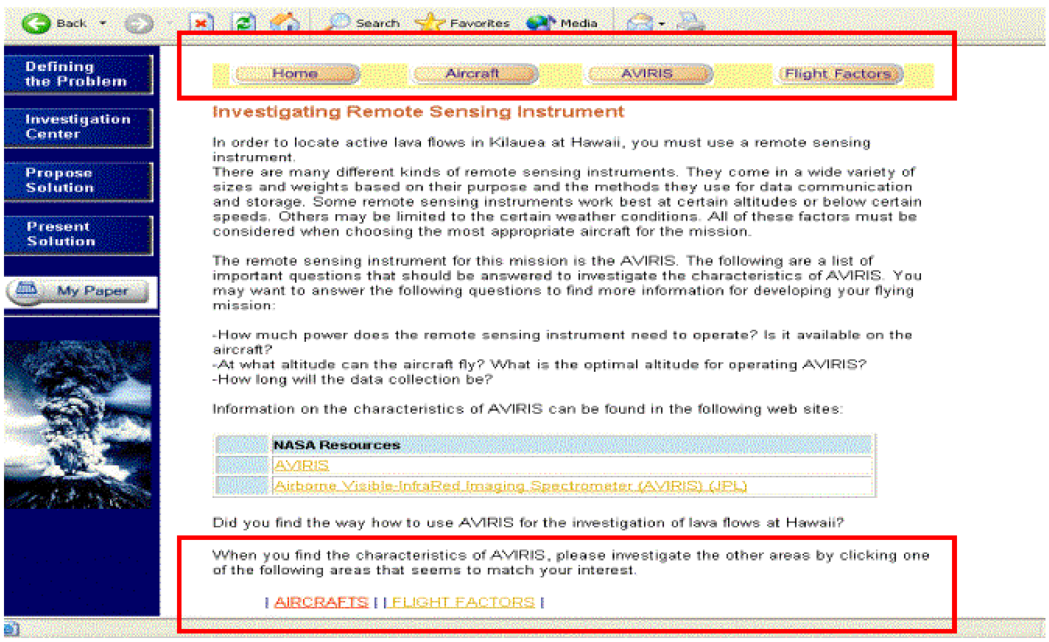

Figure 3-4. A sample screen showing distribution of authority in the learning-oriented context

Third, for *evaluation practice*, peer groups' performances were evaluated privately. Because peer groups submitted their group reports after they completed the phase of defining the problem and proposing solutions, each peer group received a total of two evaluation reports. The evaluation reports were displayed on a web bulletin board called *My Papers*. Each group's evaluation reports were password-protected and were not accessible to other peer groups. They included suggestions for factors that each group should focus on in the future, based on their group solutions (see Figure 3-5).

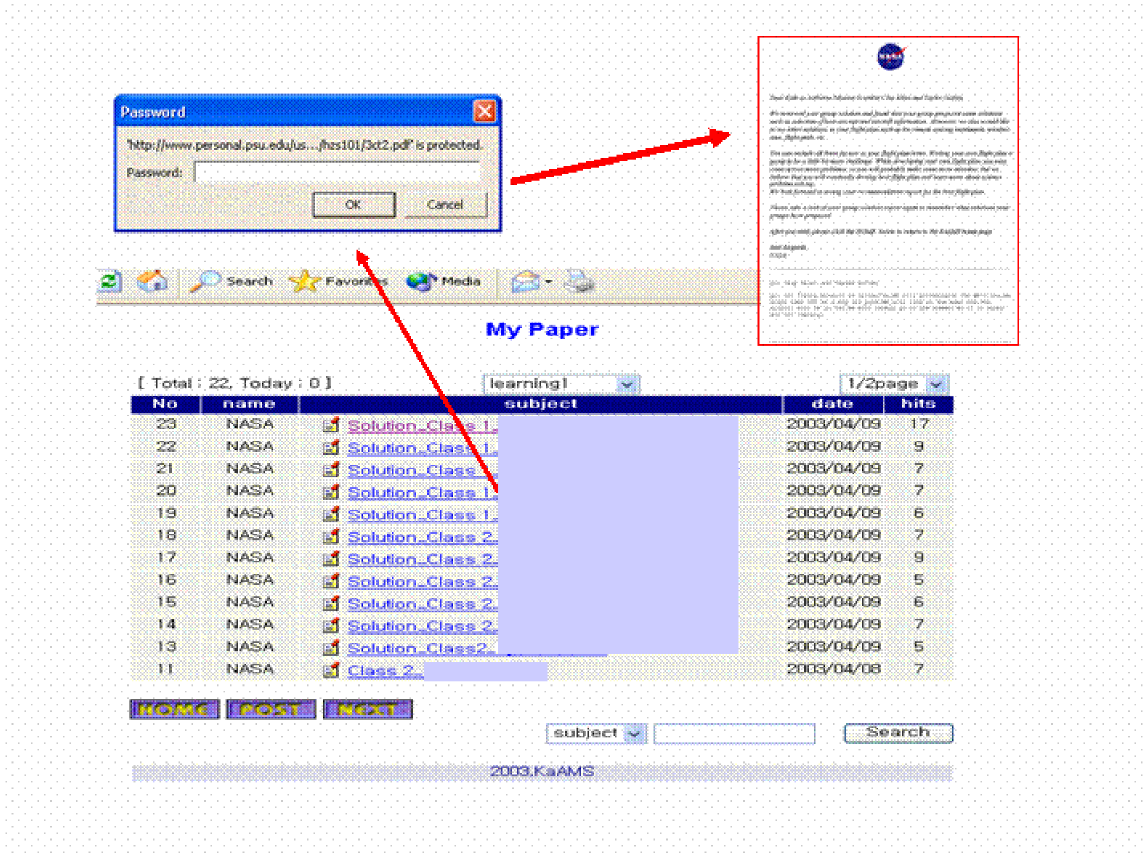

Figure 3-5. A sample screen showing evaluation practice in the learning-oriented context

Performance-Oriented Context

The aim of the performance-oriented context was to promote a performance goal-oriented climate in the peer group. This was achieved by providing the three contextual attributes according to a performance-goal orientation.

First, for *task design*, the researcher provided task-instruction messages stressing the importance of performance (see Figure 3-6).

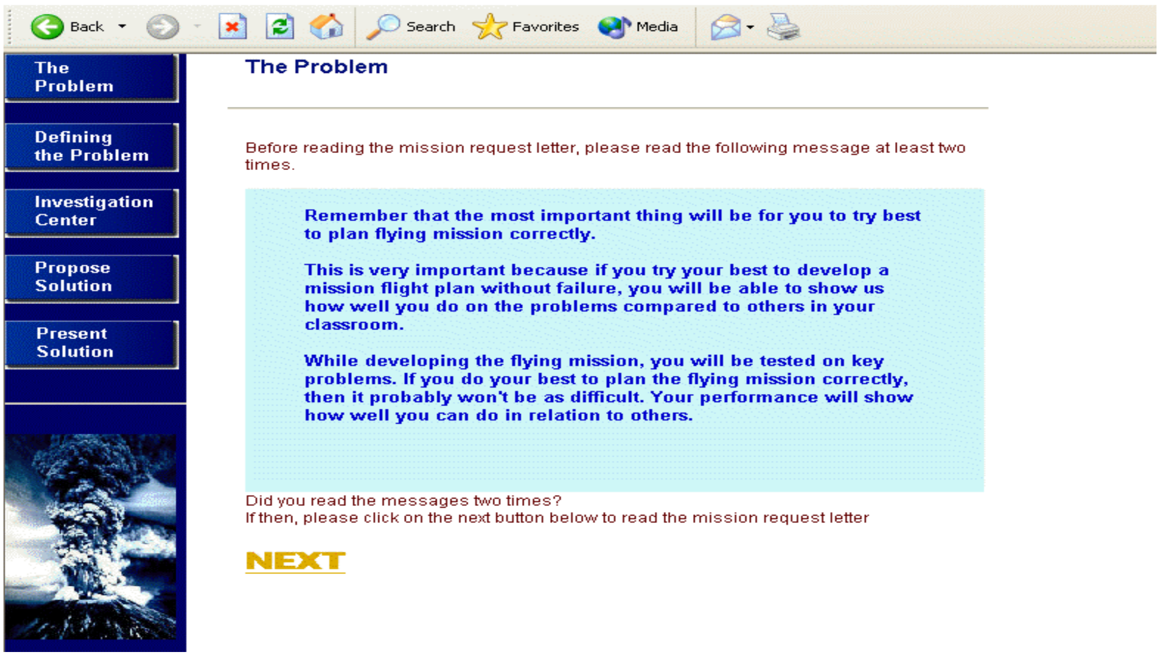

Figure 3-6. A sample screen showing a task-instruction message used in the performance-oriented context

A total of six task instruction messages were used at different steps in the problem-solving process. Detailed information on the task-instruction messages used in the performance-oriented context is also presented in Table 3-4.

Second, for *distribution of authority*, the researcher set choices or controls of learning activities. The researcher provided students with prompts leading them to the next learning activity instead of allowing them to choose which activity to work on next (see Figure 3-7). Recommendations on time management were also provided to students so that they could efficiently complete assignments within the class period.

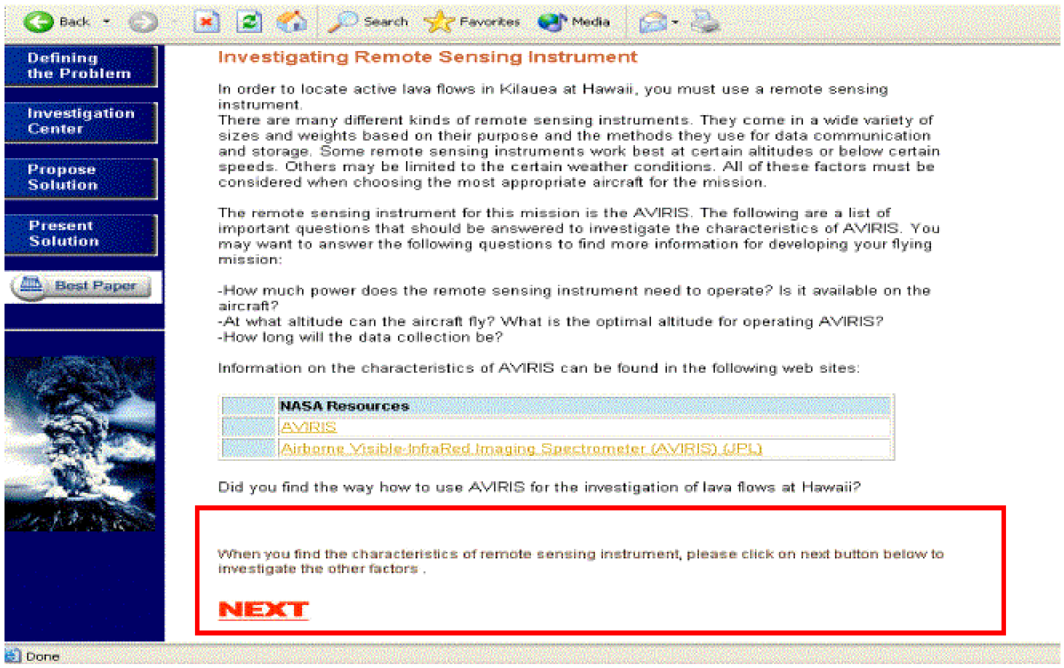

Figure 3-7. A sample screen showing distribution of authority in the performance-oriented context

Third, for *evaluation practice*, peer groups' performance evaluations were posted publicly. Two example papers were selected among peer groups' papers and displayed on a web bulletin board called *Best Papers*. Because each peer group submitted their group reports after completing the phase of defining the problem and proposing solution, a total of four best papers were displayed. These papers were not password-protected but rather were accessible to all students. They included social comparison information and evaluation comments based on norm-referenced standards (see Figure 3-8).

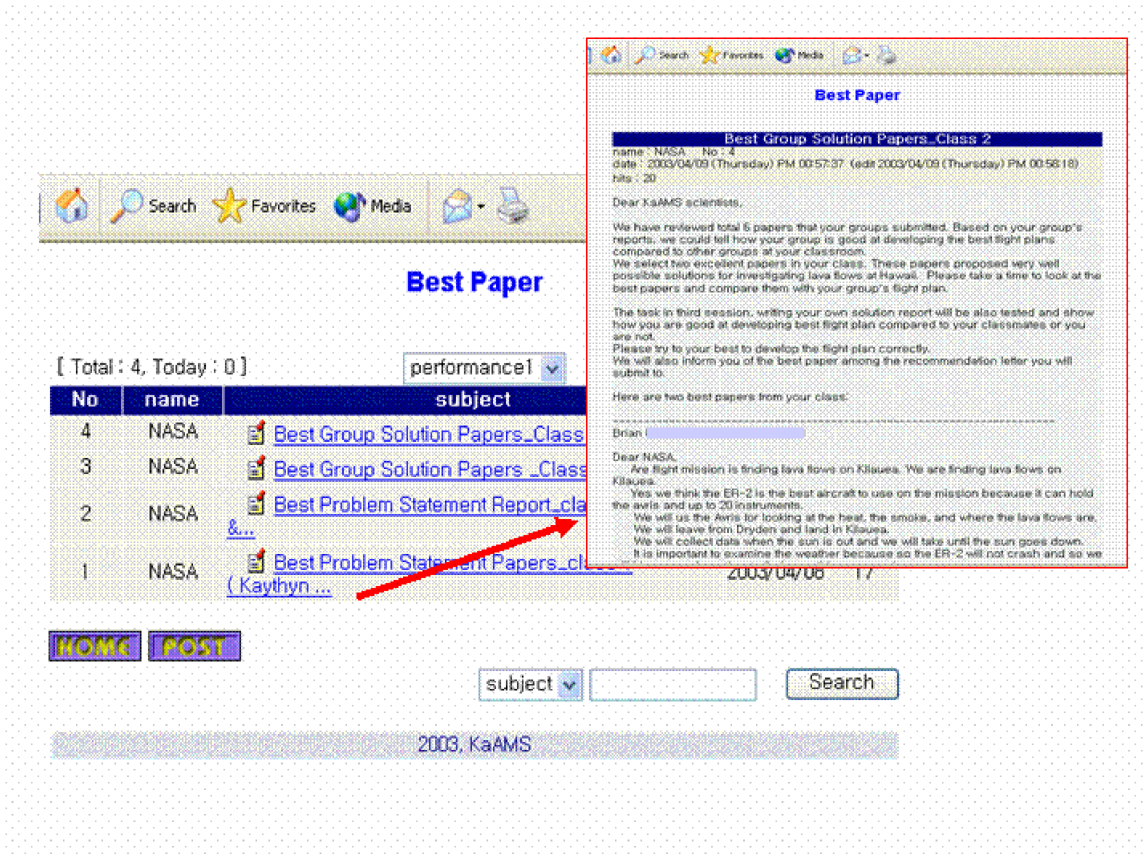

Figure 3-8. A Sample screen showing evaluation practice in the performance-oriented context

Peer Groups

Two types of peer groups were used in this study: heterogeneous peer groups and homogeneous peer groups. Peer-group composition was decided by self-efficacy scores. A heterogeneous peer group consisted of one student with a high level of self efficacy and one student with a low level of self-efficacy. The homogeneous peer groups were further categorized as either homogeneous high peer groups or homogeneous low peer groups. A homogeneous high peer group consisted of two students with high levels of self-efficacy, whereas a homogeneous low peer group consisted of two students with low levels of self-efficacy.

Assessment Instruments

Five instruments were used in this study in order to measure self-efficacy, perceived goal structure, goal orientation, intrinsic motivation, and problem solving skills.

Self-Efficacy

Fouad, Smith, and Enochs's (1997) assessment of math/science self-efficacy (12 items) was used because it was developed to measure middle-school students' self-efficacy (see Appendix B-1). Both the math and science self-efficacy items in the instrument were used because the treatment material in this study, KaAMS for Kids, was designed to facilitate knowledge construction in both science and mathematics. Fouad et al., reported an internal-consistency reliability coefficient of 0.84 for the instrument. The Cronbach alpha reliability coefficient in this study was .81. Self-efficacy was assessed with a five point Likert-type scale ranging from 1 (not possible) to 5 (very possible). Because the self-efficacy test had 12 items and used a five point Likert-type Scale, total scores on this instrument could range from 12 to 60. The mean, standard deviation, median, mode, minimum, and maximum for self-efficacy in this study are represented in Table 3-5.

Table 3-5

Mean, Standard Deviation, Median, Mode, Minimum, and Maximum of Self -Efficacy Test

	n	Mean	SD	Median	Mode	Min.	Max.
Self-Efficacy	90	44.5	6.6	46	46	30	56

Perceived Goal Structure of Peer Group Environment

Perceived goal structure of peer group environment was adapted from Perception of Classroom Goal Structure, one of subscales in the Manual for the Patterns of Adaptive Learning Scale (PALS) (Midgley et *al*., 2000) (see Appendix B-2). The scale of PALS measured students perceptions of the goal structure in the classroom environment and contained 14 perceived goal structure items (learning goal structure- 6 items, performance goal structure- 8 items). 'Classrooms' in the items at the PALS was changed into 'group' in this study to measure students' perception of goal structure in peer group environments. Both perceived learning and performance goal structure were assessed with a five point Likert-type scale ranging from 1 (not at all true) to 5 (very true). Students' scores by Likert-type scale for *the perceived learning goal structure of peer group environment* in this study were ranged from 1.83 (minimum) to 5.00 (maximum) while those for *the perceived performance goal structure* were ranged from 1.50

(minimum) to 4.88 (maximum). Midgley et al. (2000) reported that the coefficient alpha for *perceived learning goal structure* was .76. They divided *perceived performance goal structure* scale into two types (*performance-approach* and *performance-avoidance*) and reported that the performance goal scale exhibited an alpha of .70 (*perceived performance-approach goal structure*) and an alpha of .83 (*perceived performance-avoidance goal structure*). The Cronbach alpha reliability coefficient for perceived learning goal structure in this study was .81, while the Cronbach alpha reliability coefficient for *perceived performance goal structure* was .77.

Goal Orientation

Personal goal orientations from PALS were used in this study (Midgley et *al.,* 2000). Fourteen personal goal-orientation items (learning—5 items, performance—9 items) were used (see Appendix B-3). Each learning and performance goal orientation was assessed on a five point Likert-type scale ranging from 1 (not at all true) to 5 (very true). Students' scores by Likert-type scale for *the learning goal orientation* in this study were ranged from 1.40(minimum) to 5.00(maximum) while those for *the performance goal orientation* were ranged from 1.00(minimum) to 5.00(maximum). Midgley et *al.* (2000) examined the factor structure of the sets of items with confirmatory factor analysis and found that the model of the factor structure fits the data well (GFI: Goodness of Fit Index = 0.97, AGFI: Adjusted Goodness of Fit Index = 0.95). They reported that the coefficient alpha for the learning goal orientation was .85 while the performance goal scale exhibited an alpha of .89 (performance-approach goal orientation) and an alpha of

.74 (performance-avoidance goal orientation). The Cronbach alpha reliability coefficient for learning goal orientation in this study was .78, while the Cronbach alpha reliability coefficient for perceived performance goal orientation was .86.

Intrinsic Motivation

A science subscale was selected and adapted from the Children's Academic Intrinsic Motivation Inventory (CAIMI) (Gottfried, 1985) (see Appendix B-4). The instrument was adapted by asking students to express their intrinsic interests on a specific science problem-solving task used in this study, KaAMS for Kids, instead of indicating their intrinsic interests on a general science problem solving task. The internal consistency reliability coefficient alpha for the science subscale was .90. Twenty-four items were used in this study, which used a 5-point Likert-type Scale ranging from 1 (strongly disagree) to 5 (strongly agree) to measure intrinsic motivation to learn and to understand learning tasks. Students' scores by Liker-type Scale for the intrinsic motivation in this study were ranged from 1.63(minimum) to 4.75(maximum). The Cronbach alpha reliability coefficient for intrinsic motivation in this study was .89.

Problem-Solving Skills

Problem solving reports

Students were asked to write two problems solving reports to find a solution for the problem that was provided in the mission request letter. Instruction was provided at two phases of writing the problem-solving reports: Group Solution Proposal (group problem solving) and Individual Solution Presentation (individual problem solving). For the Group Solution Proposal (group problem-solving), several guiding questions were provided (see Table 3-6).

Table 3-6

Instructions for Group Problem-Solving

When your group writes a group solution report, be sure to write at least one page of report. When you finished, please click the submit button below.

Here are several questions that you have investigated. Your group's solutions may include the answers for the following questions:

- *What's your flying mission? What will you investigate?*
- *Why do you think ER2 is the best aircraft for the KaAMS mission?*
- *How will you use AVIRIS for the investigation of lava flows at Hawaii?*
- *From what airport will you leave? Where will you land?*
- *How far is it from the home base to the target?*
- *What route will you choose to achieve your flying mission? And, how many hours will it take to get to target destination?*
- *What time will you leave and land at target destination?*
- *What time of day will you collect data and how long will you collect data?*
- *Why is it important to examine weather for an airborne remote sensing mission? What is the weather like in Hawaii this time of year?*

Did you find the answers for these questions? If so, please write a paper about how to fly to investigate the lava flow.

For the Individual Solution Presentation (individual problem-solving), some guiding information about what to write and how to write the report was also provided (see Table 3-7). Only individual problem solving reports were used to test problem solving skills in this study.

Table 3-7

Instruction for Individual Problem-Solving

Now that your group generated possible solutions, the next step is to develop your own flight plan. Here is important information related to your recommendation report.

What to write:

National Aeronautics and Space Administration (NASA) would like to have your recommendation on the following question: What is your flight plan for investigating the active lava flows at Kilauea volcano in Hawaii?

They especially would like to see the following information in your recommendation letter: a) identification of the main problems that you have defined and initial ideas of what you need to know to solve the problems, b) selection and development of the best flight plans from your group's solution report, and c) explanation of the reasons why your flight plan is the best. If there is a limitation in your flight plan, you can describe that as well.

How to write:

To write a paper, you may want to start describing the purpose of the flight and initial ideas of what you have to develop the best flight plan. Then, you can describe the detailed flight plans. The plans can include the best aircraft, the characteristics of the remote sensing instrument, airport information, time, weather, and flight paths. There may be other conditions that affect the flight mission as well. Finally, you are expected to evaluate your flight plan and describe the advantages and limitations of the plans.

You can use all resources such as KaAMS web site, your group's evaluation papers, and activity sheets that you have used in this project in order to write your recommendation letter for the best flight plan. You may want to discuss what your group had studied with your partner. However, you should write your own flight plan based on your decision. Your own solution can not be the same as your partner's.

Remember that NASA would like to see at least a one page report. Please write your flight plans on the paper provided by the teacher and submit it at the end of the session to your teacher.

Scoring procedure

The individual problem-solving reports were evaluated in several steps. The problem-solution report of each participant was assigned an identification number to ensure blind grading. Before the evaluation of the problem-solution reports, the researcher met with the other two raters in order to explain the scales and sub-constructs of the scoring rubrics. The problem solution reports that were used in the pilot test were evaluated again during this meeting and the raters reached a conceptual consensus on the scale for the scoring rubrics. Then, each rater assessed the individual problem-solution reports against the scoring rubric. Finally, the scores from all three raters were collected and final scores were determined according to the following rules: (a) If all raters agreed, the researcher used the agreed-upon score; (b) If two raters agreed, the researcher used the score that had the higher level of agreement; and (c) If all three raters disagreed, the researcher took the average of the three different scores.

Scoring rubric

Individual problem-solving reports were analyzed in terms of three components of problem solving, using a scoring rubric adapted from Ge's (2001) rubric system for solving ill-structured problems (see Appendix C). Performance was measured as interval data according to degree of quality on the three major constructs of problem solving skills: problem representation, solution development, and monitoring and evaluation of solutions. First, problem representation included four sub-components: *problem definition* was assessed with 0-2 points, *sub-goal generation* was assessed with 0-2 points, *identification of relevant information* was assessed 0-3 points, and *a required information search* was assessed with 0-3 points. Second, solution development involved two sub-components: *solution development with explicit explanation* was assessed with 0-3 points and *quality of solution* was assessed with 0-5 points. Third, monitoring and evaluation of solutions also included two sub-components: *evaluation of solutions* was assessed with 0-3 points and *assessment of group solutions* was assessed with 0-3 points. Problem Representation was worth 10 points, Solution Development was worth 8 points, and Monitoring and Evaluation of Solutions was worth 6 points. Thus, each case was worth a total of 24 points. The issue of equal intervals used in the assessment rubric might be a concern in terms of statistics analyses. However, previous studies support the assumption of equal intervals on the rubric scales. For instance, according to Colaric (2001), "numerically coded category scales often produced simple rules of combination that justify an approximate equal-interval assumption" (p.66). Therefore, problem solving skills were analyzed as interval data in this study.

Inter-rater reliability

Three raters, including the researcher and two other doctoral graduate students majoring in Instructional Systems, scored each case by reading the individual problem-solution reports against the scoring rubric. Percent agreement was used as a measure of inter-rater reliability in this study. This measure consists of the ratio of the number of times the raters agreed divided by the total number of subjects studied. The percent agreement for all items was 80.8 %. A summary of the percent agreement for each item is represented in Table 3-8. A percent agreement for *assessing group's solution*, one of the sub-components in the *monitoring and evaluation of solutions* was not available because no student assessed group solutions in their individual problem solution reports.

Table 3-8

A Summary of Percent Agreement on Three Assessment Constructs

Assessment Components	Percent Agreement for the Three Raters
1. Problem Representation	79.7
• Define the problem	75.2
• Generate sub-goals	80.8
• Identify relevant information (known factors and constraints)	85.9
• Seek needed information	77.1
2. Solution Development	75.4
• Selecting or developing solutions, with explicit explanations.	72.2
• Quality of the solutions (holistic assessment)	78.5
3. Monitoring and Evaluation of Solutions	
• Evaluating solutions	95.9
• Assessing groups' solutions	NA
Total	80.8

Procedures

The procedures followed in this study consisted of five main steps (see Figure 3-9): (1) recruiting participants, (2) testing treatment materials, (3) administering the pretest, (4) assigning participants to experimental groups, and (5) implementing the

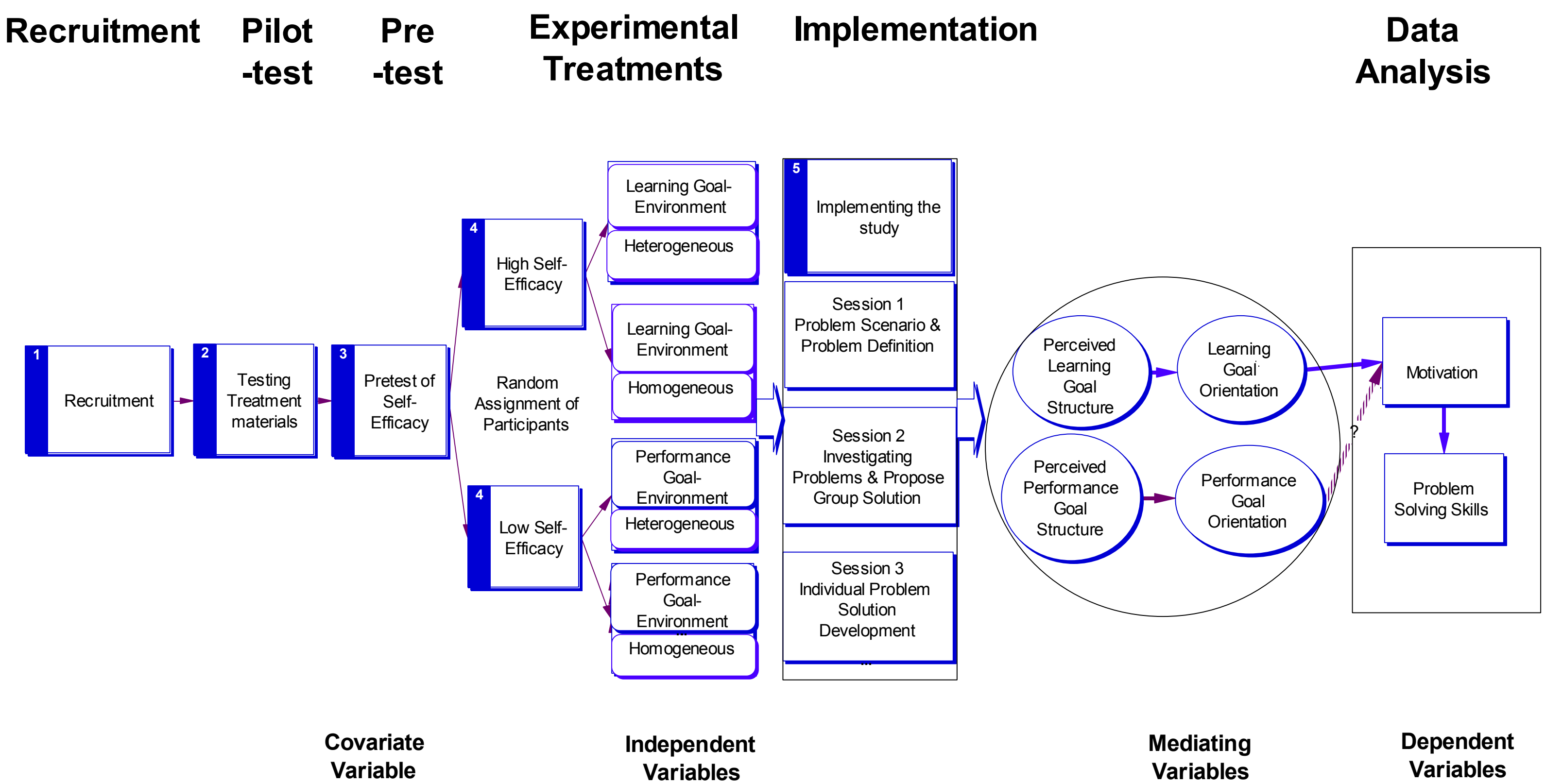

Figure 3-9. Flow chart showing the design of the study

study, including collecting data on individual problem-solving reports and self-report questionnaires. Data analyses were conducted after the data collection.

Recruiting Participants

The researcher recruited sixth-grade students from four classrooms of 23-25 students each in one rural middle school. The researcher explained the purpose of the study in each classroom. The researcher read the students a verbal-assent script and asked them to participate in the study (see Appendix A). The students who agreed to participate in the study raised their hands. All students who agreed participated in this study. The researcher also asked the teachers in the participating classrooms to distribute the parental consent forms and invitation letters with return envelopes in order to get the permission of the students' parents (see Appendix A). Since the study was implemented as a class activity, all the students participated. However, the researcher only used the data when both students and parental consent were given. There were two students whose parents did not grant permission for them to participate in the study. These students were assigned to the same peer group and their data was not used in the analysis.

Testing Treatment Materials

A pilot test was conducted prior to the study. The primary purpose of this test was to determine the readability and interpretation of the KaAMS for Kids web-based PBL tutorials with the intended subjects. The participants in the pilot test were 8 eighth-grade students who did not participate in the actual study. They were from one classroom in the same middle school from which participants were recruited.

Study implementation procedures were followed to identify any problems in the experimental procedure. Based on self efficacy scores, pilot students were randomly assigned to one of four types of treatment group: (a) learning-oriented / heterogeneous peer group, (b) learning-oriented / homogeneous peer group, (c) performance-oriented / heterogeneous peer group, or (d) performance-oriented / homogeneous peer group. Each group completed the KaAMS for Kids study material in three separate sessions of 45 minutes each. After completing the study material, student interviews were conducted to see if the treatment materials induced the intended goal orientations. Students agreed that each treatment prompted the intended goal orientation. Students interviews were also conducted to determine if there were difficult terms in the treatment materials. Those terms were revised when the researcher created the final treatment materials.

Administering the Pretest

Two weeks before the experiment, self-efficacy test was administered to all participants in the target classrooms to identify students with high and low levels of self-efficacy.

Assigning Participants to Experimental Groups

The participants in this study were taken from four different classrooms. Because the students had to remain in their classrooms, they were randomly assigned to one of four treatment groups within each classroom, according to the following procedures:

Identifying high and low self-efficacy groups

High and low self-efficacy groups were identified based on self-efficacy scores from all participants. The median self-efficacy score calculated from all participants was 46. Students who scored at and above the median of self efficacy scale (46) were categorized as having high self-efficacy and those who scoring below the median (45 and below) were categorized as having low self-efficacy. The number of high self-efficacy students was 44 and that of low self-efficacy students was 46.

Assigning high / low self-efficacy groups (heterogeneous / homogeneous)

Since this study was implemented in four intact classrooms, high and low self-efficacy groups were identified for each classroom based on the median score identified from all students (the median = 46). An example of assigning students into treatment groups for each classroom was represented at Figure 3-10.

Students in the high self-efficacy group were randomly assigned to either a heterogeneous or a homogeneous peer group. Students in the low self-efficacy peer group were also randomly assigned to either a heterogeneous peer group or a homogenous peer group.

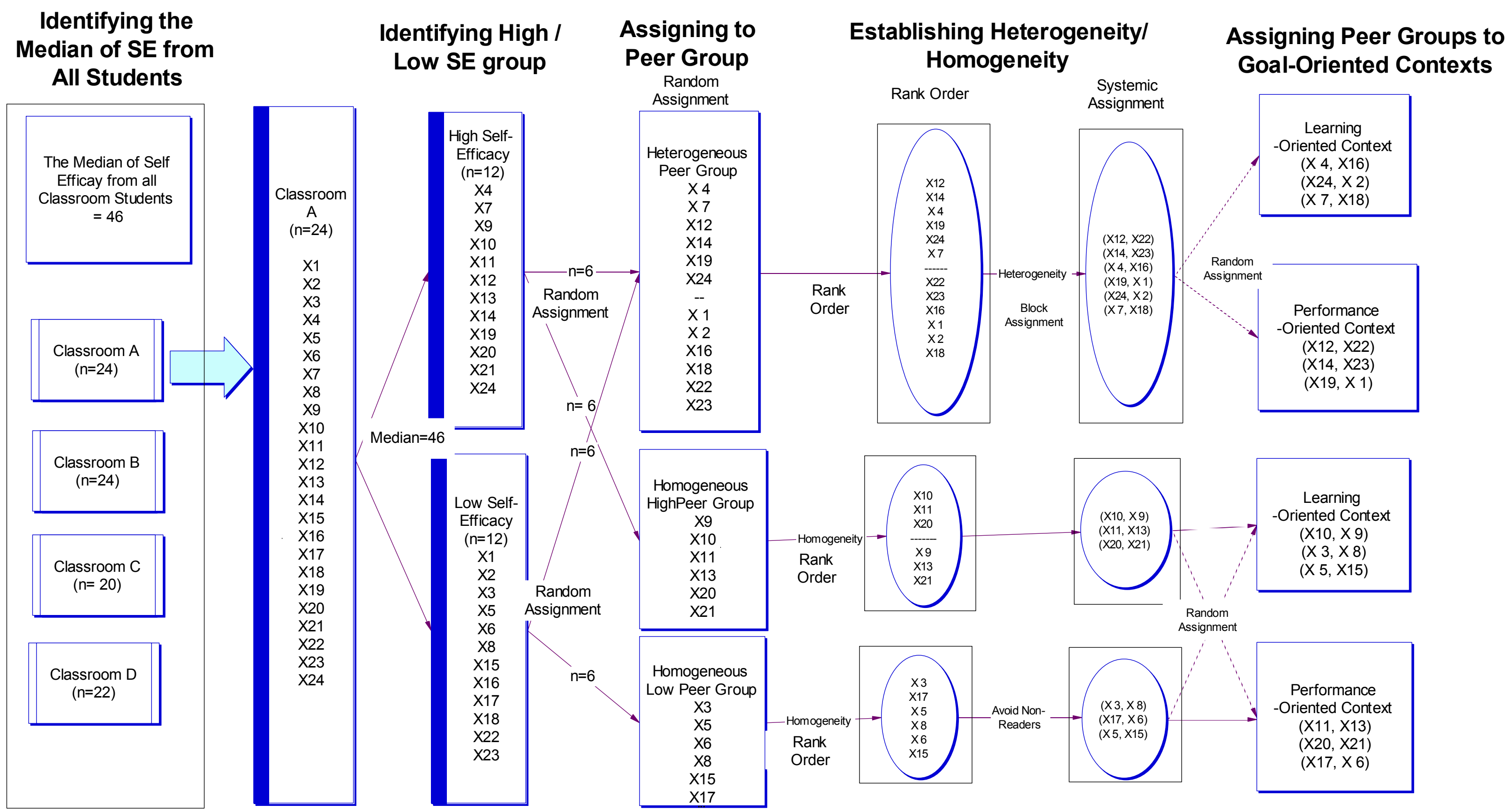

Figure 3-10. An example of assigning participants to experimental groups (Classroom A)

Establishing heterogeneity/ homogeneity in peer group

1. Establishing heterogeneity in a heterogeneous group. Each heterogeneous peer group consisted of one subject with high and one subject with low self-efficacy. To establish heterogeneity between peer group members, the student who scored highest on the self-efficacy test was paired with the one who scored just below the median; the second highest student was paired with the student who was the second below the median, and so on, so that the students just above the median were paired with the students who had the lowest scores (Singhanayok & Hooper, 1998).

2. Establishing homogeneity in a homogeneous group. There were two types of homogeneous peer group: the homogeneous high-self efficacy peer group and the homogeneous low-self efficacy peer group. Each homogeneous high-self efficacy peer group consisted of two subjects with high levels of self-efficacy, while each homogenous low-self efficacy peer group consisted of two subjects with low levels of self-efficacy. First, the homogeneous high self-efficacy groups and the homogeneous low self-efficacy groups were created. Homogeneous high self-efficacy groups consisted of high-self efficacy students who were randomly assigned to the homogeneous group, whereas homogeneous low self-efficacy groups consisted of low self-efficacy students who were randomly assigned to the homogeneous group. Next, homogeneity was established in both the homogeneous high self-efficacy group and the homogeneous low self-efficacy group. To establish the homogeneity of both groups, the researcher paired students in the high self-efficacy group with each other and paired students in the low self-efficacy

group with each other. To avoid the possibility that two non-readers might be assigned to a homogeneous peer group, the highest student in the homogeneous low self-efficacy group was paired with the one who scored just below the median in the homogeneous low self-efficacy group. Students in the homogeneous high self-efficacy group were paired by the same method.

Assigning peer groups to types of goal-oriented contexts

Heterogeneous peer groups were randomly assigned to either the learning-oriented context or the performance-oriented context. Homogeneous peer groups were also randomly assigned to either the learning-oriented context or the performance-oriented context.

Implementing the Study

The study was administered in three separate sessions of 45 minutes each. Students completed different versions of the programs that different goal-oriented contexts were provided. Students in the learning-oriented context solved a problem designed to foster a learning goal orientation; students in the performance-oriented context solved the same problem, but in a treatment designed to foster a performance goal orientation. The main learning activities of each session were as follows:

- Session 1: Students were assigned to an experimental group. The main activity of the web-based PBL session was to review the problem scenario and define the problem. Each peer group wrote learning issues defined from the problem scenario on the treatment Web site as a result of these activities.

- Session 2: Each peer group continuously worked on a different version of the Web-based PBL treatment, structured with a different goal orientation. The main activity of this session was to investigate the problem with web resources and propose group solutions. Each group submitted a group solution paper as a result of these activities.
- Session 3: Each student was asked to present his/her own solution based on the investigation of their group solution. First, each student was encouraged to review their group solutions and then, was asked to develop their own solutions. Students were asked to write individual problem-solving report on the blank paper provided by researcher in this study. After completing these individual reports and handing them in to the teachers in the classrooms, students were also asked to complete a survey questionnaire that measured perceived goal structure of peer group environment, goal orientation, and intrinsic motivation.

Data Analysis

Effects on Intrinsic Motivation- A Factorial ANCOVA

H_{a1}: Students working in the learning-oriented contexts will demonstrate higher intrinsic motivation scores than students working in the performance-oriented context.

H_{a2}: Students working in a heterogeneous peer group will demonstrate higher intrinsic motivation scores than students working in a homogeneous peer group.

H_{a3}: All students working in the learning-oriented contexts/ heterogeneous peer group will demonstrate higher intrinsic motivation scores than all other students in a combination of goal-oriented context and peer group composition treatment groups.

H_{a4}: Students with low levels of self-efficacy working in the learning-oriented context/ heterogeneous peer group will demonstrate higher intrinsic motivation scores than other students with low levels of self-efficacy in a combination of goal-oriented context and peer group composition treatment groups.

To investigate the effects of types of goal-oriented contexts and types of peer group composition on intrinsic motivation (H_{a1}, H_{a2}, and H_{a3}), a factorial analysis of covariance (ANCOVA) was applied. The use of a factorial ANCOVA in this study was justified because there was a significant positive correlation between self-efficacy and intrinsic motivation ($r = .326$, $p < .05$, $n = 90$) and thus, self-efficacy was used as a covariate variable.

A second factorial ANCOVA was conducted to identify the interaction between types of goal-oriented contexts and types of peer group composition on intrinsic motivation for students with low levels of self efficacy (H_{a4}). The use of the factorial

ANCOVA in this study was justified again because a significant positive correlation was found between self-efficacy and intrinsic motivation (r = .327, p < .05, n = 44).

Effects on Problem Solving Skills: A Factorial MANOVA and a Factorial ANOVA

H_{a5}: Students working in the learning-oriented context will demonstrate better problem solving skills than students working in the performance-oriented context.

H_{a6}: Students working in a heterogeneous peer group will demonstrate better problem solving skills than students working in a homogeneous peer group.

H_{a7}: All students working in the learning-oriented context/ heterogeneous peer group will demonstrate better problem solving skills than all students in a combination of goal-oriented context and peer group composition treatment groups.

H_{a8}: Students with low levels of self-efficacy working in the learning-oriented context/ heterogeneous peer group will demonstrate better problem solving skills than students with low levels of self-efficacy in a combination of goal-oriented context and peer group composition treatment groups.

First, a 2 X 2 multivariate analysis of variance (MANOVA) was conducted to examine the effect of types of goal-oriented contexts and types of peer group composition on two components of problem solving skills: *problem representation* and *solution development* (H_{a5}, H_{a6}, and H_{a7}). Willks's Lamda F (α = .05) was used in testing MANOVA. The use of a MANOVA was justified because of a significant positive correlation between the two dependent measures (*problem representation* and *solution* *development*), r (90) = .82, $p < .01$. The factorial MANOVA was also selected to investigate the interaction between types of goal-oriented contexts and types of peer group composition. MANOVA testing presupposes the analysis of variance assumption of normality and homogeneity. A multivariate test of homogeneity of variance (the Box's M Test and the Levene's Test) was conducted to test this assumption. The results from the Box's M test and the Levene's Test showed that the assumption of equal variance was met at .05 alpha level.

Second, a factorial ANOVA was conducted to examine the effects of types of goal-oriented contexts and types of peer group composition on *monitoring evaluation* ($H_{a5,}$ $H_{a6,}$ and H_{a7}). The factorial ANOVA was selected because there were no significant correlations between *monitoring and evaluation* and the other two components of problem solving skills (*problem representation* and *solution development*). ANOVA testing also requires the assumption of normality in which the values in each cell of the design are normally distributed. However, statistical tests showed a departure from normality in this study. Both Kolmogrorov-Smirnov (K-S) Test and Shapiro-Wilks tests show a departure from normality at the .01 alpha level. The result of the Levene's Test for the homogeneity of variance also showed that the assumption of equal variance was not met at the .05 alpha level. Although the use of the factorial ANOVA in this study violates the assumption of normality, there is emerging consensus of opinion that the violations of the normality assumption are not too serious in most cases, especially if the sample sizes are relatively large (Jobson, 1991; Lumley et al., 2002). Given that the sample size of this study (n = 90) was moderately large and the focus of the data analysis was to analyze the main effects of two independent variables (type of goal-oriented contexts, type of peer group composition) as well as interaction effect between two factors, the factorial ANOVA remained the choice of an analysis for these effects.

The second factorial MANOVA and one way factorial ANOVA were conducted to examine the interaction between types of goal-oriented contexts and types of peer group composition on problem solving skills for students with low levels of self efficacy H_{a8}. The use of MANOVA and ANOVA was justified again because a significant positive correlation was found only between *problem representation* and *solution development*, r (44) = .76, p <.01. The second factorial MANOVA was conducted to test the interaction between types of goal-oriented contexts and types of peer group composition on *problem representation* and *solution development* and the second factorial ANOVA was conducted to test the main and interaction effects on *monitoring and evaluation*.

Relationships among Perceived Goal Structure, Goal Orientation, Intrinsic Motivation, and Problem Solving Skills: Pearson's R.

H_9: There will be a significant positive correlation among perceived learning goal structure, learning goal orientations, intrinsic motivation, and problem solving skills.

H_{10}: There will be no significant positive correlation among perceived performance goal structure, performance goal orientations, intrinsic motivation, and problem solving skills.

Pearson's r was employed to find the correlation between mediating variables (types of perceived goal structures, types of goal orientations) and dependent variables (intrinsic motivation, three components of problem solving skills).

For variables related to learning goal orientation, the units of analyses were totals scores divided by the total numbers of the items for perceived learning goal structure, learning goal orientation, and intrinsic motivation and the total scores gained for each component of problem solving skill (problem representation, solution development, and monitoring and evaluation). Pearson's *r* was conducted for the students who participated in both learning-oriented context and heterogeneous peer group that were designed to increased learning goal orientation. The correlation results were compared with those calculated for students who had worked in the learning-oriented context and homogeneous peer group to further explore the relations between variables related to the learning goal orientation. It was conducted to test the research hypothesis $H_{a9.}$

For variables related to performance goal orientation, the units of analyses were total scores divided by the total numbers of items for perceived performance goal structure, performance goal orientation, and intrinsic motivation and total scores gained for each component of problem solving skills. Pearson's *r* was conducted for students who participated in both performance-oriented context and homogeneous group that were designed to increased performance goal orientation. The correlation results were compared with those calculated for the students who had worked in the performance-oriented context and heterogeneous peer group to further explore the relations between variables related to the performance goal orientation. It was conducted to test the research hypothesis $H_{a10.}$

Chapter 4

RESULTS

Introduction

This study investigated the effects of types of goal-oriented contexts and types of peer-group composition by self-efficacy on intrinsic motivation and problem-solving skills in a web-based PBL environment. Ten research hypotheses were formulated to answer the following three main research concerns: (a) the effects of goal-oriented contexts and peer group composition on intrinsic motivation; (b) the effects of goal-oriented contexts and peer group composition on three components of problem solving skills; and (c) relationships among variables related to learning goal orientation or relationships among variables related to performance goal orientation.

In order to test the research hypotheses, the statistical data analyses conducted included such as a factorial ANCOVA, a factorial MANOVA, and a factorial ANOVA, and Pearson's *r*. Statistical analyses were conducted with the use of SPSS version 11 software. Results of the statistical analyses are reported in this chapter along with a summary of the results.

Effects of Goal-Oriented Contexts and Peer Group Composition on Intrinsic Motivation

In order to determine the effects of type of goal-oriented contexts and type of peer group composition on intrinsic motivation, a factorial analysis of covariance (ANCOVA) was conducted. The results obtained for the four research hypotheses are reported below.

Effect of Goal-Oriented Context on Intrinsic Motivation

H_{o1}: There will be no significant difference between students working in the learning-oriented context and students working in the performance-oriented context in terms of intrinsic motivation scores.

H_{a1}: Students working in the learning-oriented context will demonstrate a higher intrinsic motivation score than students working in the performance-oriented context.

The hypothesis concerning goal-oriented context predicted that students who worked in the learning-oriented context would have significantly higher intrinsic motivation scores than students who worked in the performance-oriented context. Table 4-1 shows the mean scores and standard deviations for intrinsic motivation, indicating that students who worked in the learning-oriented context had an overall average of 3.49 (*SD* =.69) while students who worked in the performance-oriented context had an overall average of 3.16 (*SD* = .66).

Table 4-1

Means and Standard Deviations for Intrinsic Motivation (All students)

	Peer Group Composition								
	Heterogeneous			Homogeneous			Total		
Goal-Oriented Contexts	*M*	*SD*	*n*	*M*	*SD*	*n*	*M*	*SD*	*n*
Learning	3.54	.61	23	3.45	.77	23	3.49	.69	46
Performance	3.22	.65	23	3.10	.69	21	3.16	.66	44
Total	3.38	.65	46	3.28	.75	44	3.33	.70	90

The factorial ANCOVA showed a significant main effect for the type of goal-oriented context. The students who were in the learning-oriented context had significantly higher intrinsic motivation scores than the students working in the performance-oriented context, $F(1, 85) = 3.95$, $p = .04$, $\eta^2 = .05$. Therefore, the null hypothesis was rejected. The results of the factorial ANCOVA are presented in Table 4-2**.**

Table 4-2

Results of a Factorial Analysis of Covariance for Intrinsic Motivation

Source of Variation	Sum of Squares	d.f.	Mean Squares	F	*p*	η^2	Observed Power
Covariate Self-Efficacy	3.62	1	3.62	16.80	.00	.09	.82
Main Effects							
Goal-Oriented Contexts	1.71	1	1.71	3.95	.04	.05	.50
Group Composition	.09	1	.09	.20	.66	.00	.07
Two-way Interaction	.02	1	.02	.04	.85	.00	.05
Explained Residual	36.66	85	.43				
Total	1042.44	90					

Effect of Peer Group Composition on Intrinsic Motivation

H_{o2}: There will be no significant difference between students working in a heterogeneous peer group and students working in a homogeneous peer group in terms of intrinsic motivation.

H_{a2}: Students working in a heterogeneous peer group will demonstrate higher intrinsic motivation scores than students working in a homogeneous peer group.

The hypothesis concerning peer group composition predicted that students who worked in the heterogeneous peer group would have significantly higher intrinsic motivation scores than students who worked in the homogeneous peer group. However, the factorial ANCOVA showed no main effect for the type of peer group composition (see Table 4-2). Students who were in the heterogeneous peer group did not earn significantly higher intrinsic motivation scores than the students working in the homogeneous peer group, $F(1, 85) = .20$, $p = .66$, $\eta^2 = .00$. Therefore, the null hypothesis was retained.

Interaction Effect for All Students

H_{o3}: There will be no significant interaction between type of goal-oriented contexts and type of group composition for all students.

H_{a3}: Students working in the learning-oriented context/ heterogeneous peer group will demonstrate higher intrinsic motivation scores than other students in a combination of goal-oriented context and peer group composition treatment groups.

The hypothesis concerning the interaction between type of goal-oriented context and type of peer group composition predicted that students in the learning-oriented context and a heterogeneous peer group would have significantly higher intrinsic motivation scores than students in any of the other three treatment combinations. The results of the factorial ANCOVA did not reveal a statistical interaction between type of goal-oriented context and type of group composition, $F(1, 85) = .04$, $p = .85$, $\eta^2 = .00$ (see Table 4-2). Therefore, the null hypothesis was retained.

Interaction Effect for Students with Low Levels of Self Efficacy

H_{o4}: There will be no significant interaction between type of goal-oriented contexts and type of group composition for students with low levels of self-efficacy.

H_{a4}: Students with low levels of self-efficacy working in the learning-oriented context/ heterogeneous peer group demonstrate higher intrinsic motivation scores than students with low levels of self-efficacy in a combination of goal oriented environment and peer group composition treatment groups

It was also hypothesized that students with low levels of self-efficacy would achieve significantly higher intrinsic motivation scores if they were in both the learning-oriented context/ heterogeneous peer group than students than in any other treatment groups, because these environments were expected to provided students with low levels of self-efficacy with more comfortable conditions under which to focus on aspects of tasks critical to learning. To test for an interaction effect between type of goal-oriented context and type of group composition for students with low levels of self-efficacy only, a second factorial ANCOVA was conducted. Table 4-3 shows the mean scores and standard deviations for intrinsic motivation.

Table 4-3

Means and Standard Deviations for Intrinsic Motivation (Students with Low Levels of Self-Efficacy only)

	Peer Group Composition								
	Heterogeneous			Homogeneous			Total		
Goal-Oriented Contexts	*M*	*SD*	*N*	*M*	*SD*	*n*	*M*	*SD*	*n*
Learning	3.28	.56	10	3.32	.57	12	3.30	.55	22
Performance	3.08	.56	12	3.12	.37	10	3.09	.47	22
Total	3.17	.56	22	3.23	.49	22	3.20	.52	44

Table 4-4 shows the results of a factorial analysis of covariance (ANCOVA) for Intrinsic Motivation for students with low levels of self-efficacy only.

Table 4-4

Results of a Factorial Analysis of Covariance for Intrinsic Motivation (Students with Low Levels of Self-Efficacy Only)

Source of Variation	Sum of Squares	d.f.	Mean Squares	F	*p*	η^2	Observed Power
Covariate							
Self-Efficacy	.46	1	.46	1.67	.20	.04	
Main Effects							
Goal-Oriented Contexts	.27	1	.27	.98	.33	.02	.24
Group Composition	.05	1	.05	.18	.67	.01	.06
Two-way Interaction	-.00	1	-.00	.00	.99	.00	.05
Explained Residual	10.66	39	.27				
Total	461.58	44					

Effects of Goal-Oriented Contexts and Peer Group Composition on Problem Solving Skills

To identify the effects on problem solving skills, two types of data analyses were conducted: a factorial MANOVA for the effects on problem representation and solution development and a factorial ANOVA for the effect on monitoring and evaluation.

Effect on Problem Representation and Solution Development

Table 4-5 reports the means and standard deviations calculated for problem representation and solution development.

Table 4-5

Means and Standard Deviations for Problem Representation and Solution Development

	Heterogeneous			Homogeneous			Total		
	M	*SD*	*n*	*M*	*SD*	*n*	*M*	*SD*	*N*
Problem Representation									
Learning-Oriented	5.61	1.90	23	5.30	2.30	23	5.46	2.09	46
Performance-Oriented	5.65	2.84	23	5.90	1.67	21	5.77	2.33	44
Total	5.63	2.39	46	5.59	2.03	44	5.61	2.21	90
Solution Development									
Learning-Oriented	4.13	1.77	23	3.65	1.67	23	3.89	1.72	46
Performance-Oriented	3.91	2.52	23	4.14	2.06	21	4.02	2.29	44
Total	4.02	2.15	46	3.89	1.86	44	3.96	2.00	90

Note: The possible score range for problem representation and solution development are 0-10 and 0-8, respectively.

The results of the factorial MANOVA did not reveal significant main effects for either factor (type of goal-oriented contexts, type of peer group composition) or an interaction between type of goal-oriented contexts and type of peer group composition. Therefore, the null hypothesis was retained. The results of the factorial MANOVA are represented in Table 4-6.

Table 4-6

Results of a Factorial Multivariate Analysis of Variance for Problem Representation and Solution Development

	Multivariate Test Willks's Lamda					
Source of Variation	Value	df	F	*p*	η^2	Power
Goal-Oriented Contexts	.99	2	.32	.73	.01	.10
Group Composition	.99	2	.09	.91	.00	.07
Interaction	.99	2	.35	.71	.02	.10

Effect of goal-oriented context

H_{o5}: There will be no significant difference between students working in the learning-oriented context and students working in the performance-oriented context in terms of problem solving skills.

H_{a5}: Students working in the learning-oriented context will demonstrate better problem solving skills than students working in the performance-oriented context.

The hypothesis concerning goal-oriented context predicted that students working in the learning-oriented context would perform significantly better than those working in the performance-oriented context. The results of the factorial MANOVA, however, did not reveal a significant difference in this main effect, and thus the null hypothesis was retained, Wilks' Lambda = .99, $F(2, 85)$ = .32, p = .73, η^2 = .01 (see Table 4-6).

Effect of peer group composition

H_{o6}: There will be no significant difference between students working in a heterogeneous peer group and students working in a homogeneous peer group in terms of problem solving skill.

H_{a6}: Students working in a heterogeneous peer group will demonstrate better problem solving skills than students working in a homogeneous peer group.

The hypothesis concerning peer group-composition predicted that students working in the heterogeneous peer groups would perform significantly better than students working in the homogeneous peer groups. The results of the factorial MANOVA, however, did not reveal any significant difference in this main effect, and thus failed to support the hypothesis, Wilks' Lambda = .99, $F(2, 85)$ = .09, p = .91, η^2 = .00 (see Table 4-6). Therefore, the null hypothesis was retained.

Interaction effect for all students

H_{o7}: There will be no significant difference between type of goal-oriented context and type of group composition for all students.

H_{a7}: All students working in the learning-oriented context/ heterogeneous peer group will demonstrate better problem solving skills than students in a combination of goal-oriented context and peer group composition treatment groups.

The hypothesis concerning the interaction between type of goal-oriented context and type of peer group composition predicted that students who worked in the learning-oriented context and the heterogeneous peer group would demonstrate significantly higher scores on problem representation and solution development than all students working in all three other treatment groups. The results of the factorial MANOVA did not reveal an interaction between type of goal-oriented context and type of peer group composition, Wilks' Lambda = .99, $F(2, 85)$ = .35, p = .71, η^2 = .02 and thus, failed to support the hypothesis (see Table 4-6). Therefore, the null hypothesis was retained.

Interaction effect for students with low-levels of self efficacy

H_{o8}: There will be no significant interaction between type of goal-oriented context and type of group composition for students with low levels of self-efficacy.

H_{a8}: Students with low levels of self-efficacy working in the learning-oriented context/ heterogeneous peer group will demonstrate better problem solving skills than students with low levels of self-efficacy in a combination of goal-oriented context and peer group composition treatment groups.

It was also hypothesized that students with low levels of self-efficacy would demonstrate significantly higher scores for problem representation and solution development in the learning-oriented context/ heterogeneous peer group than students with low levels of self-efficacy under any other treatment groups, because those environments were expected to allow them to work in a more comfortably so that they would be able to focus on aspects of the tasks critical to learning. To test for an interaction between type of goal-oriented context and type of peer group composition, a second factorial MANOVA was conducted. Table 4-7 showed the mean scores and standard deviations for two components of problem solving skills for students with low levels of self-efficacy.

Table 4-7

Means and Standard Deviations for Problem Representation and Solution Development (Students with Low Levels of Self-Efficacy)

	Heterogeneous			Homogeneous			Total		
	M	*SD*	*N*	*M*	*SD*	*n*	*M*	*SD*	*n*
Problem Representation									
Learning-Oriented	5.40	2.01	10	5.25	2.73	12	5.32	2.38	22
Performance-Oriented	5.75	2.30	12	6.10	.99	10	5.91	1.80	22
Total	5.59	2.13	22	5.64	2.13	22	5.61	2.10	44
Solution Development									
Learning-Oriented	3.70	1.83	10	3.75	1.82	12	3.73	1.78	22
Performance-Oriented	4.00	2.22	12	4.00	2.21	10	4.00	2.16	22
Total	3.86	2.01	22	3.86	1.96	22	3.86	1.96	44

Note: The possible range score for problem representation and solution development are 0-10 and 0-8, respectively.

Table 4-8 showed the results of the factorial MANOVA for students with low levels of self-efficacy. The results of the factorial MANOVA did not reveal any interaction between type of goal-oriented context and type of peer group composition, Wilks' Lambda = .99, $F(2, 39)$ = .20, p = .82, η^2 = .01 and thus, the null hypothesis was retained (see Table 4-8).

Table 4-8

Results of a Factorial Multivariate Analysis of Variance for Problem Representation and Solution Development (Students with Low Levels of Self-Efficacy)

	Multivariate Test Willks's Lamda				
Source of Variation	Value	df	F	p	η^2
Goal-Oriented Contexts.	.97	2	.48	.62	.02
Group Composition	.99	2	.02	.98	.00
Interaction	.99	2	.20	.82	.01

Effect on Monitoring and Evaluation

In order to examine the effects on monitoring and evaluation, a factorial analysis of variance (ANOVA) was conducted. Table 4-9 presents the means and standard deviations calculated for monitoring and evaluation. The results of the factorial ANOVA are presented in Table 4-10.

Table 4-9

Means and Standard Deviations for Monitoring and Evaluation (All Students)

	Heterogeneous			Homogeneous			Total		
Monitoring and Evaluation	*M*	*SD*	*n*	*M*	*SD*	*n*	*M*	*SD*	*n*
Learning-Oriented	.48	.95	23	.22	.60	23	.35	.80	46
Performance-Oriented	.65	.98	23	.14	.36	21	.41	.79	44
Total	.57	.96	46	.18	.50	44	.38	.79	90

Note: The possible score range for monitoring and evaluation was 0-6.

Table 4-10

Results of a Factorial ANOVA

Source of Variation	Sum of Squares	d.f.	Mean Squares	F	*p*	η^2	Observed Power
Main Effects							
Goal-Oriented Context	-.55	1	-.55	.09	.76	.00	.06
Group Composition	3.33	1	3.33	5.57	.02	.06	.65
Two-way Interaction	.35	1	.35	.58	.45	.01	.12
Explained Residual	51.44	86	.59				
Total	68.00	90					

Effects of goal-oriented context

H_{o5}: There will be no significant difference between students working in the learning-oriented context and students working in the performance-oriented context in terms of problem solving skill.

H_{a5}: Students working in the learning-oriented context will demonstrate better problem solving skills than students working in the performance-oriented context.

The hypothesis concerning goal-oriented context predicted that students working in the learning-oriented context would perform significantly better than those working in the performance-oriented context. The results of the factorial ANOVA, however, did not reveal any significant difference in this main effect, and thus the null hypothesis was retained, $F(1, 86) = .09$, $p = .76$, $\eta^2 = .00$ (see Table 4-10).

Effect of peer group composition

H_{o6}: There will be no significant difference between students working in a heterogeneous peer group and students working in a homogeneous peer group in terms of problem solving skill.

H_{a6}: Students working in a heterogeneous peer group will demonstrate better problem solving skills than students working in a homogeneous peer group.

The hypothesis concerning peer group composition predicted that students working in the heterogeneous peer groups would perform significantly better than those working in the homogeneous peer groups. The results of the factorial ANOVA indicated a significant main effect on monitoring and evaluation skill for type of peer group composition and thus, supported this hypothesis, $F(1, 86) = 5.57$, $p = .02$, $\eta^2 = .06$ (see Table 4-10). Students working in the heterogeneous peer groups had an overall average of .57 (*SD* = .96) for monitoring and evaluation skill, while students working in the homogeneous peer groups had an overall average of .18 (*SD* = .50) (see Figure 4-9). Therefore, the null hypothesis was rejected.

Interaction effect for all students

H_{o7}: There will be no significant difference between type of goal-oriented context and type of group composition for all students on problems solving skills.

H_{a7}: All students working in the learning-oriented context/ heterogeneous peer group will demonstrate better problem solving skills than students in a combination of goal-oriented context and peer group composition treatment groups.

The hypothesis concerning interaction between type of goal-oriented context and type of peer group composition predicted that all students working in the learning-oriented context and the heterogeneous peer group would demonstrate significantly higher scores on monitoring and evaluation than all other students working in the three other treatment groups. The results of the factorial ANOVA did not reveal an interaction effect between type of goal-oriented context and type of peer group composition, $F(1, 86) = .58$, $p = .45$, $\eta^2 = .01$ (see Table 4-10) and thus, the null hypothesis was retained.

Interaction effect for students with low-levels of self efficacy

H_{o8}: There will be no significant interaction between type of goal-oriented context and type of group composition for students with low levels of self-efficacy.

H_{a8}: Students with low levels of self-efficacy working in the learning-oriented context/ heterogeneous peer group will demonstrate better problem solving skills than students with low levels of self-efficacy in a combination of goal-oriented context and peer group composition treatment groups.

It was also hypothesized that students with low levels of self-efficacy would demonstrate significantly higher scores on monitoring and evaluation in the learning-oriented context/ heterogeneous peer group than under any other treatment conditions. To test for an interaction between type of goal-oriented context and type of peer group composition for students with low levels of self-efficacy only, a second factorial ANOVA was conducted. Table 4-11 shows the mean scores and standard deviations calculated for monitoring and evaluation for students with low levels of self-efficacy.

Table 4-11

Means and Standard Deviations for Monitoring and Evaluation (Students with Low Levels of Self-Efficacy)

	Heterogeneous			Homogeneous			Total		
Monitoring and Evaluation	*M*	*SD*	*N*	*M*	*SD*	*n*	*M*	*SD*	*n*
Learning-Oriented	.40	.84	10	.17	.58	12	.27	.70	22
Performance-Oriented	.42	.79	12	.10	.32	10	.27	.63	22
Total	.41	.80	22	.13	.47	22	.27	.66	44

Table 4-12 shows the results of the factorial ANOVA. These results did not reveal an interaction between the independent variables, $F(1, 40) = .04$, $p = .83$, $\eta^2 = .00$ and thus, also failed to support the hypothesis.

Table 4-12

Results of a Factorial ANOVA (Students with low levels of self-efficacy)

Source of Variation	Sum of Squares	d.f.	Mean Squares	F	*p*	η^2	Observed Power
Main Effects							
Goal-Oriented Context	-.01	1	-.01	.02	.90	.00	.05
Group Composition	.83	1	.83	1.85	.18	.04	.26
Two-way Interaction	-.02	1	-.02	.04	.83	.00	.05
Explained Residual	17.88	40	.45				
Total	22.00	44					

Correlations among Variables Related to Types of Goal Orientation

In order to examine the relationship among perceived goal structure, types of goal orientation, and outcome variables (intrinsic motivation and problem solving skills), Pearson's *r* was calculated. Correlation analyses were conducted first for the variables related to the learning goal-orientation and then, for the variables related to performance goal orientation, respectively. The following are the results of mean, standard deviation, median, mode, minimum, maximum, and range results for the variables examined in the correlation analyses (see Table 4-13).

Table 4-13

Mean, Standard Deviation, Median, Mode, Minimum, Maximum, and Range of Instrument

	Mean	SD	Median	Mode	Min.	Max.	Range
Perceived Goal Structure							
Learning	4.18	.67	4.33	4.83	1.83	5.00	3.17
Performance	3.16	.78	3.13	3.50	1.50	4.88	3.38
Goal Orientation							
Learning	4.20	.71	4.20	5.00	1.40	5.00	3.60
Performance	3.03	.94	3.11	3.11	1.00	5.00	4.00
Intrinsic Motivation	3.33	.70	3.29	3.21	1.63	4.75	3.13
Problem Solving Skills							
Problem Rep.	5.61	2.21	6.00	6.00	1.00	10.00	9.00
Solution Dev.	3.95	2.00	4.00	4.00	.00	8.00	9.00
Monitoring	.38	.79	.00	.00	.00	3.00	3.00

Correlations among Variables Related to Learning Goal Orientation

H_9: There will be significant positive correlations among perceived learning goal structure, learning goal orientations, intrinsic motivation, and problem solving skills.

The hypothesis concerning correlation among variables related to the learning goal orientation, predicted there would be significant positive correlations among perceived learning goal structure, learning goal orientation, intrinsic motivation, and the three components of problem solving skills for students participated in a treatment group that was designed to enhance their learning goal orientation: a heterogeneous peer group in the learning-oriented context. In order to test this hypothesis, two correlation analyses were conducted.

First, Pearson's *r* was calculated for the students (*n* = 23) who were both in the learning-oriented context and a heterogeneous peer group. These students were located at (a) in Table 4-14. In order to further explore this correlation result, another Pearson's *r* was calculated for the students (*n* = 23) working in the learning-oriented context and a homogeneous peer group. These students are located at (b) in Table 4-14. These two correlation results were then compared further investigating the effect of providing a heterogeneous peer groups in the learning-oriented context.

Table 4-14

Groups Used in the Correlation Analyses of Variables Related to a Learning Goal Orientation

		Peer Group Composition	
		Heterogeneous Group	Homogeneous Group
Goal – Oriented Context	Learning-Oriented	**(a)** ***n* = 23**	**(b)** ***n* = 23**
	Performance-Oriented	(c)	(d)

It was expected that when students worked in heterogeneous peer groups within the learning-oriented context, there would be significantly more positive correlations between variables related to the learning goal orientation than when they worked in homogeneous peer groups within the same environment. This was expected because they would have the additional benefit of working with a diverse group of peers. All the correlation results are presented in Table 4-15.

As shown in Table 4-15, significant positive correlations were found for students who participated in heterogeneous peer groups within the learning-oriented context. First, a significant positive correlation was found between the perceived learning goal structure and the learning goal orientation ($r = .828$, $p < .01$, $n = 23$). These results indicated that when students perceived learning goal structure within their peer group environment, they tended to develop a stronger learning goal orientation. Second, a significant positive correlation was found between two components of problem solving skills ($r = .788$, $p < .01$, $n = 23$): problem representation and solution development. However, no significant correlation was found between problem representation and monitoring and evaluation ($r = .336$, $p > .05$, $n = 23$) or between solution development and monitoring and evaluation ($r = .260$, $p > .05$, $n = 23$). These results suggest that students who defined problems well, also tended to develop better quality of solutions. Third, a significant positive correlation was found between the learning goal orientation and solution development ($r = .491$, $p < .05$, $n = 23$). This result indicated that students who focused on a task in terms of learning or mastering how to do it would tend to be higher achievers on a solution development skill test. However, no significant correlation was found between the learning goal orientation and intrinsic motivation ($r = .296$, $p > .05$, $n = 23$).

Table 4-15

Results of Correlations (Pearson's r) among Perceived Learning Goal Structure, Learning Goal Orientation, Intrinsic Motivation, and Three Components of Problem Solving Skills

	Learning Goal Orientation	Intrinsic Motivation	Problem Representation	Solution Development	Monitoring and Evaluation
Perceived Learning Goal Structure					
Learning / Heterogeneous (n = 23)	.828 (**)	.129	.151	.247	-.114
Learning / Homogeneous (n = 23)	.688(**)	.067	-.209	-.300	.359
Learning Goal Orientation					
Learning / Heterogeneous (n = 23)		.296	.380	.491(*)	-.003
Learning / Homogeneous (n = 23)		.022	-.110	-.111	.351
Intrinsic motivation					
Learning / Heterogeneous (n = 23)			-.055	.261	.060
Learning / Homogeneous (n = 23)			-.181	-.259	.053
Problem Representation					
Learning / Heterogeneous (n = 23)				.788(**)	.336
Learning / Homogeneous (n = 23)				.856(**)	.147
Solution Development					
Learning / Heterogeneous (n = 23)					.260
Learning / Homogeneous (n = 23)					.079

Note. ** p = .01 (2 tailed)
* p = .05 (2 tailed)

Based on these correlation results, it is assumed that when the students perceived the learning goal structure in their peer group environment, they tended to develop a stronger learning goal orientation, leading to better solution skills. These results suggest that a perceived learning goal structure produced as a result of participating in a learning-oriented context and a heterogeneous peer group may contribute to the development of a learning goal orientation as well as enhancing solution development skill, one component of problem solving skills,.

A comparison of these correlation results with those obtained from the students who participated in homogeneous peer groups within the learning-oriented context resulted in several interesting findings. First, statistically positive correlations were found between perceived learning goal structure and the learning goal orientation ($r = .688$, $p < .01$, $n = 23$), and between problem representation and solution development ($r = .856$, $p < .01$, $n = 23$). These results correspond with those obtained for the heterogeneous peer groups within the learning oriented environment.

Second, interestingly, some inverse correlations were found: (a) perceived learning goal structure was negatively related to problem representation ($r = -.209$, $p > .05$, $n = 23$) and solution development ($r = -.300$, $p > .05$, $n = 23$), (b) learning goal orientation was negatively related to problem representation ($r = -.110$, $p > .05$, $n = 23$), and solution development ($r = -.110$, $p > .05$, $n = 23$), and (c) intrinsic motivation was negatively related to problem representation ($r = -.181$, $p > .05$, $n = 23$) and solution development ($r = -.259$, $p > .05$, $n = 23$). These results indicated that (a) even if students perceived the learning goal structure in their peer group environment, they could have lower problem representation and solution development skills, (b) although students had a learning goal orientation, they tended to have lower problem representation and solution development skills, and (c) even if students were motivated, they could possibly have lower problem representation and solution development skills. Additionally, the average correlation scores of this group were in most cases lower than those of the students who participated in heterogeneous peer groups in the learning-oriented context.

In sum, these results indicated that when students worked in heterogeneous peer groups, rather than homogeneous peer groups, within a learning-oriented context, there were more significant positive correlations among variables related to the learning goal orientation. This confirms the hypothesis that there would be significant positive correlations among variables related to the learning goal orientation when students participated in a treatment group designed to enhance their learning goal orientation: a heterogeneous peer group within a learning-oriented context.

Correlations among Variables Related to Performance Goal Orientation

H_{10}: There will be no significant positive correlation between perceived performance goal structure, performance goal orientations, intrinsic motivation, and problem solving skills.

In addition to the correlations among variables related to a learning goal orientation, Pearson's *r* was calculated for the variables related to the performance goal orientation: perceived performance goal structure, performance goal orientation, intrinsic motivation, and problem solving skills.

The hypothesis concerning correlations among variables related to the performance goal orientation stated that there would be no significant positive correlation among perceived performance goal structure, performance goal orientation, intrinsic motivation, and the three components of problem solving skills for students who participated in a treatment group that was designed to enhance their performance goal orientation: a homogeneous peer group in the performance-oriented context. In order to test this hypothesis, two correlation analyses were conducted.

First, Pearson's *r* was calculated for the students (*n* = 21) working in homogeneous peer groups in the performance-oriented context. These students are located at (d) in the Table 4-16. Second, in order to further explore this correlation result, another Pearson's *r* was calculated for the students (*n* = 23) working in heterogeneous peer groups in the performance-oriented context. These students are located at (c) in the Table 4-16.

Table 4-16

Groups Used in the Correlation Analyses of Variables Related to a Performance Goal Orientation

		Peer Group Composition	
		Heterogeneous Group	Homogeneous Group
Goal – Oriented Environment	Learning-Oriented	(a)	(b)
	Performance-Oriented	**(c)** ***n* = 23**	**(d)** ***n* = 21**

These two correlation results were evaluated in order to further investigate the effect of homogeneous peer grouping in a performance-oriented context. It was expected that when students worked in homogeneous peer groups in the performance-oriented context, there would be less significant positive correlations than when they worked in heterogeneous peer groups in the performance-oriented context. This was expected because they would not receive as much support to enhance their learning goal orientation. All correlation results are presented in Table 4-17.

As shown in Table 4-17, significant positive correlations were found for the students who participated in homogeneous peer groups within the performance-oriented context. First, a significant positive correlation was found between the perceived performance goal structure and the performance goal orientation ($r = .452$, $p < .05$, $n = 21$). These results indicated that when students perceived a performance goal structure within their peer group environment, they tended to develop a stronger performance goal orientation. Second, a significant positive correlation was also found between two of the components of problem solving skills ($r = .674$, $p < .01$, $n = 21$): problem representation and solution development. However, no significant correlation was found between problem representation and monitoring and evaluation ($r = .024$, $p > .05$, $n = 21$) or between solution development and monitoring and evaluation ($r = .107$, $p > .05$, $n = 21$). These results suggest that students who defined a problem well would tend to develop better quality of solutions. Aside from the correlations described above, no other statistically significant positive correlations were found. Given the theoretical relationship between (a) perceived goal structure and the performance goal orientation

Table 4-17

Results of Correlations (Pearson's r) among Perceived Performance Goal Structure, Performance Goal Orientation, Intrinsic Motivation, and Three Components of Problem Solving Skills

	Performance Goal Orientation	Intrinsic motivation	Problem Representation	Solution Development	Monitoring and Evaluation
Perceived Performance Goal Structure					
Performance / Homogeneous (n = 21)	.452(*)	-.108	-.341	-.095	.091
Performance / Heterogeneous (n = 23)	.729(**)	-.014	-.043	.124	-.027
Performance Goal Orientation					
Performance / Homogeneous (n = 21)		-.252	-.429	-.314	.074
Performance / Heterogeneous (n = 23)		-.168	-.274	.-166	-.049
Intrinsic motivation					
Performance / Homogeneous (n = 21)			.387	.255	-.113
Performance / Heterogeneous (n = 23)			237	.415(*)	-.053
Problem Representation					
Performance / Homogeneous (n = 21)				.674**	.024
Performance / Heterogeneous (n = 23)				.904**	.020
Solution Development					
Performance / Homogeneous (n = 21)					.107
Performance / Heterogeneous (n = 23)					-.031

Note. ** p = .01 (2 tailed)
* p = .05 (2 tailed)

and (b) problem representation and solution development, these results indicated that there was no significant positive correlation among variables related to performance goal orientation.

Interestingly, several negative correlations were found, although these were not significant. First, a perceived performance goal structure was negatively related to the following variables: (a) intrinsic motivation (r = -.108, p > .05, n = 21), (b) problem representation (r = -.341, p > .05, n = 21), and (c) solution development (r = -.095, p > .05, n = 21). These results indicated that when students perceived a performance goal structure in their peer group environment, they tended to show lower intrinsic motivation as well as, problem representation and solution development skills. Second, the performance goal orientation was also negatively correlated with the following variables: (a) intrinsic motivation (r = -.252, p > .05, n = 21), (b) problem representation (r = -.429, p > .05, n = 21), and (c) solution development (r = -.314, p > .05, n = 21). These results indicated that students with a performance goal orientation tended to earn lower scores in the intrinsic motivation test as well as on assessments of two components of problem solving skill tests, which included problem representation and solution development.

When comparing these correlation results with those for the students who participated in heterogeneous peer groups within the performance-oriented context, several interesting findings were uncovered. First, three statistically positive correlations were found (a) between perceived performance goal structure and performance goal orientation (r = .729, p < .01, n = 23), (b) between intrinsic motivation and solution development (r = .415, p < .05, n = 23), and (c) between problem representation and solution development (r = .904 p < .01, n = 23). A significant correlation between intrinsic motivation and solution development was found for the first time in this group. These results indicated that students who were motivated tended to have better solution development skills when they worked in heterogeneous peer groups within a performance-oriented context. Another interesting finding was that the average correlation scores from students who participated in heterogeneous peer groups within the performance-oriented context. Their correlation scores were higher than those from students who participated in homogeneous peer groups within the performance-oriented contexts (see Table 4-17).

In conclusion, these results indicated that when students worked in homogeneous peer groups, rather than heterogeneous peer groups, within a performance-oriented context, there were less significant positive correlations among variables related to performance goal orientation. This confirms the hypothesis that there would be no significant positive correlations among variables related to the performance goal orientation when students participated in a treatment group designed to encourage a performance goal orientation: a homogeneous peer group in a performance-oriented context.

Summary of the Results

A significant difference was found between different types of goal-oriented contexts on in terms of their effects on intrinsic motivation. Students in the learning-oriented context earned higher intrinsic motivation scores than students in the performance-oriented context.

A significant difference was also found between the different types of peer group composition in terms of their effects on *monitoring and evaluation skill*. Students who were in heterogeneous peer groups earned higher scores on the monitoring and evaluation skill test than those in homogeneous peer groups. However, there were no significant differences on the two components of problem solving skills: problem representation and solution development.

For the students who were in the learning-oriented context in heterogeneous peer groups, a significant positive correlation was found between learning goal orientation and one outcome variable (solution development). For the students who were in the performance-oriented context in homogeneous peer groups, on the other hand, there was no significant correlation between a performance goal orientation and any of the problem solving skills. A summary of the results is presented in Table 4-18.

Table 4-18

Summary of Results

	Intrinsic Motivation	Problem Solving Skills		
		Problem Representation	Solution Development	Monitoring & Evaluation
H_{o1}: LOE= POE	**LOE>POE***			
H_{o2}: Hetero= Homo	NSD			
H_{o3}: Interaction	NSD			
H_{o4}: Interaction for LSE Students	NSD			
H_{o5}: LOE= POE		NSD	NSD	NSD
H_{o6}: Hetero= Homo		NSD	NSD	**Hetero>Homo ***
H_{o7}: Interaction			NSD	
H_{o8}: Interaction for LSE Students			NSD	
H_{o9}: Correlation	**between Perceived Learning Goal Structure and Learning Goal Orientation (*)** **between Problem Representation and Solution Development (*)** **between Learning Goal Orientation and Solution Development (*)**			
H_{o10}: Correlation	**between Perceived Performance Goal Structure and Performance Goal Orientation (*)** **between Problem Representation and Solution Development (*)**			

* $p < .05$
LOE: Learning-Oriented Context
Hetero: Heterogeneous Peer Group
LSE: Low-Levels of Self Efficacy
NSD: No Significant Differences
POE: Performance-Oriented Context
Homo: Homogeneous Peer Group

Chapter 5

DISCUSSION

Introduction

This study investigated the effects of types of goal-oriented context and types of peer-group composition by self-efficacy level on intrinsic motivation and problem-solving skills in a web-based PBL environment. Interaction effects between types of goal-oriented contexts and types of peer group composition were analyzed for all students and then for students with low levels of self-efficacy, because heterogeneous peer groupings in the learning-oriented context were expected to pose a greater impact on intrinsic motivation and problem solving skills than treatment groups made up of any other combination of goal-oriented context and peer group composition. Intrinsic motivation was measured according to an academic intrinsic-motivation inventory. Three components of problem-solving skill were also measured: (a) problem representation, (b) solution development, and (c) monitoring and evaluation of solutions. Analyses of correlation among perceived goal structure, goal orientation, intrinsic motivation, and the three components of problem solving skills were also conducted. These were implemented to find out whether goal orientations really mediated the relationship between the independent variables (type of goal-oriented contexts, types of peer group composition) and dependent variables (intrinsic motivation, the three components of problem solving skills).

The overall findings are discussed in terms of the four main research concerns: (a) the effects of goal-oriented context on intrinsic motivation and problem solving skills, (b) the effects of peer group composition on intrinsic motivation and problem solving skills, (c) the interaction effect between types of goal-oriented contexts and types of peer group composition, and (d) the relationship among goal orientation, intrinsic motivation, and problem solving skills. Implications for instructional design and suggestions for future research based on these findings are also discussed.

Goal-Oriented Contexts, Intrinsic Motivation, and Problem Solving

One main research concern for this study was investigating the effects of goal-oriented contexts on intrinsic motivation and problem-solving skills. Before discussing the types of goal-oriented contexts in terms of their effects on intrinsic motivation and problem solving skills, the effectiveness of the treatment materials is examined in order to establish their validity.

Effectiveness of the Treatment Materials

It is interesting to interpret the scores for the three components of problem-solving skills in order to examine whether the treatments were effective overall (See Table 4-13). The students earned overall average of 5.61 (*SD* = 2.21) on problem representation, 3.95 (*SD* = 2.20) on solution development, and .38 (*SD* = .79) on monitoring and evaluation skills, respectively. Given the rating scores of the assessment rubric for this study (see Appendix C), these average scores indicated that the students engaged moderately in the process of ill-structured problem solving. First, the score of 5.61 out of total 10 points on the problem representation showed that the students defined problems at least vaguely, generated at least one sub-goal for problem solution, and identified a few known factors and constraints, and sought needed information. Second, the score of 3.95 out of total 8 points on solution development indicated that the students selected solutions with minimal explanation. Third, the score of 0.38 out of total 6 points on the monitoring and evaluation skills was exceptionally low. However, the students earned the scores (3 points) for *evaluation solution* only, indicating that many students engaged in the evaluation of the solution very superficially. In sum, these results indicated that the goal-oriented contexts included in the treatment were successful in guiding students' involvement in the process of solving problems.

Additionally, the finding of a significant correlation between perceived goal structure and goal orientation implies that the treatments in this study were effective in encouraging the development of the intended goal orientation. This correlation result confirms the assumption of this research that goal orientation is very sensitive to context and is influenced by how the individual perceives the environment (Epstein, 1989; Maehr & Midgley, 1991). When students perceived a certain goal climate within their peer-group environment, they tended to have a goal orientation corresponding to that particular climate of their peer-group environment. These results suggest that the goal-oriented contexts developed for this study were successful in encouraging their intended goal orientations.

Effect of Goal-Oriented Contexts on Intrinsic Motivation

Students in the learning-oriented context earned significantly higher intrinsic motivation scores than students in the performance-oriented context. This finding supports the hypothesis that a learning-oriented context leads to higher intrinsic motivation scores than a performance-oriented context. It extends the scope of previous studies by testing the effects of goal-oriented contexts designed to enhance intrinsic motivation. Previous studies on students' goal orientation mainly investigated the relationship between the learning goal orientation and intrinsic motivation rather than investigating the effect of contextual attributes that affect students' goal orientations. They found that the learning goal orientation is more associated with intrinsic interest and enjoyment than the performance goal orientation (Rawsthorne & Elliot, 1999).

Starting from the positive relationship between the students' learning goal orientation and outcome variables, several studies have attempted to determine the effects of individual contextual attributes that encourage the development of a learning goal orientation, but little research has investigated the effects of a combination of contextual attributes related to the development of a learning goal orientation (Elliot & Dweck, 1998; Gabriele & Montectinos, 2001; McNeil & Alibali, 2000). This study expands the efforts of previous studies by testing the effects of a combination of contextual attributes rather than only testing the effects of an individual contextual attribute on goal orientation. The learning-oriented context in this study incorporated essential contextual attributes fostering a student's learning goal orientation such as task design, distribution of authority, and evaluation practices in order to encourage students to seek challenges and to be persistent, both essential elements of intrinsic motivation (Dweck, 1985; Nicholls, 1989).

Effect of Goal-Oriented Contexts on Problem Solving

As for the effects of type of goal-oriented contexts on students' problem-solving skills, those who were in the learning-oriented context did not earn significantly higher scores on the three components of problem-solving skill than those in the performance-oriented context. These results differed from those of earlier studies on goal orientation, which have found that learning goals are more positively related to learning outcomes than performance goals (Ames & Archer, 1988). There are at least two possible explanations for these different results.

The first involves the level of the tasks performed. The students in this study were asked to find solutions to an ill-structured problem. Most research on goal orientation has investigated the relationship betweens learning goals and outcomes in terms of lower-level cognitive tasks such as memory-related tasks (Dweck & Leggett, 1988). Although some researchers suggest that providing contextual variables encouraging a student's learning goal orientation may be equally effective in increasing students performance with higher levels of cognitive tasks (Pintrich & Schunk, 2002), it might be difficult to foster students' performance on ill-structured tasks solely by providing a learning-oriented context. A problem-solving environment with ill-structured tasks is more challenging to students than other environments, so students participated in the current study might experience more difficulty, and thus need other types of cognitive or motivational support in developing their problem solving skills, given that motivation is determined not only by goals but also by other variables such as emotions and self-efficacy.

Another possible explanation is that the students in the performance-oriented context might have perceived only performance-approach goals. Researchers have suggested that the performance-approach goals enable students to maintain a competency and positive attitude, while performance-avoidance goals encourage them to focus on avoiding failure (Elliot, 1997; Linnenbrink, 2003). If students perceive performance-approach goals only from a performance-oriented context, they might be prompted to work harder and become more involved in the problem-solving process. This explanation is supported by the results of a paired T-test conducted as a part of the current study to further explore this explanation: a significant difference was found between the scores earned by the *perceived performance-approach goal structure score* ($M = 3.97$, $SD = 0.95$) and the *perceived performance-avoidance goal structure score* ($M= 2.95$, $SD = 0.80$), $t(43) = 6.23$. $p = .00$. In other words, students in the performance-oriented context perceived their peer group environments to be characterized more strongly by performance-approach goals than performance-avoidance goals, meaning that the performance-oriented context might have worked as effectively as the learning-oriented context.

Peer Group Composition, Intrinsic Motivation, and Problem Solving

Another main research concern in this study was investigating the effects of peer-group composition on intrinsic motivation and problem-solving skills.

Effect of Peer-Group Composition on Intrinsic Motivation

The students who were in heterogeneous peer groups did not earn significantly higher scores on the intrinsic motivation test than the students in homogeneous peer groups. This result fails to confirm the hypothesis of this study that heterogeneous peer groups would be more effective in increasing intrinsic motivation than homogeneous peer groups. One possible reason why no significant difference was found between the types of peer groups is that students with medium levels of self-efficacy were not dropped in composing the peer groups. Previous classroom studies of peer-group composition have showed that students of medium ability learn less in heterogeneous peer groups and most in relatively homogeneous peer groups (Lou et *al.*, 1996). These studies have revealed that when students of medium ability are assigned to heterogeneous peer groups, the heterogeneity in the peer group lessens, so that the teacher-learner relationship that often develops in heterogeneous peer groups composed of students of very high and very low ability is no longer evident. On the other hand, when these students work in homogeneous peer groups, the homogeneity in the peer groups is increased. Thus, since students of medium ability tend to compete with peers who have the same level of ability, they are apt to participate more actively (Webb, 1999). Students with medium levels of self-efficacy were not dropped from this study, but were assigned to either heterogeneous or homogeneous peer groups along with students with high or low levels of self-efficacy. Thus, heterogeneous peer groups might become less motivated with the addition of students with medium levels of self-efficacy while homogeneous peer groups might be more motivated. To test this explanation, further research should investigate the effect of peer group composition of the deletion or separation of students with medium levels of self-efficacy.

Effect of Peer Group Composition on Problem Solving

As for problem-solving skills, the students in heterogeneous peer groups performed significantly better than the students in homogeneous peer groups on *monitoring and evaluation of solutions* only. The main criteria for *monitoring and evaluation of solutions* in the assessment rubric included (a) evaluating the effectiveness of the benefits of the solutions, (b) discussing the pros and cons of the solutions, and (c) discussing constraints. On the other hand, *problem representation*s included (a) defining the problem, (b) generating goals, (c) identifying relevant information, and (d) seeking needed information, and *solution development* included (a) selecting or developing solutions and the (b) quality of the solutions. Researchers who have studied peer group learning suggest that it provides students with multiple perspectives helping them to examine problems from several different perspectives in order to develop higher-level problem solving skills (Johnson & Johnson, 1984). Given the sub-components of three problem-solving skills (problem representation, solution development, and monitoring and evaluation of solutions), it is believed that the multiple perspectives facilitated the development of assessment skills rather than problem definition or solution development skills. Accordingly, Baron (1994) suggests that heterogeneous peer grouping provides students with opportunities to "deepen their understanding of the concept being assessed" (p. 3). The results of this study add to our previous understanding of peer group learning by identifying the effects of heterogeneous peer grouping on one area of assessment, *monitoring and evaluation of solutions*.

One possible reason why the heterogeneous peer grouping had better monitoring and evaluation skills but did not demonstrate higher intrinsic motivation may be related to students' emotional reluctance to participate in peer groups. According to Nath and Ross (2001), successful peer group learning requires an adequate training in which students build positive interdependencies. However, the students in this study did not participate in such a training session. Given the fact that the emotions are important elements determining motivation, students' concerns about peer group work might lead to inconsistent results in terms of the effects of peer group composition.

Interaction Effects

The third main research concern of this study was investigating interactions between types of goal-oriented context and types of peer-group composition. It was expected that the students who were in the learning-oriented context would demonstrate higher levels of intrinsic motivation and better problem-solving skills in heterogeneous peer groups, whereas the students who were in the performance-oriented context would demonstrate higher levels of intrinsic motivation and better problem-solving skills in homogeneous peer groups. In other words, in the learning-oriented context, heterogeneous peer groups were expected to be more effective than homogeneous peer groups. On the other hand, in the performance-oriented context, homogeneous peer groups were expected to be more effective than heterogeneous peer groups. However, the results of the current study indicate no interaction between the effects of a goal-oriented context and the effects of peer-group composition on intrinsic motivation and problem-solving skills.

One possible explanation might be the close relationship between goal-oriented contexts and peer-group composition. An interaction effect may be expected in a situation when treatments have distinctively different effects. However, the two treatments (goal-oriented contexts and peer group composition) used in this study have a close relationship theoretically. According to previous research, peer-group composition is also one of the essential contextual attributes affecting the development of a learning-goal orientation and of intrinsic motivation (Ames, 1992; Epstein, 1989; Fuchs et *al.*, 1997). Previous studies indicate that the goal-oriented context is constructed through three main contextual attributes (task design, distribution of authority, and evaluation practice), as well as the use of peer group composition. When goal-oriented contexts and peer group composition were indistinguishable from each other, they might equally affect goal orientation and thus, cause no interaction effect.

There was, however a non-significant trend that students who worked in the learning-oriented context in heterogeneous peer groups had higher intrinsic motivation scores than students in the other combinations of goal-oriented context and peer-group composition. Although this trend was not significant, the result suggests the possibility that if more powerful and sophisticated treatments were designed, there could be an interaction effect favoring the use of learning-oriented contexts and heterogeneous peer groups.

Another concern of this study was related to investigating an interaction between types of goal-oriented context and types of peer-group composition for students with low levels of self-efficacy only. It was expected that the students with low levels of self-efficacy in the learning-oriented context in heterogeneous peer groups would be more motivated and demonstrate better problem-solving skills than the students in all other treatment of combinations. However, no interaction was found between type of goal-oriented contexts and type of peer-group composition, in terms of intrinsic motivation and problem-solving skills. This result is inconsistent with the findings of previous studies, which have found that students with low levels of ability benefit more from environments that support a learning-goal orientation (Dweck & Leggett, 1988).

One possible reason why no interaction was found is that the effects of peer grouping by self-efficacy rather than achievement level might not be the same. The foundation of the research hypothesis was based on previous studies reporting the benefits of the heterogeneous peer grouping by ability levels (Gabriele & Montectinos, 2001; Hooper et al., 1993). Although self-efficacy is thought to relate to ability levels, it might not be an effective construct for the group composition. The result that self-efficacy was not significantly related to problem solving skills supports this explanation. In this study, self-efficacy was not significantly related to any of the problem solving skills that follow: (a) problem representation ($r = .05$, $p > .05$, $n = 90$), (b) solution development ($r = .05$, $p > .05$, $n = 90$), or (c) monitoring and evaluation of solutions ($r = .18$, $p > .05$, $n = 90$). Therefore, not interaction could be found.

Another explanation may be related to the developmental level of self-efficacy. Researchers studying self-efficacy suggest that it is a predictor of achievement (Pintrich & Schunk, 2002). However, the teachers in the classrooms participating in this study felt that self-efficacy might be an unrealistic variable for students of the middle school-level age. For instance, they reported that some students with low-levels of self-efficacy were very higher achievers in their classroom. If there is so, group assignment by self-efficacy would not produce the desired effect on achievement.

Relations among Goal Orientation, Intrinsic Motivation, and Problem Solving Skills

Relations between Goal Orientations and Other Variables

It was expected that there would be different types of correlation according to the type of goal orientation. The results support this research hypothesis. Different patterns of correlation were found between goal orientation and outcome variables (intrinsic motivation, problem-solving skills), according to the treatments to which the students were assigned. For the students who participated in the learning-oriented context in heterogeneous peer groups, significant positive correlations were found between the learning-goal orientation and solution development. On the other hand, for the students who participated in the performance-oriented context in homogeneous peer groups, no significant correlation was found. Given the finding of a significant correlation between the learning goal structure and a learning goal orientation, and between the learning-goal orientation and solution development, the results of this study support the hypothesis that students' ability to solve problems tends to increase when they participate in a learning-oriented context in heterogeneous peer groups that affects their learning goal orientation.

Although no significant correlation was found between the learning goal orientation and intrinsic motivation, the correlation score calculated for students in heterogeneous peer groups in the learning-oriented context (r= .296) was the highest among the combination of the treatment groups. The correlation scores for learning goal orientation and intrinsic motivation were (r = .022) for students in the homogeneous peer groups in the learning-oriented context, (r = -.252) for students in the homogeneous peer groups in the performance-oriented context, and (r = -.168) for those in the heterogeneous peer groups in the performance-oriented context, respectively.

In conclusion, when considering these findings together, the results support the hypothesis that a learning-goal orientation is positively related to intrinsic motivation and problem-solving skill, whereas a performance-goal orientation is associated neither with intrinsic motivation nor with problem-solving skills.

Relations between Intrinsic Motivation and Problem-Solving Skills

The result of the study indicated that increased intrinsic motivation did not affect problem-solving skills. This finding is inconsistent with the hypothesis of this study that a learning-oriented context and heterogeneous peer groups will affect not only intrinsic motivation but also problem-solving skills. This hypothesis assumed a relationship between intrinsic motivation and problem-solving skills. In fact, there is some evidence that intrinsic motivation may predict achievement, and some researchers have suggested that intrinsic motivation variables play an important role in predicting student outcomes (Dweck, 1986). Others have reported a weaker connection between intrinsic motivation and achievement. For example, Harackiewicz et *al.* (1998) found that a learning-goal orientation did not predict interest on the learning tasks. The mixed results of this study leave the issue of a relationship between intrinsic motivation and performance open for further debate.

Implications for Instructional Design

Design of Goal-Oriented Contexts in a Learning Environment

The findings of this study have important implications for the design of learning environments that will help to foster intrinsic motivation in students during problem solving activities. There are at least two implications for instructional design. First, the design of a motivation-supported learning environment should be based on a systemic approach that includes essential contextual attributes that affect goal orientation. Goal-oriented contexts are created through design of tasks, distribution of authority, evaluation practice, and group composition. The findings of this study suggest that those attributes should be incorporated into the learning environment in order to motivate learners to become actively involved in a problem-solving environment. Incorporating more contextual attributes influencing goal orientation, they will be more effective in increasing students' intrinsic motivation. In fact, some researchers have pointed out the need for a broad systemic approach to encouraging a learning-goal orientation as a way of enhancing intrinsic motivation. According to Maehr and Midgley (1991), a school-wide approach is needed to develop a school-wide learning goal-oriented atmosphere involving other teachers and the support of school authorities. Researchers agreed that a more comprehensive approach is needed to wholly foster goal orientation.

Another design implication is related to the design of a learning environment that fosters different goals (learning and performance goals). The current study shows that a learning-oriented context can succeed in creating higher levels of intrinsic motivation but fails to lead to better problem-solving skills. These results imply that a performance-oriented context might have a positive effect on performance rather than being less effective than a learning goal oriented environment. Therefore, research on finding the distinctive effects of performance-goals needs to be examined further. Recently, a number of goal-orientation theorists have suggested that jointly pursuing learning and performance goals may be more productive than pursuing only learning goals (Barron et al., 2003). These authors separate performance-approach and performance-avoidance goals. Performance-approach goals focus on demonstrating competence relative to others, while performance-avoidance goals focus on the avoidance of challenging work. Researchers suggest that performance-avoidance goals result in negative consequences in terms of both interest and performance. They also argue that learning goals and performance-approach goals have different effects, reporting that learning goals are related to intrinsic motivation and performance-approach goals are related to performance. This new perspective on goal orientations suggests some implications for instructional design. Given the importance of both intrinsic motivation and performance in educational settings, this consideration of both learning and performance-approach goals may be more realistic than an exclusive focus on one or the other. In other words, if learning goals are associated with intrinsic motivation and performance-approach goals are associated with performance, it should be most effective to design a learning environment that supports multiple types of goals. In order to increase both intrinsic motivation and problem solving skills, instructors or instructional designers might need to provide strategies that promote performance approach goals as well as the learning goals.

The Peer Group as a Goal-Oriented Context

The positive correlation between type of perceived goal structures and type of goal orientations supports the assumption of this study that the more students perceived a certain goal climate within their peer group environment, the more likely they will be to have a goal orientation corresponding to that particular goal climate. This result implies that instructors and instructional designers should take the peer group environments into account as a learning context that can facilitate the adoption of a specific goal orientation like other environments such as the classroom (Ames, 1992, Fuchs et al., 1997) and school settings (Maehr & Midgley, 1997). For instance, they can offer learning-oriented task instruction messages, allow students to control their own learning activities, and provide more self-referenced evaluation results in the peer group learning environment in order to encourage a learning goal orientation and eventually enhance intrinsic motivation.

Peer-Group Composition as a Strategy to Foster Higher-Order Thinking Skills

Another significant finding of this study involves that students in heterogeneous peer groups earned statistically higher scores on monitoring and evaluation than students in homogeneous peer groups. This result extends the scope of previous studies by suggesting that heterogeneous peer grouping provides cognitive benefits to students with both high and low levels of self-efficacy (Hooper et al, 1993, 1998). This finding has implications for instructional design related to assessment skill, which is one of higher order thinking skills, the highest category at Bloom's (1956) cognitive-learning taxonomy. In order to promote higher levels of cognitive skills such as assessment, instructional designers should provide more opportunities for students to be grouped heterogeneously according to self-efficacy.

Suggestions for Future Research

Goal-Oriented Contexts

First, it is important to compare the each type of goal-oriented context with a control environment. One of the main concerns of this study was comparing the effects of different goal-oriented (learning-oriented and performance-oriented) contexts on intrinsic motivation and problem-solving skills. Although the focus of this study was on finding the most effective goal-oriented context in increasing intrinsic motivation, it would have been worthwhile to compare the effects of different goal-oriented contexts with those of a control environment in which goal orienting contextual attributes are not provided, in order to determine the general effects of each goal-oriented context.

Second, a comparison of pre-test scores and post-test scores could provide further information regarding the effects of each treatment. Only post-test scores were collected and analyzed in this study, due to its *post-test only design*. An analysis of gain scores achieved as a result of participation in this study would provide evidence about how the learning goal-oriented context or heterogeneous peer group might be helpful in increasing intrinsic motivation and problem solving skills, rather than noting only comparative effectiveness.

Third, further studies on the effect of each type of goal-oriented context on intrinsic motivation needs to be conducted. This study tested the effects of each type of goal-oriented context in terms of three main contextual attributes influencing goal orientation. The findings of this study suggested that a learning-oriented context was more helpful in increasing intrinsic motivation than a performance-oriented context. However, it is not clear how the three contextual attributes of the learning-oriented context better contributed to the development of intrinsic motivation. Thus, further research is needed to examine why and how the attributes of the learning oriented context lead to higher intrinsic motivation than those of the performance-oriented context.

Multiple Goal-Oriented Contexts

The finding that a learning-oriented context is more effective than a performance-oriented context in increasing intrinsic motivation only raises more questions about the effects of different goal orientations. This study was based on two types of goal orientation: the learning- and the performance goal orientations. However, some researchers further divide performance goal orientation into two categories: performance-approach and performance-avoidance goals (Elliot & Harackiewicz, 1996). Currently, some researchers on goal orientation are suggesting that learning goals can be divided into two sub-categories: learning-approach and learning-avoidance goals. That distinction results in four types of goal orientation: learning-approach, learning-avoidance, performance-approach, and performance-avoidance goals (Elliot & McGregor, 2001). This recently proposed 2 X 2 goal-orientation model is worthy of further consideration by instructional designers who hope to create more effective motivation-supported learning environments. The findings of this study suggest that the students who participated perceived the performance-oriented environment to be more performance-approach oriented than performance-avoidance oriented. If approach goals turn out to be more important than avoidance goals in increasing intrinsic motivation and problem-solving skills, then further efforts will be needed to design learning environments that support multiple goals, which include learning-approach and performance-approach goals.

Group Interaction and the Transfer Effect

Another assumption of this study was that a goal-oriented context would create an atmosphere that would affect group members' goal orientations. It was expected that when each student perceived this atmosphere within his/her peer group, his/her intrinsic motivation and problem-solving skills would increase. However, in this study intrinsic motivation and problem-solving skills were assessed only at the individual level. Thus, further assessment is needed to measure changes in intrinsic motivation and problem-solving skills at the group level. This assessment provide us with evidence as to whether transfer effects occur between the group performance and the individual performance.

Another interesting area for future research is the interaction between group members within a peer group. The outcomes of peer groups are generally attributed to interaction among group members. In fact, research suggests that different patterns of peer-group interaction result in different learning outcomes (Webb et al., 1998). Therefore, further research should be done on how individual students interact with their peers in group-learning environments. This would answer questions of the dynamics of interaction that occurs in peer-group situations.

Peer-Group Composition by Personal-Characteristic Variables

One significant finding of this study is the role that self-efficacy, a personal-characteristic variable, plays in determining the effectiveness of peer groups. It was demonstrated that when peer groups are formed according to self-efficacy, heterogeneous peer groups have a more significant positive effect than homogeneous peer groups on monitoring and evaluation skills. This result suggests that personal characteristic variables can be used to form more effective peer groups. Instructional designers and instructors need to vary group composition by other personal characteristic variables such as prior knowledge, in order to study their relationships to intrinsic motivation and a problem solving skills.

Limitations of the Study

This study suffered from several limitations. First, the problem-solving tasks that the students worked on were ill-structured, in both the learning- and the performance-oriented contexts. Ill-structured tasks were provided to both groups in order to control for the effects of different tasks. Researchers studying problem-based learning suggest that ill-structured tasks can enhance higher thinking skills by helping students to engage in cognitively challenging activities (Albanese & Mitchell, 1993; Hmelo & Ferrari, 1997). Because the students in the performance-oriented context, like those in the learning-oriented context, worked with ill-structured tasks, they might have been involved in higher cognitive process in much the same way as the students in the learning-oriented context.

The time constraints on the learning-oriented context treatment constituted another limitation. Because the study was implemented as a classroom activity to be completed during science classes, the students were asked to finish each session within a given class period. The students in the learning-oriented context were allowed to choose learning tasks that were of interest to them and were required to open their evaluation reports with a password. The process of exploring various web resources and opening the evaluation reports with a password might have cut into the time available for finding successful solutions to problems. This might help to explain why the students working in the learning-oriented context did not develop better problem solving skills.

The third major limitation of this study was that the predicted correlations between self-efficacy and prior knowledge variables were not tested. From previous research, self-efficacy was expected to relate significantly to both intrinsic motivation and problem-solving skills, based on previous research. However, the results of the study indicated that self efficacy was significantly related to intrinsic motivation only. In order to thoroughly examine the effects of peer-group composition by self-efficacy on intrinsic motivation and problem solving skills, future research must address its relationships with other variables such as prior knowledge. However, links between self-efficacy and other prior knowledge variables were not investigated in this study because prior-knowledge variables such as standard academic-achievement scores were not available from the target classrooms.

Finally, the assumption that goal orientation mediates between the goal-oriented context and intrinsic motivation was not thoroughly investigated. Although correlation analyses were conducted to investigate the mediating role of the goal-orientation on intrinsic motivation, the researcher did not investigate qualitatively how students perceived the goal structure within their peer-group environment, how this perceived goal structure influenced their goal orientation, or how this goal orientation affected their intrinsic motivation.

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Appendix A

Informed Consent Form

An Example of Informed Consent Form

Invitation Letter

Students Verbal Assent Script

ORP USE ONLY:
The Pennsylvania State University
Office for Research Protections

Approval Date: 02/13/03 TLK

Expiration Date: 02/12/04 TLK
Social Science Institutional Review Board

An Example of Informed Consent Form

INFORMED CONSENT FORM FOR SOCIAL SCIENCE RESEARCH
The Pennsylvania State University

Title of Project: The Effects of Goal-Structured Learning
Environments and Group Composition
Motivation and Problem Solving

Principal Investigator: Hae-Deok Song, Instructional Systems, Penn State University, 315 Keller Email: hzs101@psu.edu. Phone: 814-863-0853
Other Investigator(s): Barbara Grabowski, Ph. D. Instructional Systems, Penn State University, 315 Keller

1. Purpose of the Study: The purpose of this study is to see how motivation help in a problem solving environment affects middle school students' problem solving skills.
2. Procedures to be followed: Students will be asked to explore a study material and complete surveys prior to and immediately after the study. A study material is a lesson from a supplementary web-based science curriculum, Kids as Airborne Mission Scientists (KaAMS) funded by NASA. It was designed to inspire middle school kids to learn science, math, technology, and geography by their participating as scientists in activities for NASA airborne missions. Students' activities will be observed during the classes. Video and audio-taping may be used to aid in observations. The estimated time for completing this study will be around two hours.
3. Benefits: Your child will develop motivation and problem solving skills in science while actively participating in problems using aeronautics and remote sensing data from NASA and interacting with their peers.
4. Risks: There are no risks associated with this other than those encountered in everyday life. Assistants will be available for students who may feel some discomfort using the technology in their classroom.
5. Statement of Confidentiality: Your child's participation in this research is confidential. All students in your children's science classroom will participate in this study. To make sure your child's participation is confidential, your child will receive a code. Only the data with parents consent and minor assent will be used. Only investigators of this study will have access to the data. In the event of publication of this research, no personally identifying information will be disclosed. In addition, all Video/ Audio tapes will be kept in a locked cabinet where only the principal investigator can access. Tapes will be destroyed 3 years after the study ends.

6. Right to Ask Questions: You can ask questions about the research. You may ask any question about the research procedures, and these questions will be answered. Further questions should be directed to Hae-Deok Song at 814 466 7056 or hzs101@psu.edu. If you have questions about your rights as a research participant, contact Penn State's Office for Research Protections at (814) 865-1775.
7. Voluntary Participation: I understand that my participation in this research is voluntary, and that my child may withdraw from this study at any time by notifying the person in charge. My child's withdrawal from this study will not affect his/her school performance.

This is to certify that I consent to and give permission for my child's participation as a volunteer in this study. I understand and agree to the conditions of this study as described. I understand that I will receive a signed consent form. I have read this form, and understand the content of this consent form.

If you choose to participate: I give permission for my child

_____________________ ____

Child's Name Parent Signature Date

Please indicate your willingness to be audio or video recorded

_____ I give my permission to be video/audio taped.

_____ I do not give my permission to be video/audio taped.

If you choose to not participate: I do not give permission for my child

_____________________ ____

Child's Name Parent Signature Date

The informed consent procedure has been followed.

______________________________________ _____________________

Investigator Signature Date

Invitation Letter

Hae-Deok Song
The Pennsylvania State University
315 Keller Building
University Park, PA 16802
814-466-7056 FAX: 814-865-0128
hzs101 @psu.edu

Dear Parent or Guardian,

I am an educational researcher at the Pennsylvania State University and I am asking you to give permission for your child to participate in a study being conducted in his or her science classroom. In this study, I would like to see how motivation help affects middle schools students' problem solving skills by using a supplementary science curriculum, Kids as Airborne Mission Scientists (KaAMS) funded by NASA. A study material will be adapted from KaAMS. KaAMS was designed to encourage your child to learn science, math, technology, and geography by taking roles of airborne scientists.

All students in your children's science classroom will explore a problem about NASA airborne mission using aeronautics and remote sensing data from NASA. If you agree to participate in this study, students will be asked to complete short surveys before and immediately after the KaAMS lesson. Students' activities will be also observed during the classes with the use of Video and audio taping.

Please review the attached "Informed Consent Form for Science Research" and sign both copies, allowing your child to participate in this study. All students' data will be held strictly confidential and no individual information will be shared with the teacher or school. Please sign a consent form and keep one copy for your record and have your child return one signed copy to his/her teacher in a sealed envelope.

If you have any questions or concerns, please contact me at the numbers above.
Thank you.

Sincerely,

Hae-Deok Song, Ph.D. Candidate.
The Pennsylvania State University
College of Education- Instructional Systems Program

Students Verbal Assent Script

I would like to see how motivation help affects your problem solving skills in a problem-solving environment, Kids as Airborne Mission Scientists (KaAMS). KaAMS was designed to encourage you to learn science, math, technology, and geography by taking roles of airborne scientists. You will develop motivation and problem solving skills in science while actively participating in problem-solving using aeronautics and remote sensing data from NASA.

For this study, I would like to ask you to participate in the study and to watch the activities during the science class. However, you do not have to volunteer to be in this research. You can stop at any time.

If you agree to participate:

You will do activities about NASA airborne mission in science classes, and you will be asked to finish to two short surveys before and immediately after the lesson. Only data with parent consents will be used for this study. You do not have to answer all questions.

If you agree to not participate:

You will do activities about NASA airborne mission, but I will not use your data for the study. There will be no consequence for not participating, meaning that your participation does not make a difference to your work.

What questions do you have?

If you wish to participate in this study, please raise your hand.

Researcher Signature (Witness) Date

Appendix B

Assessment Instruments

<B-1> Self-Efficacy

<B-2> Perceived Goal Structure of Peer Group Environment

<B-3> Goal Orientation

<B-4> Intrinsic Motivation

<B-1> Self-Efficacy

Indicate your ability to do each of the following statements below by circling the number that best describes what you think:

1. I can earn an A in math.

1	2	3	4	5
Not possible	Probably Not	Uncertain	Probably	Very Possible

2. I can earn an A in science.

1	2	3	4	5
Not possible	Probably Not	Uncertain	Probably	Very Possible

3. I can get an A in math in high school

1	2	3	4	5
Not possible	Probably Not	Uncertain	Probably	Very Possible

4. I can get an A in science in high school.

1	2	3	4	5
Not possible	Probably Not	Uncertain	Probably	Very Possible

5. I could determine the amount of sales tax on clothes I wanted to buy.

1	2	3	4	5
Not possible	Probably Not	Uncertain	Probably	Very Possible

6. I could collect dues and determine how much to spend for a school club.

1	2	3	4	5
Not possible	Probably Not	Uncertain	Probably	Very Possible

7. I could figure out how long it will take to travel from New York to Washington D.C., driving at 55 mph.

1	2	3	4	5
Not possible	Probably Not	Uncertain	Probably	Very Possible

8. I could design and describe a science experiment that I wanted to do.

1	2	3	4	5
Not possible	Probably Not	Uncertain	Probably	Very Possible

9. I could make an educated guess about why kids watch particular TV shows.

1	2	3	4	5
Not possible	Probably Not	Uncertain	Probably	Very Possible

10. I could develop a method to figure out why kids watch particular TV shows.

1	2	3	4	5
Not possible	Probably Not	Uncertain	Probably	Very Possible

11. I could do some reading and then classify animals that I observe.

1	2	3	4	5
Not possible	Probably Not	Uncertain	Probably	Very Possible

12. I could do some reading and then predict the weather from weather maps.

1	2	3	4	5
Not possible	Probably Not	Uncertain	Probably	Very Possible

Adapted from Fouad, N. A., Smith. P.L., & Enochs L. (1997). Reliability and validity evidence for the middle school self-efficacy scale. *Measurement and Evaluation in Counseling and Development, 30*, April.

<B-2> Perceived Goal Structure of Peer Group Environment

The following questions are about your group and about the work you and your partner do in this study. Remember to say how you really feel. No one at school or home will see your answer.

1. In my group, trying hard is very important.
1 2 3 4 5
NOT AT ALL TRUE SOMEWHAT TRUE VERY TRUE

2. In my group, how much you improve is really important.
1 2 3 4 5
NOT AT ALL TRUE SOMEWHAT TRUE VERY TRUE

3. In my group, really understanding the material is the main goal.
1 2 3 4 5
NOT AT ALL TRUE SOMEWHAT TRUE VERY TRUE

4. In my group, it's important to understand the work, not just memorize it.
1 2 3 4 5
NOT AT ALL TRUE SOMEWHAT TRUE VERY TRUE

5. In my group, learning new ideas and main ideas is very important.
1 2 3 4 5
NOT AT ALL TRUE SOMEWHAT TRUE VERY TRUE

6. In my group, it's OK to make mistakes as long as you are learning.
1 2 3 4 5
NOT AT ALL TRUE SOMEWHAT TRUE VERY TRUE

7. In my group, getting good grades is the main goal.
1 2 3 4 5
NOT AT ALL TRUE SOMEWHAT TRUE VERY TRUE

8. In my group, getting right answers is very important.
1 2 3 4 5
NOT AT ALL TRUE SOMEWHAT TRUE VERY TRUE

9. In my group, it's important to get high scores on tests.
1 2 3 4 5
NOT AT ALL TRUE SOMEWHAT TRUE VERY TRUE

10. In my group, showing others that you are not bad at group work is really important.
1 2 3 4 5
NOT AT ALL TRUE SOMEWHAT TRUE VERY TRUE

11. In my group, it's important that you don't make mistakes in front of your partner.
1 2 3 4 5
NOT AT ALL TRUE SOMEWHAT TRUE VERY TRUE

12. In my group, it's important not to do worse than your partner.
1 2 3 4 5
NOT AT ALL TRUE SOMEWHAT TRUE VERY TRUE

13. In my group, it's very important not to look dumb.
1 2 3 4 5
NOT AT ALL TRUE SOMEWHAT TRUE VERY TRUE

14. In my group, one of the main goals is to avoid looking like you can't do the work.
1 2 3 4 5
NOT AT ALL TRUE SOMEWHAT TRUE VERY TRUE

Adapted from Midgley, C., Maehr, M. L., Hruda, L. Z., Anderman, E. M., Anderman, L., Freeman, K. E., et al. (2000). *Manual for the patterns of Adaptive Learning Scale*. Ann Arbor: University of Michigan.

<B-3> Goal Orientations

Here are some questions about yourself as *a student in the group*. Please circle the number that best describes what you think about working in your group.

1. It's important to me that I learn a lot of new ideas this year.
1 2 3 4 5
NOT AT ALL TRUE SOMEWHAT TRUE VERY TRUE

2. One of my goals in group work is to learn as much as I can.
1 2 3 4 5
NOT AT ALL TRUE SOMEWHAT TRUE VERY TRUE

3. One of my goals is to master a lot of new skills this year.
1 2 3 4 5
NOT AT ALL TRUE SOMEWHAT TRUE VERY TRUE

4. It's important to me that I thoroughly understand my group work.
1 2 3 4 5
NOT AT ALL TRUE SOMEWHAT TRUE VERY TRUE

5. It's important to me that I improve my skills this year.
1 2 3 4 5
NOT AT ALL TRUE SOMEWHAT TRUE VERY TRUE

6. It's important to me that the other student in my group thinks I am good at my group work.
1 2 3 4 5
NOT AT ALL TRUE SOMEWHAT TRUE VERY TRUE

7. One of my goals is to show others that I'm good at my group work.
1 2 3 4 5
NOT AT ALL TRUE SOMEWHAT TRUE VERY TRUE

8. One of my goals is to show others that group work is easy for me.
1 2 3 4 5
NOT AT ALL TRUE SOMEWHAT TRUE VERY TRUE

9. One of my goals is to look smart in comparison to the other student in my group.
1 2 3 4 5
NOT AT ALL TRUE SOMEWHAT TRUE VERY TRUE

10. It's important to me that I look smart compared to the other student in my group.
1 2 3 4 5
NOT AT ALL TRUE SOMEWHAT TRUE VERY TRUE

11. It’s important to me that I don’t look stupid in my group.

1	2	3	4	5
NOT AT ALL TRUE		SOMEWHAT TRUE		VERY TRUE

12. One of my goals is to keep others from thinking I’m not smart in during group work.

1	2	3	4	5
NOT AT ALL TRUE		SOMEWHAT TRUE		VERY TRUE

13. It’s important to me that my teacher doesn’t think that I know less than the other student in my group.

1	2	3	4	5
NOT AT ALL TRUE		SOMEWHAT TRUE		VERY TRUE

14. One of my goals in my group is to avoid looking like I have trouble doing the work.

1	2	3	4	5
NOT AT ALL TRUE		SOMEWHAT TRUE		VERY TRUE

from Midgley, C., Maehr, M. L., Hruda, L. Z., Anderman, E. M., Anderman, L., Freeman, K. E., et al. (2000). *Manual for the patterns of Adaptive Learning Scale*. Ann Arbor: University of Michigan.

<B-4> Intrinsic Motivation

Think about your opinions about solving science problems in KaAMS and circle the number that best describes what you think.

1. I enjoy learning new things when I solve science problems in KaAMS.

1	2	3	4	5
Strongly Disagree		Moderate		Strongly Agree

2. I like to find answers to questions when I solve science problems in KaAMS.

1	2	3	4	5
Strongly Disagree		Moderate		Strongly Agree

3. I think it is boring to solve science problems in KaAMS.

1	2	3	4	5
Strongly Disagree		Moderate		Strongly Agree

4. I do not enjoy solving hard science problems in KaAMS.

1	2	3	4	5
Strongly Disagree		Moderate		Strongly Agree

5. I feel good inside when I know I have learned something new from solving science problems in KaAMS.

1	2	3	4	5
Strongly Disagree		Moderate		Strongly Agree

6. I am not curious about learning things when I solve science problems in KaAMS.

1	2	3	4	5
Strongly Disagree		Moderate		Strongly Agree

7. I enjoy practicing things I've already learned from solving science problems in KaAMS.

1	2	3	4	5
Strongly Disagree		Moderate		Strongly Agree

8. I give up easily when I don't understand a problem solving assignment in KaAMS.

1	2	3	4	5
Strongly Disagree		Moderate		Strongly Agree

9. I enjoy doing easy problem solving assignments in KaAMS.

1	2	3	4	5
Strongly Disagree		Moderate		Strongly Agree

10. I enjoy understanding my work when I solve science problems in KaAMS.

1	2	3	4	5
Strongly Disagree		Moderate		Strongly Agree

11. I like to do the same problem solving assignments in KaAMS over again.

1	2	3	4	5
Strongly Disagree		Moderate		Strongly Agree

12. I like to do as much work as I can when I solve science problems in KaAMS.

1	2	3	4	5
Strongly Disagree		Moderate		Strongly Agree

13. I like to learning new things when I solve science problems in KaAMS.

1	2	3	4	5
Strongly Disagree		Moderate		Strongly Agree

14. I don't like to figure out science problems in KaAMS.

1	2	3	4	5
Strongly Disagree		Moderate		Strongly Agree

15. New ideas are not interesting to me when I solve science problems in KaAMS.

1	2	3	4	5
Strongly Disagree		Moderate		Strongly Agree

16. I would like to learn more about science problem-solving in KaAMS.

1	2	3	4	5
Strongly Disagree		Moderate		Strongly Agree

17. When I get bored, I look for new things to learn in KaAMS.

1	2	3	4	5
Strongly Disagree		Moderate		Strongly Agree

18. I like to do as little work as I can when I solve science problems in KaAMS.

1	2	3	4	5
Strongly Disagree		Moderate		Strongly Agree

19. I think it is interesting to do work in KaAMS.

1	2	3	4	5
Strongly Disagree		Moderate		Strongly Agree

20. I do not enjoy practicing things I've learned from solving problems in KaAMS.

1	2	3	4	5
Strongly Disagree		Moderate		Strongly Agree

21. I don't give up on a science problem solving assignment in KaAMS until I understand.

1	2	3	4	5
Strongly Disagree		Moderate		Strongly Agree

22. I don't like to find answers to science questions in KaAMS.

1	2	3	4	5
Strongly Disagree		Moderate		Strongly Agree

23. I enjoy doing hard problem solving assignments in KaAMS.

1	2	3	4	5
Strongly Disagree		Moderate		Strongly Agree

24. I would not like to learn more about KaAMS.

1	2	3	4	5
Strongly Disagree		Moderate		Strongly Agree

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Appendix C

Assessment Rubric for the Individual Problem Solving Skills

1. Problem representation

1.1 Define the problem

Score	Description	Examples
2	Problem clearly and completely stated	"NASA have a difficulty to locate active lava flows and ask us to develop a flight plan"
1	Problem vaguely or incompletely stated	"Developing a flight plan"
0	Problem not stated	

1.2 Generate sub goals

Score	Description	Examples
2	At least one specific goal for problem solution is clearly stated	"Some ideas I have are to use ER-2 aircraft and use AVIRIS to develop the best flight plan for the flying mission"
1	At least one goal for problem solution is clearly stated, but it is vague or general	"I chose the aircraft ER-2" "Our plan is to get a ER-2"
0	Subgoals are not stated	

1.3 Identify relevant information (Know factors and constraints)

Score	Description	Crieria
3	5 of the known factors and constraints are identified	Know factors and constraints: e.g. • Aircraft • Remote sensing instrument • Airport(departure, landing) • Weather • Flight hours, Flight time, Flight path, Route, etc.
2	3-4 of the known factors and/ or constraints are identified	
1	1-2 of the known factors and constraints are identified.	
0	0 known factors and constraints are not identified at all	

1.4 Seek need information

Score	Description	Criteria
3	4~5 pieces of the needed information discussed	Needed information such as • why ER-2 should be used • what characteristics does AVIRIS have? • What airports will be used and why? • Under what conditions (e.g. weather) will they leave? • How they will fly? What route will be used?
2	2-3 pieces of the needed information discussed	
1	1 pieces of the needed information discussed	
0	Needed information is not discussed at all	

2. Developing solutions

2.1 Selecting or developing solutions, with explicit explanation.

Score	Description	Criteria
3	Solutions is selected or developed, with explicit explanation on how the solution works.	The explanation should include the interrelationship between different critical components such as aircraft, remote sensing instrument, and flight factors
2	A solution is selected or developed, with minimal explanation on how the solution works.	
1	A solution is selected or developed, but without any explanation how it works.	
0	No solutions is selected or developed.	

2.2 Quality of the solutions (Holistic assessment)

Score	Description	Criteria
5	Exceptional : consider all three factors with good constructed arguments	The holistic assessment is based on the following: The argument quality of flight plan that include the following three factors: • Selecting the best aircraft • Investigating lava flows with the remote sensing instrument, AVIRIS • Giving an overall information of flight factors to be considered(airport, weather, flight path, flight route, flight time, et)
4	Excellent : consider all three factors with a constructed arguments	
3	Good: consider all three factors with no argument	
2	Weak: consider two factors	
1	Poor: consider one factors	
0	No solution	

3. Monitoring and Evaluating Solutions

3.1 Evaluating solutions

Score	Description	Criteria
3	The proposed solutions are evaluated, reasoning is provided, and constraints are discussed.	A statement is made about the effectiveness or benefits of the solution. The pros and cons of the solutions are discussed, supported with relevant evidence as well as how the constraints can be overcome
2	The proposed solution is evaluated, reasoning is provided, but constraints are not mentioned	A statement is made about the effectiveness or benefits of the solution. Solutions are supported with relevant evidences, but the constraints of the solution are not mentioned (e.g. I think my plan is going to be the best because it is well thought, and I searched for the best possible answers).
1	Evaluation of the solution is stated, but no reasoning is provided, and no constraints are mentioned	A statement is made about the effectiveness or benefit of the solution, but the relevant evidences and constraints of the solution are not mentioned
0	The solutions is not evaluated	No statement is made about the effectiveness or benefits of the solution

1.2 Assessing group' solutions

Score	Description	Criteria
3	All possible groups' solutions are stated, and the advantages and limitation of those solutions are discussed.	At least one group solution is discussed with reasons why the solution is selected over the others, constraints are discussed
1	All possible groups' solutions are stated, but the advantages or limitations of the solution are discussed.	At least one group solution is descried, but no reason is given why it is selected.
0		Possible solution is not mentioned at all.

Appendix D

Sample Screens of Learning-Oriented Context

<Session 1> Reviewing the Problem Scenario and Defining the Problem

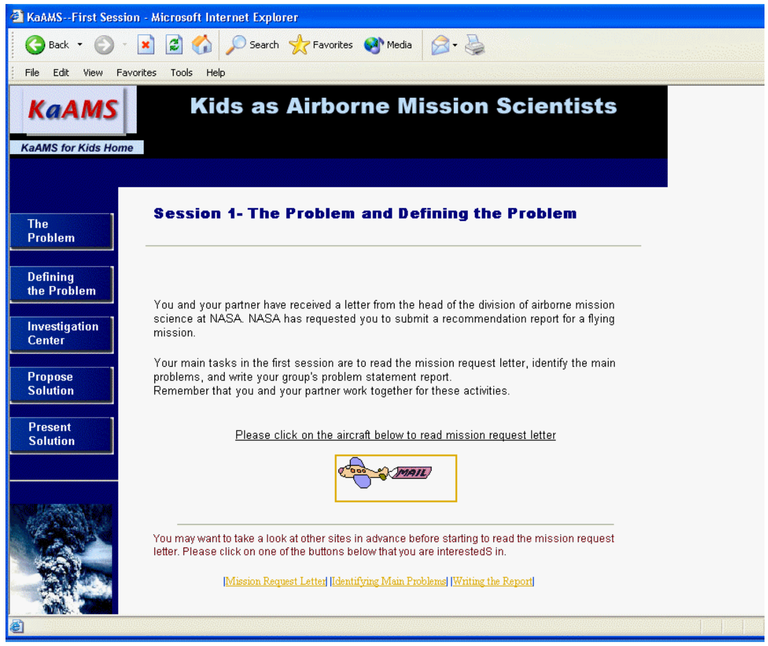

Figure D-1. A Sample Screen Showing a Main Page of Session 1

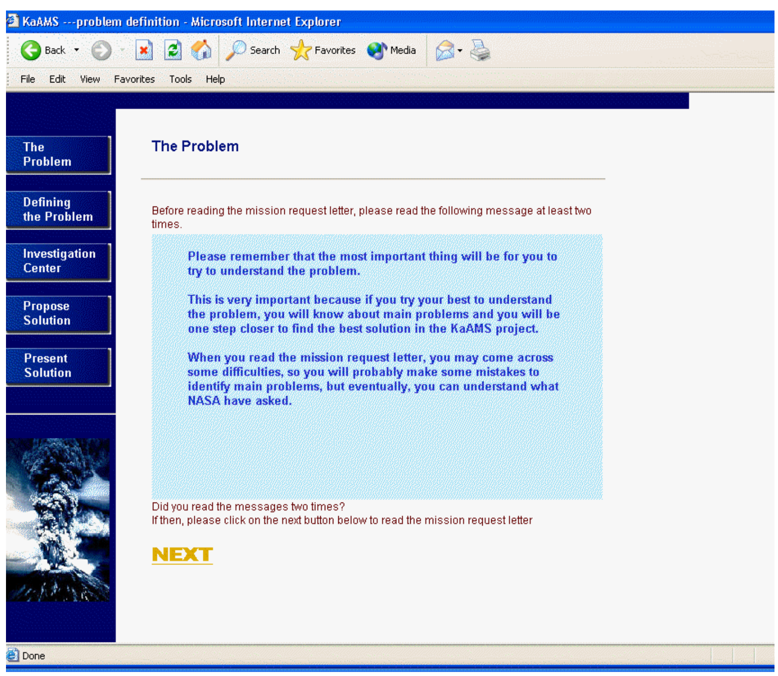

Figure D-2. A Sample Screen Showing a Task Instruction Message Used in the Phase of Reviewing the Problem Scenario

Figure D-3. A Sample Screen Showing a Problem Scenario

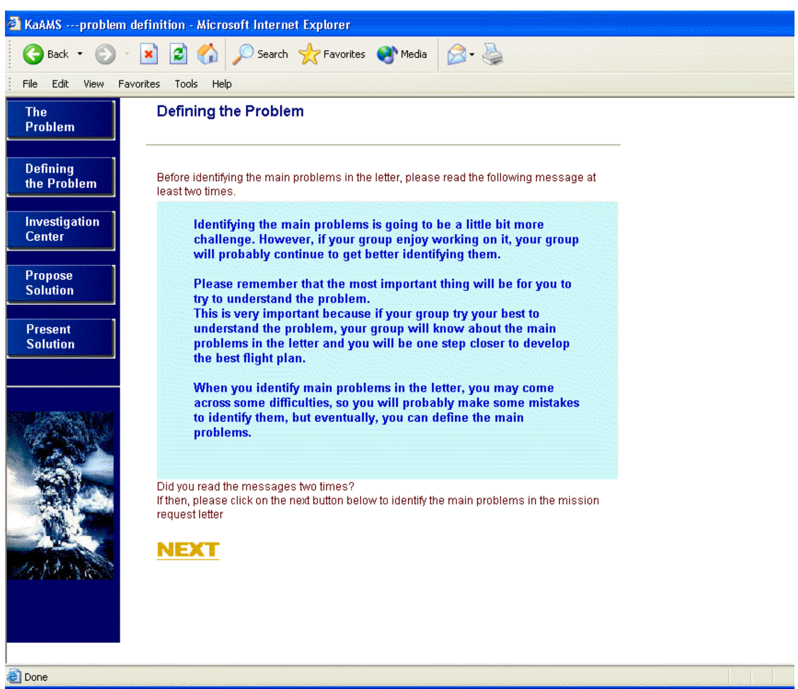

Figure D-4. A Sample Screen Showing Task Instruction Message Used in the Phase of Defining the Problem

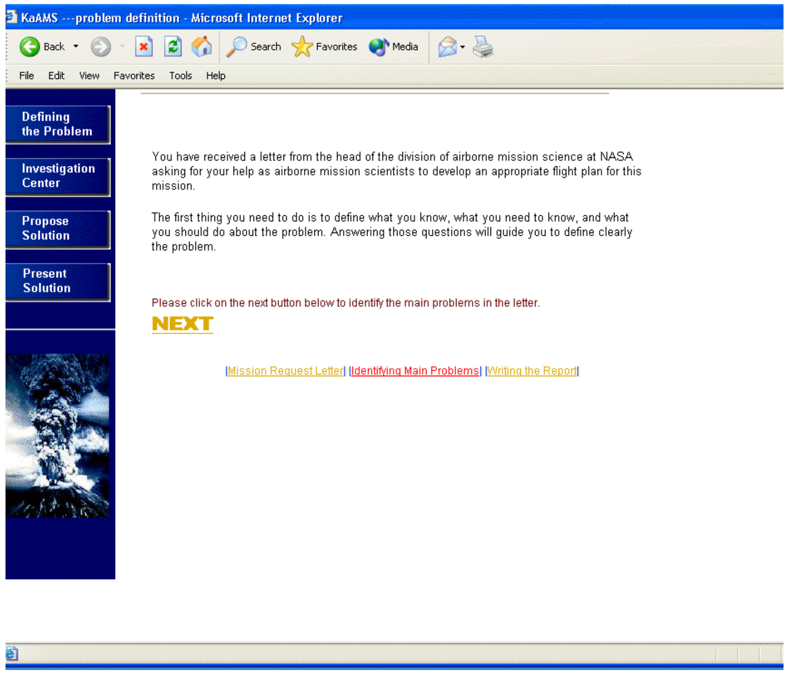

Figure D-5. A Sample Screen Showing the Phase of Defining Problem (1)

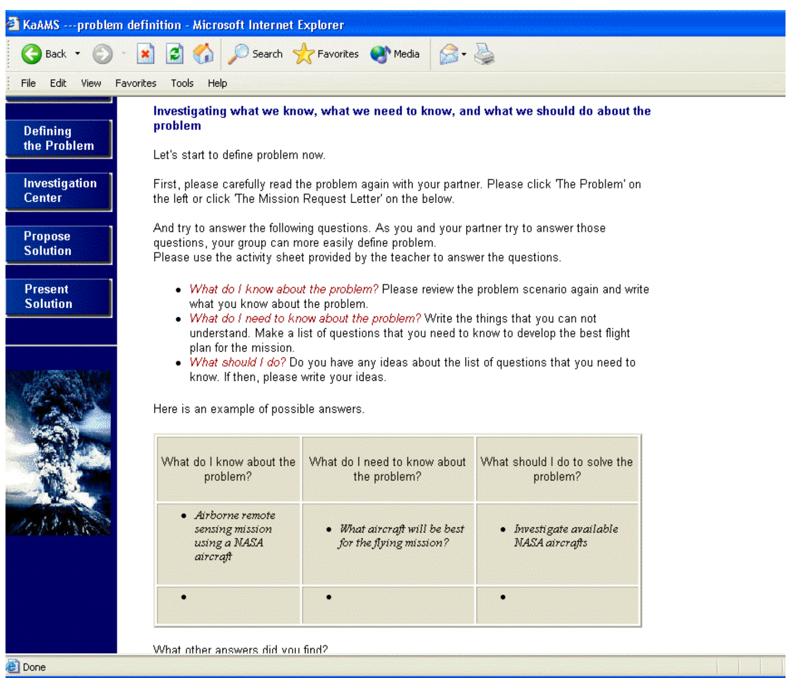

Figure D-6. A Sample Screen Showing the Phase of Defining Problem (2)

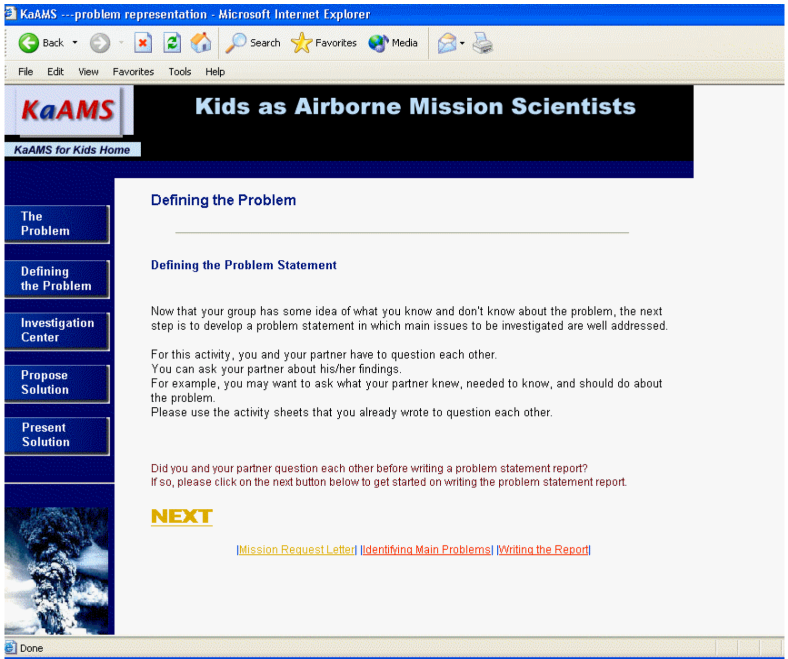

Figure D-7. A Sample Screen of the Phase of Defining the Problem (3)

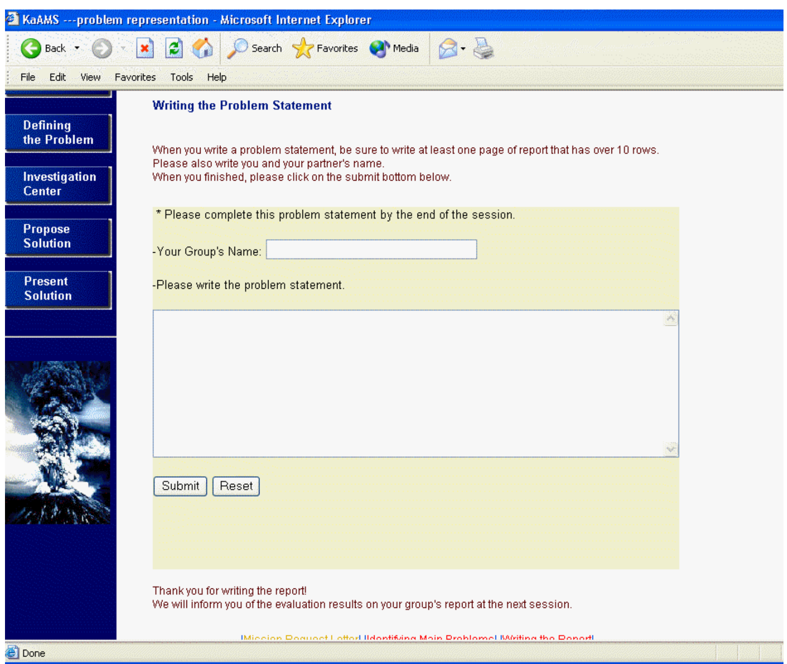

Figure D-8. A Sample Screen Showing the Phase of Defining the Problem (4)

<Session 2> Investigating the Problem and Proposing Group Solutions

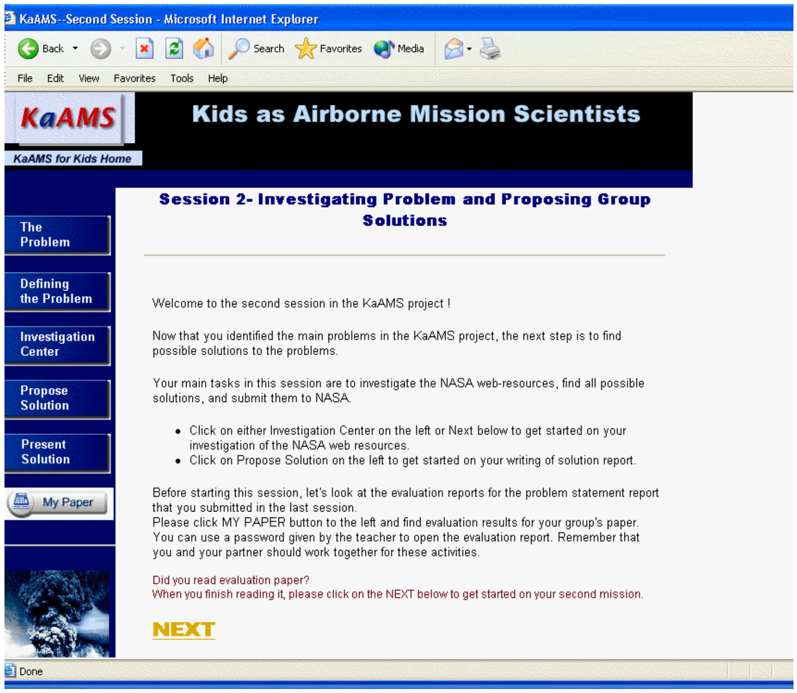

Figure D-9. A Sample Screen Showing a Main Page of Session 2

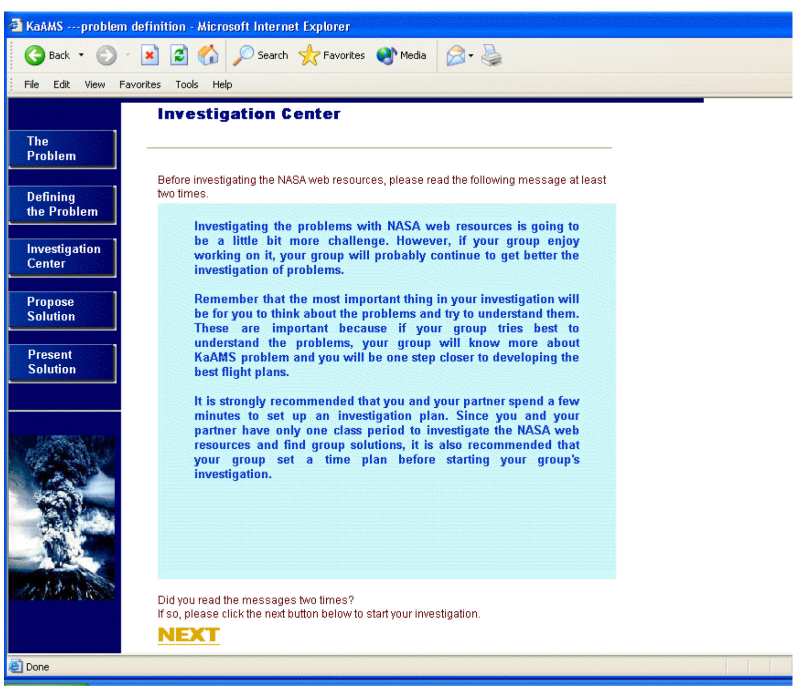

Figure D-10. A Sample Screen Showing a Task Instruction Message Used in the Phase of Investigating Problem

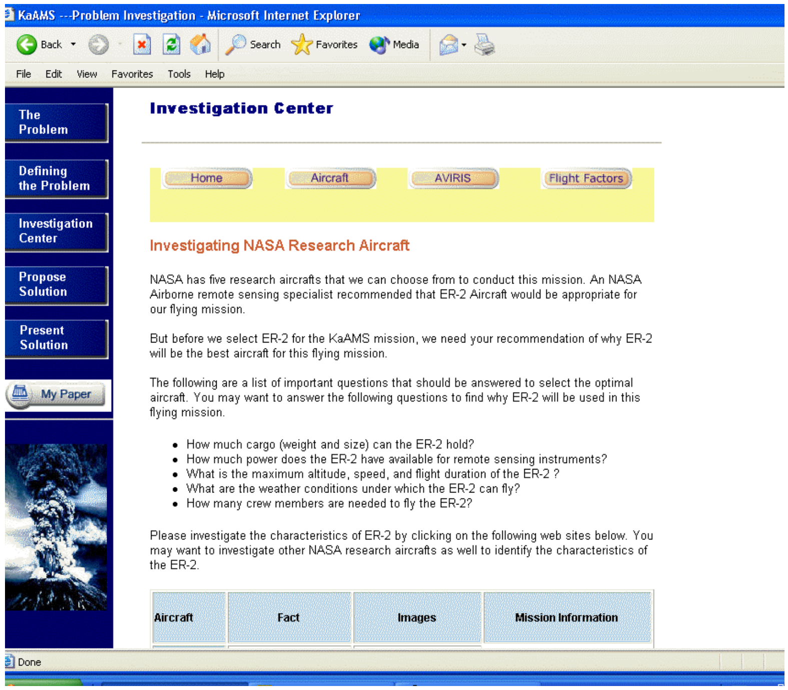

Figure D-11. A Sample Screen Showing the Phase of Investigating the Problem (1)

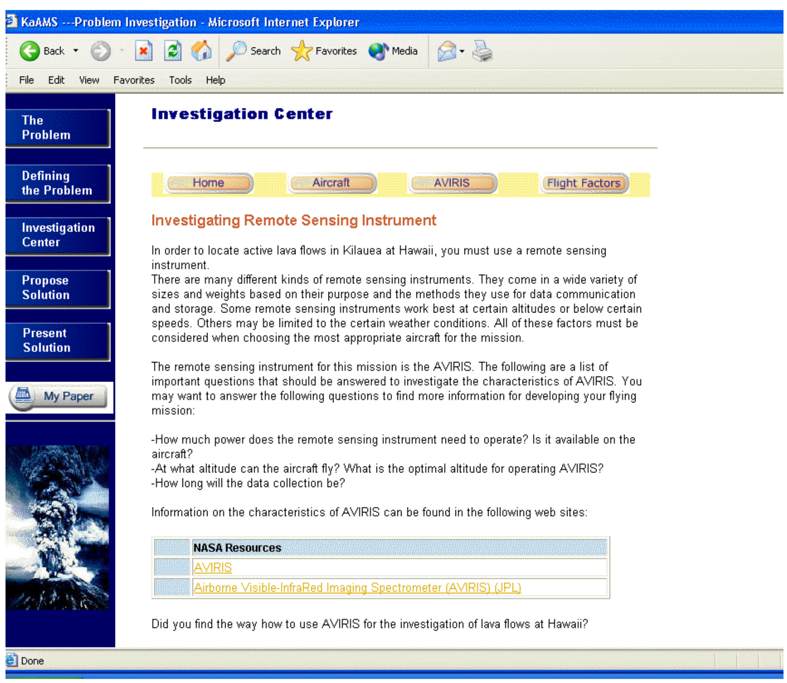

Figure D-12. A Sample Screen Showing the Phase of Investigating the Problem (2)

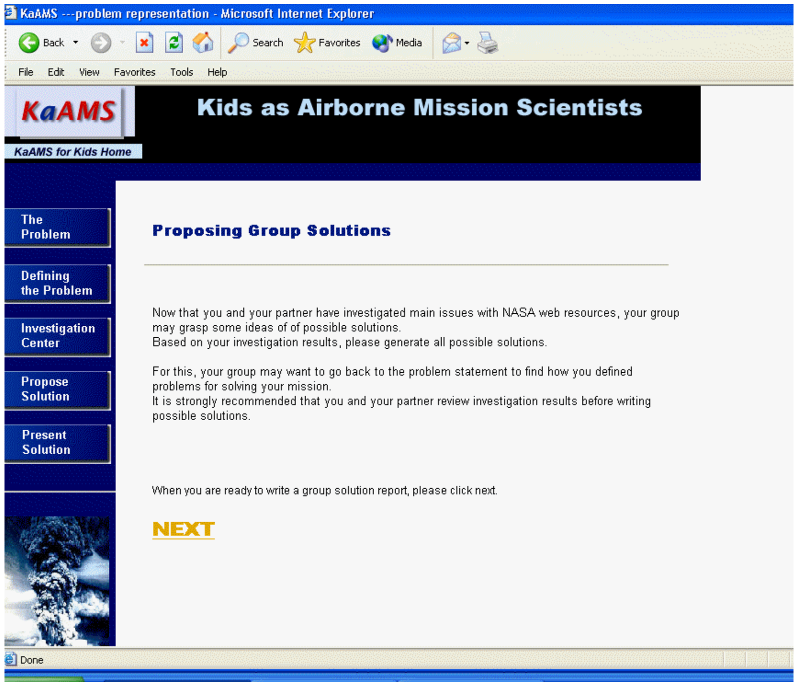

Figure D-13. A Sample Screen Showing the Phase of Proposing Group Solutions (1)

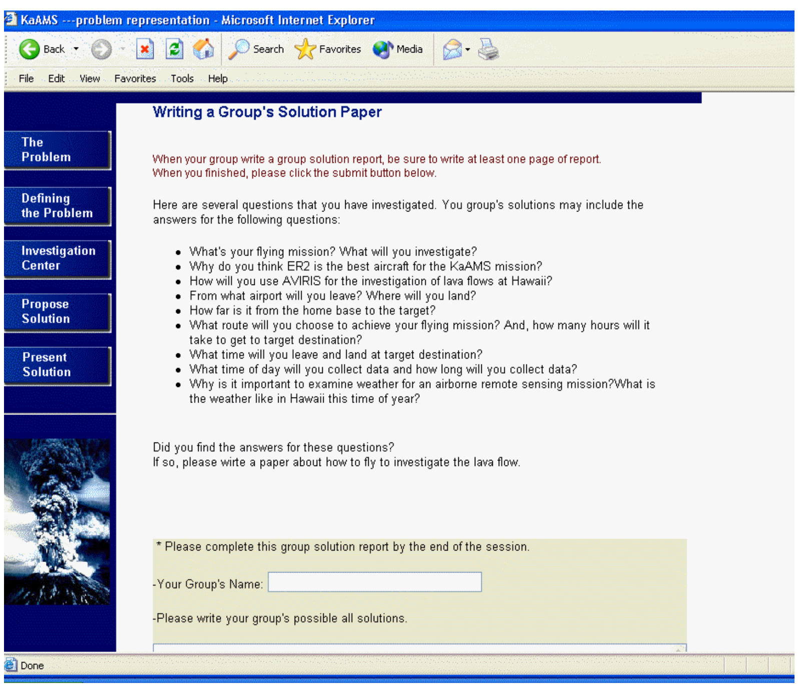

Figure D-14. A Sample Screen Showing the Phase of Proposing Group Solutions (2)

<Session 3> Presenting Individual Solutions

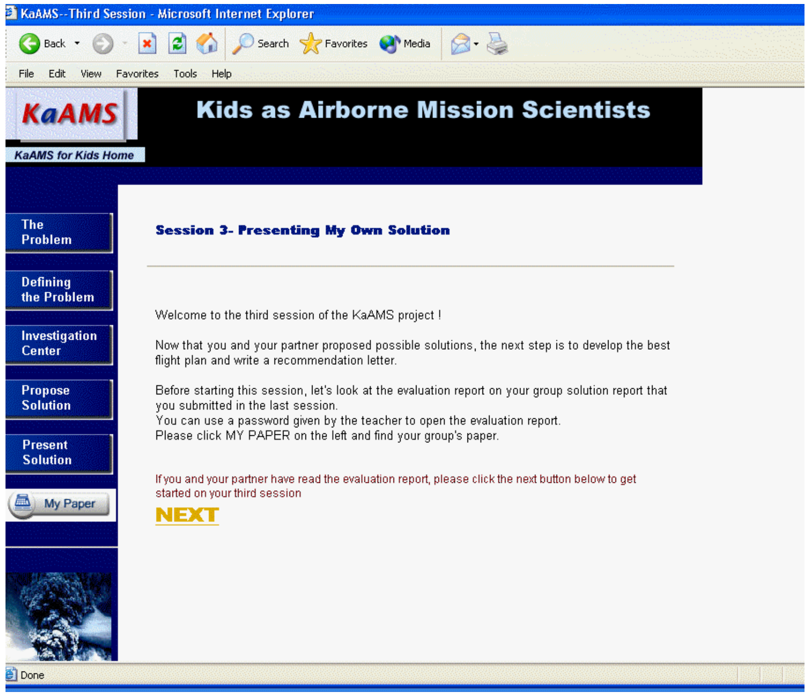

Figure D-15. A Sample Screen Showing a Main Page of Session 3

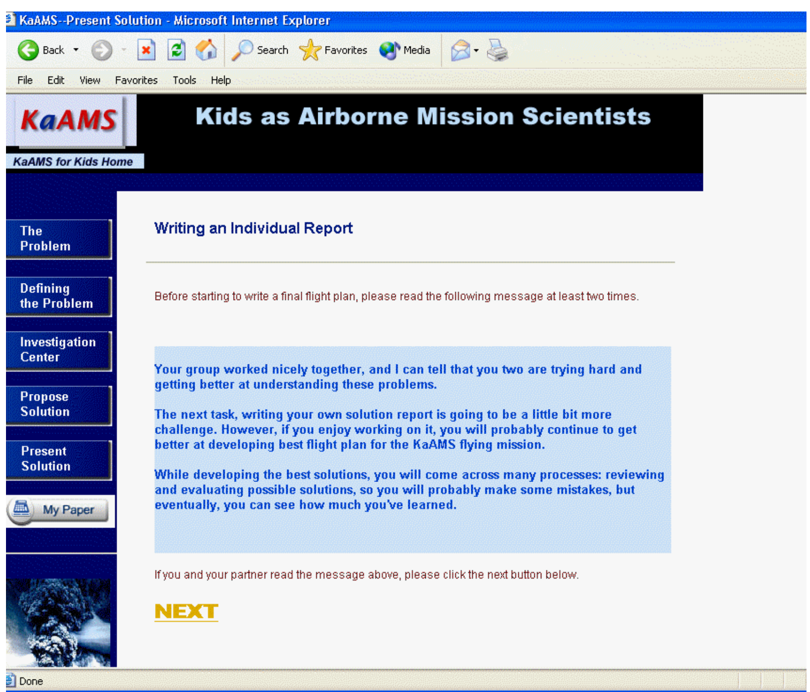

Figure D-16. A Sample Screen Showing the Task Instruction Message Used in the Phase of Presenting Individual Solutions

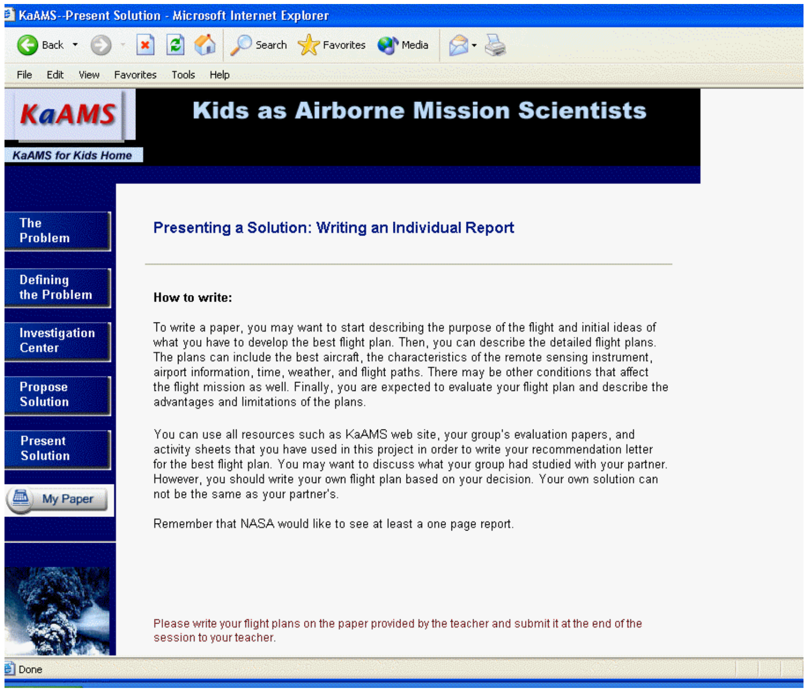

Figure D-17. A Sample Screen Showing the Phase of Presenting Individual Solutions

Appendix E

Sample Screens of Performance-Oriented Context

<Session 1> Reviewing the Problem Scenario and Defining the Problem

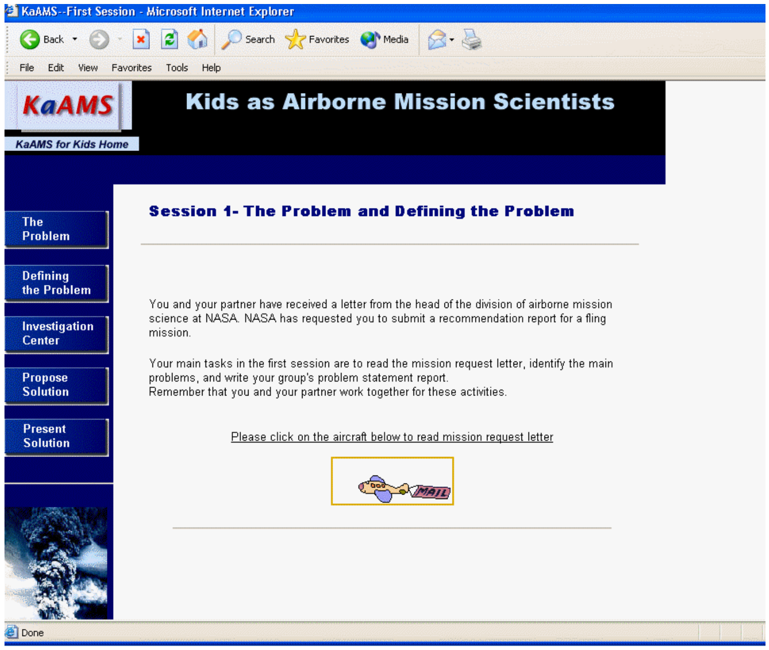

Figure E-1. A Sample Screen Showing a Main Page of Session 1

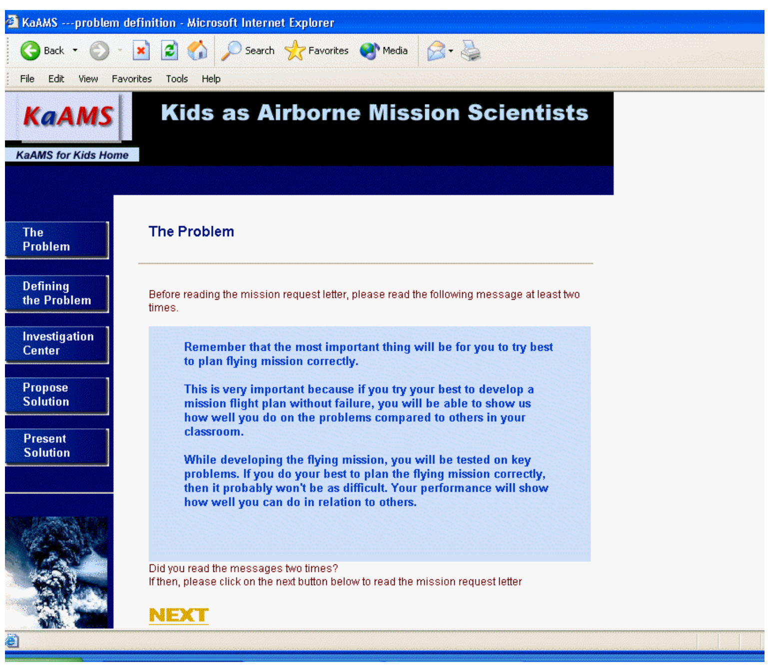

Figure E-2. A Sample Screen Showing a Task Instruction Message Used in the Phase of Reviewing the Problem Scenario

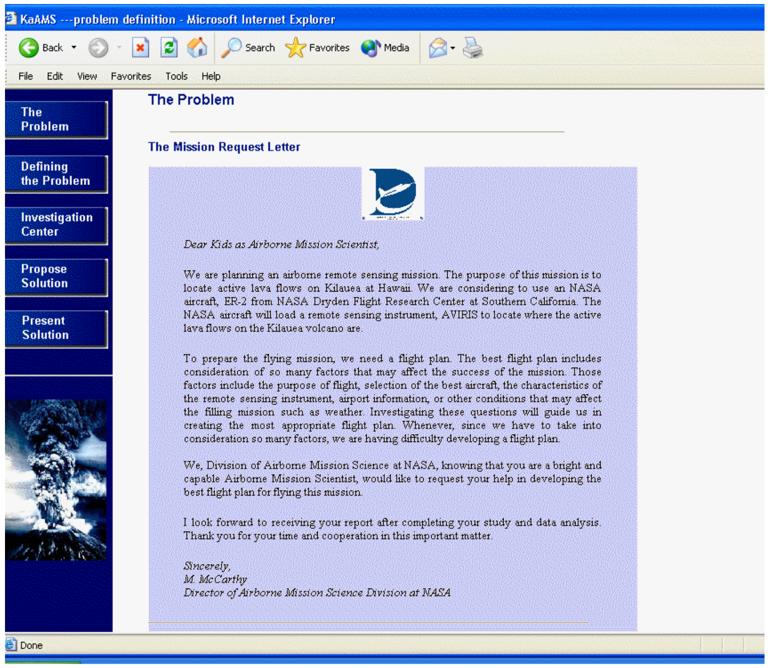

Figure E-3. A Sample Screen Showing a Problem Scenario

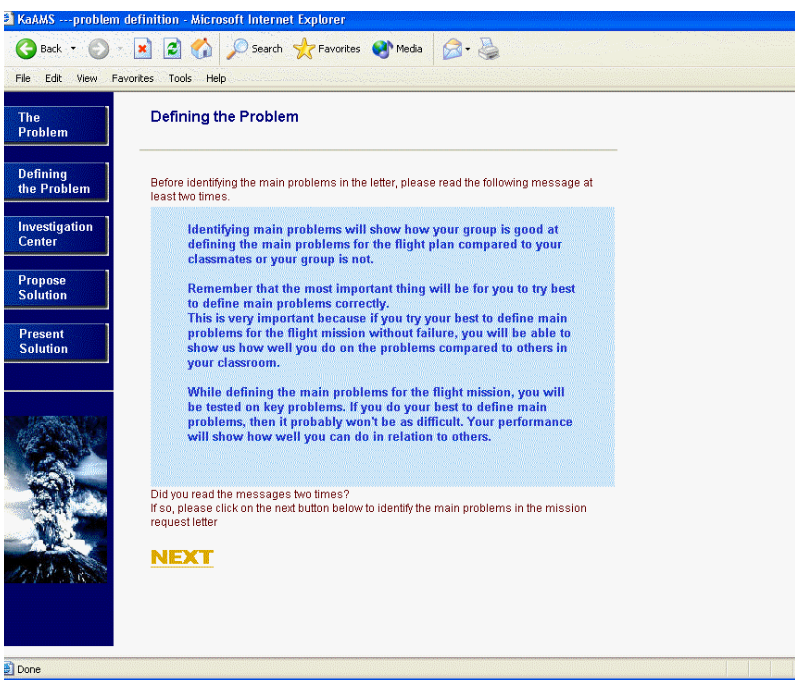

Figure E-4. A Sample Screen Showing Task Instruction Message Used in the Phase of Defining the Problem

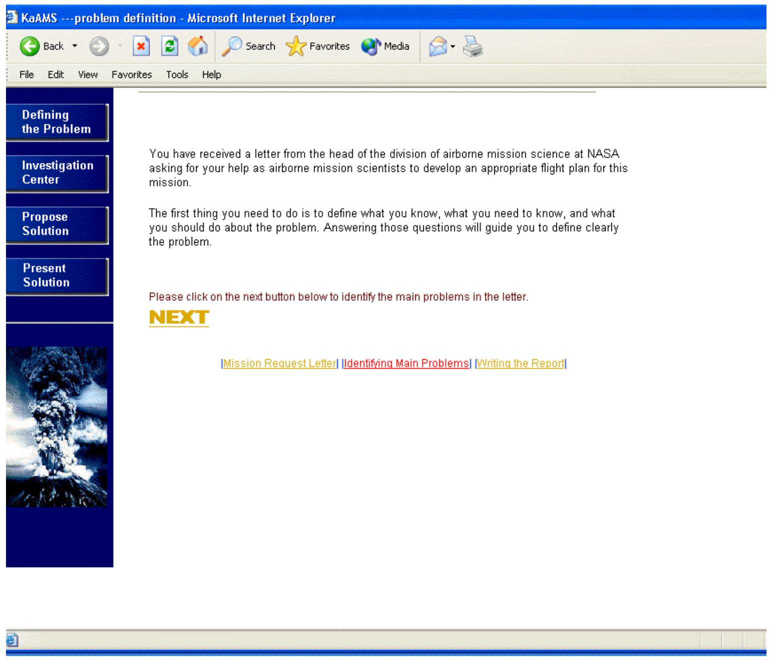

Figure E-5. A Sample Screen Showing the Phase of Defining Problem (1)

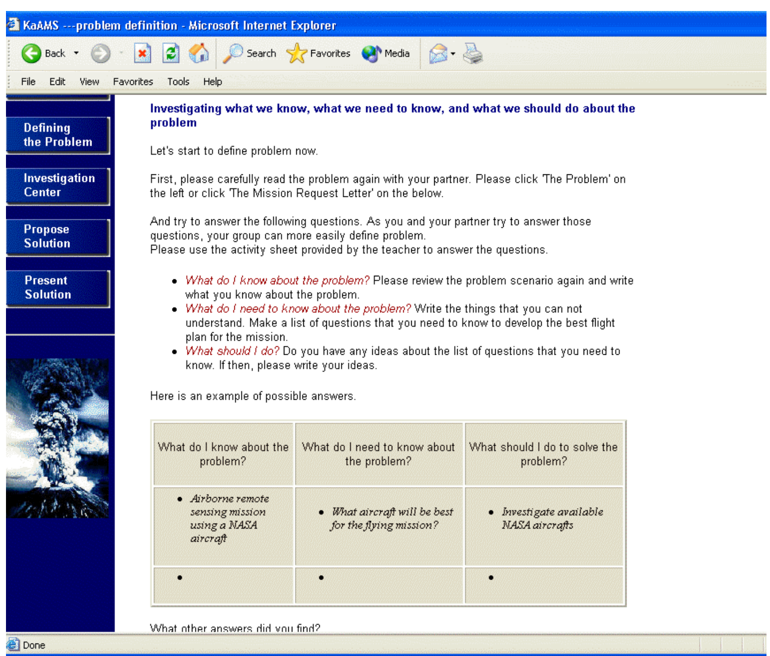

Figure E-6. A Sample Screen Showing the Phase of Defining Problem (2)

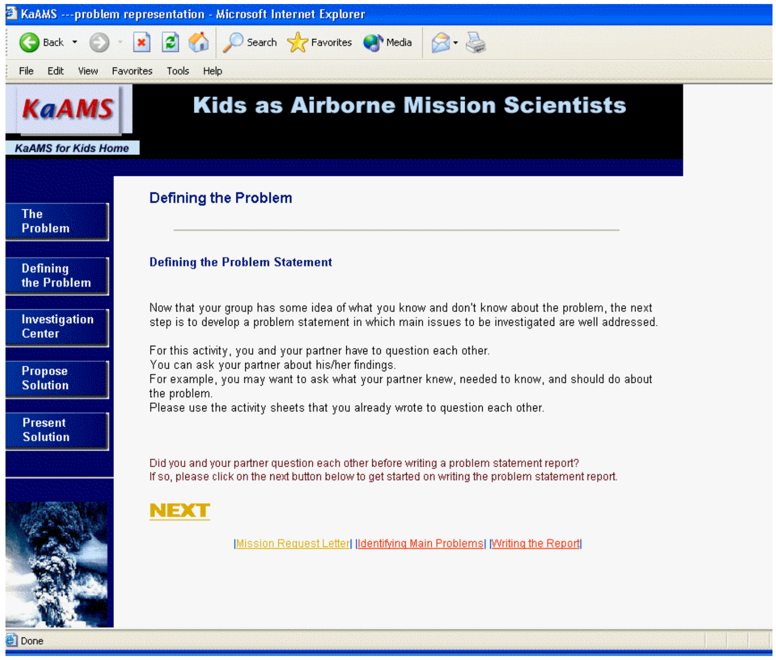

Figure E-7. A Sample Screen of the Phase of Defining the Problem (3)

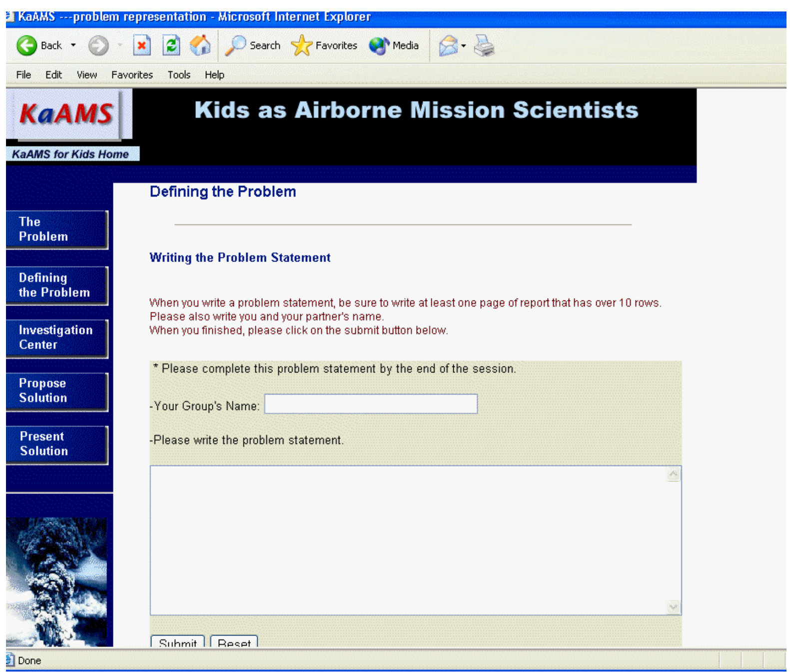

Figure E-8. A Sample Screen of the Phase of Defining the Problem (4)

<Session 2> Investigating the Problem and Proposing Group Solutions

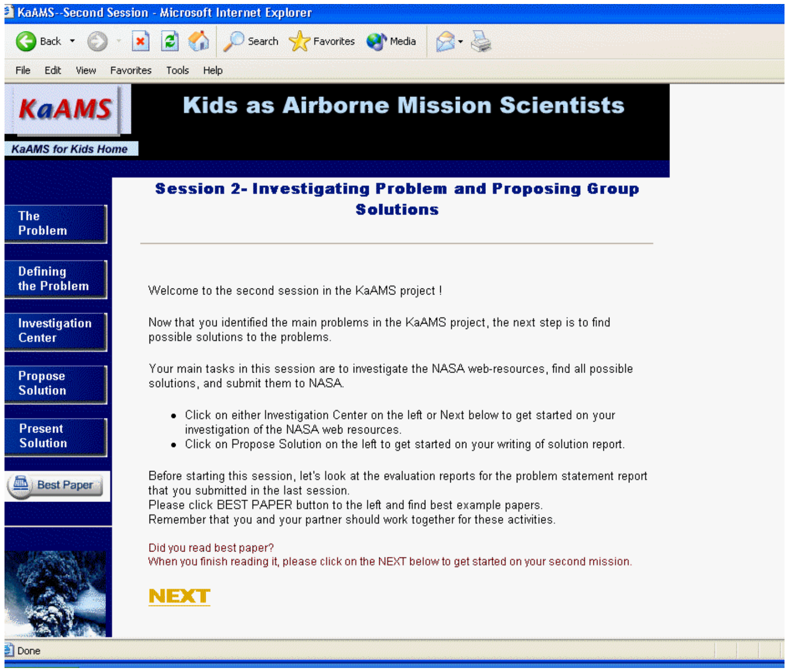

Figure E-9. A Sample Screen Showing a Main Page of Session 2

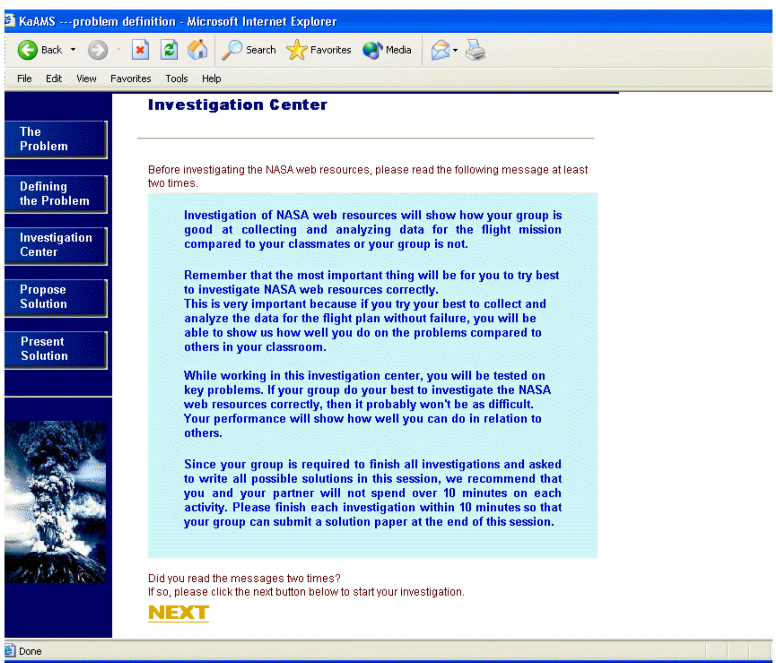

Figure E-10. A Sample Screen Showing a Task Instruction Message Used in the Phase of Investigating the Problem

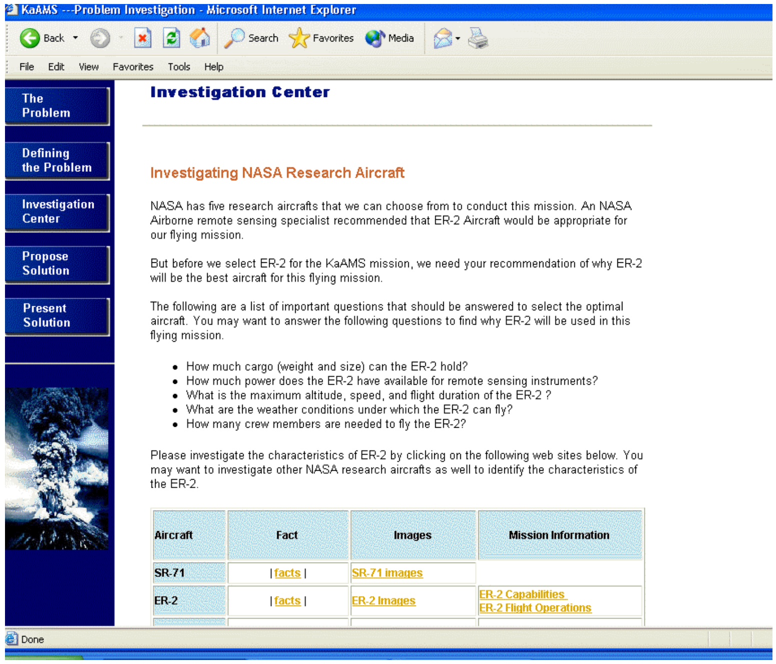

Figure E-11. A Sample Screen Showing the Phase of Investigating the Problem (1)

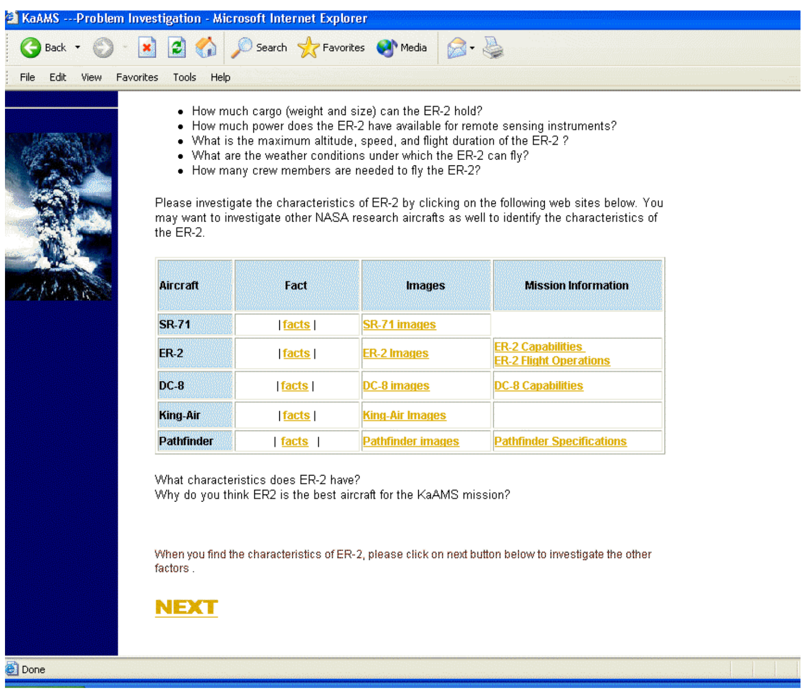

Figure E-12. A Sample Screen Showing the Phase of Investigating the Problem (2)

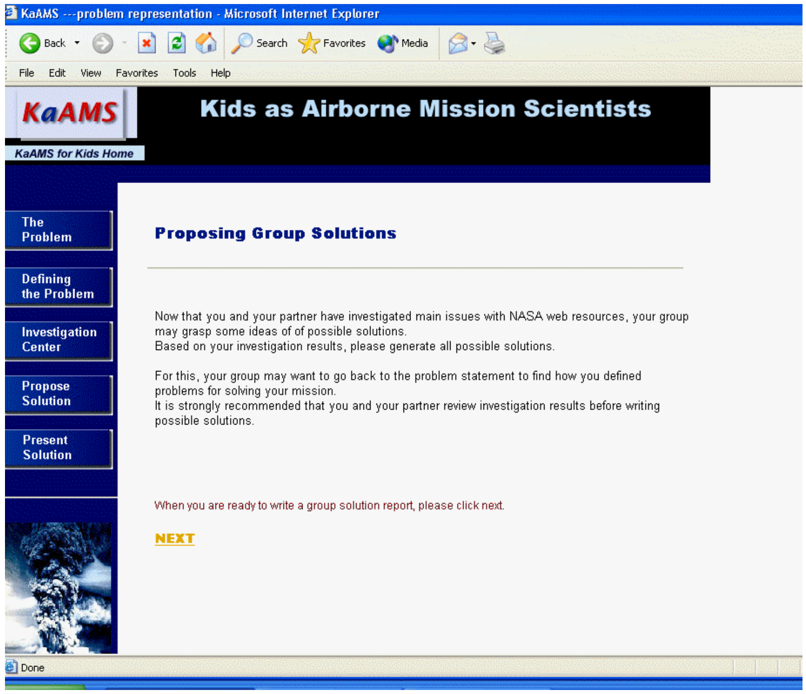

Figure E-13. A Sample Screen Showing the Phase of Proposing Group Solutions (1)

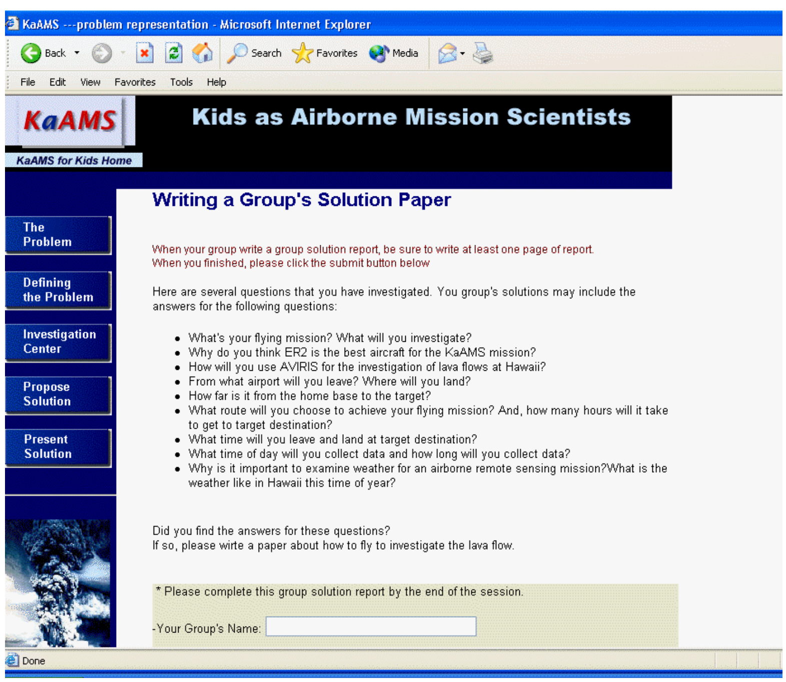

Figure E-14. A Sample Screen Showing the Phase of Proposing Group Solutions (2)

<Session 3> Presenting Individual Solutions

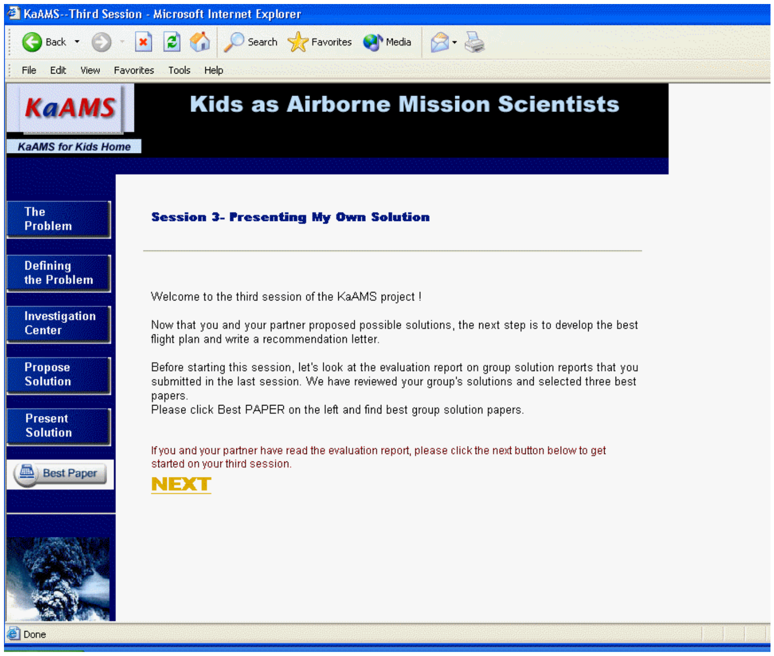

Figure E-15. A Sample Screen Showing a Main Page of Session 3

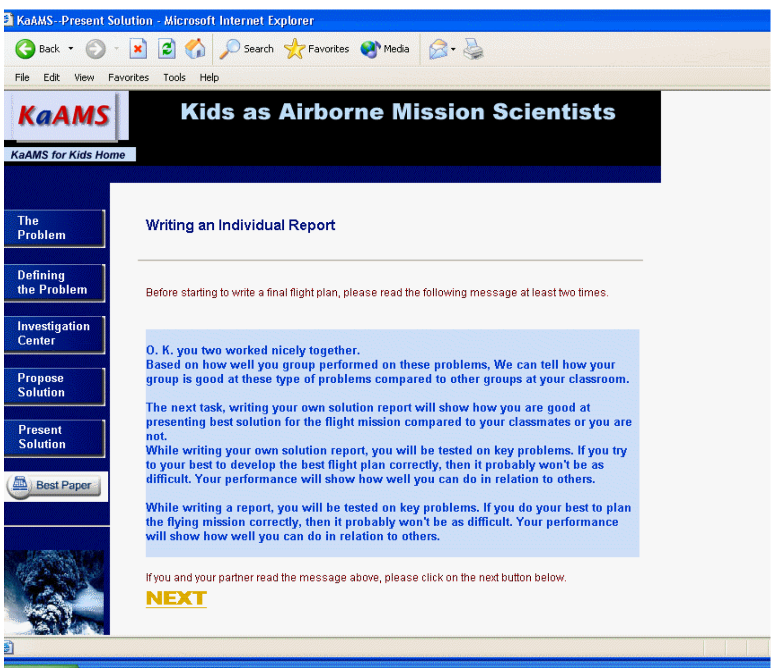

Figure E-16. A Sample Screen Showing the Task Instruction Message Used in the Phase of Presenting Individual Solutions

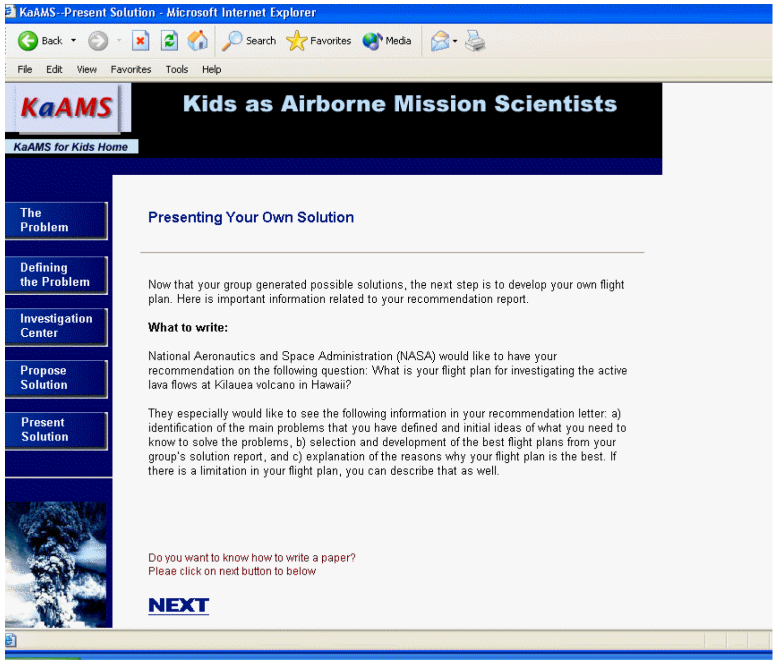

Figure E-17. A Sample Screen Showing the Phase of Presenting Individual Solutions

VITA

Hae-Deok Song

Education

Ph. D. in Instructional Systems, The Pennsylvania State University, University Park, 2004

Completion of Ph. D. Coursework in Instructional Technology, Seoul National University, Seoul, Korea, 1999.

M. Ed. in Educational Methodology, Seoul National University, Seoul, Korea, 1996.

B. A. in Education, Seoul National University of Education, Seoul, Korea, 1992.

Professional Experience

Research Associate, International Board of Standards for Training, Performance and Instruction (IBSTPI). 2003-2004.

Graduate Assistant, World Campus Academic Program Planning and Management, the Pennsylvania State University, University Park. 2002-2004.

Instructional Designer and Evaluator for NASA KaAMS (Kids as Airborne Mission Scientists) Project, Instructional Systems program, The Pennsylvania State University, University Park.2000-2002.

Researcher, Educational Research Institute, Seoul National University, Seoul, Korea, 1997.

Selected Publications

Song, H. (2004). Motivating Online Collaborative Learning: Design Implications from a Learning Goal Orientation Perspective. *Educational Technology, 44(2),* 43-48.

Song, H. (2003). The Development of a Systemic Assessment Framework for Analyzing Interaction in Online Environments. *The Quarterly Review of Distance Education, 4(4)*, 437-444.