The Effect of Guided Questioning on Student Achievement, Self Regulatory Behavior, and Self-Efficacy in a Biology for Non Majors Class

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THE EFFECT OF GUIDED QUESTIONING ON STUDENT ACHIEVEMENT, SELF-REGULATORY BEHAVIOR, AND SELF-EFFICACY IN A BIOLOGY FOR NON-MAJORS CLASS

By

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A Dissertation submitted to the Department of Educational Psychology and Learning Systems in partial fulfillment of the requirements for the degree of Doctor of Philosophy

Degree Awarded:
Summer Semester, 2007
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ACKNOWLEDGEMENTS

First and foremost, I would like to thank my Heavenly Father for all of the thoughts that came to my mind and placing people in my path who could help me with this dissertation in my life. I would like to thank my mother, Jayne Richburg, for her day-to-day support and advice. I would like to thank my father, Richard DeBroux, for his encouragement to continue my education. I would also like to acknowledge my stepfather, Glenn Richburg, whose persistence in receiving all of the education he could during his lifetime inspired me to continue despite obstacles.

I would like to thank my major professor, Dr. Walt Wager, for his patience, support, and analytical questioning to help me refine my work. I would also like to thank my committee members. Dr. Marcy Driscoll not only taught me about qualitative data analysis, but her enthusiastic nature and professionalism served as a role model for me. Dr. John Keller for opening my mind to various literature related to my dissertation. Dr. Robert Reardon taught me how to refine the pieces required within my study and how to keep the proper perspective of the dissertation, especially when balancing work.

I would like to thank Dr. Ann Lumsden and Mr. Wilbert Butler for allowing me to work with their classes. I would like to thank Dr. Barbara Gill for her help in identifying literature and structuring the analysis of my qualitative data, Dr. Merlin Smart for her assistance with the statistical analysis, and Julie Behling and Elizabeth Cranford for their editing help. I would like to thank my colleagues at the FSU Career Center and IBM who have been supportive of me and my time to work on the dissertation.

I would like to thank the many friends and family members who have supported me and are too numerous to name. I especially would like to thank Russell Dhoray for his daily patience, support, and help. I also want to thank Kim Thompson, Beth Lulgiraj, Rachel Lewis, Karen Terry-Sport, Teri Leidy, and Donnie and Cathy Jackson.

I want to thank my extended family for their support, especially my aunts, Liz Villafane, Ginger Proaper, and Karen Sharp. I also want to thank my cousin, Traci Cook-Spraker, who has always been like a sister to me. I would like to acknowledge my grandparents, William and Clara Tomlinson, whose love and support of their family has inspired me beyond their lifetimes. And, to answer the question asked numerous times, “Yes, Granddaddy, I am finally finished.”
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ABSTRACT

This study examined the effect of guided questioning prompts within cooperative learning groups on group performance and individual achievement, self-regulation, and domain self-efficacy. In comparison to the less guided questioning prompts, the more guided questioning prompts would be used to facilitate reflection activities within a group, which would serve as a model for learners to incorporate such reflective activities into their individual self-regulation. It is anticipated that the development of individual self-regulation will increase domain-specific self-efficacy, and in turn, improve academic achievement.

A pretest-posttest comparison group design was utilized in which 37 learners enrolled in two sections of a non-majors biology course at a Southeastern community college worked in cooperative learning groups of three to four learners. Over the course of four weeks, the cooperative learning groups were given either more guided questioning prompts (MGQP) or less guided questioning prompts (LGQP) to facilitate discussion about planning and monitoring group processes to create a group project of a presentation and paper. Pre- and post- intervention survey data were collected in regard to individual academic achievement, self-regulatory behaviors, and biology self-efficacy.

This study did not find any quantitative support for the hypotheses and the qualitative data yielded mixed support for the hypotheses. Cooperative learning groups in the MGQP treatment level produced papers that appeared to be more collaborative and were more likely to mention specific activities that worked well during the process of developing the project. However, cooperative learning groups in the LGQP treatment level demonstrated less variance in their progress toward the project goal, especially during the meeting prior to project submission. In addition, members of the cooperative learning groups in the LGQP treatment level were more likely to mention the social aspects of the project, such as being committed to the group. The implications and limitations of this study are presented as well as recommendations for future research.
CHAPTER 1: INTRODUCTION

Background

In recent years, society has shifted its paradigm about the purpose and importance of education. Lifelong learning is encouraged in order to stay current in today’s information society, resulting in more people pursuing higher levels of education. Senge (1990) described the role of learning in maintaining the vitality of business organizations, and Gray and Herr (2000) have noted the rising trend in learners pursuing post-secondary education.

To meet the demands resulting from these two trends, higher education has developed two new programs: online education and curriculum for developmental learners. However, these new programs have caused concern for educators because of the special circumstances and characteristics of learners in both programs. Online learners seldom attend face-to-face classes, requiring them to develop their own resources for success. Educators are especially concerned about developmental learners, as these are learners who have not met the minimum criteria for entrance into college.

Community colleges allow opportunities for many who would otherwise be unable to obtain a higher education. For example, the National Center for Education Statistics (1996) reported that 41 percent of incoming community college learners and 22 percent of incoming university learners participate in developmental courses. Community colleges are an important part of the higher education system because they serve as the foundation of higher education for many people. This role becomes more vital when it is considered that attrition levels are often the highest during the first year of college (Noel, Levitz, & Saluri, 1985).

Because a major concern of educators of developmental and first year learners is retention, educators have looked for ways to aid them in the learning process. Many educators have become interested in the role of self-regulation and group interactions as methods to aid in learner retention.

Self-regulation includes skills such as monitoring, organizing, self-consequating, and help-seeking behaviors. Because formal education is the place where many learners develop their attitudes and habits about learning, educators have assumed roles as teachers and facilitators of learner self-regulatory behavior. Boekarts (1997) states that
educators and policy makers “defend the view that a major goal of formal education is to teach students self-regulatory skills” (p. 161). It is the expectation of educators that as learners become more self-regulated they will be successful outside of the classroom by being able to educate themselves and update their knowledge as needed. Because self-regulation is viewed as a method to aid learners in being successful in academics, many researchers have examined instructional strategies to facilitate self-regulation whether in online environments (Cennamo, & Ross, 2000; Cennamo, Ross, & Rogers, 2002; King, Harner, & Brown, 2000; McMahon & Luca, 2001; McMahon & Oliver, 2001) or with developmental learners (Ley and Young, 1998; Young & Ley, 2001; 2002).

Another part of Senge’s (1990) vision of learning organizations is the use of knowledge being distributed and exchanged effectively among the various members of the work organization. Because many organizations are turning to team environments, educators are becoming aware of the need to integrate group-based learning activities into their curriculum. A large part of the interest educators have in group-based learning is that social connections facilitate learner retention and performance.

Educators working with developmental learners are also concerned about learners developing communities and learning social skills. In a study examining the reasons that developmental learners leave college, Ericco, Valeri-Gold, Deming, Kears, and Callahan (2001) suggest that developmental learners participate in orientation programs that teach academic and social skills and provide academic, financial, and career counseling. Additionally, Phillips (2001) suggests that faculty members sponsor clubs as well as conduct academic advising and study skills workshops for developmental learners.

Though much of the interest in teaching these skills focuses on these contexts, the use of instructional strategies that encourage self-regulation and cooperative learning can provide positive results for all learners. It is hoped that all learners will gain these skills in the formal academic setting in order to extend their use beyond the college setting into the work environment, the context of most lifelong learning.

Statement of the Problem

Though both self-regulation and cooperative learning strategies are thought to be important to the success of learners, little research has been done to examine the use of cooperative learning to foster self-regulation. Several studies have focused on the effect
of interaction on group metacognitive activities and goal achievement (Englert, Raphael, & Anderson, 1992; Ge & Land, 2003, Ryser, Beeler, & McKenzie, 1995; Young, 1997). Other studies deal with the effect that initial self-regulatory behavior of the individual has on participation within a group (Gleber, 2001; Gully, 1998; Lebow, 1995).

Only one study was found in which the researchers investigated self-regulatory behaviors in small group activities. Stright and Supplee (2003) observed third grade learners engaged in teacher directed instruction, individual seatwork and small group interactions during mathematics and science lessons. They examined five self-regulatory behaviors: attention to instructions, seeking help, monitoring progress, organization, and metacognitive talk. These behaviors could be found during teacher-directed instruction or individual seatwork; however, they were used more frequently by learners participating in small group activities. In particular, learners participating in small group activities were more likely to attend to instructions, monitor their work, and ask for help than those in teacher-directed activities. In addition, they are more likely to engage in metacognitive talk than those in the seatwork activities. The only self-regulatory behavior that did not appear during small group activities was organization. Therefore, small group learning provides more opportunities to engage in self-regulatory activities than other common class activities.

One method that utilizes peer interaction is guided questioning, in which learners are prompted in asking their peers questions in order to facilitate metacognition about a project. King (1990, 1991, 1992a, 1994; King & Rosenshine, 1993) developed a set of metacognitive prompts and has conducted various studies examining their effectiveness in comprehension and metacognitive activities for problem solving. Young (1997) examined the effects of similar prompts and found that the use of the prompts led to a greater amount of higher level metacognitive discussions within groups.

Ge and Land (2003) dissected the components of guided questioning to examine the effect and interaction of peer interaction and guided questioning prompts on learner metacognitive activities for an ill-structured problem-solving task. Though peer interaction improved learner achievement, learners who used question prompts, whether as individuals or as part of a group, had the most success.
Most of the research about guided questioning prompts has been how learners think about the problem that they are trying to solve or in changes in attitude toward the domain. However, little has been done to examine how guided questioning prompts affect learner individual self-regulatory processes, including goal-setting and monitoring, in a group context.

Significance of the Study

This study sought to extend the understanding of the use of guided questioning prompts as a method to promote group performance by facilitating group monitoring and group processing. In particular, this study sought to examine the role that guided questioning prompts within a cooperative learning environment serves as a model and for developing individual self-regulatory behaviors, and the relevant variables of domain self-efficacy and knowledge. This study sought to examine whether the use of guided questioning prompts aids in group and individual performance as well as increases changes in self-regulatory behaviors and initial domain self-efficacy. The context in which this study takes place is a Biology for Non-majors course at a community college.

Purpose of the Study

The purpose of this study was to examine the effect of guided questioning prompts on group performance and individual perceptions of self-regulatory behavior, domain self-efficacy, and academic achievement within the structure of cooperative learning groups. This study also examined the effect that prior knowledge, initial self-regulatory behavior, and initial domain self-efficacy have on group performance when learners utilize guided questioning prompts.

Research Questions

This study focused on the impact of guided questioning prompts within a cooperative learning environment on group performance. This research specifically addressed the following questions.

1. What effect does two levels of guided questioning prompts within cooperative learning groups have on:
   a. group performance,
   b. individual academic achievement,
   c. individual perception of use of self-regulatory behaviors, and
d. individual biology self-efficacy?

2. What effect on individual academic achievement does the interaction of the two levels of guided questioning prompts have with each of the aptitude variables of initial self-regulatory behavior and biology self-efficacy?
CHAPTER 2: LITERATURE REVIEW

Introduction

This study examined the effects of guided questioning prompts within cooperative learning groups on group performance, individual achievement, self-regulatory behavior, and domain self-efficacy. This chapter begins with a discussion of prior knowledge. This is followed by self-efficacy, which has been found to be a moderating factor between prior knowledge and individual achievement. Self-regulation is discussed in terms of its relationship to the use of cognitive and metacognitive strategies in the learning process and the phases of forethought, volitional or performance control, and self-reflection. Next, the chapter discusses instructional strategies and the rationale for using cooperative learning to foster the development of self-regulation. Finally, the use of guided questioning prompts as a means to induce self-regulatory processes is discussed.

Prior Knowledge

Prior knowledge is one of the key factors of learner success when learning new concepts and topics. In fact, it has been found to be a major predictor of learner achievement (BouJaoude & Giuliano, 1994; Ericsson, 1996; Glaser & Chi, 1988). When Ross and Zamboanga (2003) controlled for other influences on achievement, such as homework and attendance, it was found that pretest scores were significant positively correlated predictors of learner achievement.

Prior knowledge is important to the learning process because learners are able to integrate new knowledge into their schema about a particular topic. The greater prior knowledge that a learner has of a topic, the fewer fundamental skills the learner will be required to learn, allowing the learner to focus on more advanced concepts. Previous experiences with the topic also shape learner motivation to delve deeper into the topic. In addition, prior knowledge may be helpful when learners are monitoring their progress within a specific domain. Nietfeld & Schraw (2002) state that prior knowledge serves as a basis for making monitoring judgments because higher levels of prior knowledge contributes to improved performance, making the task of monitoring one's learning easier (Schraw & Nietfeld, 1998).

In addition to being a predictor of future achievement and influencing self-regulatory processes, prior knowledge is a correlate of self-efficacy. As learners discover
more about a particular domain, they will develop self-efficacy within it. This increased domain-specific self-efficacy results in greater persistence; more time engaged in learning; and ultimately, greater achievement.

Self-Efficacy

According to Bandura (1977), self-efficacy is the judgment of one’s capability to perform activities within a particular domain and has a strong influence on learner achievement. Learners gain self-efficacy within a particular domain through four primary sources: (1) enactive mastery, where the learners master the domain through personal experiences, (2) vicarious learning, where the learners gain information through observing the experiences of others, (3) verbal persuasion, in which learners are encouraged by others, and (4) emotional arousal, where the learners develop strong feelings toward the domain (Bandura, 1997).

Of these four sources of self-efficacy, enactive mastery has the greatest affect on learner self-efficacy. Through personal experiences, learners develop feelings about their ability to accomplish tasks, or self-efficacy, within a particular domain. Past experiences are primary sources of a person’s self-efficacy, and may be manifested in a learner’s prior knowledge of a domain. While prior knowledge impacts academic achievement and self-efficacy (Schunk, 1985), self-efficacy acts as a moderating variable between prior knowledge and achievement (Pajares, 1996).

In a 1984 study, Lyman, Prentice-Dunn, Wilson, and Bonfilio found that efficacious learners persisted in academic tasks despite being told that they did not succeed at their task. However, if the learner does not feel efficacious, he/she will be more likely to discontinue the activity. Berry (1987) describes an even broader effect of self-efficacy through his findings that perceived efficacy not only contributes to memory performance directly, but also indirectly by enhancing persistence. Learners not only perform well because they believed they could, but they were more persistent in their task. This persistence led to more time on task, which also led to greater achievement.

The process of monitoring performance and determining whether to persist may be described through the process of self-regulation. Developing self-regulatory skills, goal setting in particular, has been found to enhance self-efficacy. For example, Leach (1999) trained salespersons to develop goal setting, time management, performance
monitoring, and goal attainment planning. The level of salesperson motivation and emotion control was increased directly through the training and indirectly through the training’s effect on self-efficacy.

Self-Regulation

Though many studies describe self-efficacy as the predictor of self-regulation, some studies have found that self-regulation may have an impact on self-efficacy (Schunk, 2003). In 1994, Schunk and Zimmerman stated, “self-regulation refers to learners’ self-generated thoughts, feelings, and actions which are systematically oriented toward attainment of their goals” (p. ix). Since that time, Zimmerman (2001) has defined self-regulation as the “the degree to which students are metacognitively, motivationally, and behaviorally active participants in their learning process. These students self-generate thoughts, feelings, and actions to attain their learning goals” (p. 5). Both of these definitions describe the multifaceted components of self-regulation, which include both metacognitive and affective components.

To understand the metacognitive component of self-regulation, it is helpful to understand the relationship between cognitive, metacognitive, and self-regulatory strategies. In order to learn academic content, learners utilize cognitive strategies. Weinstein and Mayer (1986) placed cognitive strategies into the categories of rehearsal, elaboration, and organizational strategies. For example, a rehearsal strategy may include repetition as a method for remembering facts. As learners utilize these cognitive strategies to learn the subject or content area, they may engage in metacognitive strategies, or metacognition. Metacognition is the process through which learners use cognitive strategies to control and monitor learning (Flavell, 1979). Self-regulation expands on the metacognitive process as learners not only evaluate their use of cognitive strategies, but also compare the effectiveness of these strategies in achieving academic goals. This is the core of Zimmerman and Schunk’s (2001) definition of self-regulation: “students’ self-generated thoughts, feelings, and actions which are systematically oriented toward attainment of their goals” (p. ix).

Cognitive Strategies

Cognitive strategies are methods that learners use to facilitate the learning process. Various researchers have studied the effectiveness of individual cognitive
strategies, such as highlighting (Schraeder, 1997), mnemonics (Hwang & Levin, 2002; Stephens & Dwyer, 1997) and concept mapping (Chang, Sung, & Chen, 2002; Jegede, Alaiyemola, & Okebukola, 1990; Prater & Terry, 1988) on academic achievement. Learners determine the use and effectiveness of cognitive strategies during the learning process through metacognition.

**Metacognitive Strategies**

Metacognition is the process through which learners analyze their learning processes and determine which cognitive strategies to use. Swanson (1990) found that when intellectual ability was controlled, fifth- and sixth-graders who utilized these skills improved the speed and accuracy of problem solving, demonstrating that metacognitive strategies could compensate for ability.

In order for learners to determine which cognitive strategy to use, they must have declarative, procedural, and conditional knowledge of different types of strategies, and know how and when to use them. Declarative knowledge allows learners to describe the strategies while procedural knowledge facilitates their actual use. With conditional knowledge, learners determine which strategies to use based to their specific goals, academic tasks, and classroom context (Hofer, Yu, and Pintrich, 1998).

Depending on the task and context, learners decide which types of cognitive strategies will aid them in accomplishing their goals. Hadwin, Winne, Stockley, Nesbit, and Woszyczyna (2001) placed learners in three learning contexts: reading for learning, composing a brief essay, and studying for an exam. For each situation, learners rated the frequency with which they used particular study tactics, textbook resources, and goals. The researchers found that learners reported using different types of strategies depending on the learning context. When learners utilize metacognitive strategies in order to achieve their learning goals, they are engaged in self-regulatory behavior.

**Self-Regulatory Strategies**

Zimmerman and Martinez-Pons (1986) conducted structured interviews with high school learners classified as either high or low achievers to identify 14 self-regulatory strategies used by high-achieving learners. These strategies include: (1) self-evaluation, (2) organizing and transforming, (3) goal setting and planning, (4) seeking information, (5) keeping records and self-monitoring, (6) environmental structuring, (7) self-
Goal setting and monitoring have been found to not only improve learner achievement, but also decrease the time needed to engage in the learning task. Delclos and Harrington (1991) placed fifth- and sixth-grade learners into three groups to solve logic problems using a computer-based game. One group was trained in monitoring plus problem solving, the second group was trained in problem solving only, and the third group received no training. The monitoring plus problem-solving group outperformed the other two groups and took less time to solve the problems.

While self-regulating during the learning process, Zimmerman (2002) states that learners move through three phases: (1) forethought, (2) performance or volitional control, and (3) self-reflection.

**Forethought Phase**

According to Schunk (2001), the key components of the forethought phase are goal setting and social modeling. At this point, learners develop the learning goals they want to accomplish. To develop these goals, learners look to the accomplishments of others to gauge what their own should be.

During this phase, learners set goals related to the material. Schunk (2001) states there are three components of goals: specificity, proximity, and task difficulty. Specificity is related to the degree to which a goal is concrete; such as rate, quantity, quality, and originality. Proximity relates to how distant the goal is for the learner. Some goals may be more long-term, taking more time to achieve, while others may be completed quickly. The level of difficulty relates to how hard the goal may be to attain. An intermediate goal is optimal for learners to assess their progress.

In a ring toss experiment, Atkinson (1974) found that those with a high need for achievement chose a middle point from which to stand to toss a ring around a pole. However, those who had a low need for achievement either selected tasks that were
considerably above or below their ability. Wigfield and Eccles (1992) stated that the choice to perform an intermediate task provides learners with information about their ability and not about the task.

When goals are specific, proximal, and of reasonable difficulty, learners become efficacious (Schunk, 1990). Bandura and Schunk (1981) conducted a study about children and self-directed learning in which they were: 1) told to set proximal subgoals for mastering different mathematical skills, 2) set a distal goal of mastering all the skills by a future time, or 3) not directed to set any goals. Learners who established either distal goals or no goals maintained self-doubts about their capabilities and did not achieve as much as those who had proximal subgoals. Bandura (1997) noted: “The same accomplishment that indicates significant progress when evaluated against a short-term subgoal may appear trifling and disappointing when compared against lofty long-range aspirations. People can be acquiring skills but deriving little sense of efficacy because of the wide disparity between current attainment and distal standard (p. 217).”

Also during the forethought phase, learners examine the study material to identify strategies that will be beneficial for content mastery. Ertmer, Newby and MacDougall (1996) explain that learners are able to select, control, and monitor the effectiveness of cognitive strategies to reach their learning goals through consideration of: (1) themselves as learners, (2) the task requirements for the assignment or activity, and (3) the specific cognitive strategy. When selecting cognitive strategies, learners examine specific strategies that have previously been effective for them in accomplishing a similar task.

Performance or Volitional Control Phase

During the performance or volitional control phase, learners participate in the learning process by utilizing the cognitive strategies determined during the forethought stage. At this point, learners may utilize self-regulatory strategies in which they record and monitor their use of cognitive strategies.

It is during this phase that learners engage in the activities of social comparison, attributional feedback, and self-verbalization of strategies. Learners monitor their behavior by comparing their accomplishments with peers, assign attributions for the amount of progress they have made toward a goal, and verbalize the strategies they utilize to achieve their goals (Schunk, 2001). All of these activities aid learners in
monitoring their progress and strategies, which then enables learners to determine whether the strategies should be adjusted in the future.

**Self-Reflection Phase**

During the self-reflection phase, learners evaluate the effectiveness of a particular learning strategy. Schunk (2001) states that the key components in this phase are progress feedback and self-evaluation, self-monitoring, and reward contingencies. It is in this phase when learners determine the amount of progress they have made and conduct self-evaluations. To conduct these self-evaluations, learners initiate the three subprocesses of self-observation, self-judgment, and self-reaction. To conduct self-observations, learners monitor the strategies utilized during the learning process. In the self-judgment process, learners compare their performances to a self-selected predetermined standard. Based on their self-judgment, learners determine the next steps or goals during the process of self-reaction. It is at this point that reward contingencies may play a factor in learning.

Though instructors can provide reward contingencies, learners may also choose to self-administer rewards or punishments. Zimmerman and Martinez-Pons (1986) identified self-consequences as one of the strategies that highly self-regulated learners utilize. If a learner is content with his/her own performance, he/she may assign positive self-consequences. It is at this point that the affective, or motivational, component of self-regulation comes into play. According to Schunk (1991), “While observing aspects of one’s own behavior, one may judge them against standards and react positively or negatively. One’s evaluations and reactions set the stage for additional observations of the same behavioral aspects or of others (p. 88).”

A major factor in self-reaction is the learners’ attribution of success or failure. There are four main attributions that people have for success: ability, effort, task difficulty, and luck (Weiner, 1962). These attributions are the basis on which learners judge past performances and develop future expectancies. For example, if learners attribute failures to task difficulty rather than ability, they will believe the failure has more to do with the task and continue to believe in their ability to perform the task in the future with more effort. They will be more likely to persist in spite of failures. In contrast, learners who attribute failures to ability rather than task difficulty will believe they
cannot perform the task now or in the future. Therefore, they will be more likely to give up on the task.

The third key component of the self-reflection phase is self-monitoring, which should be frequent for optimum performance. Schunk (1996) found that learners studying fractions who monitored their learning process frequently performed better and had higher self-efficacy and motivation than those who did not. A later study which examined how learners gained computer skills at the college level yielded similar findings (Schunk & Ertmer, 1999).

**Interventions for Fostering Self-Regulation**

Because self-regulation is a correlate with achievement and self-efficacy, various researchers have been interested in interventions that may enable the development of learner self-regulation. Within the social cognitive theory, Schunk (2001) proposes that learners become self-regulated through a series of phases which occur within social contexts. In the early phases, learners gain insight into performing self-regulatory behaviors by observing and emulating models. In the later phases, the learners gain self-control and then become self-regulated.

In the earlier phases, modeling has been used to teach self-regulatory behavior with a variety of learning topics, including writing (Zimmerman & Kitsantas, 2002), mathematics (Schunk & Hanson, 1985), and athletics (Kitsantas, Zimmerman, & Cleary, 2000). In the later phases, the structure of the learning environment is paramount in allowing learners to gain self-control and become self-regulated, by providing opportunities for learners to engage in those behaviors. As learners are given more freedom to choose their learning activities, they have more opportunities to develop self-regulation.

The current study examined the development of self-regulatory behavior within the social context of cooperative learning. Cooperative learning activities provide learners with the opportunity to see peer models of self-regulation and provide a more open environment in which learners are able to regulate their own learning.

One reason that cooperative learning activities may foster the development of self-regulatory behaviors is that these environments enable learners to observe peers modeling self-regulatory behaviors. Schunk (2001) proposed that learners begin to
develop self-regulation through observing the models of others. Cooperative learning activities provide such opportunities. Learners should work with peers who are at similar cognitive levels in order to observe the differences in self-regulatory behaviors (Slavin, 1996). Schunk and Hanson (1985) placed learners in groups in which some learners observed peers work subtraction problems either as mastery models who worked quickly or coping models who worked on the problem slowly. They found that those learners who observed the coping models developed greater skills and self-efficacy. Schunk, Hanson, and Cox (1987) found similar results with learners studying fractions. Karabenick (1996) found that learners in cooperative learning groups became more keenly aware of their own trouble spots in learning the material after observing other group members' seeking help for difficulties.

A second reason that cooperative learning activities are particularly helpful in developing self-regulatory skills is that learners are given more opportunities to self-regulate their behavior in smaller learning groups than they would in a large-group, teacher-directed context (Blumenfeld & Meece, 1988; Meece, Blumenfeld, & Hoyle, 1988; Paris & Newman, 1990).

Thirdly, cooperative learning groups may be effective for developing self-regulation because learners would be more likely to verbalize their monitoring processes in this setting. In a study that compared learner self-regulatory behaviors in different instructional contexts, Stright and Supplee (2003) found that learners were more likely to discuss their thinking processes during small-group work than in teacher-directed activities or individual seatwork. Small-group instruction provides a unique setting for encouraging learners' metacognitive talk.

Measurement of Self-Regulation

Though researchers agree that self-regulation is beneficial to learner achievement, they have differing views of the construct, its indicators, and the methods to measure those indicators. In an introductory chapter of a book about various theoretical frameworks, Zimmerman (2001) defines self-regulation as the “the degree to which students are metacognitively, motivationally, and behaviorally active participants in their learning process. These students self-generate thoughts, feelings, and actions to attain their learning goals. (p. 5)” This definition is still too broad to attach exact indicators of
this construct. Depending on the theoretical framework from which the researcher adheres, the indicators of the construct will vary. For example, some perspectives exclude motivation aspects (Winne, 2001), while others center their definitions on them (Corno, 2001). The way a construct is defined determines how it will be measured.

For the methods that are used to measure self-regulation, Winne and Perry (2000) describe seven methods to measure self-regulation: self-report questionnaires, structured interviews, teacher judgments, think aloud measures (learners periodically stop and describe their thought processes to the researcher), error detection tasks (researchers introduce errors in learning material and record when and how learners deal with those errors), trace methodologies (examining the highlighting learners use within materials), and observations of performance. The focus of this list on the metacognitive strategies learners employ during their studying process may simply be because external behavior is easier to measure than other aspects of self-regulation.

Further, Winne and Perry (2000) express concern that having differing views about the underlying nature of self-regulation, as either an aptitude or event, has on its measurement. If self-regulatory behavior is an aptitude, then the person’s general behavior will be the same in any situation. This is the assumption that many of the measurements take in determining a person’s level of self-regulation. However, if self-regulation is viewed as an event, where the actual processes are observed, then different types of measurements should be used, such as a think aloud protocol. Though more time-consuming, the latter method would be a more empirically-based measure of a person’s level of self-regulation.

Researchers have developed various instruments, such as self-report questionnaires, teacher reports, or interview protocols to measure self-regulation. Though others have been developed, the instruments selected as the focus of this discussion are longstanding in nature and have been used as the basis for other instruments. These instruments are: (1) Self-Regulated Learning Interview Schedule, (2) Rating Student Self-Regulated Learning Outcomes: A Teacher Scale, (3) Motivated Strategies for Learning Questionnaire (MSLQ), and the (4) Learning and Study Strategies Inventory (LASSI).

Other instruments are not included in this discussion for a variety of reasons. For example, the Self-efficacy for Self-regulated Learning Scale (Gredler & Schwartz, 1997),
and Bandura’s (1989) *Multidimensional Scales of Perceived Self-Efficacy* (MSPS) are based on Zimmerman and Martinez-Pons’ (1988) work, which is discussed in this section. Some instruments, such as the *Academic Volitional Strategy Inventory (AVSI)* is as according to the researchers, “still a work in progress” (McCann & Garcia, 1999, p. 22). Other instruments, such as the one (no name) developed by O’Neil (Hong & O’Neil, 2001), the *Strategic Flexibility Questionnaire (SFQ)* (Cantwell & Moore, 1996), and the *Dynamic and Active Learning Inventory (DALI)* (Iran-nejad & Chissom, 1992 in Crowson, 1998) deal with issues related to state vs. trait nature of self-regulation or issues related to the individual feeling in control of his/her self-regulatory behavior. One scale that was considered during the literature review, *The School Attitude Assessment Survey* (McCoach, 2002), is not included in this discussion because self-regulation is only assessed as a subscale of the instrument.

**Self-Regulated Learning Interview Schedule**

Because several other instruments have been based on the *Self-Regulated Learning Interview Schedule*, an in-depth discussion is warranted. This instrument was developed based on structured interviews (Zimmerman & Martinez-Pons, 1986). The researchers examined the differences between learners classified as high achievers and those failing to excel in their academic pursuits. Through these interviews, they identified 14 different categories within self-regulation that may be grouped under the three components of self-regulation described by the authors: metacognitive, behavioral, and motivational. Self-regulation activities that are related to the metacognitive component are: (1) organizing and transforming, (2) rehearsing and memorizing, (3) reviewing notes, (4) reviewing tests, (5) reviewing textbooks, (6) keeping records and self monitoring, (7) self-evaluation, and (8) goal setting and planning. Behavioral components of self-regulation include: (9) seeking information, (10) environmental structuring, (11) seeking peer assistance, (12) seeking teacher assistance, and (13) seeking adult assistance. The fourteenth and final self-regulatory component described by the authors is administering self-consequences, which falls under the motivational component of regulating one’s own learning.
Rating Students Self Regulated Outcomes: A Teacher Scale

Zimmerman & Martinez-Pons (1988) went on to compare teacher assessment of learner performance with the *Rating Students Self Regulated Outcomes: A Teacher Scale* with the *Self-Regulated Learning Interview Schedule* (Zimmerman & Martinez-Pons, 1986) and found that their measures were highly correlated with each other. The process used by Zimmerman and Martinez-Pons (1986, 1988) to validate their instruments provides support from a variety of sources of the validity of their instrument. Their adhering to a theoretical framework to develop an instrument, conducting research to ask questions about the construct, and comparing two instruments that measure the same construct provide various methods to strengthen the assertion that an instrument is valid. Both of these instruments are used to measure learners’ global use of self-regulatory strategies. The fourteen subscales of the *Self-Regulated Learning Interview Schedule* and the *Rating Students Self Regulated Outcomes: A Teacher Scale* have subsequently served as the basis for the development of several other instruments.

*Learning and Study Strategies Inventory (LASSI)*

The *Learning and Study Strategies Inventory (LASSI)* (Weinstein & Palmer, 2002) measures learners’ study strategies on a global level. Learners are able to self-score this inventory and determine areas to improve upon within three scales: skill, will, and self-regulation. The skill scale includes the following subscales: information processing, selecting main ideas, and test strategies. Attitude, motivation, and anxiety comprise the will scale, while the self-regulation scale encompasses concentration, time management, self-testing, and study aids.

The *LASSI* also measures the three previously discussed components of self-regulation as defined by Zimmerman (2001): metacognitive, motivational, and behavioral. The information processing, selecting main ideas, test strategies, self-testing, study aids, concentration subscales address the metacognitive component of self-regulation. The attitude, motivation, and anxiety subscales measure the motivational component, while time management measures the behavioral component.

*Motivated Strategies Learning Questionnaire (MSLQ)*

Pintrich, Smith, Garcia and McKeachie (1991) developed the *Motivated Strategies Learning Questionnaire (MSLQ)* based on a social-cognitive perspective. The
scale was developed to measure areas of learning behaviors, including self-regulation, at the level of a course rather than at a global level as self-regulation may vary according to course. The MSLQ is divided into two scales: motivation and learning strategies, each is made of various components and subscales:

1. motivation
   a. value components
      i. intrinsic goal orientation
      ii. extrinsic goal orientation
      iii. task value
   b. expectancy components
      i. control beliefs
      ii. self-efficacy for learning and performance
   c. affective component
      i. test anxiety
2. learning strategies
   a. cognitive and metacognitive strategies
      i. rehearsal
      ii. elaboration
      iii. organization
      iv. critical thinking
      v. metacognitive self-regulation
   b. resource management strategies
      i. time and study environment
      ii. effort regulation
      iii. peer learning
      iv. help seeking

The MSLQ also addresses Zimmerman’s (2001) components of self-regulation, namely the metacognitive, motivational, and behavioral. For example, the cognitive and metacognitive subscale is related to the metacognitive component of self-regulation. In addition, the value components, expectancy components, and affective component subscales are related to the motivational component of self-regulation. The resource
management strategies subscales are related to the behavioral component of self-regulation.

Cooperative Learning

Since the early 1970’s, cooperative learning has been a topic of consideration in the educational psychology field. In 1983, Slavin described the history of cooperative learning research and stated that most studies comparing cooperative learning with traditional, individualistic approaches have found success.

Often, the term, “cooperative learning” has denoted various types of group learning environments. Cohen (1994) broadly defined small-group instruction as learners working together in a small group on a collective task. Some group learning environments include learning communities, cooperative learning, and collaborative learning. Sometimes, these different types of group learning environments are discussed interchangeably. Many, including educators, use a more broad definition of cooperative learning. In fact, Antil, Jenkins, Wayne, & Vadasy (1998) found that 93 percent of the 85 teachers they surveyed defined their instructional activities as cooperative learning activities, although they would not meet the definitions described in the theoretical and empirical literature.

Each type of group learning environment serves a different learning purpose, resulting in different types of structure. Because cooperative and collaborative learning are often used interchangeably, Panitz (1997) describes their distinctions. Cooperative learning may be thought of as a method while collaborative learning may be deemed a philosophy. Cooperative learning is highly structured and effective for well-structured tasks with limited solutions and the acquisition of knowledge and skills in a well-defined domain. Collaborative learning is less structured than cooperative learning. It is effective in loosely structured problems with flexible solutions and the acquisition of knowledge and skills in an ill-defined domain. The current study was conducted in an introductory biology class in which the content and task are specific; therefore it is appropriate to utilize cooperative learning.

Elements of Cooperative Learning

To provide structure for cooperative learning groups, Johnson and Johnson (1990) stated five elements should be present: (1) positive interdependence, (2) individual
accountability, (3) face-to-face promotive interaction, (4) interpersonal and small-group skills, and (5) group processing.

*Positive Interdependence*

For learners to become aware that they are positively interdependent on each other, Johnson and Johnson (1987) state that learners must perceive a mutual benefit, common fate, mutually caused performance, shared identity, and joint celebration in order for this to be attained. In other words, group members must strive for a benefit that all members will gain. All group members gain or lose on the basis of the performance of the group, are responsible for the productivity of all others, and are obligated to each other for support and assistance. In this way, members realize they have a shared identity in which each individual feels a part of a team, shares in the group’s successes and celebrations, and give and receive respect and appreciation for the accomplishments of each individual.

Positive interdependence comes in various forms, including goal, resource, and task interdependence. In each case, group members depend on each other to accomplish the main goal together. For example, cooperative learning groups that are structured to include goal interdependence promote the concept that all members of the group are striving for the same goal. Cooperative learning groups with resource interdependence distribute classroom resources such as books among its members. Task interdependence in a group may come as members divide tasks amongst themselves. Similarly, groups may incorporate role interdependence by dividing roles, such as leaders and editors (Johnson & Johnson, 1987).

Positive interdependence is of interest to those studying the self-regulatory behaviors of individuals within a cooperative learning group because it emphasizes the importance of the individual’s contribution to the group. According to Johnson and Johnson (1995), one of the three key mediating conditions in cooperative learning relates to positive interdependence. They state, “Inherent in positive interdependence is individual accountability, which exists when performance of each individual student is assessed and the results are given back to the group and the individual.”
**Individual Accountability**

Individual accountability is related to whether or not each member of the group is studying and absorbing the material. After reviewing the literature related to cooperative learning, Slavin (1996) emphasizes the importance of individual accountability in cooperative learning. Among the various aspects of cooperative learning, individual accountability along with group goals yielded the most positive achievement results.

**Face-to-Face Promotive Interaction**

Key to the interactions of a group is the ability for members to work with each other in the same setting. By performing together, learners are able to discuss the material and goals and build on each other’s ideas (Johnson & Johnson, 1995).

**Social Skills**

Social skills of cooperative learning group members encompass the various interactions within a cooperative learning environment that promote positive affect. Webb (1989, 1997) conducted various studies that examined effective interactions within groups. Miller and Harrington (1992) also examined social skills within a cooperative learning environment, particularly in the area of providing feedback.

**Group Processing**

Key to effective cooperative learning groups is the conducting of group processing activities. In the realm of group processing endeavors, the group members discuss the progress of their goals and projects (Johnson & Johnson, 1995).

**Guided Questioning**

Questioning has been examined by various researchers for its use in increasing comprehension, facilitating deeper thinking, and monitoring progress. Rosenshine, Meister, and Chapman (1996) reviewed 26 studies in which learners participated in questioning activities. Most of these studies focused on the use of questioning to facilitate comprehension and elaboration of content. Though this study is more interested in the use of questioning for monitoring progress, much can be gained from the research about the use of questioning in aiding comprehension and elaboration.

**Questions for Comprehension**

Several studies found that the use of guided questioning aids in the comprehension of material more than unguided questioning (Foote, 2003; King, 1989,
Davis (2003) examined the impact that varying degrees of question specificity has on performance. It was found that more open-ended prompts facilitated greater comprehension. The researchers mention that the more open-ended questions enable learners to draw upon their own schemas and methods for learning. Researchers also indicate that questioning using teacher-prepared prompts may not be helpful for all learners, possibly resulting from the teacher’s assumption that learners come to the class with similar prior knowledge.

Palincsar and Brown (1984; Palincsar, Brown, & Martin, 1987) examined their reciprocal teaching program to evaluate the effect of peer interaction on self-regulation. In this program, learners were placed in dyads and prompted to exchange questions and responses as a method of comprehension monitoring in language arts. They found that reciprocal teaching led to improved quality of summaries and questions, criterion tests, transfer of activity, as well as the ability to generalize to other academic activities. According to Glaser (1990), one key component of the success of this program is its social setting, which enables joint negotiation for understanding.

Questions for Elaboration

Questioning in the learning process is purposeful as learners discuss and elaborate on a topic. King (1990; King & Rosenshine, 1993) has examined the use of questioning strategies as a means for learners to reflect and elaborate on their learning.

King and Rosenshine (1993) divided fifth grade learners into three treatment groups. In two of the groups, learners were trained in generating different types of questions. One of the groups was prepared to ask questions that directed their partner’s thinking. The second group was taught to question their partner, but not to provide guidance in questioning. The third group was told to ask and answer each other’s questions. The group using the questions that directed their partner’s thinking outperformed both of the other two groups in solving math problems.

Building on King’s work, Young (1997) examined the processes and discussions of learning groups who were either provided with guided questioning prompts or given no such direction. Although some study groups within the experimental group did not follow the prompts, she found that the groups who did employ the questioning prompts had more higher-order discussions than the others.
Ge and Land (2003) also built on King’s work. Learners in an introductory Information Science class were divided into four groups with a factorial design of guided questioning vs. unguided questioning interacted with peer vs. individual work. They found that questioning made a greater impact on learner performance than peer interaction. They ascertained that those in the guided questioning with peer group performed better on problem-solving tasks than those in the other groups. They also determined that those in both guided questioning groups performed better overall than those in the unguided questioning groups.

**Questioning for Monitoring**

Questions have also been used to aid learners in monitoring their progress. For example, Schoenfeld (1985) found that mathematics learners were more focused on the problem-solving process and improved their performance when they periodically paused to ask each other questions about their progress. Scardamalia, Bereiter, and Steinbach (1984) also used a set of open statements to facilitate learners’ planning and reflection during creative writing.

To aid learners in monitoring their progress during the problem-solving process, King (1991) developed a series of strategic prompts divided into three sections: planning, monitoring, and evaluating. These phases and their corresponding questions are strikingly similar to the activities conducted during the self-regulatory phases of forethought, performance or volitional control, and self-reflection. It is King’s work upon which this study is based.

**Summary**

This study examined the effect of guided questioning prompts within cooperative learning groups on group performance, individual academic achievement, self-regulation, and domain self-efficacy.

Cooperative learning provides learners with the opportunity to observe peer models of self-regulation, provide a more open environment in which learners are able to regulate their own learning, and discuss strategies used during the learning process. Guided questioning prompts provide learners with the cues to monitor their progress and initiate discussions about the learning process. Through group monitoring and discussions, it was anticipated that individual group members would begin to incorporate
these skills into their own self-regulatory behaviors. And, as learners developed self-regulatory skills, a positive feedback loop was expected to be set in motion. Figure 2.1 illustrates the feedback loop that was anticipated.

In this loop, learners begin with prior domain knowledge. Prior domain knowledge impacts both academic achievement and domain self-efficacy. The lines indicate the relationship that prior knowledge has with academic achievement and domain self-efficacy. Because prior knowledge is static, its relationships are noted with dotted lines. Domain self-efficacy impacts both academic achievement and self-regulatory behaviors. When learners feel efficacious about their ability to achieve in the domain, they will perform better and will persist through difficult times.

Self-regulation impacts both academic achievement and domain self-efficacy. Through self-regulation, learners are able to monitor and modify their strategies for learning the content. If learners regulate with and are successful in achieving specific, proximal, and moderately difficult goals, they will be more efficacious.
The prompts used in this study are based on King’s (1991) work with strategic questioning. In her study, she utilized a series of prompts in the three phases of planning, monitoring, and evaluating to aid learners in solving specific mathematical problems. These phases seem to be similar to the ones described by Schunk (2001). Goal setting is conducted during Schunk’s forethought phase and King’s planning phase. In Schunk’s performance or volitional control phase and King’s monitoring phase, learners work through the learning activity and monitoring their strategies. Finally, learners review their activities and determine future plans during Schunk’s (2001) self-reflection phase and King’s (1991) evaluation phase. In this study, some modifications were made to King’s (1991) prompts to guide learners through some of the processes that Schunk (2001) describes as being part of the self-regulatory process. Table 2.1 shows the comparison of Schunk’s (2001) terminology with King’s (1991) terminology for each phase.

<table>
<thead>
<tr>
<th>Self-regulation phase (Schunk, 2001)</th>
<th>Guided questioning prompt phase (King, 1991)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forethought</td>
<td>Planning</td>
</tr>
<tr>
<td>Performance or volitional control</td>
<td>Monitoring</td>
</tr>
<tr>
<td>Self-reflection</td>
<td>Evaluating</td>
</tr>
</tbody>
</table>

In this study, it was anticipated that as learners worked through the prompts, they would develop self-regulatory skills, and these self-regulatory behaviors would impact group performance. Because the cooperative learning activities provided a model for the individuals, the prompts were expected to help individual group members to develop self-regulation.

It was expected that as the individual learners became more self-regulated, their individual academic achievement was expected to improve, facilitating an increase in group academic achievement, individual domain knowledge, and individual domain self-efficacy. As learners’ domain self-efficacy increased, they were expected to persist in activities that foster academic achievement, such as self-regulatory behaviors. It was hoped that those activities, in turn, would result in greater academic achievement and
self-efficacy leading learners to ever-increasing positive effects within the domain. These relationships are noted with solid lines in the figure.

Hypotheses

From this review of the literature, the following hypotheses were made:

1. Learners in cooperative learning groups who receive the more guided questioning prompts would do the following when compared to those who receive the less guided questioning prompts:
   a. perform better as a group on the project (presentation and paper), as measured by project scores,
   b. perform better on individual achievement, as measured by the topic-specific knowledge questionnaire,
   c. have greater perceived use of self-regulatory behaviors, and
   d. have greater biology self-efficacy.

2. Learners who are initially low on the aptitude variables of self-regulation and self-efficacy will benefit more from guided questioning prompts than those initially high, in terms of individual academic achievement.
CHAPTER 3: METHOD

Purpose

The purpose of this study was to examine the effect of two levels of guided questioning prompts within cooperative learning groups on group performance, individual academic achievement, individual self-regulatory behavior, and individual biology self-efficacy of learners in two sections of a non-majors biology class at a community college. This study also examined the interaction of initial self-regulatory behavior and biology self-efficacy with the two levels of guided questioning prompts on individual academic achievement.

Research Design

A pretest-posttest comparison group design was used over four weeks. Learners worked in cooperative learning groups of three or four learners to develop a project consisting of a presentation and a paper. Depending on the course section in which they were enrolled, the cooperative learning groups studied one human body system or an endangered species. Prior to and at the conclusion of the intervention, learners were assessed on three dependent variables: self-regulatory behavior, biology self-efficacy, and topic-specific knowledge. Cooperative learning groups participated in one of two treatments: more guided questioning prompts (MGQP) or less guided questioning prompts (LGQP).

Participants

The participants were 37 learners enrolled in two sections of a Biology for Non-majors course at a community college in the Southeastern United States. Prior to the intervention, 66 participants completed the following questionnaires: a demographics questionnaire, the Motivated Strategies Learning Questionnaire (MSLQ) (Pintrich, Smith, Garcia, & McKeachie, 1991), the College Biology Self-efficacy Instrument for Non-majors (Baldwin, Ebert-May, & Burns, 1999), and a topic-specific competency test.

Of the original 66 learners, only 37 completed all of the treatment activities and post-intervention measures. Of these 37 participants, 16 (43.2%) were male and 21 (56.8%) were female. According to the respondents, 16 (43.2) were African-American, 14 (37.8%) were Caucasian (White), two (5.4%) were Hispanic, one (2.7%) was Native American, three (8.1%) classified themselves as “Other”, and one (2.7%) preferred to not
respond. Thirteen learners (35.1%) were freshmen, 20 (54.1%) were sophomores, and four (10.8%) were juniors in college. The mean age of the learners was 21.86.

Sampling Procedure

The study took place in two sections of Biology for Non-majors course at a community college in the southeastern United States. The community college was in a moderately-sized city and provides services to three counties, two of which were rural. During the semester in which the study was conducted, there were 20 sections of the course. Two sections, taught by two different instructors, were selected for this study based on agreement by the instructors to participate. The two sections will be referred to as Course Section A and Course Section B.

Cooperative Learning Group and Treatment Level Assignment

Cooperative learning groups were formed according to the method determined by the instructor and assigned to a treatment level based on the cooperative learning group’s number. In Course Section A, cooperative learning group membership was determined by learner selection of presentation topic. Cooperative learning group numbers were established by the order that the topic was named. In Course Section B, cooperative learning group membership and numbers were established by seating arrangements at the beginning of the semester. All learners in Course Section A were required to participate in cooperative learning group activities, while learners in Course Section B were given the option to work alone.

Those cooperative learning groups whose number was odd received the more guided questioning prompts, while those cooperative learning groups whose number was even received the less guided questioning prompts. This procedure was utilized so that the greater number of cooperative learning groups may participate in the more guided prompt activities in the case of an odd number of cooperative learning groups within a course section.

Sample Size

In 1996, Rosenshine, Meister, and Chapman conducted a review of the literature related to questioning techniques. In this review, the studies were classified according to questioning techniques.
The category, generic question stems and generic questions, is of particular relevance to the current study. This category referred to studies in which learners were given questions that could be used in a variety of content areas to prompt metacognition. Within this category, four studies were identified (King, 1989, 1990, 1992a; Weiner, 1978). The effect sizes for these studies ranged from 0.63 to 1.70 with an overall effect size of 1.12.

Rosenshine, Meister, and Chapman (1996) calculated the effect sizes of the studies using the standardized difference, or d-index, computing the difference between the means of the experimental and control groups and dividing by the standard deviation of the control group. They found that the average effect size for all interventions that utilize questioning techniques was 0.36.

Though not listed in Rosenshine et al.’s (1996) review, King’s (1991) study was used as the basis of the current study. King’s (1991) examined the use of guided prompts and signal words in comparison to a control group. Because the current study examined the use of guided questioning prompts, the effect size of the King’s (1991) guided prompts group was calculated, using the same method as Rosenshine et al. (1996) described earlier. King (1991) adjusted the mean scores to account for pretest scores. It was found that the effect size for the adjusted scores was 1.07, while the effect size calculated from the true means was 1.13.

The sample size needed for this study was calculated using the same methods described above. After the effect size was calculated, the d-index (number of treatment levels = 2) was then used to estimate the required sample size to power of 0.80 with alpha = 0.05. When the effect size was calculated from the true means, the effect size was 1.13. This effect size was similar to the findings of Rosenshine, Meister, and Chapman (1996) for the studies in the generic question stems and generic questions category. In the current study, the sample size was calculated to be 14 participants for one group, with a total of 28.

Variables

*Independent Variable*

One independent variable that was examined in this study: guided questioning prompts within cooperative learning groups. There were two levels of guided questioning
prompts within cooperative learning groups: more guided (MGQP) and less guided (LGQP).

**Independent Attribute Variables**

There were three learner characteristics, or attributes, which were examined in this study: (1) prior knowledge, (2) initial self-regulatory behavior, and (3) initial biology self-efficacy. These attribute variables were examined for their effects on the dependent variables. Prior knowledge was measured using the competency test, developed by the researcher, for the relevant topic area administered prior to the intervention. Initial self-regulatory behavior was assessed using the *Motivated Strategies Learning Questionnaire (MSLQ)* (Pintrich, Smith, Garcia, & McKeachie, 1991) administered prior to the intervention. Initial biology self-efficacy was measured using the *College Biology Self-efficacy Instrument for Non-majors* (Baldwin, Ebert-May, & Burns, 1999) administered prior to the intervention.

**Dependent Variables**

There were four dependent variables in this study: (1) group performance, (2) individual academic achievement, (3) post-intervention self-regulatory behavior, and (4) post-intervention biology self-efficacy. Group performance was measured by the instructor assessment of the adherence of the presentation and paper to the pre-determined rubric. In particular, the degree to which the cooperative learning groups discussed the assigned material in their presentations and paper was assessed. Academic achievement was measured using the topic-specific competency test administered at the conclusion of the intervention. Self-regulatory behavior was assessed using the *Motivated Strategies Learning Questionnaire (MSLQ)* (Pintrich et al., 1991) administered at the conclusion of the intervention. Self-efficacy was measured using the *College Biology Self-efficacy Instrument for Non-majors* (Baldwin et al., 1999) administered at the conclusion of the intervention. Table 3.1 illustrates the variables in this study and their corresponding types of variable, assessment instruments, and times of assessment.
### Table 3.1: Variables and Assessments

<table>
<thead>
<tr>
<th>Variable</th>
<th>Type of Variable</th>
<th>Assessment Instrument</th>
<th>Time of Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guided questioning prompts within cooperative learning groups</td>
<td>Independent</td>
<td>Intervention – Different prompts for the more guided prompt group and the less guided prompt group</td>
<td>Intervention</td>
</tr>
<tr>
<td>Initial self-regulatory behaviors</td>
<td>Attribute</td>
<td>Motivated Strategies Learning Questionnaire</td>
<td>Pre-intervention</td>
</tr>
<tr>
<td>Initial biology Self-efficacy</td>
<td>Attribute</td>
<td>College Biology Self-Efficacy Instrument for Non-Majors</td>
<td>Pre-intervention</td>
</tr>
<tr>
<td>Prior domain knowledge</td>
<td>Attribute</td>
<td>Instructor/Researcher developed assessment</td>
<td>Pre-intervention</td>
</tr>
<tr>
<td>Group performance</td>
<td>Dependent</td>
<td>Project – presentation and paper</td>
<td>Post-intervention</td>
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<tr>
<td>Domain knowledge</td>
<td>Dependent</td>
<td>Knowledge questionnaire</td>
<td>Post-intervention</td>
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<tr>
<td>Final perceived use of self-regulatory behaviors</td>
<td>Dependent</td>
<td>Motivated Strategies Learning Questionnaire</td>
<td>Post-intervention</td>
</tr>
<tr>
<td>Final biology self-efficacy</td>
<td>Dependent</td>
<td>College Biology Self-efficacy Instrument</td>
<td>Post-intervention</td>
</tr>
</tbody>
</table>

### Instructional Activities

This study took place over a four-week period. Throughout the duration of the study, the learners worked in cooperative learning groups of three to four learners to develop a presentation and paper related to either a human system or an endangered species.

This study was conducted in two sections of a Biology for Non-majors course. A different instructor taught each section. In both sections, each cooperative learning group of learners gave a presentation to the class and wrote a paper related to the topic emphasized in the particular section. In the first section (Course Section A), the instructional activity, Biology Belle, was related to the human body systems. The instructional activity in the second course section (Course Section B) was a presentation and paper about a Florida Endangered Species.
Class Activities

In the Biology Belle project, cooperative learning groups constructed a model and provided information on one of seven human systems. These systems were: skeletal, circulatory, respiratory, nervous, digestive, reproductive, and excretory. Each cooperative learning group presented on the purpose of the system, placed replicas of organs related to the system on a pipe model shaped like a body with limbs, described the processes that occur within the system, and discussed diseases related to the system. The cooperative learning groups were permitted to present the material in any manner and were encouraged by the instructor to be creative. Each cooperative learning group also wrote a one-page, 250-word paper about the human system. See Appendix J for the instructor rubric for the Biology Belle project.

For the Florida Endangered Species project, cooperative learning groups developed a 10-minute slideshow presentation about one endangered species in Florida. Each cooperative learning group presented on the species’ taxonomy, habitat, role in the food chain and environment, and ways humans can reduce the likelihood of extinction. In addition, each cooperative learning group wrote a 1,000-word paper about the endangered species. See Appendix K for the instructor rubric for the Florida Endangered Species project.

Structure of Cooperative Learning Groups

The cooperative learning groups in both treatments were structured to incorporate the elements of cooperative learning groups: positive interdependence, individual accountability, face-to-face promotive interaction, social skills, and group processing (Johnson & Johnson, 1990).

Positive Interdependence

To foster positive interdependence, all learners within a cooperative learning group received the same grade. Prior to the intervention, learners were given the Suggestions for Developing the Project document, in Appendix M, which encouraged them to divide the tasks and roles needed to complete the project. Learners were also given the Responsibilities Chart, in Appendix L, and corresponding examples to facilitate the division of work.
Though a division of labor was encouraged, all learners were expected to learn all of the material about the topic. Additionally, the content lent itself well for encouraging learners to learn about all aspects of the topic, whether about a human body system or endangered species within an ecological system.

**Individual Accountability**

To foster individual accountability, learners were given instruction encouraging them to specialize in a particular portion of the topic and were expected to teach that portion to the others. On the first day of the intervention, learners received guidance about dividing roles and tasks so that each member was responsible for a portion of the project. This information is included in Appendix M, *Suggestions for Developing the Project*. To emphasize individual accountability, learners submitted a *Responsibilities Chart* at the conclusion of the intervention. The *Responsibilities Chart* and corresponding examples that were distributed and discussed on the first day of the intervention are included as Appendix L.

One role that is important to the cooperative learning group is the leader. In Course Section A, the cooperative learning group leaders were assigned according to the first person who selected a particular system. In Course Section B, learners were permitted to select a leader.

**Face-to-Face Promotive Interaction**

To facilitate face-to-face promotive interaction, learners were given 5-15 minutes during class each week to work on their projects.

**Social Skills**

To facilitate social interactions within the cooperative learning group, the *Suggestions for Developing the Project* sheet, found in Appendix M, was distributed and discussed with the learners at the beginning of the intervention. This sheet contains suggestions gleaned from various researchers who have studied small group interactions. Much of the information about interaction within small groups came from Webb’s (1989, 1997) work. The information about explaining content to others is based on Webb’s (1989) work. In a 1997 article, Webb described how to resolve disagreements which was incorporated into the suggestion sheet. Miller and Harrington (1992) provided the basis...
of the information about providing feedback. The researcher reviewed this material and solicited questions from the learners.

*Group Processing*

Group processing is the activity in which the cooperative learning group periodically discusses how well they were performing together. The prompts, particularly the more guided questioning prompts, served to facilitate group processing. See Appendix C for the more guided questioning prompts and Appendix D for the less guided questioning prompts.

*Collaboration Materials*

*Introductory Materials*

On the first day of the intervention, the researcher discussed the points contained in the *Suggestions for Developing the Project* sheet to the entire class. This information, as described in the “Social Skills” section of this chapter, is based on various authors who have researched goal setting and interactions within small groups. See Appendix M for this sheet.

Learners were also given a *Responsibilities Chart* and corresponding example. The purpose of the *Responsibilities Chart* was to help cooperative learning group members identify and record the contributions of individual cooperative learning group members. Cooperative learning group members noted who researched a particular topic, performed a specific role, and completed various tasks. See Appendix L for this chart.

*Treatment Materials*

During the course of the intervention, each cooperative learning group received a folder containing papers with the relevant prompt. Prompts from previous weeks were attached to the folder with a clasp in a reversed chronological manner, so that learners could review previous responses to prompts.

The material for the intervention was based on King’s (1991) guided questioning prompts. These prompts cover three phases of the learning process: Planning, Monitoring, and Evaluating. These three phases correspond to the self-regulatory processes described by Schunk (2001): forethought, performance or volitional control, and self-reflection. During the first week of the study, learners participated in the Planning phase. For the two intervening weeks, learners participated in the Monitoring
phase. During the fourth week of the study, learners submitted their papers and began conducting presentations. The intervening time between the submission of the paper and the conclusion of the presentations varied according to course section. Both course sections then concluded with the Evaluating phase. The prompts given to cooperative learning groups in the more guided questioning prompt (MGQP) treatment level can be found in Appendix C. The prompts given to cooperative learning groups in the less guided questioning prompt (LGQP) treatment level can be found in Appendix D. Each phase of the study will now be discussed.

Planning Phase

During the first week of the study, learners participated in Planning prompts. The cooperative learning groups who were in the less guided questioning prompt (LGQP) treatment level answered the following prompt:

- Develop a presentation plan to teach the class about your group’s system.

The cooperative learning groups in the more guided questioning prompt (MGQP) treatment level received the following prompts based on King’s (1991) Planning prompts:

- What are we trying to do here?
- What do we know about the problem so far?
- What characteristics or abilities do we have that may be used to accomplish this project?
- Knowing the characteristics and abilities we do or do not have, what strategies can we use to accomplish this project?
- What is our plan?
- Is there another way to do this?
- What should we do next?

The prompts for the more guided questioning prompt treatment level were selected to provide an overview of the activities within the planning or forethought phase. Ertmer, Newby, and MacDougall (1996) state that during the forethought phase, learners examine the task and their own abilities to select appropriate strategies. Therefore, the questions, “What characteristics or abilities do we have that may be used to accomplish this project?” and “Knowing the characteristics and abilities we do or do not have, what
strategies can we use to accomplish this project?” have been added to engage the learners in the process of thinking about their abilities in order to plan for accomplishing the task.

**Monitoring Phase**

Between the second and fourth week of the study, both treatments engaged in prompts related to the monitoring process. Cooperative learning groups within the LGQP treatment level answered the following prompt:

- Report about group activities.

The cooperative learning groups in the MGQP treatment level received the following prompts based on King’s (1991) Monitoring prompts:

- Are we using our plan or strategy? How closely are we following our plan or strategy?
- Are we getting closer to our goal? Why or why not?
- Do we need a new strategy? If so, what is it?
- What should we do next?

Because King’s (1991) questions, “Are we using our plan or strategy?” and “Are we getting closer to our goal?” are closed-ended questions and may be answered with a “Yes” or “No” response, follow-up questions, “How closely are we following our plan or strategy?” and “Why or why not?” were developed for the respective questions. These questions were developed to elicit a more descriptive response from the learners to facilitate reflection.

The question, “How closely are we following our plan or strategy?” encourages the learners to compare the previously set goals with the amount of progress and activities that have occurred. Schunk and Zimmerman (1994) describe one of the steps in the self-regulatory process as being self-judgment in which the learner compares their performance with a previous goal.

The question, “Why or why not?” was used as a follow-up to the question, “Are we getting closer to our goal?” This question has been added to elicit the cooperative learning group’s attribution of the performance in comparison with the goal. This activity was in line with Schunk’s (2001) description of the third phase in the self-regulatory process, self-reflection. In this phase, the learners think about their performance, feelings about it, and attributions for how the activities were performed.
**Evaluating Phase**

After all groups completed their presentations and turned in their projects, each cooperative learning group responded to Evaluating prompts. Cooperative learning groups in the LGQP treatment level were asked the following prompt:

- Analyze what worked and what you would change.

Cooperative learning groups in the MGQP treatment level responded to guided questioning prompts based on King’s (1991) Evaluating guided-questioning prompts:

- How well did we accomplish our goal?
- How do we feel about our accomplishment?
- What worked?
- What didn’t work?
- What would we do differently next time?

The questions, “How well did we accomplish our goal?” and “How do we feel about our accomplishment?” were added to elicit the learners to discuss the degree to which they accomplished their goal. The purpose of this question was to facilitate the learner in the self-judgment and self-reaction processes as discussed by Schunk (2001).

**Assessments**

Prior to the intervention, learners completed the following instruments as part of the pre-intervention assessment: a demographic questionnaire, the Motivated Strategies for Learning Questionnaire (MSLQ) (Pintrich et al., 1991), College Biology Self-efficacy Instrument for Non-majors (Baldwin et al., 1999), and an assessment of prior knowledge developed by the researcher and instructor based on the course text material related to the project. At the conclusion of the study, the learners completed these same assessments again. However, the demographic questionnaire was more related to time commitments and the order of the items of the topic-specific competency test was changed.

**Demographic Questionnaire**

The demographic questionnaire requested the following information: age, gender, year in school (high school or college), number of science courses taken in high school, number of science courses taken in college including this course, number of years or months since last science class prior to the current course, Math ACT or SAT score, and English ACT or SAT score.
Respondents were also asked to list their majors. Then, they were asked to complete the *Satisfaction with Choice Item* (Holland, Gottfredson, & Nafziger 1973) by identifying the degree to which they were satisfied with their choice of majors.

The next four items were adapted from the Activities section of the *Self-Directed Search* (Holland, Powell, & Fritzsche, 1994), which is an instrument used to aid in career decision-making. The *Self-Directed Search* asks respondents to rate their interests, competencies, and aspirations within six categories of interest. The activities listed in this demographic questionnaire were adapted from the category related to scientific careers. See Appendix E for the demographic questionnaire.

*Motivated Strategies for Learning Questionnaire (MSLQ)*

Learners completed the *Motivated Strategies for Learning Questionnaire (MSLQ)* (Pintrich et al., 1991) to assess self-reported use of self-regulatory behavior. This scale, based on a social-cognitive view of learning, examines two areas of learning behaviors: motivation and learning strategies. As described in Chapter 2, this instrument focuses on the course-level use of self-regulatory behaviors. Because Winne and Perry (2000) suggest using the most specific measure of self-regulation as possible, this instrument was selected for this study. Other instruments examine self-regulation in a global manner, whereas the *Motivated Strategies for Learning Questionnaire (MSLQ)* (Pintrich et al., 1991) is focused on the course level.

This instrument was validated with 380 undergraduate college learners from 14 subject areas within five disciplines from a large Midwestern university. According to the instrument’s authors, the data indicated that the scale reliabilities were robust, the confirmatory factor analyses demonstrated good factor structure, and the scale showed reasonable predictive validity to learner course performance (Garcia & Pintrich, 1996; Pintrich et al., 1991). To view the entire scale, see Appendix F.

This 81-item instrument is divided primarily into two sections: motivation and learning strategies. The motivation section is further divided into three components: value components, expectancy components, and an affective component. The value component includes intrinsic goal orientation, extrinsic goal orientation, and task value. The expectancy component includes control beliefs and self-efficacy for learning and performance. The affective component is test anxiety. The learning strategies section is
divided into two main components: cognitive and metacognitive strategies and resource management strategies. Cognitive and metacognitive strategies include rehearsal, elaboration, organization, critical thinking, and metacognitive self-regulation. Resource management strategies include time and study environment, effort regulation, peer learning, and help seeking. For the current study, the reliability was found to be .9535 for the pre-intervention assessment and .9617 for the post-intervention assessment.

*College Biology Self-efficacy Instrument for Non-majors*

Learners completed a modified version of the *College Biology Self-efficacy Instrument for Non-majors* developed by Baldwin, Ebert-May, and Burns (1999). The instrument was originally validated with 1,096 learners enrolled in a biology course and completed a national examination to assess learners' change in biological literacy. This instrument is composed of three subscales: methods of biology, generalization to other biology/science course and analyzing data, and application of biological concepts and skills. The authors found that the analysis of internal reliability yield a Cronbach’s alpha of 0.88 for methods of biology, 0.88 for generalization to other biology/science course and analyzing data, and 0.89 for application of biological concepts and skills. These alpha scores indicate a high level of reliability. Because the course in the current study does not have a lab component, the “methods of biology” subscale was not used. Therefore, fifteen items from this instrument were used. In addition, the geographic location of the example was changed to be relevant to the location of the study. For this study, the reliability for the pre-intervention administration of the *College Biology Self-efficacy Instrument for Non-majors* was .9270 and .9289 for its post-intervention administration. See Appendix G for this scale.

*Topic-Specific Competency Test*

Learners completed a topic-specific competency test to assess prior knowledge and knowledge gain of the subject matter content. This 35-item assessment was developed by the researcher and reviewed by the instructor. The items for both the pre- and post- intervention administrations were the same. However, the items were rearranged. Depending on the course section, the content of this assessment was related to the seven systems of the body or adaptations of five categories of species.
Because the subject matter was different in each course section, the competency tests were developed differently. For Course Section A, the projects focused on seven human systems: skeletal, circulatory, nervous, digestive, respiratory, female reproduction, and excretory. For each system, five items were developed from material in the course text.

For Course Section B, the projects focused on endangered species within five categories of animals: fishes, amphibians, reptiles, birds, and mammals. Due to the variability of the number of species within each category, the number of items for each category of species varied to reflect the ratio in the projects. There were three items for fish, three items for amphibians, eleven items for reptiles, eleven items for birds, and seven items for mammals.

In order to gain content validity of the competency test, both instructors reviewed the items for his/her topic area and for the other instructor’s topic area. Adjustments were according to the instructors’ suggestions. Internal consistency reliability was determined for each of the administrations of the topic-specific competency tests using Cronbach’s alpha. The reliability for the pre-intervention administration of the Course Section A’s human systems competency test was .4033 and .6697 for its post-intervention administration. The reliability for the pre-intervention administration of the Course Section B’s endangered species competency test was .7643 and .7241 for its post-intervention administration.

See Appendix H for the Course Section A’s Human Systems competency test and Appendix I for the Course Section B’s Endangered Species competency test.

Project score

The score each cooperative learning group received for the project was reviewed. All learners in a cooperative learning group received the same score.

Responsibilities Chart

The Responsibilities Chart outlined the topic areas, roles, and tasks that each learner in the cooperative learning group performed. All cooperative learning group members were to participate in completing the Responsibilities Chart. See Appendix L for the Responsibilities Chart and corresponding examples.
Follow-up Questionnaire

At the conclusion of the study, respondents were asked about the amount of time they committed to class activities. These questions were similar to the demographic data questions asked by Pintrich et al.’s (1991) *Motivated Strategies for Learning Questionnaire (MSLQ)*. These questions asked about the amount of time the learner spent in activities not related to the course, such as, “How many credit hours did you take this semester?” Similar questions, such as, “On average, how many hours a week do you spend with other responsibilities (family, community organizations, etc.)?” were developed by the researcher to assess additional factors that may decrease time involvement in the course. Rather than asking these questions at the beginning of the semester as done by Pintrich et al. (1991), it was determined that these questions would be asked after the conclusion of the intervention so that learners may be able to assess past time rather than estimate future time spent in non-course activities.

Learners were again asked to list their majors and respond to the *Satisfaction with Choice Item* (Holland, Gottfredson, & Nafziger, 1973). They were also asked to rate their interest in scientific activities that were adapted from the Activities section of the *Self-Directed Search* (Holland, Powell, & Fritzsche, 1994). See Appendix N for this questionnaire.

*Individual Assessment of Project Activities*

The *Individual Assessment of Project Activities* provided learners with the opportunity to discuss their perceptions of the usefulness of the cooperative learning group activities and prompts, particularly in terms of their usefulness in the learning processes as an individual and as a cooperative learning group. See Appendix Q for this questionnaire.

*Follow-up Interview Starter Questions*

One member from half of the cooperative learning groups in each of the treatments was interviewed. The interview questions asked how well the project helped or hindered the individual in learning about biology, being self-regulated, and strengthening self-efficacy about learning and explaining biology topics. Additionally, the interviewee was asked to describe the way his/her cooperative learning group
interacted to accomplish the goals of the project. See Appendix P for a list of the starter interview questions.

**Procedure**

Data were collected through questionnaires administered prior to and at the conclusion of the study, written responses to the prompts, observations of the cooperative learning group interim discussions, observations of the cooperative learning group presentations, and review of the cooperative learning group papers. The questionnaires were related to learner demographics, perceived use of self-regulatory behaviors, biology self-efficacy, and knowledge of the relevant biology topic. Data were analyzed using quantitative and qualitative methods. This section describes the procedure used to collect and analyze the data for this study.

Figure 3.1 illustrates the sequence and type of activities conducted for each treatment level. Procedural similarities and differences between the two course sections are noted in Table 3.2. Appendix O illustrates the week within the semester that each activity occurred for both course sections. Because the studies started at different times of the semester for each course section, Appendix R illustrates the week within the semester that each activity occurred.

**Pre-Intervention Activities**

Prior to the study, the instructor presented the project to the class and allowed learners to choose the human system or endangered species to discuss. Within the next two weeks, the researcher attended class and obtained informed consent from the learners. Because this class was an introductory college course, it was thought that some learners might be under 18 years of age. Though this was not the case, the researcher, was prepared to provide learners under 18-years old with parental consent forms and minor assent forms to be returned one week later.
### Figure 3.1: Sequence and Comparison of Activities

<table>
<thead>
<tr>
<th>Time</th>
<th>Prior to the intervention</th>
<th>Intervention Instructions</th>
<th>Planning Prompts</th>
<th>Monitoring Prompts</th>
<th>Project Completion</th>
<th>Evaluating Prompts</th>
<th>After the intervention</th>
<th>After MSLQ and Self-Efficacy Instruments were completed</th>
<th>After individual assessments were completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>More guided questioning prompts</td>
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<td></td>
<td>- What are we trying to do here?</td>
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<td>- Are we using our plan or strategy? How closely are we following our plan or strategy?</td>
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<td>- What do we know about the problem so far?</td>
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<td>- Are we getting close to our goal? Why or why not?</td>
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<td>- What characteristics or abilities do we have that may be used to accomplish this project?</td>
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<td>- Do we need a new strategy? If so, what is it?</td>
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<td>Knowing the characteristics and abilities we do or do not have, what strategies can we use to accomplish this project?</td>
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<td>- What should we do next?</td>
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<td>- What is our plan?</td>
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<td>- Is there another way to do this?</td>
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<td>- Turn in paper</td>
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<td></td>
<td>- Motivated Strategies for Learning Questionnaire</td>
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<td>- Turn in Responsibilities Chart</td>
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<td>- College Biology Self-efficacy Instrument for Non-majors</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>- Directions for the activity</td>
<td></td>
<td></td>
<td></td>
<td>- Analyze what worked and what you would change</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Suggestions for developing the project</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- What is our plan?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Is there another way to do this?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- What should we do next?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Figure 3.1: Sequence and Comparison of Activities**
In this class session, learners completed the pre-intervention assessments: a demographics questionnaire, *Motivated Strategies for Learning Questionnaire (MSLQ)* (Pintrich et al., 1991), *College Biology Self-Efficacy Instrument for Non-Majors* (Baldwin et al., 1999), and the competency test related to the course section’s topic area (human systems or endangered species). Learners were given one class period to complete the pre-intervention assessments. During the next week, learners who did not complete the forms in class were given the option either to complete the forms in class or to complete all forms, except the competency test, outside of class.

**Intervention Activities**

For five to fifteen minutes during class each week, cooperative learning groups were able to discuss their project. Each cooperative learning group received and responded to the guided questioning prompts, described in the Instructional Materials section, on paper. The researcher circulated through the class, observing communication within the cooperative learning groups.

**Post-intervention Activities**

During the fourth week of the intervention, learners submitted their cooperative learning group paper and began to give their presentations to the class. At the conclusion of the study, each cooperative learning group submitted a *Responsibilities Chart* that outlined the roles and tasks completed by each cooperative learning group member.

Learners completed the *Motivated Strategies Learning Questionnaire (MSLQ)* (Pintrich et al., 1991) and *College Biology Self-Efficacy Instrument for Non-Majors* (Baldwin et al., 1999) a second time.

The demographics questionnaire was replaced with the follow-up questionnaire about the amount of time spent weekly in activities not related to the course. Learners were also asked to name their major as well as their interest in scientific activities. See Appendix N for this questionnaire.

Learners were also given an *Individual Assessment of Project Activities* questionnaire, in which they were able to discuss their perceptions of the usefulness of the cooperative learning group activities and prompts as well as the participation within their cooperative learning groups. See Appendix Q for this questionnaire.
Additionally, the researcher interviewed selected learners. One learner from half of the cooperative learning groups within each treatment level, usually the cooperative learning group leader, was asked to talk to the researcher about their experiences with the activities. Though it was anticipated that the interviews would be no longer than 15 minutes, they varied in length depending on the interviewee from 15 to 25 minutes. See Appendix P for the list of starter interview questions.

To select learners to interview, the researcher used a random number generator to select the groups to be interviewed. If the group had a leader, this person participated in the interview. However, if the group leader was unable to conduct the interview, other group members were asked to participate in the interview as available.

**Procedural Differences Between Course Sections**

Because the study took place in two course sections, it would be helpful to note the similarities and differences between these sections, as illustrated in Table 3.2.

<table>
<thead>
<tr>
<th>Component</th>
<th>Course Section A</th>
<th>Course Section B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Topic Area</td>
<td>Human body systems</td>
<td>Florida endangered species</td>
</tr>
<tr>
<td>Presentation</td>
<td>Place organs on model; explain purpose, function, and diseases of system; Creative method of presenting</td>
<td>PowerPoint slides of endangered species, including habitat and relationships with other organisms</td>
</tr>
<tr>
<td>Paper Length</td>
<td>1 page</td>
<td>1,000 words</td>
</tr>
<tr>
<td>Class Environment</td>
<td>M, W, F</td>
<td>T, Th</td>
</tr>
<tr>
<td>Class session days</td>
<td>50 minutes</td>
<td>75 minutes</td>
</tr>
<tr>
<td>Time of class session</td>
<td>7:00-7:50 AM</td>
<td>8:35-8:50 AM</td>
</tr>
<tr>
<td>Component</td>
<td>Course Section A</td>
<td>Course Section B</td>
</tr>
<tr>
<td>------------------------------------------------</td>
<td>------------------</td>
<td>-----------------------------------------------------</td>
</tr>
<tr>
<td>Cooperative Learning</td>
<td>Yes</td>
<td>No-Some may opt to work individually</td>
</tr>
<tr>
<td>All class members participating in groups</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Previous use of CL in class</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Group formation</td>
<td>Selection of system</td>
<td>Seating arrangement on first day of class</td>
</tr>
<tr>
<td>Other group activities during the intervention</td>
<td>No</td>
<td>Daily discussions with same group/quiz by 1 member of the group once a week</td>
</tr>
<tr>
<td>Instructional Materials</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suggestions for Developing Project</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Responsibilities Chart</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Responsibilities Chart Example</td>
<td>Adapted for human system</td>
<td>Adapted for endangered species</td>
</tr>
<tr>
<td>Selection of Treatment</td>
<td>Odd, even (odd –to have more in more guided prompt treatment)</td>
<td>Odd, even (odd –to have more in more guided prompt treatment)</td>
</tr>
</tbody>
</table>

Both courses met in the morning on the community college’s main campus for the duration of the entire semester. However, Course Section A met three days a week for 50 minutes each, while Course Section B met two days a week for 75 minutes each.

The projects in each course were similar in that learners worked in cooperative learning groups of four (except for some cooperative learning groups that had less people) to develop a paper and presentation to the class about a biology topic. However, they differed in the biology topic, length of paper, and type of presentation.

There were several differences in the manner in which the cooperative learning groups were formed for each course section. In Course Section A, group membership was determined by learner selection of presentation topic. Group numbers were established by the order that the topic was named. In Course Section B, group membership and group numbers were established by seating arrangements at the beginning of the semester. Cooperative learning groups in Course Section A had a designated leader, while
cooperative learning groups in Course Section B did not. All learners in Course Section A were required to participate in cooperative learning group activities, while learners in Course Section B were given the option to work alone. Assignment of cooperative learning groups to treatments was the same for both course sections.

Learners in Course Section A did not have structured in-class cooperative learning activities prior to the commencement of this study, whereas learners in Course Section B were already participating in cooperative learning group activities with the same cooperative learning groups on a weekly basis prior to the beginning of this study.

The commencement of the intervention occurred at differing points in the semester due to the instructor’s schedule. Course Section A began the intervention during the fifth week of the semester, while Course Section B began the intervention during the eighth week of the semester. There were also differences in the administration of the questionnaires. Learners in Course Section A were asked to complete all post-intervention questionnaires, except for the competency test, outside of class. However, learners in Course Section B completed all questionnaires during class.

The intervention activities were the same for both course sections. In both sections, learners were given the same guidelines for working in groups and prompts. The Responsibilities Charts were the same, except that the examples were adapted to content related to the course section’s topic. Once a week, learners worked in cooperative learning groups to respond to the prompts. Each course section received the Planning and Monitoring prompts over the same duration of time.

All of the cooperative learning groups completed their presentations and responded to the Evaluating prompts as a group. However, due to the differing number of cooperative learning groups, one course section spent more time conducting presentations than the other. Therefore, different amounts of time elapsed between the time of the last Monitoring prompts and the Evaluating prompts. After the cooperative learning groups evaluated their activities, individuals completed the post-intervention assessments, including the Individual Assessment of Project Activities. After completing these questionnaires, learners were given the topic-specific competency test. After the post-intervention questionnaires were completed, one learner from half of the cooperative learning groups in each treatment level participated in an interview with the researcher.
Hypotheses

The following were the hypotheses related to this study:

Hypothesis 1a

The cooperative learning groups who receive the more guided questioning prompts will perform better on the project (presentation and paper), as measured by project scores, than those who receive the less guided questioning prompts.

Rationale for Hypothesis 1a

It was anticipated that the more guided questioning prompts would lead the cooperative learning group through the process of monitoring. According to Schunk (2001), learners go through three subprocesses in self-regulation: self-observation, self-judgment, and self-reaction. In the self-observation subprocess, learners record their behaviors used to accomplish a goal. The learners then judge their accomplishment against the predetermined standards. Next, the learners react to these judgments, by examining reasons and attributions for goal attainment. These reactions then affect future goals. The prompts given to those in the MGQP treatment level in the Monitoring phase were developed to facilitate this process.

As stated earlier, cooperative learning groups in the MGQP treatment level were asked, “Are we using our plan or strategy? How closely are we following our plan or strategy?” To facilitate self-judgment, learners were asked, “Are we getting closer to our goal?” They were then asked, “Why or why not?” to facilitate self-reaction. Finally, they were asked, “Do we need a new strategy? If so, what is it?” and “What should we do next?” to push them to begin the cycle again.

The cooperative learning groups with less guided questioning prompts were simply asked to “Report on group activities.” Schunk (1996) found that as learners were able to conduct self-evaluations during the learning process, they had higher self-efficacy and motivation and performed better on the task than those who were only given goals. Though cooperative learning groups in both treatments in the current study were able to conduct self-evaluations during the course of the project, the cooperative learning groups in the MGQP treatment level were given a process that models the self-regulation subprocesses of self-observation, self-judgment, and self-reaction. Additionally, these learners were prompted to develop new learning and project development strategies, if
needed. It was anticipated that learners in the MGQP treatment level would be more likely to modify and adopt strategies that would, in turn, improve their process of achieving success. Therefore, it was anticipated that these learners would be more evaluative of their process for developing the project and would adjust their strategies, leading to higher performance.

*Hypothesis 1b*

The individual learners in cooperative learning groups who receive the more guided questioning prompts will perform better on the topic-specific competency test than those learners whose cooperative learning groups receive the less guided questioning prompts.

*Rationale for Hypothesis 1b*

It was anticipated that learners who received the more guided questioning prompts would perform better on the post-intervention topic-specific competency test than those who received the less guided questioning prompts because they would be more likely to (1) engage in deeper thinking within their cooperative learning group discussions and (2) transfer the self-regulatory skills learned within the cooperative learning group activities to their own studying activities. The self-regulatory skills used during individual study time would result in greater performance on individual assessments.

It was anticipated that learners who received the more guided questioning prompts would be more likely to engage in deeper discussion of the material during the time that the cooperative learning group discussed the material and project monitoring. Though the questions used in other studies were more directly related to problem-solving, other researchers have found that guided questioning prompts facilitate deeper thinking about the material (King, 1991; Ge & Land, 2003; Young, 1997). It was hypothesized that elaborated discussions within the cooperative learning group environment would enable learners to learn the material for themselves, resulting in better performance on individual assessments.

Second, it was anticipated that learners who received the more guided questioning prompts would be more likely to transfer the self-regulatory skills to their own personal learning activities, as will be discussed in Hypotheses 1c. Key to the purpose of the more
guided questioning prompts was that learners were guided through the subprocesses of self-regulation and encouraged to modify their use of cognitive strategies during the learning process. Though both treatments allowed cooperative learning groups to monitor their activities and utilize cognitive strategies to some degree, it was anticipated that those receiving the more guided questioning prompts would develop the processes of self-regulation. Pintrich and DeGroot (1990) found that academic achievement could be better predicted using self-regulatory strategies than using cognitive strategies alone. Therefore, those who utilize the more guided questioning prompts would be more likely to develop self-regulatory skills as individuals, which in turn, enable them to perform better on individual assessments of knowledge.

Hypothesis 1c

Those individual learners whose cooperative learning groups receive the more guided questioning prompts will have greater perceived use of self-regulatory behaviors than those who receive the less guided questioning prompts when considering pre-intervention ratings, as measured by the Motivated Strategies for Learning Questionnaire (MSLQ) (Pintrich et al., 1991).

Rationale for Hypothesis 1c

Zimmerman (Schunk & Zimmerman, 1997; Zimmerman, 2000) states there are four stages in which learners develop and implement self-regulation. They are observation, emulation, self-controlled, and self-regulation. During the observation stage, learners observe how others who are self-regulated model their self-regulation. During the emulation stage, learners practice self-regulatory behaviors and are provided feedback. During the self-controlled stage, learners attempt to integrate these skills on their own in other similar situations. Finally, those in the self-regulated stage adopt these skills in a variety of situations.

The current study examined the use of guided questioning prompts within a cooperative learning group as a way for learners to develop self-regulatory skills and then to apply them to themselves. Stright and Supplee (2003) state that small group activities provide the unique opportunity for learners to develop self-regulatory skills. When compared to teacher-directed and individual seatwork activities, small group activities provide an optimal chance to develop self-regulation skills, because the advantages of
teacher-directed activities and of individual seatwork are combined. Like teacher-directed activities, learners are able to work with peers who may model self-regulatory behavior while having the independence of individual seatwork to be able to self-regulate their learning.

Within a cooperative learning group, learners may see others modeling self-regulatory behaviors, which is fundamental in the observation phase. The more guided questioning prompts guide the learners through the process of self-regulation, in which they would have the opportunity to practice the self-regulatory process and provide each other feedback, which is key to the emulation phase. As learners practice the self-regulatory process within their cooperative learning groups, they were more likely to move into the self-controlled phase, in which they incorporate these skills into other similar activities. Therefore, it was anticipated that learners in the MGQP treatment level would report greater use of self-regulatory skills on the post-intervention administration of the MSLQ when considering pre-intervention ratings.

**Hypothesis 1d**

Those individual learners whose cooperative learning groups receive the more guided questioning prompts will have greater biology self-efficacy than those who receive the less guided questioning prompts when considering pre-intervention scores, as measured by the College Biology Self-Efficacy Instrument for Non-Majors (Baldwin et al., 1999).

**Rationale for Hypothesis 1d**

It was anticipated that learners who received the more guided questioning prompts would have greater biology self-efficacy because the prompts: (1) explicitly guided the learner through regular monitoring of goals, (2) led them through the self-evaluative process, including attribution identification, and (3) encouraged the learners to modify their strategies to improve performance. When strategies are modified and performance improved, learners would feel more efficacious.

A factor in the development of self-efficacy is the type of goals that are set and monitored. Schunk (2003) states that self-efficacy can be boosted through the planning and monitoring of goals that are specific, proximal, and of moderate difficulty. Part of self-regulatory behavior is setting interim goals and monitoring them on a regular,
frequent basis. The more guided questioning prompts explicitly guide the learner through regular monitoring of goals, by asking, “Are we getting closer to our goal?”

As learners evaluate their progress with their interim goals, their efficacy would be affected. As learners achieve their goals, they would feel more efficacious. The opposite would typically be true if they did not achieve their goal. However, the reasons that learners attribute for not attaining the goal impact their efficacy and later goal setting (Zimmerman, 1998). If cooperative learning groups do not succeed at their interim goals, it was anticipated that the prompts, “Are we closer to our goal? Why or why not?” would enable the learners to reflect on their attributions.

Learner attributions about their level of success provide input into how they adapt their learning activities (Zimmerman & Martinez-Pons, 1992). To facilitate this movement from identifying attributions to modifying learning activities, the more guided questioning prompts asked, “Do we need a new strategy? If so, what is it?” and “What should we do next?” to adjust their strategy. As learners adjust their strategies, it was anticipated that they would be more successful, which would lead to greater self-efficacy. Therefore, it was anticipated that those learners in the MGQP treatment level would report greater biology self-efficacy when considering initial biology self-efficacy scores on the *College Biology Self-Efficacy Instrument for Non-Majors* (Baldwin et al., 1999).

**Hypothesis 2**

Learners who were initially low on the aptitude variables of self-regulation and self-efficacy will benefit more from guided questioning prompts than those initially high, in terms of individual academic achievement.

**Rationale for Hypothesis 2**

Many factors affect performance. The use of self-regulatory behaviors and self-efficacy has been positively correlated with each other. They are also positively correlated with prior knowledge. It is very likely that those who initially rate themselves high in their perceived use of self-regulatory behaviors and biology self-efficacy have been successful learners in the past and have developed strategies to increase success. They were more likely to rely on strategies that have been successful in the past and would be less likely to use new strategies. However, those who initially rate themselves
low on the aptitude variables of self-regulation and self-efficacy would be more likely to utilize new strategies.

Young (1996) conducted a study in which fifth grade learners participated in computer-based instruction with two levels of control: learner and performance. Those in the learner-controlled environment were able to select the order of the instruction, while those in the performance-controlled environment followed a pre-determined order of instruction. He found that learners who initially rated themselves high in self-regulatory behaviors performed better on learner-controlled activities than those learners who rated themselves low, but also found that learners who initially rated themselves high in self-regulatory behaviors performed similarly to those learners who rated themselves low in performance-controlled activities. Because the degree of control in the performance-controlled computer-based instruction was higher than in the learner-controlled computer-based instruction, learners who initially rated themselves low on their use of self-regulatory behaviors benefited more from the computer-based instruction’s greater scaffolding of learning activities.

Similar to Young’s (1996) study, the current study provided more scaffolding for those who receive the more guided questioning prompts than those who receive the less guided questioning prompts. It was anticipated that those who rated themselves low on the aptitude variables of self-regulation and biology self-efficacy would benefit more from the more guided questioning prompts than those who initially rated themselves high. It was anticipated that those who rated themselves low would be more likely to use the new self-regulatory behaviors to obtain success. Those who rated themselves high on initial use of self-regulatory behaviors would be less likely to use the new self-regulatory behaviors, because they already developed strategies that have helped them to attain their level of success.
CHAPTER 4: RESULTS

The reader is reminded that this study compared student performance in two different sections of a biology for non-majors course. Different instructors taught the sections and students studied different topics. One section studied human systems (Course Section A) and the other studied endangered species (Course Section B). In each section, students were placed into groups of 3 or 4; half of the groups received either the more guided questioning prompts (MGQP) treatment, or the less guided questioning prompt (LGQP) treatment. Dependent variables included performance on a group project, individual academic performance on a topic-specific competency test, pre- and post-intervention self-regulation inventory, and pre- and post-intervention biology self-efficacy scores.

Prior to the intervention, 66 participants in 17 cooperative learning groups completed the questionnaires. However, data from 37 participants in 12 cooperative learning groups were analyzed. Twenty-nine participants and five cooperative learning groups were not included in the final analysis for various reasons. One student completed the pre-intervention questionnaires, but did not complete the course and begin the intervention. Nine students did not complete the course and project. Three students did not complete the project as part of their assigned group. Two students were not present to participate in at least two sets of prompts. Ten students did not complete the post-intervention questionnaires, despite being provided various opportunities to complete the questionnaires within one month of the study’s completion.

Because of this attrition, one cooperative learning group had no participants who completed at least two sets of prompts and post-intervention questionnaires. Therefore, the group data for this cooperative learning group were removed. Four cooperative learning groups each had only one member participate in at least two sets of prompts and complete the post-intervention questionnaires. In order to have data from cooperative learning groups of similar size, the group as well as the individual data were removed.

This chapter will present the results in correspondence with each hypothesis. First, a preliminary analysis related to the sample and testing of assumptions for parametric tests will be presented. Then, those findings associated with the quantitative analysis of each hypothesis will be presented, followed by a qualitative analysis.
Quantitative Analysis

Preliminary Analysis

The following were examined as part of the preliminary analysis to ensure the validity of the study’s findings: missing participants, missing participants according to treatment level, and individual cases, as noted in Appendix S. In addition, the methods for managing data were determined for: missing data, equality of treatment group sizes, and topic-specific competency test differences.

Missing Participants Analysis

To calculate whether there were any significant difference between the students who completed the final surveys and the missing participants, an analysis of variance (ANOVA) was calculated for each of the following pre-intervention assessments: knowledge questionnaire, overall and scale scores on the Motivated Strategies for Learning Questionnaire (MSLQ) (Pintrich et al., 1991), and overall and scale scores on the College Biology Self-Efficacy Instrument for Non-Majors (Baldwin et al., 1999). As illustrated in Table 4.1, no significant differences were found between these two groups; therefore, the study’s validity was maintained. See Appendix S for a description of the examination of the assumptions for the analysis of variance (ANOVA) test.

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Intervention Topic-Specific Competency Test</td>
<td>$F(1,64)= 1.260, p=.266$</td>
</tr>
<tr>
<td>Motivated Strategies for Learning Questionnaire</td>
<td></td>
</tr>
<tr>
<td>Overall</td>
<td>$F(1,64)= .001, p=.975$</td>
</tr>
<tr>
<td>Motivation scale</td>
<td></td>
</tr>
<tr>
<td>Value components</td>
<td></td>
</tr>
<tr>
<td>Intrinsic goal orientation</td>
<td>$F(1,64)= .699, p=.406$</td>
</tr>
<tr>
<td>Extrinsic goal orientation</td>
<td>$F(1,64)= .612 , p=.437$</td>
</tr>
<tr>
<td>Task Value</td>
<td>$F(1,64)= .069 , p=.794$</td>
</tr>
<tr>
<td>Expectancy components</td>
<td></td>
</tr>
<tr>
<td>Control beliefs</td>
<td>$F(1,64)= 1.411, p=.239$</td>
</tr>
<tr>
<td>Self-efficacy for learning and performance</td>
<td>$F(1,64)= .107 , p=.744$</td>
</tr>
<tr>
<td>Affective component</td>
<td></td>
</tr>
<tr>
<td>Test anxiety</td>
<td>$F(1,64)= .240, p=.626$</td>
</tr>
</tbody>
</table>
Table 4.1: Results of ANOVA for Missing Participants Continued

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Learning strategies scale</strong></td>
<td><strong>Results</strong></td>
</tr>
<tr>
<td><strong>Cognitive and metacognitive strategies</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Rehearsal</strong></td>
<td>F(1,64)= .296, p=.589</td>
</tr>
<tr>
<td><strong>Elaboration</strong></td>
<td>F(1,64)= .007, p=.934</td>
</tr>
<tr>
<td><strong>Organization</strong></td>
<td>F(1,64)= .738, p=.393</td>
</tr>
<tr>
<td><strong>Critical thinking</strong></td>
<td>F(1,64)= 2.137, p=.149</td>
</tr>
<tr>
<td><strong>Metacognitive self-regulation</strong></td>
<td>F(1,64)= .905, p=.345</td>
</tr>
<tr>
<td><strong>Resource management strategies</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Time and study environment</strong></td>
<td>F(1,64)= .030 , p=.863</td>
</tr>
<tr>
<td><strong>Effort regulation</strong></td>
<td>F(1,64)= .369 , p=.546</td>
</tr>
<tr>
<td><strong>Peer learning</strong></td>
<td>F(1,64)= .246, p=.622</td>
</tr>
<tr>
<td><strong>Help seeking</strong></td>
<td>F(1,64)= .121, p=.729</td>
</tr>
<tr>
<td><strong>College Biology Self-efficacy Instrument for Non-majors</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Overall</strong></td>
<td>F(1,64)= .580 , p=.449</td>
</tr>
<tr>
<td><strong>Generalization to other biology/science course and analyzing data</strong></td>
<td>F(1,64)= 1.207, p=.276</td>
</tr>
<tr>
<td><strong>Application of biological concepts and skills</strong></td>
<td>F(1,64)= .019, p=.891</td>
</tr>
</tbody>
</table>

**Missing Participant Analysis According to Treatment Level**

To calculate whether there were any significant difference between the students who completed the final surveys and the missing participants in the two treatment levels, a two-way ANOVA was calculated for each of the following pre-intervention assessments: knowledge questionnaire, overall and scale scores on the Motivated Strategies for Learning Questionnaire (MSLQ) (Pintrich et al., 1991), and overall and scale scores on the College Biology Self-Efficacy Instrument for Non-Majors (Baldwin et al., 1999). No interactions between the treatment and the type of completion were found for each assessment and subscale. In addition, no main effects were found either the treatment or the type of completion for each assessment and subscale. Therefore, the study’s validity was maintained. The results of the two-way analysis of variance (2-way ANOVA) are noted in Table 4.2. See Appendix S for a description of the examination of the assumptions for the two-way analysis of variance (2-way ANOVA) test.
<table>
<thead>
<tr>
<th>Assessment</th>
<th>Interaction</th>
<th>Main Effect for Treatment Level</th>
<th>Main Effect for Completing Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge questionnaire</td>
<td>F(1, 62)=.780, p=.380</td>
<td>F(1, 62)=.182, p=.743</td>
<td>F(1, 62)=1.979, p=.393</td>
</tr>
<tr>
<td>MSLQ</td>
<td>F(1, 62)=.258, p=.613</td>
<td>F(1, 62)=.001, p=.970</td>
<td>F(1, 62)=.187, p=.667</td>
</tr>
<tr>
<td>Motivation scale</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Value components</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intrinsic goal orientation</td>
<td>F(1, 62)=2.878, p=.095</td>
<td>F(1, 62)=.697, p=.407</td>
<td>F(1, 62)=.596, p=.443</td>
</tr>
<tr>
<td>Extrinsic goal orientation</td>
<td>F(1, 62)=.357, p=.552</td>
<td>F(1, 62)=1.657, p=.203</td>
<td>F(1, 62)=.787, p=.378</td>
</tr>
<tr>
<td>Task Value</td>
<td>F(1, 62)=.150, p=.700</td>
<td>F(1, 62)=.083, p=.775</td>
<td>F(1, 62)=.031, p=.862</td>
</tr>
<tr>
<td>Expectancy components</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control beliefs</td>
<td>F(1, 62)=.025, p=.875</td>
<td>F(1, 62)=.068, p=.796</td>
<td>F(1, 62)=1.456, p=.232</td>
</tr>
<tr>
<td>Self-efficacy for learning and performance</td>
<td>F(1, 62)=.746, p=.391</td>
<td>F(1, 62)=.328, p=.569</td>
<td>F(1, 62)=.110, p=.742</td>
</tr>
<tr>
<td>Affective component</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test anxiety</td>
<td>F(1, 62)=2.248, p=.139</td>
<td>F(1, 62)=.477, p=.492</td>
<td>F(1, 62)=.180, p=.673</td>
</tr>
<tr>
<td>Learning strategies scale</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cognitive and metacognitive strategies</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rehearsal</td>
<td>F(1, 62)=.631, p=.430</td>
<td>F(1, 62)=2.451, p=.123</td>
<td>F(1, 62)=.455, p=.503</td>
</tr>
<tr>
<td>Elaboration</td>
<td>F(1, 62)=.220, p=.641</td>
<td>F(1, 62)=.040, p=.843</td>
<td>F(1, 62)=.025, p=.876</td>
</tr>
<tr>
<td>Organization</td>
<td>F(1, 62)=.921, p=.341</td>
<td>F(1, 62)=.148, p=.702</td>
<td>F(1, 62)=.630, p=.430</td>
</tr>
<tr>
<td>Critical thinking</td>
<td>F(1, 62)=.837, p=.364</td>
<td>F(1, 62)=.547, p=.462</td>
<td>F(1, 62)=2.075, p=.155</td>
</tr>
<tr>
<td>Metacognitive self-regulation</td>
<td>F(1, 62)=.405, p=.527</td>
<td>F(1, 62)=.325, p=.571</td>
<td>F(1, 62)=.839, p=.363</td>
</tr>
<tr>
<td>Resource management strategies</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time and study environment</td>
<td>F(1, 62)=.084, p=.773</td>
<td>F(1, 62)=.208, p=.650</td>
<td>F(1, 62)=.018, p=.893</td>
</tr>
<tr>
<td>Effort regulation</td>
<td>F(1, 62)=.000, p=.997</td>
<td>F(1, 62)=.269, p=.606</td>
<td>F(1, 62)=.269, p=.606</td>
</tr>
<tr>
<td>Peer learning</td>
<td>F(1, 62)=.794, p=.376</td>
<td>F(1, 62)=1.655, p=.203</td>
<td>F(1, 62)=.332, p=.567</td>
</tr>
<tr>
<td>Help seeking</td>
<td>F(1, 62)=1.774, p=.188</td>
<td>F(1, 62)=1.179, p=.282</td>
<td>F(1, 62)=.405, p=.527</td>
</tr>
<tr>
<td>College Biology Self-efficacy Instrument for Non-majors</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall</td>
<td>F(1, 62)=.030, p=.863</td>
<td>F(1, 62)=.319, p=.574</td>
<td>F(1, 62)=.702, p=.405</td>
</tr>
<tr>
<td>Generalization to other biology/science course and analyzing data</td>
<td>F(1, 62)=.119, p=.731</td>
<td>F(1, 62)=.055, p=.816</td>
<td>F(1, 62)=1.291, p=.260</td>
</tr>
<tr>
<td>Application of biological concepts and skills</td>
<td>F(1, 62)=.013, p=.911</td>
<td>F(1, 62)=.950, p=.334</td>
<td>F(1, 62)=.067, p=.797</td>
</tr>
</tbody>
</table>
Analyses of Individual Cases

To calculate whether there were any outliers in the data, a box and whisker plot was utilized for the scores on the post-intervention knowledge questionnaire, overall and scale scores *Motivated Strategies for Learning Questionnaire (MSLQ)* (Pintrich et al., 1991), and overall and scale scores on the *College Biology Self-Efficacy Instrument for Non-Majors* (Baldwin et al., 1999).

*Group project performance*. There was one group of three students in the MGQP treatment level who was displayed as an outlier, as noted in Figure 4.1.

![Figure 4.1: Box Plot and Whisker of Outliers for Group Project Grade](image)

Individual academic achievement-Content Area for Course Section A. There were no outliers for this dependent variable, as noted in Figure 4.2.
Individual academic achievement-Content Area for Course Section B. There were no outliers for this dependent variable, as noted in Figure 4.3.

Self-regulatory behaviors. There were no outliers for this dependent variable, as noted in Figure 4.4.
**Biology self-efficacy.** There were no outliers for this dependent variable, as noted in Figure 4.5.

*Missing Data*

After the post-intervention administration of the various assessments, attempts were made requesting participants to complete missing items. Though several of these attempts were successful, some students had missing items in their final data. The following methods were used to account for this missing data in each of the assessments.
Demographics questionnaire. Though attempts were made to contact students regarding the demographics, no action was taken to account for missing items. The items on this questionnaire are unique, so it was not possible to triangulate existing data to determine responses to missing items.

Topic-specific competency test. Skipped items on the topic-specific competency test were considered incorrect.

Motivated Strategies for Learning Questionnaire (MSLQ). Missing data were accounted for using steps suggested by one of the authors (McKeachie email, 2005). First, for each student, the remaining scores within scales with missing items were used to calculate the median of the scale. Then, the derived median was entered to replace the missing data.

College Biology Self-Efficacy Instrument for Non-Majors. As suggested by one of the authors (Baldwin email, 2005), missing data were accounted for using the following steps. First, for each student, the remaining scores within scales with missing items were used to calculate the mean of the scale. Then, the derived mean was entered to replace the missing data.

Equality of Treatment Group Sizes

Students were assigned to one of 17 cooperative learning groups. At the beginning of the intervention, nine cooperative learning groups received the MGQP treatment and eight cooperative learning groups received the LGQP treatment. Most cooperative learning groups began the intervention with four students. One group in one course section had three students. One group in the other course section had two students due to attrition in the group prior to the intervention activities.

In the initial stage of the study, there were 37 students in nine cooperative learning groups in the MGQP treatment level and 29 students in eight cooperative learning groups in the LGQP treatment level. At the conclusion of the study, there were 23 students in eight cooperative learning groups in the MGQP treatment level and 14 students in four cooperative learning groups in the LGQP treatment level. Therefore, data were analyzed for eight cooperative learning groups who received the MGQP treatment and four cooperative learning groups who received the LGQP treatment.
**Topic-Specific Competency Tests Differences**

The two course sections studied different units in biology (Human Systems and Endangered Species). Hence, participants received different topic-specific competency tests. These topic-specific competency tests varied in the nature of the subject matter and reliability. These variations required separate analysis of these topic-specific competency tests, thus affecting Hypotheses 1b, 2a, and 2b.

**Assumptions for Parametric Tests**

For each hypothesis, preliminary analyses were conducted to determine whether the assumptions for parametric statistics were met. To test each hypothesis, it was proposed that the following would be used: a *t-test* for Hypothesis 1a; a separate *analysis of covariance (ANCOVA)* for Hypotheses 1b, 1c, and 1d; and an aptitude-treatment interaction utilizing a *Moderated Multiple Regression (MMR)* for Hypothesis 2 for both initial self-regulation and initial self-efficacy. Assumptions for each test were examined for each hypothesis, as noted in Appendix T.

**Alternative Statistical Methods for Hypothesis 1**

As illustrated in Table 4.3, the assumptions for the parametric tests were not met for Hypotheses 1a, 1b, 1c, and 1d. The following factors were also considered in determining the choice of statistical methods: size of each group, unequal sample sizes, differences in variance, presence of skewed data or other violations (i.e., outliers and kurtosis) of the assumptions of normality. Based on these factors, it was determined that alternative non-parametric statistics would be used in place of the parametric methods.

**Hypothesis 1a**

For Hypothesis 1a, the assumption of normality was not met. Therefore, it was determined that the non-parametric *Mann-Whitney U* would be used in place of the parametric *t-test*.
<table>
<thead>
<tr>
<th>Assumption</th>
<th>1a</th>
<th>1b - HS</th>
<th>1b - ES</th>
<th>1c</th>
<th>1d</th>
<th>2a - HS</th>
<th>2a - ES</th>
<th>2b - HS</th>
<th>2b - ES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proposed Parametric Test</td>
<td>t-test</td>
<td>ANCOVA</td>
<td>ANCOVA</td>
<td>ANCOVA</td>
<td>ANCOVA</td>
<td>ATI</td>
<td>ATI</td>
<td>ATI</td>
<td>ATI</td>
</tr>
<tr>
<td>Interval Level of Measurement</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Independence</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Normality</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Homogeneity of Variance</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Linearity of DV(s) and Covariate(s)</td>
<td>N/A</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Equality of the Slopes</td>
<td>N/A</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Reliability of the Covariate(s)</td>
<td>N/A</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Linearity of DV(s) and Predictor(s)</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Less Than Complete Multicollinearity</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Use Proposed Test?</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Test to be Used</td>
<td>Mann-Whitney U</td>
<td>Kruskal-Wallis</td>
<td>Kruskal-Wallis</td>
<td>Kruskal-Wallis</td>
<td>Kruskal-Wallis</td>
<td>Moderated Multiple Regression</td>
<td>Moderated Multiple Regression</td>
<td>Moderated Multiple Regression</td>
<td>Moderated Multiple Regression</td>
</tr>
</tbody>
</table>
Hypothesis 1b-Content Area for Course Section A

For Hypotheses 1b of the content area for Course Section A, the following assumptions were not met: homogeneity of variance, linearity of the dependent variables and covariates, equality of the slopes, and reliability of the covariate. Therefore, it was determined that the non-parametric \textit{Kruskal-Wallis} would be used in place of the parametric \textit{analysis of covariance (ANCOVA)}. The \textit{Kruskal-Wallis} is the non-parametric alternative to the parametric \textit{analysis of variance (ANOVA)}. The ANCOVA is a special type of ANOVA; hence the \textit{Kruskal-Wallis} was used in this instance.

Hypothesis 1b-Content Area for Course Section B

For Hypotheses 1b for the content area for Course Section B, all the assumptions were met. However, the assumptions for the content area for Course Section A were not met for this hypothesis. For this hypothesis, the two units will be compared. In order for this comparison to be analogous, the same statistical procedure used with Content Area A, the \textit{Kruskal-Wallis} was used in place of the parametric \textit{analysis of covariance (ANCOVA)}. As discussed in the section of content area for Course Section A, the \textit{Kruskal-Wallis} is the non-parametric alternative to the parametric \textit{analysis of variance (ANOVA)}. The ANCOVA is a special type of ANOVA; hence the \textit{Kruskal-Wallis} was used in these instances.

Hypothesis 1c

The assumption of equality of slopes was not met. Therefore, it was determined that the non-parametric \textit{Kruskal-Wallis} would be used in place of the parametric \textit{analysis of covariance (ANCOVA)}. The \textit{Kruskal-Wallis} is the non-parametric alternative to the parametric \textit{analysis of variance (ANOVA)}. The ANCOVA is a special type of ANOVA; hence the \textit{Kruskal-Wallis} was used in these instances.

Hypothesis 1d

The assumption of equality of slopes was not met. Therefore, it was determined that the non-parametric \textit{Kruskal-Wallis} would be used in place of the parametric \textit{analysis of covariance (ANCOVA)}. The \textit{Kruskal-Wallis} is the non-parametric alternative to the parametric \textit{analysis of variance (ANOVA)}. The ANCOVA is a special type of ANOVA; hence the \textit{Kruskal-Wallis} was used in these instances.
Examination of Assumptions for Hypothesis 2

It was proposed that, “this hypothesis will be analyzed with two trait-treatment interaction analyses. The first analysis will be plotted with performance on the y-axis and initial self-efficacy on the x-axis. The second analysis will be plotted with performance on the y-axis and initial self-regulation on the x-axis. An appropriate trait-treatment analysis will be used to test for significance of the interaction.”

Because two analyses will be conducted, this hypothesis will be divided into two sections, Hypotheses 2a and 2b. To be consistent with other sections of the final write-up about this study, self-regulation will be discussed prior to biology self-efficacy. Hypothesis 2a will discuss the analysis of initial self-regulation. Hypothesis 2b will discuss the analysis of initial biology self-efficacy.

The dependent variable in this hypothesis is the individual academic achievement, as measured by the topic-specific competency test. As noted in the section, “Differences in Topic-Specific Competency Tests,” the analysis of each hypothesis related to this dependent variable was divided according to the topic of the unit covered in each competency test for Course Section A and Course Section B.

Moderated Multiple Regression (MMR)

It was determined that the appropriate trait-treatment analysis would be a Moderated Multiple Regression. According to Overton (2001, p. 218), “this form of moderator effect also has been referred to as an aptitude-treatment interaction” by others (Pintrich, Cross, Kozma, & McKeachie, 1986; Snow & Lohman, 1984). In addition, he quotes others (Aguinis & Pierce, 1998; Aiken & West, 1991; Jaccard, Turrisi, & Wan, 1990; Judd, McClelland, & Culhane, 1995; West, Aiken, & Krull, 1996) who state that Moderated Multiple Regression has become “the most popular statistical technique for investigating interactions in correlational data (p. 218).”

Presentation of Results

Hypothesis 1a

It was hypothesized that students in cooperative learning groups within the MGQP treatment level will perform better on the project (paper and presentation) than those in the LGQP treatment level.
The result of performance on the project was based on the quality of the paper and presentation, using the instructor-developed rubrics. Due to the violation of the normality assumption, the Mann-Whitney U, a non-parametric alternative to the t-test, was used to test this hypothesis. Results of this test showed that there was no statistically significant difference in cooperative learning group performance for the MGQP and LGQP treatment levels (U= 113.5, p=.138).

Hypothesis 1b-Content Area for Course Section A

It was hypothesized that students within the MGQP treatment level will improve more in individual academic achievement than the LGQP treatment level.

Due to the violation of several assumptions related to the analysis of covariance (ANCOVA) test, the Kruskal-Wallis, a non-parametric alternative of the analysis of variance (ANOVA), was used to test this hypothesis. Results of the Kruskal-Wallis test showed that there was no statistically significant mean difference between the MGQP and LGQP treatment levels for individual academic achievement (χ²KW = .759, p=.384).

Hypothesis 1b-Content Area for Course Section B

It was hypothesized that students within the MGQP treatment level will improve more in individual academic achievement than the LGQP treatment level.

Due to the violation of the “equality of slopes” assumption of the analysis of covariance (ANCOVA), the Kruskal-Wallis, a non-parametric alternative of the analysis of variance (ANOVA), was used to test this hypothesis. Results of the Kruskal-Wallis test showed that there was no statistically significant mean difference between the MGQP and LGQP treatment levels for individual academic achievement (χ²KW = 2.119, p=.145).

Hypothesis 1c

It was hypothesized that students within the MGQP treatment level will improve more in perceived use of self-regulatory behaviors than the LGQP treatment level.

Due to the violation of the “equality of slopes” assumption of the analysis of covariance (ANCOVA), the Kruskal-Wallis, a non-parametric alternative of the analysis of variance (ANOVA), was used to test this hypothesis. Results of the Kruskal-Wallis test showed that there was no statistically significant mean difference between the MGQP and LGQP treatment levels for individual academic achievement (χ²KW = .453, p=.501).
Hypothesis 1d

It was hypothesized that students within the MGQP treatment level would have greater biology self-efficacy than the LGQP treatment level.

Due to the violation of the “equality of slopes” assumption of the analysis of covariance (ANCOVA), the Kruskal-Wallis, a non-parametric alternative of the analysis of variance (ANOVA), was used to test this hypothesis. Results of the Kruskal-Wallis test showed that there was no statistically significant mean difference between the MGQP and LGQP treatment levels for individual academic achievement ($\chi^{2}_{KW} = .236, p = .627$).

Hypothesis 2a

It was hypothesized that students who are initially low on self-regulation will benefit more from the MGQP treatment level than those who are initially high on the aptitude variables. The Moderated Multiple Regression (MMR) was used to determine whether there was any significance in the interactive effect of guided questioning prompts and initial self-regulation on individual academic achievement. The results of the MMR failed to identify an interaction of these variables.

Content Area for Course Section A. A review of the trait-treatment diagram of the content area for Course Section A for Hypothesis 2a did not reveal an interaction between the guided questioning prompt treatment levels and initial self-regulation on post-intervention individual academic achievement, as noted in Figure 4.6. This lack of interaction was also supported using the analysis of variance (ANOVA) test ($F = .002, df = 1, 11, p = .962$).
Content Area for Course Section B. A review of the trait-treatment diagram of the content area for Course Section B for Hypothesis 2a did not reveal an interaction between the guided questioning prompt treatment levels and initial self-regulation on post-intervention individual academic achievement, as noted in Figure 4.7. This lack of interaction was also supported using the *analysis of variance (ANOVA)* test (*F* = .076; df=1, 18; *p* = .785).
Hypothesis 2a was not supported for the content area in neither Course Section A nor Course Section B.

Hypothesis 2b

It was hypothesized that students who are initially low on biology self-efficacy will benefit more from the MGQP treatment level than those who are initially high. The Moderated Multiple Regression (MMR) was used to determine whether there was any significance in the interactive effect of guided questioning prompts and initial biology self-efficacy on individual academic achievement. The results of the MMR failed to identify an interaction of these variables.

Content Area for Course Section A. A review of the trait-treatment diagram of the content area for Course Section A for Hypothesis 2b did not reveal an interaction between the guided questioning prompt treatment levels and initial biology self-efficacy on post-intervention individual academic achievement, as noted in Figure 4.8. This lack of interaction was also supported using the analysis of variance (ANOVA) test (F = .446; df = 1, 11; p = .518).

![Figure 4.8: Treatment Level and Initial Self-Efficacy Interaction on Academic Achievement–Content Area for Course Section](image-url)
Content Area for Course Section B. A review of the trait-treatment diagram of the content area for Course Section B for Hypothesis 2b did not reveal an interaction between initial biology self-efficacy and post-intervention individual academic achievement, as noted in Figure 4.9. This lack of interaction was also supported using the analysis of variance (ANOVA) test ($F = .150; \text{df}=1, 18; p = .703$).

![Figure 4.9: Treatment Level and Initial Self-Efficacy Interaction on Academic Achievement-Content Area for Course Section B](image)

Hypothesis 2b was not supported for the content area in neither Course Section A nor Course Section B.

Qualitative Data

The data from five artifacts were qualitatively analyzed, including the project (written and oral reports), group responses to the questioning prompts, comments observed while students engaged in the prompts, student comments to the Individual Assessment of Project Activities questionnaire, and information obtained during interviews with cooperative learning group members at the end of the project.

Development of Coding Schemes

The development of coding schemes varied according to data source and relationship to each dependent variable. Table 4.4 illustrates the data sources for each
dependent variable and hypothesis.

<table>
<thead>
<tr>
<th>Dependent Variable / Hypotheses</th>
<th>Data Source(s)</th>
</tr>
</thead>
</table>
| Group project performance       | - Project: Review of paper  
| 1a: Effect of intervention      | - Project: Observations of presentation  
|                                 | - Responses to prompts  
|                                 | - Interim observations  
|                                 | - *Individual Assessment of Project Activities questionnaire*  
|                                 | - Interviews |
| Individual academic achievement | - Project: Review of paper  
| 1b: Effect of intervention      | - Project: Observations of presentation  
| 2a: Interaction of intervention with initial self-regulatory behaviors | - *Individual Assessment of Project Activities questionnaire*  
| 2b: Interaction of intervention with initial biology self-efficacy | - Interviews |
| Self-regulatory behaviors       | - Responses to prompts  
| 1c: Effect of intervention      | - Interim observations  
|                                 | - *Individual Assessment of Project Activities questionnaire*  
|                                 | - Interviews |
| Biology self-efficacy           | - Responses to prompts  
| 1d: Effect of intervention      | - Interim observations  
|                                 | - *Individual Assessment of Project Activities questionnaire*  
|                                 | - Interviews |

Within each data source, the information was divided so that each chunk of information was related to the same concept. This may mean that one chunk of information was incorporated in more than one sentence. Those sentences that incorporate more than one concept were listed more than once and the portions of the sentence were highlighted according to the various concepts. The following sections describe the codes that were related to each data source.
**Group Project**

The paper and presentation were reviewed in terms of content and style, based on the instructor rubrics. To compare the two class sections similarly, the researcher compiled the criteria from the two instructor rubrics. Because some criteria did not apply to both classes, they were removed. For example, a slideshow presentation was not required in one of the course sections. Because grammar mechanics in the presentation would be difficult to review in the other course section, this criterion was eliminated from both sections.

In addition to content and style, interactions of the cooperative learning group members within their group, other classmates, and the instructor were observed. This interaction was particularly apparent during the post-presentation, question and answer activities. During this time, class members were able to ask questions. In addition, the instructor asked questions and elaborated on the topic. From this post-presentation activity, two codes emerged: student interaction and instructor interaction. Table 4.5 provides a list of the categories related to group project performance and their corresponding codes, subcodes, and subcode definitions.

<table>
<thead>
<tr>
<th>Table 4.5: Codes related to Group Project Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Category/Code</strong></td>
</tr>
<tr>
<td><strong>Paper</strong></td>
</tr>
<tr>
<td><strong>Content</strong></td>
</tr>
<tr>
<td>Required topics are addressed</td>
</tr>
<tr>
<td>Topics elaborated and explained on appropriate level</td>
</tr>
<tr>
<td><strong>Written Style</strong></td>
</tr>
<tr>
<td>Professional/formal style</td>
</tr>
<tr>
<td>Correct spelling, grammar</td>
</tr>
<tr>
<td>Coherence within topics</td>
</tr>
<tr>
<td>Coherence between topics</td>
</tr>
</tbody>
</table>
Table 4.5: Codes related to Group Project Performance Continued

<table>
<thead>
<tr>
<th>Category/Code</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Presentation</td>
<td></td>
</tr>
<tr>
<td>Content Explanation</td>
<td></td>
</tr>
<tr>
<td>Required topics are addressed</td>
<td>The topics required by the instructor were presented</td>
</tr>
<tr>
<td>Topics explained on appropriate level</td>
<td>The topics were explained at the level of detail as defined by the instructor</td>
</tr>
<tr>
<td>Presentation Style</td>
<td></td>
</tr>
<tr>
<td>Organization</td>
<td>Group members presented the material in a logical manner and each group member appeared to know the sequence of the presentation and his/her role</td>
</tr>
<tr>
<td>Creativity</td>
<td>The presentation include creative aspects above the expectation of sharing information</td>
</tr>
<tr>
<td>Even distribution</td>
<td>Each group member participated in the presentation in an equal manner</td>
</tr>
<tr>
<td>Student Interaction</td>
<td></td>
</tr>
<tr>
<td>Able to answer questions</td>
<td>At least one member of the group was able to answer student questions</td>
</tr>
<tr>
<td>Responses were evenly divided</td>
<td>All group members participated in answering student questions</td>
</tr>
<tr>
<td>Instructor Interaction</td>
<td></td>
</tr>
<tr>
<td>Discussion prompts</td>
<td>The instructor prompted the group to discuss a topic further by asking questions</td>
</tr>
<tr>
<td>Elaborated explanations</td>
<td>The instructor provided explanations about topics discussed by the group</td>
</tr>
</tbody>
</table>

**Responses Made to Prompts**

The responses to the Planning and both Monitoring prompts were categorized according to whether the response was related to developing the project goal and commitment to the group, developing a strategy to achieve the goal, performing individual tasks, compiling the project, communicating with group members, and assessing group progress. The codes that emerged from the Evaluating prompts are similar to those discussed in the “Group Learning” portion of the *Individual Assessment of Project Activities* section of this chapter. Table 4.6 provides a list of the categories related to the responses to the Planning and two Monitoring prompts and their corresponding codes and code definitions.
<table>
<thead>
<tr>
<th>Category/Code</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Develop goal/commitment</td>
<td></td>
</tr>
<tr>
<td>Determine goal</td>
<td>The group determined the goal of the project (i.e., good grade or learn about the topic)</td>
</tr>
<tr>
<td>Commit to group</td>
<td>Group members committed to the group that they would work together toward the group goal</td>
</tr>
<tr>
<td>Develop strategy</td>
<td></td>
</tr>
<tr>
<td>Develop plan</td>
<td>The group developed a general plan of how they wanted to accomplish the group goal</td>
</tr>
<tr>
<td>Divide tasks/resources</td>
<td>The group determined who would do what activities and the resources they will use (i.e., library or Internet)</td>
</tr>
<tr>
<td>Assign topics</td>
<td>The group named specific people to research designated topics or perform certain activities</td>
</tr>
<tr>
<td>Develop timeline</td>
<td>The group established interim deadlines to complete activities</td>
</tr>
<tr>
<td>Plan for obstacles</td>
<td>The group planned for obstacles they could foresee (i.e., not accomplishing much during Spring Break)</td>
</tr>
<tr>
<td>Perform individual tasks</td>
<td></td>
</tr>
<tr>
<td>Conduct research</td>
<td>Group members conducted research about their individual topic areas</td>
</tr>
<tr>
<td>Assess progress</td>
<td>The group discussed how each individual was progressing with his/her individual topic</td>
</tr>
<tr>
<td>Compile project</td>
<td></td>
</tr>
<tr>
<td>Compile information</td>
<td>The group compiled all of the information identified by individual into the group project, usually the paper</td>
</tr>
<tr>
<td>Work on presentation</td>
<td>The group developed the final presentation (i.e., created the slideshow presentation or gather materials for the Biology Belle)</td>
</tr>
<tr>
<td>Finalize project</td>
<td>The group finalized the project (i.e., complete the bibliography or add some extra information)</td>
</tr>
<tr>
<td>Communicate with group members</td>
<td></td>
</tr>
<tr>
<td>Meet during class</td>
<td>Group members met only during the delegated class time</td>
</tr>
<tr>
<td>Meet before/after class</td>
<td>Group members met prior to or after class</td>
</tr>
<tr>
<td>Meet outside of class</td>
<td>Group members met at times other than class days</td>
</tr>
<tr>
<td>Email</td>
<td>Group members communicated with each other via e-mail</td>
</tr>
<tr>
<td>Assess group progress</td>
<td></td>
</tr>
<tr>
<td>Assess plan/strategy</td>
<td>The group examined their progress and usefulness of the strategy in accomplishing the goals of the project</td>
</tr>
<tr>
<td>Adjust plan/strategy</td>
<td>The group changed their strategy for accomplishing the goals of the project during the course of the project</td>
</tr>
</tbody>
</table>
**Observations of Interim Activities**

Prior to the study, it was anticipated that the observations of interim activities would be coded according to Stright and Supplee’s (2003) framework. However, the codes that emerged from the data did not align with that framework. The data were categorized first as to who was in attendance during the in-class group meeting. For those who were in attendance, their level of engagement was examined. The definitions of the codes related to the observation of interim activities are described in Table 4.7.

<table>
<thead>
<tr>
<th>Category/Code</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attendance</td>
<td></td>
</tr>
<tr>
<td>Attendees</td>
<td>Group members attended the class/group meeting</td>
</tr>
<tr>
<td>Absentees</td>
<td>Group members did not attend the class/group meeting</td>
</tr>
<tr>
<td>Level of Engagement</td>
<td></td>
</tr>
<tr>
<td>Engaged</td>
<td>Group member participated in the group discussion</td>
</tr>
<tr>
<td>Moderately engaged</td>
<td>Group member participated in the group discussion part of the time and did not participate in the group discussion for the remainder of the time</td>
</tr>
<tr>
<td>Not engaged</td>
<td>Group member did not participate in the group discussion</td>
</tr>
</tbody>
</table>

**Individual Assessment of Project Activities Questionnaire**

The comments written in the *Individual Assessment* of Project Activities were placed categorized according to their relevance to the four dependent variables: (1) group learning, (2) individual learning, (3) individual self-regulatory behaviors, and (4) individual biology self-efficacy. Data were further categorized within each of the dependent variables as described in the following sections.

Group learning. Data related to group learning were categorized using Johnson and Johnson’s (1990) elements of cooperative learning: positive interdependence, individual accountability, face-to-face promotive interaction, interpersonal and small-
group skills, and group processing. Table 4.8 provides definitions of the codes related to group learning which emerged.

<table>
<thead>
<tr>
<th>Category/Code</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive interdependence</td>
<td>Interaction is characterized by an accepted common goal on which all group members will be rewarded equally for the performance of the group as a whole</td>
</tr>
<tr>
<td>Goal interdependence</td>
<td></td>
</tr>
<tr>
<td>Task interdependence</td>
<td>Each member of the group is responsible for a portion of the tasks which need to be completed</td>
</tr>
<tr>
<td>Resource interdependence</td>
<td>Group members are interdependent on each other because they must share resources</td>
</tr>
<tr>
<td>Individual accountability</td>
<td></td>
</tr>
<tr>
<td>Above or expected level of effort</td>
<td>Group members completed allocated tasks at levels which met or exceeded group expectations</td>
</tr>
<tr>
<td>Minimal or no effort</td>
<td>Group members did not complete allocated tasks or completed them at a substandard level</td>
</tr>
<tr>
<td>Tracking individual progress was helpful</td>
<td>Statement by group member(s) that tracking individual progress benefited the group and project</td>
</tr>
<tr>
<td>Unclear/Inaccurate individual progress reports</td>
<td>Group members provided vague or inaccurate reports about individual progress at the interim meetings</td>
</tr>
<tr>
<td>Able to focus on one topic</td>
<td>Statement by group member(s) that a positive aspect of the project was being able to focus on one topic</td>
</tr>
<tr>
<td>Able to work at own pace</td>
<td>Statement by group member(s) that a positive aspect of the project was being able to work at own pace</td>
</tr>
<tr>
<td>Face-to-face promotive interaction</td>
<td></td>
</tr>
<tr>
<td>Held in-class meetings</td>
<td>The group only met during the time allocated during the class when prompts were given</td>
</tr>
<tr>
<td>Met outside of class</td>
<td>The group met outside of class on a regular basis</td>
</tr>
<tr>
<td>Exchanged information</td>
<td>Group members shared findings from individual research and discussed how the findings of the various group members are connected</td>
</tr>
<tr>
<td>Provided feedback</td>
<td>Group members provided individual group members feedback about his/her section of the project</td>
</tr>
</tbody>
</table>
Table 4.8: Codes Related to Elements of Group Learning Continued  

<table>
<thead>
<tr>
<th>Category/Code</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Had difficulties meeting outside of class</td>
<td>The reasons that group provided that they were unable to meet outside of class, such as conflicting or work schedules</td>
</tr>
<tr>
<td>Communicated via email</td>
<td>The group communicated using email</td>
</tr>
<tr>
<td>Small-group skills</td>
<td></td>
</tr>
<tr>
<td>Got to know and trust each other</td>
<td>Group members developed friendships and trusted each other</td>
</tr>
<tr>
<td>Developed leadership skills</td>
<td>Group members gained skills in which they guided other group members or attempted to ensure that all work was completed</td>
</tr>
<tr>
<td>Helped those who needed extra help</td>
<td>Group members offered and/or helped those who had difficulty understanding or completing project tasks</td>
</tr>
<tr>
<td>Communicated accurately and unambiguously</td>
<td>Communication among group members was clear and accurate</td>
</tr>
<tr>
<td>Communicated poorly and in a limited manner</td>
<td>Communication did not occur often or was vague</td>
</tr>
<tr>
<td>Group processing</td>
<td></td>
</tr>
<tr>
<td>Plan/strategy worked well</td>
<td>The plan/strategy helped the group to complete the project well</td>
</tr>
<tr>
<td>Dividing work made project easier</td>
<td>Group (member) perception that dividing work made the project easier than working on the project alone</td>
</tr>
<tr>
<td>Kept on task/schedule</td>
<td>The group, as a whole and as individuals, completed interim tasks and the project according to the scheduled plan</td>
</tr>
<tr>
<td>Did not begin project early enough</td>
<td>Group (member) perception that the group did not begin the project early enough to achieve the project goals</td>
</tr>
<tr>
<td>Difficulty due to other class activities</td>
<td>Group (member) statement that the group had difficulties because there were multiple class activities that caused distractions</td>
</tr>
<tr>
<td>Difficulty due to individual factors</td>
<td>Group (member) statement that the group had difficulties because group members had personal factors that causes distractions</td>
</tr>
<tr>
<td>Difficulty in pulling project together</td>
<td>Group (member) perception that difficulties, whether external factors or group member behaviors, impacted the ability for the project to be completed</td>
</tr>
<tr>
<td>Overcame difficulties</td>
<td>Group (member) statement that the group or its members overcame difficulties to complete the project</td>
</tr>
<tr>
<td>Pleased with process</td>
<td>Group (member) evaluation that the development of the project was positive</td>
</tr>
<tr>
<td>Not pleased with process</td>
<td>Group (member) evaluation that the development of the project was negative</td>
</tr>
<tr>
<td>Pleased with project result</td>
<td>Group (member) evaluation that the project outcome was positive</td>
</tr>
<tr>
<td>Not pleased with project result</td>
<td>Group (member) evaluation that the project outcome was negative</td>
</tr>
</tbody>
</table>
**Individual learning.** The information related to individual learning was first categorized as to whether learners stated that their knowledge for varying levels of scientific topics increased or remained the same during the project. The comments about an increase in learning were further coded as to whether the learner gained a basic overview or in-depth understanding of the material. Table 4.9 provides a list of the categories, related to individual learning and their corresponding codes, subcodes, and subcode definitions.

<table>
<thead>
<tr>
<th>Table 4.9: Codes Related to Individual Learning</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Category/ Code/Subcode</strong></td>
</tr>
<tr>
<td>Increase</td>
</tr>
<tr>
<td>Basic overview</td>
</tr>
<tr>
<td>Science/Biology</td>
</tr>
<tr>
<td>Relationships across presentations</td>
</tr>
<tr>
<td>Presentation topic</td>
</tr>
<tr>
<td>Individual topic</td>
</tr>
<tr>
<td>In-depth</td>
</tr>
<tr>
<td>Science/Biology</td>
</tr>
<tr>
<td>Presentation topic</td>
</tr>
<tr>
<td>Individual topic</td>
</tr>
<tr>
<td>Same</td>
</tr>
<tr>
<td>Science/Biology</td>
</tr>
<tr>
<td>Presentation topic</td>
</tr>
</tbody>
</table>
Individual self-regulatory behaviors. The information related to individual self-regulatory behaviors was categorized using the scales of the Motivated Learning Strategies Questionnaire (Pintrich et al., 1991). The data were then coded according to the components of the MSLQ and further divided into subcodes related to MSLQ subscales. Table 4.10 provides the list of the categories, codes, and subcodes of for each MSLQ scale, component, and subscale identified in the qualitative data of this study and the corresponding definition of the subcodes.

<table>
<thead>
<tr>
<th>Category /Code/Subcode</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motivation Value</td>
<td></td>
</tr>
<tr>
<td>Intrinsic goal orientation</td>
<td>The degree to which the learner’s participation in the task is an end all to itself, rather than participation being a means to an end.</td>
</tr>
<tr>
<td>Extrinsic goal orientation</td>
<td>The degree to which the learner’s main concern is related to issues that are not directly related to participating in the task itself (such as grades, rewards, comparing one’s performance to that of others).</td>
</tr>
<tr>
<td>Task value</td>
<td>Learner’s evaluation of the how interesting, important, and useful the task is.</td>
</tr>
<tr>
<td>Expectancy</td>
<td></td>
</tr>
<tr>
<td>Control of learning beliefs</td>
<td>Learner’s belief that learning outcomes are contingent on one’s own effort.</td>
</tr>
<tr>
<td>Self-efficacy for learning and performance</td>
<td>Judgments about one’s ability to accomplish a task as well as one’s confidence in one’s skills to perform that task.</td>
</tr>
<tr>
<td>Learning Strategies</td>
<td></td>
</tr>
<tr>
<td>Cognitive and Metacognitive Strategies</td>
<td>Perception of the learner that the project helped to increase their self-regulatory behaviors</td>
</tr>
<tr>
<td>Project helped metacognitive self-regulation</td>
<td>Perception of the learner that the project did not change their self-regulatory behaviors</td>
</tr>
<tr>
<td>Project did not help metacognitive self-regulation</td>
<td>Perception of the learner that the project did not change their self-regulatory behaviors</td>
</tr>
</tbody>
</table>
Table 4.10: Codes Related to Individual Self-Regulatory Behaviors Continued

<table>
<thead>
<tr>
<th>Category /Code/Subcode</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resource Management Strategies</td>
<td>Learners’ ability to control their effort and attention in the face of distractions and uninteresting tasks.</td>
</tr>
<tr>
<td>Effort regulation</td>
<td></td>
</tr>
<tr>
<td>Peer learning</td>
<td>The degree to which the learner participated in conversations with peers to clarify course material and reach insights one may not have attained on one’s own.</td>
</tr>
<tr>
<td>Time and study environment</td>
<td>The ability of the learner to manage his/her time through planning, scheduling, and arranging an environment to minimize distractions.</td>
</tr>
</tbody>
</table>

Individual biology self-efficacy. The information related to individual biology self-efficacy was first categorized according to whether the learner stated that their self-efficacy increased or remained the same. Then, the data were coded using the scales of the College Biology Self-Efficacy Instrument for Non-Majors (Baldwin et al., 1999). The scales represented in this study include: “Application of biological concepts and skills” and “Generalization to other biology/science course and analyzing data.” The “Application of biological concepts and skills” scale is represented by the codes, “Confidence to learn” and “Confidence to explain.” The “Generalization to other biology/science course and analyzing data” scale is represented by the code, “Interest.” Finally, the data were coded according to topic for which the type of self-efficacy was discussed. Table 4.11 provides the list of categories, codes, subcodes and subcode definitions related to biology self-efficacy.

Table 4.11: Codes Related to Individual Biology Self-Efficacy

<table>
<thead>
<tr>
<th>Category /Code</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase Interest</td>
<td></td>
</tr>
<tr>
<td>Biology</td>
<td>Learner statement that he/she developed an interest, including a desire to learning more about, biology in general</td>
</tr>
<tr>
<td>Presentation topic</td>
<td>Learner statement that he/she developed an interest, including a desire to learning more about, the presentation topic</td>
</tr>
</tbody>
</table>
### Table 4.11: Codes Related to Individual Biology Self-Efficacy Continued

<table>
<thead>
<tr>
<th>Category / Code</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase (cont.)</td>
<td></td>
</tr>
<tr>
<td>Confidence to Learn Biology</td>
<td>Learner statement that he/she increased his/her confidence to learn about biology in general</td>
</tr>
<tr>
<td>Individual topic</td>
<td>Learner statement that he/she increased his/her confidence to learn about the topic he/she researched within the group’s presentation topic</td>
</tr>
<tr>
<td>Confidence to Explain Biology</td>
<td>Learner statement that he/she increased his/her confidence to explain biology topics to others.</td>
</tr>
<tr>
<td>Presentation topic</td>
<td>Learner statement that he/she increased his/her confidence to explain the group’s presentation topic to others.</td>
</tr>
<tr>
<td>Same</td>
<td></td>
</tr>
<tr>
<td>Interest</td>
<td></td>
</tr>
<tr>
<td>Science</td>
<td>Learner statement that his/her interest in science remained the same</td>
</tr>
<tr>
<td>Explain</td>
<td></td>
</tr>
<tr>
<td>Biology</td>
<td>Learner statement that his/her confidence to explain biology topics remained the same</td>
</tr>
</tbody>
</table>

**Interviews with Selected Cooperative Learning Group Members**

Similar to the coding process used with the *Individual Assessment of Project Activities* questionnaire, the information obtained through the interviews with selected cooperative learning group members was categorized according to its relevance to the four dependent variables: (1) group learning, (2) individual achievement, (3) individual self-regulatory behaviors, and (4) individual biology self-efficacy.

**Process of Comparison**

Since the number of cooperative learning groups and individuals in the treatment levels were unequal, the frequency of counts of codes was converted to percentages. The counts were obtained using the following steps:

1. Responses with the same code from any one individual were grouped together and counted only once.
2. The total number of codes from each treatment level was converted to percentages by dividing them by the number of groups or individuals in each treatment level.
3. The percentages were compared to each other.

*Hypothesis 1a*

It was hypothesized that the cooperative learning groups in the MGQP treatment level would perform better on the project (paper and presentation) than those in the LGQP treatment level. The researcher examined the qualitative data related to this hypothesis in four ways. First, the researcher analyzed the group papers and observations made during the project presentations. Second, the researcher examined the progress of project activities by reviewing the types of activities listed in the responses to the prompts or observed during the interim class sessions. These activities were categorized according to whether the cooperative learning groups stated them as having been completed, in the process of completing, or were planned to complete in the future. Third, the researcher examined the attendance and level of engagement of learners in the discussion of the prompts and project activities. Fourth, the researcher examined the responses to prompts and researcher observations when groups discussed the Evaluating prompts in addition to individual responses to the *Individual Assessment of Project Activities* questionnaire.

*Group Project*

First, the researcher examined the paper and observed the presentations noting the presentation of content and interaction among group members and the class. Then the information was categorized according to the codes developed from the instructor rubrics and observations of the presentations. Table 4.12 notes the percentage of cooperative learning groups which demonstrated each code related to project performance.

<table>
<thead>
<tr>
<th>Table 4.12: Qualitative Results Related to Project Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Category/Code</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Paper</td>
</tr>
<tr>
<td>Content</td>
</tr>
<tr>
<td>Required topics are addressed</td>
</tr>
<tr>
<td>Topics elaborated and explained on appropriate level</td>
</tr>
<tr>
<td>Written style</td>
</tr>
<tr>
<td>Professional/formal style</td>
</tr>
<tr>
<td>Correct spelling, grammar</td>
</tr>
<tr>
<td>Coherence within topics</td>
</tr>
<tr>
<td>Coherence between topics</td>
</tr>
</tbody>
</table>
Cooperative learning groups in both the MGQP and LGQP treatment levels were similar in addressing the required topics and writing in a professional, formal style. However, the papers submitted by the cooperative learning groups in the MGQP treatment level illustrated more collaboration than the cooperative learning groups in the LGQP treatment level. However, more cooperative learning groups in the LGQP treatment level elaborated and explained the various topics at an appropriate level and had more cohesive transitions between topics than those in the MGQP treatment.

During the presentation, cooperative learning groups in both the MGQP and LGQP treatments were similar in addressing the required topics, explaining topics at an appropriate level, dividing the presentation among group members. During the student and instructor question and answer portion of the presentation, a similar percentage of cooperative learning groups in both treatments were able to answer student questions and did so evenly among the group members. In addition, the percentage of cooperative learning groups for whom the instructor prompted discussions was similar. It was found that a greater percentage of cooperative learning groups in the MGQP treatment level demonstrated more organization in their presentations than those in the LGQP treatment level. In addition, the instructor provided elaborated explanations of the presentation topic for a lower percentage of cooperative learning groups in the MGQP treatment level than the LGQP treatment level. However, a greater percentage of cooperative learning
groups in the LGQP treatment level conducted presentations which were more creative than those in the MGQP treatment.

In general, this hypothesis was not supported. However, it is interesting to note that the division of labor in the written portion of the project was more noticeable for cooperative learning groups in the LGQP treatment level than those in the MGQP treatment level. Some divisions of labor were strikingly evident: one group submitted a paper that had page breaks between each section and another group listed the name of the group member responsible for a particular section. The writing style throughout the papers submitted from the cooperative learning groups in the MGQP treatment level remained the same; whereas, the writing style in the papers of the cooperative learning groups in the LGQP treatment level changed as evidenced by differing levels of correct grammar, spelling and punctuation, possibly indicating different authors.

*Interim Progress of Project Activities*

To examine this hypothesis in terms of the progress of cooperative learning groups during the project, responses to prompts and researcher observations during the Planning phase and two sessions in the Monitoring phase were analyzed. The data were categorized according to the activity that groups stated were completed, in the process of being completed, or planning to occur in the future. Table 4.13 illustrates the weekly percentages of cooperative learning groups in each treatment level which discussed project activities as being completed, in process, or planned.

*Week 1.* Cooperative learning groups in both treatment levels were similar in several ways. The percentages of cooperative learning groups were similarly high in both treatment levels for assigning tasks and resources to group members. Cooperative learning groups in both treatment levels did not discuss plans for overcoming obstacles, the later activities of preparing the presentation and finalizing the project, and meeting at times other than during or adjacent to class sessions. As to be expected during the first week, no groups assessed the group project strategy or made adjustments to it.
Table 4.13: Qualitative Results Related to Interim Progress of Project Activities

<table>
<thead>
<tr>
<th>Category/Code</th>
<th>Week 1</th>
<th>Week 2</th>
<th>Week 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Develop goal/commitment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Determine goal</td>
<td>88% 100% 0% 25%</td>
<td>0% 25% 0% 25%</td>
<td>0% 0% 13% 0%</td>
</tr>
<tr>
<td>Commit to group</td>
<td>50% 25% 0% 0%</td>
<td>0% 0% 13% 0%</td>
<td>0% 0% 13% 0%</td>
</tr>
<tr>
<td>Develop strategy</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Develop plan</td>
<td>63% 100% 13% 0%</td>
<td>0% 50% 13% 0%</td>
<td>0% 0% 13% 0%</td>
</tr>
<tr>
<td>Divide tasks/resources</td>
<td>75% 75% 25% 50%</td>
<td>25% 50% 13% 50%</td>
<td>0% 0% 13% 0%</td>
</tr>
<tr>
<td>Assign topics</td>
<td>13% 50% 0% 0%</td>
<td>0% 0% 13% 0%</td>
<td>0% 0% 13% 0%</td>
</tr>
<tr>
<td>Develop timeline</td>
<td>13% 0% 0% 0%</td>
<td>0% 0% 25% 25%</td>
<td>0% 0% 25% 25%</td>
</tr>
<tr>
<td>Plan for obstacles</td>
<td>0% 0% 0% 0%</td>
<td>0% 0% 25% 25%</td>
<td>0% 0% 25% 25%</td>
</tr>
<tr>
<td>Perform individual tasks</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conduct research</td>
<td>0% 0% 50% 25%</td>
<td>0% 0% 50% 25%</td>
<td>0% 0% 50% 25%</td>
</tr>
<tr>
<td>Assess progress</td>
<td>0% 0% 13% 0%</td>
<td>0% 0% 38% 0%</td>
<td>0% 0% 13% 0%</td>
</tr>
<tr>
<td>Compile project</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compile information</td>
<td>0% 0% 13% 25%</td>
<td>0% 0% 0% 0%</td>
<td>0% 0% 0% 0%</td>
</tr>
<tr>
<td>Work on presentation</td>
<td>0% 0% 0% 0%</td>
<td>0% 0% 0% 0%</td>
<td>0% 0% 0% 0%</td>
</tr>
<tr>
<td>Finalize project</td>
<td>0% 0% 0% 0%</td>
<td>0% 0% 0% 0%</td>
<td>0% 0% 0% 0%</td>
</tr>
<tr>
<td>Communicate with group</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meet during class</td>
<td>0% 0% 13% 0%</td>
<td>0% 0% 0% 0%</td>
<td>0% 0% 0% 0%</td>
</tr>
<tr>
<td>Meet before/after class</td>
<td>0% 0% 13% 0%</td>
<td>0% 0% 0% 0%</td>
<td>0% 0% 0% 0%</td>
</tr>
<tr>
<td>Meet outside of class</td>
<td>0% 0% 13% 0%</td>
<td>0% 0% 0% 0%</td>
<td>0% 0% 0% 0%</td>
</tr>
<tr>
<td>Email</td>
<td>0% 0% 13% 25%</td>
<td>0% 0% 0% 0%</td>
<td>0% 0% 0% 0%</td>
</tr>
<tr>
<td>Assess group progress</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assess plan/strategy</td>
<td>0% 0% 0% 0%</td>
<td>0% 0% 50% 0%</td>
<td>0% 0% 0% 0%</td>
</tr>
<tr>
<td>Adjust plan/strategy</td>
<td>0% 0% 0% 0%</td>
<td>0% 0% 38% 0%</td>
<td>0% 0% 0% 0%</td>
</tr>
</tbody>
</table>
During this session, a greater percentage of cooperative learning groups in the MGQP treatment level than those in the LGQP treatment level were in the process of making commitments to their group and developing a timeline. In addition, a greater percentage of cooperative learning groups in the MGQP treatment level than those in the LGQP treatment level were more likely to plan the future activities of continuing to discuss the project plan, conducting individual research, tracking individual progress, and communicating by meeting during or times adjacent to class sessions.

A greater percentage of cooperative learning groups in the LGQP treatment level than those in the MGQP treatment level were in the process of determining the project goal, developing a project plan, and assigning specific topics to certain group members. In addition, a greater percentage of cooperative learning groups in the LGQP treatment level than those in the MGQP treatment level were more likely to plan the future activities of continuing to discuss the project goal, continuing to assign tasks and resources to group members, compiling individual information into a final project, and communicating via email.

Overall, a higher percentage of cooperative learning groups in the LGQP treatment level were proactive in their planning activities during the first week, or the Planning phase, than cooperative learning groups in the MGQP treatment level. For example, a higher percentage of cooperative learning groups in the LGQP treatment level discussed plans for a greater variety of project strategy activities and assigned specific topics to specific group members than those in the MGQP treatment level. In addition, a higher percentage of cooperative learning groups in the LGQP treatment level than those in the MGQP treatment level went beyond the expected form of communication of meeting during or adjacent to class sessions by using e-mail to communicate.

*Week 2.* During the second week, or first session of the Monitoring phase, cooperative learning groups in both treatment levels were similar in that they planned for obstacles. This session occurred prior to Spring Break for Course Section B. In addition, cooperative learning groups in both treatment levels did not discuss finalizing the project and nor make plans to meet during class time.

The percentage of cooperative learning groups in the MGQP treatment level who met outside of class during the previous week was higher than those in the LGQP
treatment level. A greater percentage of cooperative learning groups in the MGQP treatment level than those in the LGQP treatment level were in the process of committing to the group, developing a project plan, assigning specific topics to particular group members, conducting individual research, assessing individual progress, assessing the group strategy, and making adjustments to the strategy. In addition, a greater percentage of cooperative learning groups in the MGQP treatment level than those in the LGQP treatment level were more likely to plan the future activities of committing to the group, developing the project plan, compiling individual information into the combined project, working on the presentation, and communicating by meeting at times adjacent to class sessions.

The percentages of cooperative learning groups in the LGQP treatment level who completed the following activities were higher than those in the MGQP treatment level: determining project goals, developing the project plan, and assigning tasks and resources to group members. A greater percentage of cooperative learning groups in the LGQP treatment level than those in the MGQP treatment level were in the process of determining project goals, developing a timeline, and assigning tasks and resources to group members. In addition, a greater percentage of cooperative learning groups in the LGQP treatment level than those in the MGQP treatment level were more likely to plan the future activities of conducting individual research and communicating by meeting outside of class and via email.

Though the cooperative learning groups in the LGQP treatment level completed more preliminary activities and focused on planning intermediate types of activities, cooperative learning groups in the MGQP treatment level were in the process of completing both preliminary and intermediary activities as well as planning for the final activities of the project. The cooperative learning groups in the LGQP treatment level appear to have taken a sequential approach to developing the project, whereas cooperative learning groups in the MGQP treatment level appeared to not only work on current tasks but were also planning for upcoming activities.

Week 3. During the third week, or second session of the Monitoring phase, cooperative learning groups in both treatment levels were similar in that were in the process of assessing individual progress and adjusting the group project strategy. In
addition, no cooperative learning groups in either treatment level discussed the preliminary activities of the project; such as committing to the group, developing a timeline, assigning tasks and resources to group members, and planning for obstacles. In addition, none of the cooperative learning groups in either treatment level mentioned communicating by meeting during class sessions.

The percentage of cooperative learning groups in the MGQP treatment level who completed the following activity was higher than those in the LGQP treatment level: finalizing the project. A greater percentage of cooperative learning groups in the MGQP treatment level than those in the LGQP treatment level were in the process of determining the project goal, developing the project plan, conducting individual research, and assessing the group project strategy. In addition, a greater percentage of cooperative learning groups in the MGQP treatment level than those in the LGQP treatment level were more likely to plan the future activities of adjusting the group project strategy and communicating by meeting at times adjacent to class sessions.

The percentages of cooperative learning groups in the LGQP treatment level who completed the following activities were higher than those in the MGQP treatment level: conducting individual research and compiling individual information into the group project. A greater percentage of cooperative learning groups in the LGQP treatment level than those in the MGQP treatment level were in the process of compiling individual information into the group project and communicating via email. In addition, a greater percentage of cooperative learning groups in the LGQP treatment level than those in the MGQP treatment level were more likely to plan the future activities of compiling individual information into the group project, working on the presentation, finalizing the project and communicating by meeting outside of class.

Cooperative learning groups in the MGQP treatment level appeared to have a greater range in regards to the point where they were in the process of developing the project. Some cooperative learning groups stated that they completed finalizing the project or were in the process of compiling individual information into the group project. Others were planning the final steps of compiling individual information into the group project and finalizing the project. There was also a small percentage of groups in the
process of completing the preliminary and intermediary activities of determining the project goal, developing the project plan, and conducting individual research.

Cooperative learning groups in the LGQP treatment level appeared to be more similar in regards to the point they were in the process of developing the project. None of the cooperative learning groups mentioned the preliminary types of activities. Cooperative learning groups in the LGQP treatment level were more likely to state that they had completed conducting individual research and compiling individual information into the group project. At a similar point in the process, several cooperative learning groups in the LGQP treatment level were more likely to state that they were in the process of compiling individual information into the group project and planning to compile individual information into the group project, work on the presentation, and finalize the project. Cooperative learning groups in the LGQP treatment level were more likely than those in the MGQP treatment level to mention communicating by meeting outside of class, while cooperative learning groups in the MGQP treatment level were more likely than those in the LGQP treatment level to mention communicating by meeting at times adjacent to the class sessions.

As in Week 2, cooperative learning groups in the LGQP treatment level appeared to take a linear approach to planning the project. Cooperative learning groups in the MGQP treatment level seemed to have more variance about the point where they were in the process of completing the project. This is of particular concern, because this was the last meeting prior to conducting the presentation and submitting the paper to the instructor.

Summary of Weekly Activities. During the first week, cooperative learning groups in the LGQP were more proactive in their planning by determining their project goals, developing their plan, and planning to assign tasks and resources to group members. Of special note, it is important to note that cooperative learning groups in the LGQP treatment level were more likely to specifically name the members who would conduct research about particular topics and perform certain activities. In addition, they were proactive in planning to communicate outside of class via email. During the second week, cooperative learning groups in the LGQP treatment level were more likely to state that they had completed several preliminary activities. They appeared to be approaching the
project in a sequential manner, while cooperative learning groups appeared to be approaching the project working on the preliminary and intermediate activities while planning for the final stages of the project. Cooperative learning groups in the LGQP treatment level were still more likely to discuss plans to communicate with each other not only with email, but added meetings outside of class to their plans. As in Week 2, cooperative learning groups in the LGQP treatment level appeared were more sequential in their approach to planning the project than cooperative learning groups in the MGQP treatment level. Also similar to Week 2, there was more variety in the points in the process of developing the project for cooperative learning groups in the MGQP treatment level than for cooperative learning groups in the LGQP treatment level. As in all prior weeks, cooperative learning groups in the LGQP treatment level were more committed to communicating with each other. They were more likely than those in the MGQP treatment level to mention communicating by meeting outside of class whereas the small percentage of cooperative learning groups in the MGQP treatment level who mentioned communication discussed meeting at times adjacent to the class sessions.

**Engagement in Interim Discussions**

To examine the processes that occurred during group learning, the researcher observed the interactions of the group members while discussing the prompts during the Planning phase and the two sessions of the Monitoring phase. Table 4.14 illustrates the weekly percentage of students in each treatment level who were engaged in the prompts at varying degrees.

<table>
<thead>
<tr>
<th>Category/Code</th>
<th>Week 1</th>
<th>Week 2</th>
<th>Week 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MGQP N=23</td>
<td>LGQP N=14</td>
<td>MGQP N=23</td>
</tr>
<tr>
<td>Attendance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attendees</td>
<td>18 (78%)</td>
<td>10 (71%)</td>
<td>22 (96%)</td>
</tr>
<tr>
<td>Absentees</td>
<td>5 (22%)</td>
<td>4 (29%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Level of Engagement</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engaged</td>
<td>15 (65%)</td>
<td>9 (64%)</td>
<td>16 (70%)</td>
</tr>
<tr>
<td>Moderately engaged</td>
<td>3 (13%)</td>
<td>1 (7%)</td>
<td>1 (4%)</td>
</tr>
<tr>
<td>Not Engaged</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>5 (22%)</td>
</tr>
</tbody>
</table>
For each week, the percentages of members of cooperative learning groups in both the MGQP and LGQP treatments were similar. For the most part, the percentages of members of cooperative learning groups who engaged in the discussion of the prompts were similar each week. The only exception to this occurrence was during Week 2 in which a greater percentage of members of cooperative learning groups in the LGQP treatment level were engaged or moderately engaged in discussing the prompts while a higher percentage of members of cooperative learning groups in the MGQP treatment level were not engaged in discussion about the prompts. It should also be noted that no members of cooperative learning groups in the LGQP treatment level were identified as not being engaged in the discussing the prompts, while members of cooperative learning groups in the MGQP treatment level were identified as not being engaged in discussing the prompts during Weeks 2 and 3.

**Group Learning Process**

To examine this hypothesis in terms of the group learning processes used by the cooperative learning groups, the researcher examined responses to the *Individual Assessment of Project Activities* and the responses made to the prompts and observations of the researcher during the Evaluating phase of the project. Table 4.15 provides the percentage of cooperative learning groups in each treatment level in which at least one member discussed the aspect of the group learning process.

<table>
<thead>
<tr>
<th>Category/Code</th>
<th>MGQP</th>
<th></th>
<th>LGQP</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Positive interdependence</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Goal interdependence</td>
<td>2</td>
<td>25%</td>
<td>3</td>
<td>75%</td>
</tr>
<tr>
<td>Task interdependence</td>
<td>8</td>
<td>100%</td>
<td>4</td>
<td>100%</td>
</tr>
<tr>
<td>Resource interdependence</td>
<td>2</td>
<td>25%</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td><strong>Individual accountability</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Above or expected effort</td>
<td>5</td>
<td>63%</td>
<td>3</td>
<td>75%</td>
</tr>
<tr>
<td>Minimal or no effort</td>
<td>5</td>
<td>63%</td>
<td>4</td>
<td>100%</td>
</tr>
<tr>
<td>Tracking individual progress was helpful</td>
<td>4</td>
<td>50%</td>
<td>1</td>
<td>25%</td>
</tr>
<tr>
<td>Unclear/Inaccurate individual progress reports</td>
<td>2</td>
<td>25%</td>
<td>2</td>
<td>50%</td>
</tr>
<tr>
<td>Able to focus on one topic</td>
<td>3</td>
<td>38%</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Able to work at own pace</td>
<td>1</td>
<td>13%</td>
<td>0</td>
<td>0%</td>
</tr>
</tbody>
</table>
Table 4.15: Qualitative Results Related to Group Learning Process Continued

<table>
<thead>
<tr>
<th>Category/Code</th>
<th>MGQP</th>
<th></th>
<th>LGQP</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N = 8</td>
<td>%</td>
<td>N = 4</td>
<td>%</td>
</tr>
<tr>
<td>Promotive interaction</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Held in-class meetings</td>
<td>2</td>
<td>25%</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Met outside of class</td>
<td>2</td>
<td>25%</td>
<td>1</td>
<td>25%</td>
</tr>
<tr>
<td>Exchanged information</td>
<td>6</td>
<td>75%</td>
<td>2</td>
<td>50%</td>
</tr>
<tr>
<td>Provided feedback</td>
<td>2</td>
<td>25%</td>
<td>1</td>
<td>25%</td>
</tr>
<tr>
<td>Had difficulties meeting outside of class</td>
<td>5</td>
<td>63%</td>
<td>4</td>
<td>100%</td>
</tr>
<tr>
<td>Communicated via email</td>
<td>2</td>
<td>25%</td>
<td>2</td>
<td>50%</td>
</tr>
<tr>
<td>Social skills</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Got to know and trust each other</td>
<td>3</td>
<td>38%</td>
<td>3</td>
<td>75%</td>
</tr>
<tr>
<td>Developed leadership skills</td>
<td>3</td>
<td>38%</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Helped those who needed extra help</td>
<td>1</td>
<td>13%</td>
<td>1</td>
<td>25%</td>
</tr>
<tr>
<td>Communicated accurately and unambiguously</td>
<td>7</td>
<td>88%</td>
<td>3</td>
<td>75%</td>
</tr>
<tr>
<td>Communicated poorly and in a limited manner</td>
<td>3</td>
<td>38%</td>
<td>1</td>
<td>25%</td>
</tr>
<tr>
<td>Group processing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plan/strategy worked well</td>
<td>2</td>
<td>25%</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Dividing work made project easier</td>
<td>5</td>
<td>63%</td>
<td>1</td>
<td>25%</td>
</tr>
<tr>
<td>Group kept on task/schedule</td>
<td>0</td>
<td>0%</td>
<td>1</td>
<td>25%</td>
</tr>
<tr>
<td>Did not begin project early enough</td>
<td>2</td>
<td>25%</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Difficulty due to other class activities</td>
<td>1</td>
<td>13%</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Difficulty due to individual factors</td>
<td>1</td>
<td>13%</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Difficulty in pulling project together</td>
<td>2</td>
<td>25%</td>
<td>1</td>
<td>25%</td>
</tr>
<tr>
<td>Overcame difficulties</td>
<td>2</td>
<td>25%</td>
<td>2</td>
<td>50%</td>
</tr>
<tr>
<td>Pleased with process</td>
<td>3</td>
<td>38%</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Not pleased with process</td>
<td>0</td>
<td>0%</td>
<td>1</td>
<td>25%</td>
</tr>
<tr>
<td>Pleased with project result</td>
<td>4</td>
<td>50%</td>
<td>1</td>
<td>25%</td>
</tr>
<tr>
<td>Not pleased with project result</td>
<td>1</td>
<td>13%</td>
<td>0</td>
<td>0%</td>
</tr>
</tbody>
</table>

The same percentage of cooperative learning groups in the MGQP and LGQP treatment levels had at least one person mention that the cooperative learning group members provided feedback to each other. In addition, the same percentage of cooperative learning groups in the MGQP and LGQP treatment levels had at least one person mention that the cooperative learning group met outside of class and had difficulty pulling the project together. From the qualitative data, it seemed that cooperative learning groups in the MGQP treatment level were more focused on tasks of the project, while those in the LGQP treatment level were more focused on the social interactions that occurred during the project.

For the positive interdependence element of cooperative learning, a greater percentage of cooperative learning groups in the MGQP treatment level than the LGQP treatment level had at least one person mention the group’s resource interdependence,
while a greater percentage of cooperative learning groups in the LGQP treatment level than the MGQP treatment level had at least one person mention the group’s goal interdependence.

For the individual accountability element of cooperative learning, a greater percentage of cooperative learning groups in the MGQP treatment level than the LGQP treatment level had at least one person mention that tracking individual progress was helpful and that the activity enabled them to focus on one topic and work at their own pace. A greater percentage of cooperative learning groups in the LGQP treatment level than the MGQP treatment level had at least one person mention the level of effort of group members, whether they performed above or at expected levels and a minimal or no level of effort. In addition, they were more likely to mention that group members provided unclear or inaccurate individual progress reports.

For the promotive interaction element of cooperative learning, a greater percentage of cooperative learning groups in the MGQP treatment level than the LGQP treatment level had at least one person mentioned that they held in-class meetings and exchanged information during those meetings. A greater percentage of cooperative learning groups in the LGQP treatment level than the MGQP treatment level had at least one person mention that they had difficulties meeting outside of class and communicated via email.

For the element of cooperative learning related to social skills, a greater percentage of cooperative learning groups in the MGQP treatment level than the LGQP treatment level had at least one person mentioned that leadership skills were developed and discussed the communication within the group, whether it was accurate and unambiguous or poor and limited. A greater percentage of cooperative learning groups in the LGQP treatment level than the MGQP treatment level had at least one person mention that they got to know and trust each other and helped those who needed extra help.

For group processing, a greater percentage of cooperative learning groups in the MGQP treatment level than the LGQP treatment level had at least one person mentioned that their group’s plan or strategy worked well, dividing work made the project easier, and the group did not begin the project early enough. They were also more likely to mention that there were difficulties due to other class activities or individual factors.
Overall, they were pleased with the process that was used to complete the project and were more likely to state whether or not they were pleased with the project result. A greater percentage of cooperative learning groups in the LGQP treatment level than the MGQP treatment level had at least one person mention that the group kept on task with the schedule during the project and overcame difficulties. They were also more likely to mention that they were not pleased with the process used to develop the project.

**Group Composition**

The composition of each cooperative learning group was examined for the group project grade and number of group members who completed the project as well as the mean, standard deviation, and range of scores for pre- and post-intervention scores on the topic-specific competency tests, *Motivated Strategies for Learning Questionnaire* (MSLQ; Pintrich et al, 1991), and *College Biology Self-Efficacy Instrument for Non-Majors* (Baldwin et al, 1999). No meaningful pattern appeared as a function of group composition. See Appendix U for a table illustrating cooperative learning group composition.

**Hypothesis 1b**

For Hypothesis 1b, it was hypothesized that those individuals in the MGQP treatment level would have greater individual academic achievement than those individuals in the LGQP treatment level. To examine this hypothesis, comments from the *Individual Assessment of Project Activities* and interviews of representative cooperative learning group members were examined. Table 4.16 notes the percentage of individuals from each treatment level who provided statements about the amount and type of learning they obtained.

<table>
<thead>
<tr>
<th>Category/Code</th>
<th>MGQP</th>
<th>%</th>
<th>LGQP</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basic overview</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Science/Biology</td>
<td>1</td>
<td>4%</td>
<td>2</td>
<td>14%</td>
</tr>
<tr>
<td>Relationships across presentations</td>
<td>3</td>
<td>13%</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Presentation topic</td>
<td>1</td>
<td>4%</td>
<td>2</td>
<td>14%</td>
</tr>
<tr>
<td>Individual topic</td>
<td>1</td>
<td>4%</td>
<td>2</td>
<td>14%</td>
</tr>
</tbody>
</table>
Table 4.16: Qualitative Results Related to Individual Academic Achievement Continued

<table>
<thead>
<tr>
<th>Category/Code</th>
<th>MGQP N=23</th>
<th>%</th>
<th>LGQP N=14</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase (Continued)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In-depth</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Science/Biology</td>
<td>2</td>
<td>8%</td>
<td>1</td>
<td>7%</td>
</tr>
<tr>
<td>Presentation topic</td>
<td>6</td>
<td>26%</td>
<td>2</td>
<td>14%</td>
</tr>
<tr>
<td>Individual topic</td>
<td>2</td>
<td>9%</td>
<td>1</td>
<td>7%</td>
</tr>
<tr>
<td>Same</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Science/Biology</td>
<td>1</td>
<td>4%</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Presentation topic</td>
<td>1</td>
<td>4%</td>
<td>1</td>
<td>7%</td>
</tr>
</tbody>
</table>

Individuals in both the MGQP and LGQP treatment levels were similar in stating that they increased in an in-depth understanding of science, biology, and individual topics within the presentation. Additionally, individuals in both the MGQP and LGQP treatment levels were similar in stating that their knowledge of their presentation topic remained the same as it had prior to the project.

It was found that individuals in the MGQP treatment level were more likely to state that they increased in a basic overview of the scientific concepts across the various presentations and an in-depth understanding of their presentation topics than those individuals in the LGQP treatment level. In addition, they were more likely to state that their knowledge of science and biology remained the same.

It was also found that individuals in the LGQP treatment level were more likely to state that they gained a basic understanding of science and biology, their presentation topic, and individual topics.

This hypothesis was somewhat supported in that the type and amount of knowledge gained by individuals in the MGQP treatment level was more intensive than the type and amount of knowledge gained by those in the LGQP treatment level. Though learners in the LGQP treatment level were more likely to state an increased basic understanding of various topics, only learners in the MGQP treatment level stated that they gained a basic overview across the presentations. This type of understanding requires learners to make connections of concepts across the various presentations. In addition, those in the MGQP treatment level were more likely to state they gained an in-depth understanding of the presentation topic. Overall, the hypothesis was not supported.
Hypothesis 1c

For Hypothesis 1c, it was hypothesized that individuals in the MGQP treatment level would become more self-regulated in their individual study behaviors than individuals in the LGQP treatment level. To examine this hypothesis, comments from the Individual Assessment of Project Activities and interviews of representative cooperative learning group members were examined. Table 4.17 notes the percentage of individuals from each treatment level who provided statements about their individual self-regulatory behaviors.

Table 4.17: Qualitative Results Related to Self-perceptions of Individual Self-regulatory Behaviors

<table>
<thead>
<tr>
<th>Category/Code</th>
<th>MGQP</th>
<th></th>
<th>LGQP</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>N=23</td>
<td></td>
<td>%</td>
<td>N=14</td>
<td>%</td>
</tr>
<tr>
<td>Motivation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Value</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intrinsic goal orientation</td>
<td>1</td>
<td>4%</td>
<td>1</td>
<td>7%</td>
</tr>
<tr>
<td>Extrinsic Goal Orientation</td>
<td>3</td>
<td>13%</td>
<td>3</td>
<td>21%</td>
</tr>
<tr>
<td>Task Value</td>
<td>1</td>
<td>4%</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Expectancy</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control of Learning Beliefs</td>
<td>4</td>
<td>17%</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Self-Efficacy for Learning and Performance</td>
<td>2</td>
<td>9%</td>
<td>1</td>
<td>7%</td>
</tr>
<tr>
<td>Learning Strategies</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cognitive and Metacognitive Strategies</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Project helped metacognitive self-regulation</td>
<td>1</td>
<td>4%</td>
<td>2</td>
<td>14%</td>
</tr>
<tr>
<td>Project did not help metacognitive self-regulation</td>
<td>5</td>
<td>22%</td>
<td>2</td>
<td>14%</td>
</tr>
<tr>
<td>Resource management</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Effort regulation</td>
<td>3</td>
<td>13%</td>
<td>3</td>
<td>21%</td>
</tr>
<tr>
<td>Peer Learning</td>
<td>6</td>
<td>26%</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Time and Study Environment</td>
<td>4</td>
<td>17%</td>
<td>1</td>
<td>7%</td>
</tr>
</tbody>
</table>

Individuals in both the MGQP and LGQP treatment levels were similar in making comments related to having self-efficacy for learning and performance, intrinsic goal orientation, and the value of the task, or project. Those in the MGQP treatment level were more likely than those in the LGQP treatment level to make comments related to having a strong belief in their individual control of learning, especially in terms of not wanting to depend on others. Those in the MGQP treatment level were more likely than those in the
LGQP treatment level to discuss having peers help them and that they increased their management of their time and study environment, especially in terms of staying on schedule.

Those in the LGQP treatment level were more likely to state that the project helped them improve their individual self-regulatory behaviors and to discuss the persistence of individuals in accomplishing the goals of the project despite personal or group concerns than those in the MGQP treatment level. In addition, those in the LGQP treatment level were more likely than those in the MGQP treatment level to make comments indicating an extrinsic goal orientation of wanting to perform well for the instructor or peers.

Therefore, this hypothesis was contradicted. Those in the LGQP treatment level were more likely to state that the project helped them improve their individual self-regulatory behaviors than those in the MGQP treatment level. To further substantiate this finding, those in the MGQP treatment level were more likely than those in the LGQP treatment level to state that the project did not help them improve their individual self-regulatory behaviors.

It is interesting to note that individuals in the LGQP treatment level were more influenced by external factors than individuals in the MGQP treatment level. Those in the LGQP treatment level stated that their goals were related to grades and instructor and cooperative group member expectations. They were also more likely to describe the persistence in the face of external, personal issues.

**Hypothesis 1d**

For Hypothesis 1d, it was hypothesized that individuals in the MGQP treatment level would be more self-efficacious about biology than those in the LGQP treatment level. To examine this hypothesis, comments from the *Individual Assessment of Project Activities* and interviews of representative cooperative learning group members were examined. From these artifacts, it was found that individuals in both of the MGQP and LGQP treatment levels felt efficacious about learning biology. Table 4.18 notes the percentage of individuals from each treatment level who provided statements about the amount and type of biology self-efficacy they obtained.
Table 4.18: Qualitative Results Related to Individual Biology Self-efficacy

<table>
<thead>
<tr>
<th>Category/Code</th>
<th>MGQP N=23</th>
<th>MGQP %</th>
<th>LGQP N=14</th>
<th>LGQP %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interest</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biology</td>
<td>1</td>
<td>4%</td>
<td>2</td>
<td>14%</td>
</tr>
<tr>
<td>Presentation topic</td>
<td>1</td>
<td>4%</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Confidence to Learn</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biology</td>
<td>2</td>
<td>9%</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Individual topic</td>
<td>1</td>
<td>4%</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Confidence to Explain</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biology</td>
<td>1</td>
<td>4%</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Presentation topic</td>
<td>2</td>
<td>9%</td>
<td>2</td>
<td>14%</td>
</tr>
<tr>
<td>Same</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interest</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Science</td>
<td>1</td>
<td>4%</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Confidence to Explain</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biology</td>
<td>0</td>
<td>0%</td>
<td>1</td>
<td>7%</td>
</tr>
</tbody>
</table>

Individuals in both the MGQP and LGQP treatment levels were similar in stating that they increased their interest in their presentation topic, self-efficacy for learning their individual topic, and self-efficacy to explain biology topics and their presentation topics. Individuals in the MGQP treatment level were more likely to state that they increased in their efficacy to learn biology topics than those in the LGQP treatment level. Individuals in the LGQP treatment level were more likely to state that their interest in biology increased and self-efficacy to explain biology topics remained the same than those in the MGQP treatment level. This hypothesis was not supported.

**Hypothesis 2**

For Hypothesis 2, it was hypothesized that students who are initially low on the aptitude variables of self-regulation and self-efficacy will benefit more from guided questioning prompts than those initially high, in terms of individual academic achievement. To examine this hypothesis, comments from the *Individual Assessment of Project Activities* and interviews of representative cooperative learning group members were examined along with observations of oral presentations, written projects, group interactions, and notations on the *Responsibilities Chart.*
Learners were categorized as having either high or low initial self-regulatory behaviors depending on their self-perceived ratings on the Motivated Strategies for Learning Questionnaire (Pintrich et al, 1991) and having high or low initial self-efficacy for biology depending on their self-perceived ratings on the College Biology Self-Efficacy Instrument for Non-Majors (Baldwin et al., 1999).

For both aptitudes, 13 of the 23 learners in the MGQP treatment were categorized as initially having a high amount of each aptitude while 10 were categorized as initially having a low amount of each aptitude. Similarly, 6 of the 14 learners in the LGQP treatment level initially had a high amount of both aptitudes and 8 initially had a low amount of both aptitudes.

Hypothesis 2a: Interaction of Initial Self-Regulation and Treatment Level

For Hypothesis 2a, it was hypothesized that students who are initially low on the aptitude variable of self-regulation will benefit more from guided questioning prompts than those initially high, in terms of individual academic achievement. Table 4.19 illustrates the number and percentage of learners in each combination of treatment level and initial self-perceived self-regulatory behaviors who commented on each type and amount of learning.

Table 4.19: Qualitative Results Related to Interaction of Treatment Level with Initial Self-regulation

<table>
<thead>
<tr>
<th>Category/Code</th>
<th>MGQP</th>
<th></th>
<th></th>
<th>LGQP</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High SR N=13</td>
<td>Low SR N=10 %</td>
<td></td>
<td>High SR N=6</td>
<td>Low SR N=8 %</td>
</tr>
<tr>
<td>Increase</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basic overview</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Science/Biology</td>
<td>0 0%</td>
<td>1 10%</td>
<td>0 0%</td>
<td>2 25%</td>
<td></td>
</tr>
<tr>
<td>Relationships across presentations</td>
<td>3 23%</td>
<td>0 0%</td>
<td>0 0%</td>
<td>0 0%</td>
<td></td>
</tr>
<tr>
<td>Presentation topic</td>
<td>0 0%</td>
<td>1 10%</td>
<td>1 17%</td>
<td>1 13%</td>
<td></td>
</tr>
<tr>
<td>Individual topic</td>
<td>0 0%</td>
<td>1 10%</td>
<td>1 17%</td>
<td>1 13%</td>
<td></td>
</tr>
<tr>
<td>In-depth</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Science/Biology</td>
<td>2 16%</td>
<td>0 0%</td>
<td>1 17%</td>
<td>0 0%</td>
<td></td>
</tr>
<tr>
<td>Presentation topic</td>
<td>6 46%</td>
<td>0 0%</td>
<td>1 17%</td>
<td>1 13%</td>
<td></td>
</tr>
<tr>
<td>Individual topic</td>
<td>2 15%</td>
<td>0 0%</td>
<td>0 0%</td>
<td>1 13%</td>
<td></td>
</tr>
<tr>
<td>Same</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Science</td>
<td>0 0%</td>
<td>1 10%</td>
<td>0 0%</td>
<td>0 0%</td>
<td></td>
</tr>
<tr>
<td>Biology</td>
<td>1 8%</td>
<td>0 0%</td>
<td>0 0%</td>
<td>1 13%</td>
<td></td>
</tr>
</tbody>
</table>
Learners in the MGQP treatment level who initially rated themselves as having a high number of self-regulatory behaviors were more likely than any other group to state that they gained a basic overview of scientific concepts across all of the presentations and an in-depth understanding of their group presentation topics. This finding may show an effect of the treatment level with those who rate themselves as having a high amount of self-regulatory behaviors. Learners in the MGQP treatment level who initially rated themselves as having a low number of self-regulatory behaviors were more likely than any other group to state that their knowledge of science remained the same. This finding is one factor which contradicts the hypothesis. Learners in the LGQP treatment level who initially rated themselves as having a low number of self-regulatory behaviors were more likely than any other group to state that they gained a basic overview of science and biology.

Learners who initially rated themselves as having a high number of self-regulatory behaviors, whether they were in the MGQP or LGQP treatment level, were more likely to state that they gained an in-depth understanding of science and biology. Though no learners in the MGQP treatment level who initially rated themselves as having a high number of self-regulatory behaviors stated that they gained a basic overview of their group’s presentation topic or individual topic within the presentation topic, a small percentage from each of the other three categories stated that they did.

It was also found that learners who initially rated themselves as having a high number of self-regulatory behaviors in the MGQP treatment level and those who initially rated themselves as having a low number of self-regulatory behaviors in the LGQP treatment level were similar in gaining an in-depth knowledge of their individual topic while remaining same in their knowledge of science. No learners who initially rated themselves as having a low number of self-regulatory behaviors in the MGQP treatment level and those who initially rated themselves as having a high number of self-regulatory behaviors in the LGQP treatment level referred to those topics of learning. This hypothesis was not supported.

**Hypothesis 2b: Interaction of Initial Biology Self-Efficacy and Treatment Level**

For Hypothesis 2b, it was hypothesized that students who are initially low on the aptitude variable of biology self-efficacy will benefit more from guided questioning.
prompts than those initially high, in terms of individual academic achievement. Table 4.20 illustrates the number and percentage of learners in each combination of treatment level and initial biology self-efficacy who commented on each type and amount of learning.

<table>
<thead>
<tr>
<th>Category/Code</th>
<th>MGQP High SE</th>
<th>MGQP Low SE</th>
<th>LGQP High SE</th>
<th>LGQP Low SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basic overview</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Science/Biology</td>
<td>0 0%</td>
<td>1 10%</td>
<td>0 0%</td>
<td>2 25%</td>
</tr>
<tr>
<td>Relationships across presentations</td>
<td>2 15%</td>
<td>1 10%</td>
<td>0 0%</td>
<td>0 0%</td>
</tr>
<tr>
<td>Presentation topic</td>
<td>0 0%</td>
<td>1 10%</td>
<td>1 17%</td>
<td>1 13%</td>
</tr>
<tr>
<td>Individual topic</td>
<td>0 0%</td>
<td>1 10%</td>
<td>1 17%</td>
<td>1 13%</td>
</tr>
<tr>
<td>In-depth</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Science/Biology</td>
<td>0 0%</td>
<td>2 20%</td>
<td>1 17%</td>
<td>0 0%</td>
</tr>
<tr>
<td>Presentation topic</td>
<td>3 23%</td>
<td>3 30%</td>
<td>0 0%</td>
<td>2 25%</td>
</tr>
<tr>
<td>Individual topic</td>
<td>1 8%</td>
<td>1 10%</td>
<td>0 0%</td>
<td>1 13%</td>
</tr>
<tr>
<td>Same</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Science</td>
<td>0 0%</td>
<td>1 10%</td>
<td>0 0%</td>
<td>0 0%</td>
</tr>
<tr>
<td>Biology</td>
<td>1 8%</td>
<td>0 0%</td>
<td>0 0%</td>
<td>1 13%</td>
</tr>
</tbody>
</table>

Learners in the MGQP treatment level, whether they initially rated themselves as having a high or low amount of biology self-efficacy were more likely to state that they gained a basic overview of scientific concepts across all of the presentations. This finding lends some support to the hypothesis in that no learners in the LGQP treatment level mentioned gaining this type of knowledge. However, learners in the MGQP treatment level who initially rated themselves as having a low amount of biology self-efficacy were more likely than any other group to state that their knowledge of science remained the same. This finding is one factor which contradicts the hypothesis.

Learners who initially rated themselves as having a low amount of biology self-efficacy, whether they were in the MGQP or LGQP treatment level, were more likely to state that they gained a basic overview understanding of science and biology.
Though no learners in the MGQP treatment level who initially rated themselves as having a high amount of biology self-efficacy stated that they gained a basic overview of their group’s presentation topic or individual topic within the presentation topic, a small percentage from each of the other three categories stated that they did. Somewhat similar in the terms of initial self-ratings, learners in the LGQP treatment level who initially rated themselves as having a high amount of biology self-efficacy stated that they gained an in-depth understanding of their group’s presentation topic or individual topic within the presentation topic, while a small percentage from each of the other three categories stated that they did.

It was also found that learners who initially rated themselves as having a high amount of biology self-efficacy in the MGQP treatment level and those who initially rated themselves as having a low amount of biology self-efficacy in the LGQP treatment level were similar in remaining same in their knowledge of science. No learners who initially rated themselves as having a low amount of biology self-efficacy in the MGQP treatment level and those who initially rated themselves as having a high amount of biology self-efficacy in the LGQP treatment level mentioned remaining same in their knowledge of science. In contrast, learners who initially rated themselves as having a low amount of biology self-efficacy in the MGQP treatment level and those who initially rated themselves as having a high amount of biology self-efficacy in the LGQP treatment level were similar in gaining an in-depth understanding of science and biology. No learners who initially rated themselves as having a high amount of biology self-efficacy in the MGQP treatment level and those who initially rated themselves as having a low amount of biology self-efficacy in the LGQP treatment level mentioned remaining same in their knowledge of science. This hypothesis was not supported.

Summary

Overall, the hypotheses were not confirmed in relation to group performance, individual academic achievement, student perceived use of self-regulatory behaviors, and biology self-efficacy. Also, the hypotheses related to the interaction of the guided questioning prompt treatment levels with the initial aptitudes of self-regulatory behaviors and biology self-efficacy were not confirmed.
CHAPTER 5: DISCUSSION AND CONCLUSION

Overview

The purpose of this study was to examine the effect of two levels of guided questioning prompts within cooperative learning groups on group performance, individual academic achievement, individual self-regulatory behavior, and individual biology self-efficacy of learners in two sections of a non-majors biology class at a community college. Also examined were the effects of initial self-regulatory behavior, biology self-efficacy, and prior knowledge on individual academic achievement.

This chapter first provides a brief summary of the results, and then describes possible explanations for the results related to each hypotheses based on relevant literature. This discussion is followed by the implications and limitations of this study. Finally, the implications of the current study and recommendations for future studies are presented.

Summary of Results

For the final data analysis, data from 37 of the original 66 participants were used; 29 participants were eliminated due to incomplete data. Contrary to the hypotheses, the statistical analysis results did not show significant effects of more guided questioning prompts (MGQP) on group performance, individual academic achievement, perceived use of self-regulatory behaviors, and biology self-efficacy as compared to those of less guided questioning prompts (LGQP). Additionally, statistical significance was not found in the interaction between the two levels of guided questioning prompts with neither initial self-regulation nor initial biology self-efficacy on individual academic achievement.

The qualitative data provided some support for the hypothesis that the more guided questioning prompts (MGQP) provided more benefit than the less guided questioning prompts (LGQP) regarding group project performance in terms of project outcomes. However, the qualitative data related to group project performance in terms of the processes used by cooperative learning groups to complete the project contradicted the hypothesis. The qualitative data yielded some support of the hypothesis regarding individual academic achievement. However, the qualitative data did not support the hypotheses in terms of the perceived use of self-regulatory behaviors and biology self-
efficacy. In addition, the qualitative data did not support the hypotheses that the guided questioning prompts would have an interactive effect with the initial attributes of self-regulatory behaviors or biology self-efficacy on individual academic achievement. The following section discusses the findings in relationship to each dependent variable.

Discussion

Group Project Performance

It was anticipated that the cooperative learning groups in the MGQP treatment level would perform better on the project (presentation and paper), as measured by project scores, than those who were in the LGQP treatment level.

As previously noted, no statistical differences were found in the quantitative data. However, the qualitative data did yield some support to the hypothesis in that the papers of cooperative learning groups in the MGQP treatment level seemed to be more collaborative and showed less division than papers submitted by cooperative learning groups in the LGQP treatment level. For instance, cooperative learning groups in the LGQP treatment level were more likely to submit papers with headers, and one even had the names of the individual group members associated with specific sections of the paper.

In addition, the qualitative data from the responses made by cooperative learning groups to the Evaluating prompts and Individual Assessment of Project Activities questionnaire provided some support for the hypothesis in that cooperative learning groups in the MGQP treatment level provided more specific descriptions when evaluating what did or did not work than cooperative learning groups in the LGQP treatment level. A greater percentage of cooperative learning groups in the MGQP than the LGQP treatment level had at least one person mention specific factors related to group achievement; such as, not beginning the project early enough and having difficulties due to other class activities or individual factors.

However, the qualitative data contradicted the hypothesis in that the processes used to develop the project by cooperative learning groups in the MGQP treatment level was more varied than the processes used by the cooperative learning groups in the LGQP treatment level, especially in terms of their points of progress during the final session before conducting presentations and submitting papers.
The qualitative data from the Evaluating prompts and *Individual Assessment of Project Activities* questionnaire also illustrated the difference in the focus of the cooperative learning groups in the MGQP treatment level and those in the LGQP treatment level. The cooperative learning groups in the MGQP treatment level seemed to be more focused on the project activities or tasks, while those cooperative learning groups in the LGQP treatment level were focused on the social relationships of the group to perform the task. For example, a greater percentage of cooperative learning groups in the MGQP treatment level than the LGQP treatment level had at least one person mention that dividing the work made the project easier and that the project benefited the individual in that the individuals were able to focus on one topic and work at their own pace. In addition, the social skills more likely to be discussed by those in the MGQP treatment level were related to leadership and communication activities; whereas the social skills described by those in the LGQP treatment level were related to getting to know and trust each other and helping those who needed extra help. It is also interesting to note that the mode of communication was different for each treatment level. Cooperative learning groups in the MGQP treatment level were more likely to communicate during or times adjacent to class sessions while those in the LGQP treatment level were more likely to mention the difficulties with meeting outside of class and resorting to email for communication. It is interesting to note that though the same percent of cooperative learning groups in each treatment level mentioned that they had difficulties pulling the project together, cooperative learning groups in the LGQP treatment level were more likely to have at least one person mention that the group overcame their difficulties.

Possible reasons for these findings are limited implementation of the intervention by participants and limited time for the cooperative learning groups to develop.

*Limited Implementation of Intervention by Participants*

One factor that may have contributed to not finding a significant difference between the two levels of the independent variable is that the guided questioning prompts were not utilized as intended. After the Planning prompts were implemented, the cooperative learning groups did not engage in consensus-building communication for the remainder of the prompts.
After the Planning session, the researcher noted that many of the participants in the cooperative learning groups did not engage in discussions of the prompts. In many cases, only one person wrote a response to the prompts. Therefore, they probably did not benefit from the treatment, and the interaction predicted to increase self-regulatory behaviors and biology self-efficacy.

Young (1997) also found that learners did not utilize the prompts as intended. She provided graduate level learners cue cards that they could refer to when conducting discussions. In addition, she conducted a practice session in which the learners could gain experience using the prompts. However, she found that only 2 of the 4 groups with guided questioning prompts referred to them.

The current study tried to alleviate similar behavior by requesting written responses to the prompts. Though the learners did not have a practice session as those in Young’s (1997) study, the Monitoring prompts were the same so learners became familiar with them through repeated use. In addition, it was anticipated that because the learners had less experience in college (first two years of college vs. graduate program), they would be more likely to utilize the prompts in this activity. However, these factors did not alleviate behavior that was found in Young’s (1997) study.

*Limited Time to Develop Collective Efficacy*

Another reason that many of the groups did not engage in discussions of the prompts may have been that little time was afforded in the Monitoring sessions for the cooperative learning groups to develop collective efficacy. Bandura (1997) states that perceived collective efficacy is, “a group's shared belief in its conjoint capabilities to organize and execute the courses of action required to produce given levels of attainments" (p. 477). Collective efficacy has been found to be a strong predictor of group performance (Lin, 2002; Little & Madigan, 1997; Watson, Chemers, & Preiser, 2001). Lin (2002) goes on to state that collective efficacy predicts the level of group effort invested and group performance. In order for a group to develop a shared belief in its ability to organize and execute courses of action, a group needs to develop transactive memory, which is the combination of individual group member knowledge with a shared awareness of the roles and strengths of each group member (Smith, 2000). Along with
group efficacy, transactive memory has also been found to be a consistent predictor of group performance (Grace, 2004).

Familiarity of group members with each other is vital to the development of transactive memory. Smith (2000) found that turnover of personnel on basketball teams led to lower transactive memory. Similarly, Blickensderfer (2000) found that team familiarity in 2-person tennis teams was positively related to shared knowledge of rules and responsibilities. Lee, Tinsley, and Bobko (2002) found that familiarity of learners with each other is important for group success.

To develop familiarity and have interim performances, time is required. Baker (2001) found that members began to agree about the group's ability to perform early in the group's development, but there was some variation of those perceptions within the groups. Jung and Sosik (2003) found that group members developed more homogeneous perceptions of their group’s efficacy as time progressed over a 15-week time period.

Cooperative learning groups in the MGQP treatment level received prompts in the Planning Phase which aided in the start of the development of collective efficacy. Because the prompts for the MGQP treatment level facilitated more discussion about the project, the learners may have felt more comfortable discussing the project and topics with each other. Therefore, they were better able to combine the research gathered by the group members to create a comprehensive project. It appears that some level of collective efficacy was developed in the beginning, similar to Baker’s (2001) findings. This may have been a reason that the cooperative learning groups in the MGQP treatment level developed papers which appeared to be more collaborative than the cooperative learning groups in the LGQP treatment level. During the Monitoring phase, cooperative learning groups in the MGQP treatment level were given prompts which could elicit a group’s transactive memory through a discussion of the group’s use of the strategy developed in the Planning phase. But, because limited time was given to utilize those prompts, cooperative learning groups in the MGQP treatment level may not have been able to develop stronger collective efficacy over time.

However, it appeared that over time cooperative learning groups in the LGQP treatment level were more likely to develop cohesiveness. It is interesting to note that a higher percentage of cooperative learning groups in the LGQP treatment level were more
likely to commit to the group and were more focused on getting to know and trust each other as well as helping those who needed extra help. In contrast, a higher percentage of cooperative learning groups in the MGQP treatment level were more focused on the project tasks. Though the learners expressed more commitment to the group, the number of questions in the prompts may have enabled cooperative learning group members to spend more time discussing specifics of the project and learned what members needed in terms of support.

*Individual Academic Achievement*

It was anticipated that the individual learners in cooperative learning groups who receive the more guided questioning prompts would perform better on the topic-specific knowledge questionnaire than those learners whose cooperative learning groups received the less guided questioning prompts. Although the hypothesis was not supported in the quantitative findings of this study, the qualitative findings yielded support for this hypothesis in that those in the MGQP treatment level were more likely to state they gained an overview of the relationships across the various presentation topics and an in-depth understanding of their presentation topic. Overall, however, this hypothesis was not supported. There may have been several factors for the general lack of support of this hypothesis: lack of reinforcement across topics, limited content-related reflection activities, cognitive load, and interference from other class tasks.

*Lack of Reinforcement across Topics*

To a certain degree, the MGQP prompts may have facilitated higher level thinking leading some learners to state an understanding of the material across topics. However, this finding should be observed with caution. A closer examination found that those who mentioned this outcome were those who initially rated themselves high in using self-regulatory behaviors prior to the intervention.

For the other learners, there may not have been enough reinforcement of the common concepts across the various presentation topics. The topic-specific competency test included items that were related to each of the topics discussed within the particular course section. The items were developed in reference to the points that were anticipated to be taught by the various cooperative learning groups. In some cases, concepts related to the items were not discussed.
When examining the change scores by topics, those topics presented by multiple groups were more likely to show improvement. As discussed in the Assessment section of Chapter 3, the topic-specific competency tests were developed differently based on the course section. In one course, the test was divided into seven topics of five items, while the other test was divided into five topics of seven items. In the course section with the seven topics, only one presentation was conducted for each topic. However, in the other section there were multiple presentations for three of the five topics. Change scores for the topics presented multiple times were greater than those topics presented only once. It was also interesting to note that those change scores in the section with seven topics which showed improvement were those presentations that utilized graphic presentations or were organized with the presenters discussing the points in order as requested in the activity description. These findings illustrate the need for the repetition and reinforcement of concepts as well as the use of multiple modalities to gain information.

Limited Content-Related Reflection Activities

The main purpose of the guided questioning prompts in the current study was to facilitate the project development process. Therefore, the focus of the in-class interaction of the cooperative learning groups was on the development of the project, rather than discussion of the content. Though a couple of groups were observed discussing the content during the second Monitoring phase, most of the conversation focused on the development of the project.

In their discussion of problem-based learning, Savery and Duffy (1995) discussed the importance of supporting reflection for both the learning process and content learned. Although they mentioned that instructors may act as models for learners to see the process of engaging in reflective activities, the prompts in the current study were implemented to guide learners through reflective activities and replace instructors. However, the prompts in this study emphasized learning process and little reflection about the biology content occurred. Because the prompts did not encourage high levels of reflection about the biology content, there was very little difference in the achievement of individual learners for each treatment level.
Cognitive Load

Another factor that may have contributed to there being little difference between the individual achievements of learners in the two treatment levels is that the cognitive load required for learning the material for the topic-specific knowledge questionnaire may have been too great for the learners. Cognitive load is “the manner in which cognitive resources are focused and used during learning and problem solving” (Chandler & Sweller, 1991, p.294). There are two sources of cognitive load, intrinsic and extraneous. Intrinsic cognitive load refers to elements inherent in the cognitive task, while extraneous cognitive load is created because of the design of the instructional materials. Though intrinsic cognitive load can be high due to the complexity of a task, it is important to design learning activities so that the extraneous cognitive load does not create difficulties for the learners (Sweller & Chandler, 1994).

One source of extraneous cognitive load is split attention (Chandler and Sweller, 1991; 1992). With split attention, learners divide their attentions among multiple sources to obtain information. The qualitative findings in the current study suggest learners’ mental resources were disproportionately allocated to the prompts, detracting their focus from the project itself. A learner in the LGQP treatment level mentioned that “…noting what was going on weekly is a slow process and does not help getting the project done.” Similarly, another student stated, “I feel that the prompts were no help to the group work at all. We never really had enough time to respond to the questions.”

Interference from Other Class Tasks

The qualitative findings also suggest that learners had difficulty learning the material, because they were either distracted by attempting to learn course content being taught concurrently or became narrowly focused on individual topic areas of the presentation. Work on the cooperative learning project took place concurrently with lecture sessions about other course topics. The learners may not have been able to manage the task of learning two different topics in the subject concurrently. One learner in the MGQP treatment level stated, “Two foci [different subject matter in the class] at once made it intimidating.”

Learners were not able to manage the task of learning about their presentation topic, because they were focused on learning the material for which they were
accountable within their cooperative learning group. One learner in the MGQP treatment level mentioned that when learners work in groups, you would “…mainly study on your own section - not learn all material thoroughly.”

**Self-Regulatory Behaviors**

It was anticipated that those individual learners whose cooperative learning groups received the more guided questioning prompts would have greater perceived use of self-regulatory behaviors than those who received the less guided questioning prompts when considering pre-intervention ratings, as measured by the *Motivated Strategies for Learning Questionnaire (MSLQ)* (Pintrich et al., 1991). The hypothesis was not supported in this study. Reasons for this occurrence are the method of measuring self-regulation, learners’ prior levels of self-regulatory behaviors, limited time to develop monitoring skills, limited discussion of individual accountability, and structure not allowing for opportunities for self-regulation.

**Method of Measuring Self-Regulation**

Using the *MSLQ* to measure self-regulation in this setting may not have provided completely accurate findings for a couple of reasons. First, the use of a self-report is based on the perspective and reflective recall of the learner, which may not be what is actually happening. Second, the *MSLQ* may have measured a broader level of self-regulation than what was being focused upon in this study.

When providing self-reports, learners only provide their own perspective which may not be reflective of actual events. Young and Ley (2005) raise concerns about relying on learner memory to measure self-regulatory behaviors. They conducted structured interviews to examine the degree to which developmental students reported self-regulatory behaviors using a Likert scale instrument. They are concerned that both methods may be inaccurate, because they rely on the learner to recall activities. They found that learners did not mention using some self-regulatory activities in the structured interview, but indicated their usage on the Likert scale instrument. Young and Ley (2005) suggest learners may have responded in a socially appropriate manner and in reality do not use those activities. They suggest that learners keep a log of strategies used to perform particular learning activities.
Winne and Perry (2000) also raise concerns about measuring self-regulation in survey style. They state that determining the foundational nature of self-regulation should drive how self-regulation is evaluated. They state that self-regulation is either an aptitude or an event. If self-regulatory behavior is an aptitude, then the person’s general behavior will be the same in any situation. This is the assumption that many of the measurements take in determining a person’s level of self-regulation. Winne and Perry (2000) argue that self-regulation be measured as an event, in which learning behaviors are documented as they occur. The researcher attempted to alleviate Winne and Perry’s (2000) concern that many measurements of self-regulation assess self-regulatory behaviors in a broad fashion. The *MSLO* was selected for this study, because it measures self-regulation at a finer degree than other assessments, the course level. However, it may have been more appropriate to focus the questions on the use of self-regulatory behavior in regard to the project rather than on the class. Learners may have answered the questions when reflecting on concurrent class activities, which may have diluted an understanding of learner self-regulatory behaviors used to complete the project.

Similar to Winne and Perry’s (2001) suggestion to measure self-regulation as an event, Ley and Young (2005) suggest that learners keep a log of strategies used to perform particular learning activities. Though time consuming, this type of measurement of self-regulation may paint a more accurate picture of the strategies that learners use. The qualitative data found in this study confirms the issues other researchers have about measuring self-regulation. In this study, the researcher noticed that some learners rated themselves high in self-regulation, even though they did not attend class sessions as frequently as others. Fellow group members alluded to absenteeism in their *Individual Assessment of Project Activities* questionnaire.

**Learners’ Prior Level of Self-Regulatory Behaviors**

Young (1997) also found that learners did not develop self-regulatory behaviors when utilizing guided questioning prompts. She attributed this finding to the learners’ prior levels of self-regulatory behaviors. Because learners in the current study had less experience in college (first two years of college vs. graduate program), it was anticipated that they would be more likely to utilize the prompts in this activity. However, these factors did not alleviate behavior that was found in Young’s (1997) study. The learners
were college students, so they have developed some level of self-regulatory behaviors during their schooling. One learner in the MGQP treatment level noted, “It was nothing that I have not gone threw [through] with any group I have done before. Some people carry their weight and some don’t. But I still liked working with a group…”

Limited Time to Develop Monitoring Skills

A premise for the use of the more guided questioning prompts was that they would aid the group in moving through the phases of self-regulation as described by Schunk (2001): (1) forethought, (2) performance or volitional control, and (3) self-reflection which correspond to King’s (1991) series of strategic prompts: Planning, Monitoring, and Evaluating.

Schunk (2001) states that during the performance or volitional control phase, or King’s (1991) Monitoring phase, learners engage in the learning process utilizing the cognitive strategies determined during the forethought, or King’s (1991) Planning, phase. At this point, learners may engage in self-regulatory strategies in which they record and monitor their use of cognitive strategies by comparing their accomplishments with peers, assigning attributions for the amount of progress they have made toward a goal, and verbalizing the strategies they utilize to achieve their goals (Schunk, 2001). These activities aid learners in determining whether their strategies should be adjusted.

Cooperative learning groups in the current study spent longer than anticipated time in the Planning phase. Therefore, less time was spent in the Monitoring phase, which did not allow for full implementation of the Monitoring prompts. Cooperative learning groups were unable to engage in the activities that Schunk (2001) suggests should occur during the Monitoring phase. Because the cooperative learning groups could not engage in these activities, individual learners did not see the activities modeled; therefore, they were unable to incorporate them into their individual self-regulatory behaviors. Because the majority of self-regulatory behaviors occur during the monitoring phase, the partial implementation of the prompts during the Monitoring phase played a critical role in the effect of the treatment on the learners.

Limited Discussion of Individual Accountability

It was anticipated that group discussions of the following prompts would elicit responses about individual activities:
- Are we using our plan or strategy? How closely are we following our plan or strategy?
- Are we getting closer to our goal? Why or why not?

However, the responses were related only to the group as a whole and all groups responded in the affirmative although little progress was made.

In an interview, one learner in the MGQP treatment level described the positive effects of the prompts regarding individual accountability, “I liked the questions and prompts because they made you realize that there is more - or what is left- let you know who has done what by certain points.” This learner later mentioned the importance of the Responsibilities Chart in their group’s activities, “The prompts and chart helped me see what everyone has done.” During the interim observations, the researcher noticed that some groups were more focused on the Responsibilities Chart than the prompts. The role of the Responsibilities Chart in tracking progress was greater than anticipated and beneficial to those groups who incorporated its use in their group discussions. Because its use was not emphasized in the prompts, there may have been little discussion regarding individual progress which would elicit individual accountability.

Structure not Allowing for Opportunities for Independent Self-regulation Choices

A key aspect of helping learners to develop self-regulation is providing opportunities for learners to make choices to demonstrate self-regulation. Some aspects of this project may have been too structured to allow learners enough opportunities to demonstrate self-regulation. Graham, Harris, and Troia (1998) describe six instructional stages of their self-regulated strategy development (SRSD) model. The model moves progressively through the following stages: (1) develop background knowledge, (2) discuss it, (3) model it, (4) memorize it, (5) support it, and (6) independent performance. When learners are in the independent performance stage, they would be encouraged to not rely on charts or reminders to guide them through the self-regulation process. Though the current study addressed activities in each of the other five stages, learners were not given opportunities that would be found in the independent performance stage. Because learners did not have the opportunity to utilize the prompts on enough occasions to memorize and internalize them so that the use of the prompts could be phased out, the
activity could not progress to the independent performance stage which allows learners to make choices about using self-regulatory behaviors.

Biology Self-Efficacy

It was anticipated that those individual learners whose cooperative learning groups received the more guided questioning prompts would have greater biology self-efficacy than those who received the less guided questioning prompts when considering pre-intervention scores, as measured by the College Biology Self-Efficacy Instrument for Non-Majors (Baldwin et al., 1999). The hypothesis was not supported in this study.

Minimal Discussion of Attributions

A key factor in developing self-efficacy is how learners attribute their successes or failures (Schunk, 1982). Similar to individuals, one aspect of the development of collective efficacy is how the group attributes its interim progress. Feltz and Lirgg (1998) found that collective efficacy changed according to game results. In the current study, the prompts were developed to enable cooperative learning groups to model the attribution process for the learners.

The current study attempted to elicit both individual and group attributions for interim performances. Cooperative learning groups in both the MGQP and LGQP treatment levels received the Responsibilities Chart, in which team members listed their roles and activities. In addition, questions given to the cooperative learning groups in the MGQP treatment level were designed to model a discussion of the group’s attributions for the use of their strategy for the individuals. Those questions were:

- Are we using our plan or strategy? How closely are we following our plan or strategy?
- Are we getting closer to our goal? Why or why not?
- Do we need a new strategy? If so, what is it?

However, all cooperative learning groups in the MGQP treatment level stated their strategies were successful, even when they had not made much progress toward their goals. Because attributions related to group success were not discussed, the process to model a discussion of attributions did not occur. Therefore, neither group efficacy nor individual self-efficacy could be developed.
Lack of Difference in Individual Use of Self-Regulatory Behaviors

In Chapter 2, a feedback loop was presented to illustrate the hypothesized process that would occur through the use of the more guided questioning prompts. More than those in the LGQP treatment level, it was hypothesized that the MGQP prompts would provide a model for individual self-regulatory behaviors. The increased use of individual self-regulatory behaviors would impact individual academic achievement, and in turn, biology self-efficacy. Because it was found that the intervention did not affect individual self-regulatory behaviors, the subsequent effects of the intervention were not realized. Therefore, learner biology self-efficacy did not differ between the MGQP and LGQP treatment levels.

Interaction of Treatment and Attribute Variables

It was hypothesized that learners who are initially low on the attribute variables of self-regulatory behaviors and biology self-efficacy would benefit more from guided questioning prompts than those initially high, in terms of individual academic achievement. This hypothesis was not supported in this study by either the quantitative or qualitative findings.

Inadequate Structure

Young (1996) found fewer differences between learners with a high level of self-regulated learning strategies and those with a low level of self-regulated learning strategies when they participated in program-controlled computer-based instruction than those who participated in learner-controlled computer-based instruction. His study emphasized the need for learners with low usage of self-regulatory strategies to have structure in the learning environment. In the current study, it was hypothesized that the prompts given the cooperative learning groups in the MGQP treatment would provide the structure needed to aid learners who rated themselves low in using self-regulation prior to the current study. The current study did not find that the guided questioning prompts provided the structure needed to aid learners who initially rated themselves low in the use of self-regulatory behaviors.

The current study also illustrated that learners who initially rated themselves low in terms of biology self-efficacy may not have had enough structure to promote greater biology self-efficacy. This finding was similar to other studies utilizing guided
questioning prompts. McInerney, McInerney, and Marsh (1997) states that novice learners should be given enough structure, such as direct instruction, to alleviate anxiety when learning computer skills. In addition, Suh (2005) suggests learners be given structure when using questioning prompts while participating in Web-based discussion boards until they gain confidence.

*Inaccurate Calibration of Attribute Variables with Performance*

Though the current study did not ask whether learners were participating in developmental courses, information from the research about developmental learners may provide insights about data from those who initially rated themselves low in using self-regulatory behaviors or having biology self-efficacy may be examined as data from developmental learners.

Ley and Young have conducted various studies about the self-regulation and self-efficacy of developmental learners, or those who attend developmental college classes. They found that developmental learners have difficulty monitoring their efforts and judging their performances accurately (Ley & Young, 1998; Young & Ley, 2002). They noted that their findings were similar to other researchers (Deming, Valeri-Gold, & Idelman, 1994; Nist, Mealey, Simpson, & Kroc, 1990).

Young and Ley (2002) also found that some developmental learners have developed an inflated level of self-efficacy in comparison to their performance. This finding was also found in this study. One learner who initially rated themselves as being high in biology self-efficacy in the MGQP treatment level stated, “Made me look at myself and I realized I knew more than I thought…When they had questions, I had answers - for once.” Though the learner rated themselves as high on the Likert scale measurement prior to the intervention, the learner comments during the interview would reflect a different level of biology self-efficacy.

Other learners in this study illustrated this tendency. One learner who initially rated themselves as being high in biology self-efficacy in the MGQP treatment level stated, “I already felt confident. Gotta feel that way going in… If you come to class thinking you can't do it, the game is half over. College is easy; it just takes time. Grades could be better if I take more time.” During the interview, another learner in the MGQP treatment level who initially rated themselves as having low biology self-efficacy stated
that the experienced help them to learn about biology. The learner also stated, “I can explain it, though how I did [individual course grade] doesn't show it.” These comments illustrate that learner self-efficacy may not align with performance. In this study, the lack of difference between the two treatment levels may be confounded by learners having an inflated sense of self-efficacy.

Limitations of the Study

The limitations of the study were limited time, learner attrition leading to unequal numbers in the treatment levels, and learner distractions to external factors.

Limited Time

Time appeared to be a factor in the outcomes of group project performance in two ways. First, the amount of time allotted for each class session did not allow for adequate time for the treatment. This especially applied to the MGQP treatment level because they had more questions to answer during each session. Second, the number of sessions devoted to the treatment was insufficient.

In class observations of the cooperative learning groups, it was noted that several groups engaged in the planning process for two class sessions, rather than one as planned, leaving too little time for the Monitoring phase of the project.

The effect of the intervention may not have been realized due to the insufficient time allotted to complete the prompts. For both levels of the intervention, learners noted that there was not enough time to work on the project. On a couple of occasions, learners were only allowed five minutes to complete the prompts. In these cases, learners did not have enough time to engage in discussion of the content. Learners mentioned that they wanted more time to work together. To compensate for the lack of time during class, many groups held meetings outside of class, communicated via e-mail, or immediately before or after class sessions. Though this was practiced by many, it was difficult due to time commitments in other areas of their lives.

Not only was it difficult for group members to meet outside of class, but meeting in class was difficult for some groups because of a lack of attendance. One learner stated, “The prompts were not as much of help considering the fact that the class was early and it was hard for everyone to come on the same day. So the prompts mostly did not include everyone in the group.” A member of another cooperative learning group said, “Using
prompts was okay but at times it was hard trying to meet up with my group. Everyone had their own schedule.”

*Learner Attrition Leading to Unequal Sizes of Treatment Levels*

The LGQP group exhibited more attrition than the MGQP group. However, this was not due to any pre-intervention variables. The 66 learners were assigned to one of 17 cooperative learning groups. At the beginning of the intervention, there were 37 learners in nine cooperative learning groups who received the MGQP treatment level and 29 learners in eight groups who received the LGQP treatment.

Most cooperative learning groups began the intervention with four learners. One cooperative learning group in the LGQP treatment level in one course section had three learners. One cooperative learning group in the LGQP treatment level in the other course section had two learners due to attrition in the group prior to the intervention activities. Data from both of these groups were eventually removed due to attrition of group members.

Data from 29 participants and five cooperative learning groups were not included because the learners did not complete the course, project, or post-intervention questionnaires. In some cases, learner data were excluded because the learner was the solitary group member to complete all of the above activities. In addition, group data for groups with fewer than two learners were removed. In the final analysis, data from 37 learners in 12 cooperative learning groups were analyzed. Data were analyzed for 23 learners in eight cooperative learning groups in the MGQP treatment level and 14 learners in four cooperative learning groups in the LGQP treatment level.

The greater attrition in the LGQP treatment level led to unequal sample sizes. To compensate for this, non-parametric statistics were used for the quantitative data. In addition, percentages were used to describe the qualitative data.

*Learner Distractions to External Factors*

Time was a factor in this study because of the outside responsibilities of the learners. A significant correlation was noted between the MGQP treatment level and the number of hours spent in volunteer, community, or family obligations ($r(35) = .460, p < .01$). Though this correlation may not solely account for the lack of differences between the MGQP and LGQP treatment levels, it may be a mitigating factor.
According to Atkinson (1964), individuals place their efforts where they feel they will have the most benefit. The selection of the activity in which the person chooses to become engaged is determined by the value of the person places upon the activity. Atkinson (1964) noted that there are three factors in determining the value of a task: the motive for success, the probability of success, and the incentive of success. It may be that the competing external factors may have had more value to the learners on one or more of Atkinson’s three factors for determining task value. In some cases, the learners may have viewed the incentives for studying for a task as being less than the incentives of the other factors in their lives. For example, many people in the study had full-time jobs and family obligations that may have been a greater incentive than the project tasks.

Implications of the Study

The results of this study illustrate the need for students to have sufficient time and scaffolding resources to enable group processing skills to be transferred to individual behaviors.

First, the findings illustrate the need for cooperative learning groups to participate in and solidify planning activities. Several cooperative learning groups did not move to the Monitoring phase or its questions until they completed the Planning phase. In addition, it may be helpful for the Planning prompts to elicit explicit explanations about the roles and responsibilities of each member.

Second, it would be helpful to provide more scaffolding for learners to transfer group processing skills to individual behaviors. The Responsibilities Chart was emphasized more than the researcher expected. Some cooperative learning groups seemed to focus on that document than the prompts themselves. This document provided cooperative learning groups the framework for which they would monitor their activities. This document provides a framework for cooperative learning groups to not only monitor group progress but also to monitor individual progress. By monitoring individual progress over an extended period of time, learners may develop individual monitoring skills which are important to individual self-regulation.

Third, though the study added additional prompts to elicit group attributions of progress during the Monitoring phase, groups did not elaborate on them. This study
illustrates that learners may need more explicit prompts to activate discussions regarding how the group attributes its progress in the Monitoring phase.

Fourth, this study illustrated the importance of social interaction and cohesiveness within cooperative learning groups. When compared to cooperative learning groups in the MGQP treatment level, there was little variance in the weekly progress of interim activities for cooperative learning groups in the LGQP treatment. In addition, cooperative learning groups in the LGQP treatment level were more likely to discuss being committed to the group, getting to know and trust each other, and helping those who needed extra help. Because the cooperative learning groups in the LGQP treatment level were not tied to the prompts focused on the project, they may have been more able to develop relationships to aid in completing the project.

Recommendations for Future Studies

This study was conducted in a regular college course where faculties feel they never have enough time to cover course material. Running a study like this, that requires class time, does not get the support from the instructor that learners’ efforts need. However, one has to balance the loss of control against trying an intervention in an ecologically valid setting. In a future study, the project should be more integrated into the activities of the course.

In the future, a study like this may yield more insights through when learners are afforded more time and encouragement to participate in group discussions. One way to do this would be to conduct a similar study in an online setting. As in this study, learners were required to make written responses to the prompts. As in Young’s (1997) classroom-based study, not everyone in the group engaged in the discussion of the prompts. However, unlike Young’s (1997) study, the learners had to refer to the prompts. An online environment would more likely elicit learners to respond to the prompts and engage in discussion.

In a future study, the Planning phase should be allowed to take place over at least two sessions. As illustrated in the current study, cooperative learning groups needed more time to plan. In addition, it may be helpful for the Monitoring phase to be longer than two weeks in order for the learners to incorporate the guided questions into their individual
learning strategies. A similar study may be more effective when conducted over the course of an entire semester.

A future study may examine the role of prompts that promote social interaction and cohesiveness. These prompts should be simple and open-ended, so that learners can elaborate on the prompts and get to know each other in order to build trust.

In order to facilitate individual performance on academic achievement, self-regulatory behaviors and biology self-efficacy, more scaffolding of individual accountability should be provided in the future. For example, an emphasis should be placed on resources such as the Responsibilities Chart to encourage individual accountability.

To examine the development of self-efficacy within a group setting, a future study may look at the role, type, and numbers of prompts which elicit group attributions in the Monitoring phase have on individual self-efficacy.

Conclusion

This study provided insight into the use of guided questioning prompts within cooperative learning environments. It also suggested instructional activities that may aid learners in developing individual self-regulatory behaviors and domain self-efficacy within a cooperative learning environment. Findings from this study will inform future research on the use of guided questioning prompts in cooperative learning groups to develop individual self-regulation and domain self-efficacy.
APPROVAL MEMORANDUM
from the Human Subjects Committee

Date: September 15, 2003
From: David Quadagno, Chair
To: Margie DeBroux
         925 E. Magnolia Drive, Apt. J-8
         Tallahassee, FL 32301
Dept: Educational Psychology and Learning Systems
Re: Use of Human subjects in Research
     Project entitled: The Effect of Guided Questioning on Student
     Achievement, Self-Regulatory Behavior and Self-Efficacy in a
     Biology for Non-Majors Class

The forms that you submitted to this office in regard to the use of human subjects in the
proposal referenced above have been reviewed by the Human Subjects Committee at its
meeting on September 10, 2003. Your project was approved by the Committee.

The Human Subjects Committee has not evaluated your proposal for scientific merit,
extcept to weigh the risk to the human participants and the aspects of the proposal
related to potential risk and benefit. This approval does not replace any departmental
or other approvals which may be required.

If the project has not been completed by September 9, 2004, you must request renewed
approval for continuation of the project.

You are advised that any change in protocol in this project must be approved by
resubmission of the project to the Committee for approval. Also, the principal investigator
must promptly report, in writing, any unexpected problems causing risks to research subjects
or others.

By copy of this memorandum, the chairman of your department and/or your major professor
is reminded that he/she is responsible for being informed concerning research projects
involving human subjects in the department, and should review protocols of such
investigations as often as needed to insure that the project is being conducted in compliance
with our institution and with DHHS regulations.

This institution has an Assurance on file with the Office for Protection from Research Risks.
The Assurance Number is IRB00000446.

APPLICATION NO. 03.465
Co: W. Wagner
Office of the Vice President For Research  
Human Subjects Committee  
Tallahassee, Florida 32306-2763  
(850) 644-8673  FAX (850) 644-4392

APPROVAL MEMORANDUM (for change in research protocol)

Date: 3/8/2004

To:  
Margie DeBroux  
925 East Magnolia Dr apt J-8  
Tallahassee Fl 32301

Dept:  Educational Psychology and Learning Systems

From:  John Tomkowiak Chair

Re:  Use of Human subjects in Research  
Project entitled: The Effect of Guided Questioning on Student Achievement, Self-Regulatory behavior and Self-Efficacy in a Biology for Non-Majors Class

The memorandum that you submitted to this office in regard to the requested change in your research protocol for the above-referenced project have been reviewed and approved. Thank you for informing the Committee of this change.

A reminder that if the project has not been completed by 9/9/2004, you must request renewed approval for continuation of the project.

By copy of this memorandum, the chairman of your department and/or your major professor is reminded that he/she is responsible for being informed concerning research projects involving human subjects in the department, and should review protocols of such investigations as often as needed to ensure that the project is being conducted in compliance with our institution and with DHHS regulations.

This institution has an Assurance on file with the Office for Protection from Research Risks. The Assurance Number is IRB00000446.

cc: Walter W Wager  
APPLICATION NO. 2003.465
TALLAHASSEE COMMUNITY COLLEGE REQUEST FOR ACCESS TO
EDUCATIONAL RECORDS FOR RESEARCH

OFFICE OF ENROLLMENT SERVICES
REQUEST FOR ACCESS TO EDUCATIONAL RECORDS FOR RESEARCH

An individual may be permitted access to educational records for research purposes (according to procedures established by the Director of Enrollment Services Office) if he/she agrees to protect the confidentiality of the information received and agrees to design the report so that it does not identify the students on whom the data was collected.

The student researcher must also either:
1. Secure written authorization, as indicated below, that the information to be gathered is for a “legitimate educational interest” and that the individual is acting as a “school official” for this project only. OR
2. Obtain written consent from the students whose records are to be examined.

TO BE COMPLETED BY THE INDIVIDUAL REQUESTING ACCESS TO RECORDS

Submit a copy of approval from student's research institution/organization.

Describe the purpose of the research.

See attached.

List the type of data needed (e.g. social security number, test scores, academic records, etc.).

See attached.

Describe the group to which the needed data is limited (e.g. students with GPA of 3.00 or above, etc.).

See attached.

See student signature page of attached application.

Student Signature (I agree to protect the confidentiality of the data gathered).

Date

[Signature]

[Date] 10/21/03

Signature of Requestor Date
Approval to examine student records without students' consent (if applicable).

N/A

Director of Enrollment Services (I approve of the project described above).

Date

(Vice President for Academic Affairs
(I agree with the above and approve the researcher as an acting school official for this project only).

Date

Federal law provides that the definition of "school official" is left up to each institution. For the purposes of this authorization we have defined the term as a person approved, at the level of Director of Enrollment Services and Vice President for Academic Affairs, to act as a school official for on the project described herein.

"Legitimate educational interest" (for the purpose of this authorization only) means that the research in some way may help the College improve its policies or programs.
APPENDIX B

PERMISSION TO REPRINT AND REPUBLISH MATERIAL
ADAPTATION OF QUESTION PROMPTS

American Psychological Association

Copyright Permission Request Form

APA Journals

Please make sure the material you want to use is copyrighted by American Psychological Association (APA).

After filling out the relevant information, email this form to permissions@apa.org.

Additional contact information:
APA Permissions Office, 750 First Street, NE, Washington, DC 20002-4242
Phone: 1-800-374-2722 or 202-336-5766 x5541
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For use of APA Journal material
Date: July 5, 2007

Your contact information:
Name: Margie DeBroux
Organization Name: Florida State University
Department: Department of Educational Psychology and Learning Systems
Complete postal address: PO Box 566372, Atlanta, GA 31156
Country: United States of America
Office Phone: (850) 671-3104
Fax number: (404) 888-5160
Email: mld7332@garnet.acns.fsu.edu
Your Reference Code Number (if required)

1. The APA or EPF material that you wish to use:
Complete Journal citation (Journal title, Authors, Article title, Publication year, Volume, Issue, Month, and Pagination)


2. Material that you wish to use from the journal article (check box(s) and fill in information):
□ Entire article

☒ Portions of the article: Adapted list of questions based on those in Figure 1 on Page 309.

NOTE: If you are reprinting short text excerpts into a journal article or book chapter, please read about our “automatic permission” at http://www.apa.org/about/limited.html. If you use does not fall under this category, please complete this form.
☐ Article Abstract only [Note: Abstracts may not be altered or edited in any way.]

☐ Scale or test material (APA permission is required)  APA page number ___

☐ Figure  APA Figure number ___  APA page number ___
☐ Table  APA Table number ___  APA page number ___

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☐ Appendix material  APA page number ___

☐ Other  Please specify:

3. I wish to use the APA/EPF journal material in the following media (check box and fill in information as required):

☐ Print
☐ Electronic  Please give details ___
☒ Both Print and Electronic  Please give details Dissertation will become part of UMI/Proquest’s Digital Dissertation and Thesis database. In addition, print copies may be created by UMI/Proquest.
☐ Other  Please give details ___

4. The material will be used in (check block and fill in information for one or more of the following):

☐ Journal or Newsletter
  Title of journal or newsletter
  Publisher
  Is journal/newsletter  PRINT ELECTRONIC BOTH

☐ A published Book
  Complete citation of the planned book (Author(s)/Editor(s), Title, Edition, Publisher, Publication Date)
  Print Run
  The author(s) of your book chapter

☐ Presentation or Seminar
  Title
  Date
  Number of copies needed
  Is the presenter the author of the APA material?  YES NO
  Is the Presentation or Seminar continuing education?  YES NO
  Is there a fee for attendees?  YES NO
☒ Dissertation – I will be completing a doctoral dissertation at Florida State University entitled, “The Effect of Guided Questioning on Student Achievement, Self-Regulatory Behavior, and Self-Efficacy in a Biology for Non-Majors Class”.

☐ Thesis

☐ Other Uses (please specify)

☐ Classroom use/Print [Note: If you live in the US, you must go through the Copyright Clearance Center (http://www.copyright.com/ or 978-750-8400) for permission.]
  School name
  Title of class
  Semester
  Instructor’s Name
  Number of copies needed

☐ Classroom use/Electronic reserve.
  Institution
  Title of class
If your school has a PsycARTICLES license, your site license policy grants permission to put articles into password protected electronic (not print) course packs or electronic reserve for your Users. Please see the PsycARTICLES license policy at [www.apa.org/librarians/policies/course-packs.html](http://www.apa.org/librarians/policies/course-packs.html) for more information and discuss with your librarian.

5. Any additional information to tell us:
Attached are the questions as they appeared in the activity for the learners. The appendix title page as it will appear in the dissertation is also attached. Learners worked in groups to complete the questions and received the set of “Monitoring” questions twice. The study took place in Spring 2004. Because I recently realized that I may need to obtain permission for reprinting the adapted version of questions, I am in the process of requesting to reprint one page of the article for each learner from Copyright Clearance Center. Please let me know if there are any further actions I should take.
Received Mon 8 Mar 2004, 8:20 AM

Marie,

I will be sending you a letter about republishing the MSLQ in my dissertation and have a couple of questions.

(1) What is your title that I should use so that it is clear that are one the one responsible for approving my ability to republish the MSLQ in my dissertation?

__________________________________________

Marie-Anne Bien, Secretary to Paul R. Pintrich (dec.)
The University of Michigan
Combined Program in Education & Psychology (CPEP)

(2) If I am administering the MSLQ with the formatting changes described in the earlier email, can I also republish it in my dissertation with those formatting changes?

Yes, as long as you give Paul R. Pintrich credit for the MSLQ.

Thank you,

Margie

On Wed, 3 Mar 2004 08:09:42 -0500 Marie Bien wrote:

Dear Margie, I looked at your modifications and yes, you can do that for your own personal use. You will not be violating copyright agreements as you did give credit at the end. Thank you.

...Marie>

Hi Marie,

Last fall, I requested to use the MSLQ in my research study. I received the manual, but would like to know if I am able to use the MSLQ with a modification to its format. The questions, instructions, and scale are the same, but I would like to place the MSLQ in landscape orientation and use shading to differentiate the items from each other.

Attached is a copy of the MSLQ with the modifications mentioned. Please let me know if I may make these changes.

Thank you,

Margie DeBroux
Marie,

Thank you for allowing me to use the MSLQ in my study and sending it to me.

Thank you,
Margie

On Tue, 2 Sep 2003 15:40:14 -0400 Marie Bien wrote:

Dear Margie, as we spoke on the phone, the fee for the MSLQ is $10.
Make your check payable to the University of Michigan and mail it to me at my address. ...Marie

Ms. Bien,
I am a doctoral candidate at Florida State University interested in using the Motivated Strategies for Learning Questionnaire developed at your institution as part of my dissertation, The Effect of Guided Questioning on Student Achievement, Self-Regulatory Behavior, and Self-Efficacy in a Biology for Non-Majors Class. I am interested in administering it to about 250 students on a pre- and post- intervention basis. Please let me know of any payment and copyright information that I should be aware.

Thank you,
Margie DeBroux

925 East Magnolia Drive Apt. J-8
Tallahassee, FL 32301
mld7332@garnet.acns.fsu.edu
(850) 671-3104 (H)
(850) 644-0968 (W)
ADAPTATION OF THE COLLEGE BIOLOGY SELF-EFFICACY INSTRUMENT FOR
NON-MAJORS – REPRINT
March 12, 2004

Margie DeBroux
Florida State University

Dear Ms. DeBroux:


Permission is granted for this use, except that if the material appears in our work with credit to another source, you must also obtain permission from the original source cited in our work.

Permitted use is limited to your edition described above, and does not include the right to grant others permission to photocopy or otherwise reproduce this material except for versions made for use by visually or physically handicapped persons. Up to five copies of the published thesis may be photocopied by a microfilm company.

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4. This license is non-transferable. This license is for non-exclusive English language print rights and microfilm storage rights by Florida State University only, throughout the world. For translation rights, please reapply for a license when you have plans to translate your work into a specific language.

Sincerely,

Paulette Goldweber
Senior Permissions Asst.
PLANNING

Group ___________________   Date __________________

Group members who participated in this activity: ______________________

______________________    ______________________
______________________    ______________________
______________________    ______________________

As a group, respond to the following prompts. Each member of the group should provide input.

What are we trying to do here?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

What do we know about the problem so far?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

What characteristics or abilities do we have that may be used to accomplish this project?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
Knowing the characteristics and abilities we do or do not have, what strategies can we use to accomplish this project?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

What is our plan?
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

Is there another way to do this?
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

What should we do next?
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
As a group, respond to the following prompts. Each member of the group should provide input.

Are we using our plan or strategy? How closely are we following our plan or strategy?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

Are we getting closer to our goal? Why or why not?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
Do we need a new strategy? If so, what is it?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
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________________________________________________________________________
________________________________________________________________________

What should we do next?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
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________________________________________________________________________
EVALUATING

Group ___________________   Date __________________

Group members who participated in this activity:

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

As a group, respond to the following prompts. Each member of the group should provide input.

How well did we accomplish our goal?
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

What worked?
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
What didn’t work?

________________________________________________________________________
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What would we do differently next time?

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What didn’t work?

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What would we do differently next time?

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APPENDIX D

LESS GUIDED QUESTIONING PROMPTS
As a group, respond to the following prompt. Each member of the group should provide input.

Develop a plan to teach the class about your group’s system.
MONITORING

Group ________________________   Date _____________________

Group members who participated in this activity: ________________________________

__________________________________________
__________________________________________

As a group, respond to the following prompt. Each member of the group should provide input.

Report on group activities.

__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
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__________________________________________________________________________
EVALUATING

Group ________________________   Date _____________________

Group members who participated in this activity: ___________________________

__________________________________________________________

As a group, respond to the following prompt. Each member of the group should provide input.

Analyze what worked and what you would change.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

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APPENDIX E

DEMOGRAPHIC DATA
Demographics Questionnaire

1. What year are you in school? (Circle the one that applies to you.)

   College:  Freshman  Sophomore  Junior  Senior  Graduate

   High School:  Sophomore  Junior  Senior

2. What is your gender?  Male _____ Female _____

3. What is your age? (in years) _____

4. What is your race/ethnicity?

   African-American/Black  Native American
   Asian/Pacific Islander  Other
   Caucasian (White)  International student
   Hispanic  Prefer not to respond

5. What is your GPA? _____

6. What was your score on the ACT: Math _____  English _____  Did not take it _____

7. What was your score on the SAT: Math _____  English _____  Did not take it _____

8. How many science courses did you take in high school? ________

9. How many science courses have you taken in college? _________

10. How long ago did you take your last science class? ________ years ________ months

11. What is your major? _____________________________________________

12. How well are you satisfied with your choice of major?  

   Well satisfied with choice  Dissatisfied, but intend to remain
   Satisfied, but have a few doubts  Very dissatisfied and intend to change
   Not sure  Undecided about my future career

   Rate the following activities according to how interested you are in participating in them: 

   1 = Not at all interested  3= Very interested
   2= Somewhat interested 4= Extremely interested

13. Pursue a career in science  1  2  3  4

14. Read scientific articles  1  2  3  4

15. Solve problems using a scientific method  1  2  3  4

16. Take more science courses  1  2  3  4

1Satisfaction with Choice Item from Holland, Gottfredson, & Nafziger (1973).
APPENDIX F

MOTIVATED STRATEGIES FOR LEARNING QUESTIONNAIRE (MSLQ)

(PINTRICH, SMITH, GARCIA, & MCKEACHIE, 1991)
Motivated Strategies for Learning Questionnaire

A. Motivation
The following questions ask about your motivation for and attitudes about this class. Remember there are no right or wrong answers. Answer the questions about how you study in this class as accurately as possible. Use the scale below to answer the questions. If you think the statement is very true of you, choose 7; if a statement is not at all true of you, choose 1. If the statement is more or less true of you, find the number between 1 and 7 that best describes you.

<table>
<thead>
<tr>
<th>Question</th>
<th>Scale</th>
<th>Not at all true of me</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>Very true of me</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. In a class like this, I prefer course material that really challenges me so I can learn new things.</td>
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<td>2. If I study in appropriate ways, then I will be able to learn the material in this course.</td>
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<td>3. When I take a test I think about how poorly I am doing compared with other students.</td>
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<td>4. I think I will be able to use what I learn in this course in other courses.</td>
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<td>5. I believe I will receive an excellent grade in this class.</td>
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<td>6. I'm certain I can understand the most difficult material presented in the reading for this course.</td>
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<tr>
<td>7. Getting a good grade in this class is the most satisfying thing for me right now.</td>
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<tr>
<td>8. When I take a test I think about items on other parts of the test I can't answer</td>
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<td>9. It is my own fault if I don't learn the material in this course.</td>
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<tr>
<td>10. It is important for me to learn the course material in this class.</td>
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<tr>
<td>11. The most important thing for me right now is improving my overall grade point average, so my main concern in this class is getting a good grade.</td>
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<tr>
<td>12. I'm confident I can learn the basic concepts taught in this course.</td>
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<tr>
<td>13. If I can, I want to get better grades in this class than most the other students.</td>
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<tr>
<td>14. When I take tests I think of the consequences of failing.</td>
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<td></td>
<td></td>
<td>Very true of me</td>
<td></td>
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<tr>
<td>15. I'm confident I can understand the most complex material presented by the instructor in this course.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td></td>
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<tr>
<td>16. In a class like this, I prefer course material that arouses my curiosity, even if it is difficult to learn.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td></td>
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</tr>
<tr>
<td>17. I am very interested in the content area of this course.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>18. If I try hard enough, then I will understand the course material.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19. I have an uneasy, upset feeling when I take an exam.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20. I'm confident I can do an excellent job on the assignments and tests in this course.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>21. I expect to do well in this class.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>22. The most satisfying thing for me in this course is trying to understand the content as thoroughly as possible.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>23. I think the course material in this class is useful for me to learn.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>24. When I have the opportunity in this class, I choose course assignments that I can learn from even if they don't guarantee a good grade.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25. If I don't understand the course material, it is because I didn't try hard enough.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>26. I like the subject matter of this course.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>27. Understanding the subject matter of this course is very important to me.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>28. I feel my heart beating fast when I take an exam.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
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<td>29. I'm certain I can master the skills being taught in this class.</td>
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<td>30. I want to do well in this class because it is important to show my ability to my family, friends, employer, or others.</td>
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<td>31. Considering the difficulty of this course, the teacher, and my skills, I think I will do well in this class.</td>
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</table>
### B. Learning Strategies

The following questions ask about your learning strategies and study skills for this class. **Again, there are no right or wrong answers. Answer the questions about how you study in this class as accurately as possible.** Use the same scale below to answer the remaining questions. If you think the statement is very true of you, choose 7; if a statement is not at all true of you, choose 1. If the statement is more or less true of you, find the number between 1 and 7 that best describes you.

<table>
<thead>
<tr>
<th>Question</th>
<th>Very true of me</th>
<th>7</th>
<th>6</th>
<th>5</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
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</thead>
<tbody>
<tr>
<td>32. When I study the readings for this course, I outline the material to help me organize my thoughts.</td>
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<td>33. During class time I often miss important points because I'm thinking of other things.</td>
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<tr>
<td>34. When studying for this course, I often try to explain the material to classmate of friend.</td>
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<td>35. I usually study in a place where I can concentrate on my course work.</td>
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<td>36. When reading for this course, I make up questions to help focus my reading.</td>
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<tr>
<td>37. I often feel so lazy or bored when I study for this class that I quit before I finish what I planned to do.</td>
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<td>38. I often find myself questioning things I hear or read in this course to decide if I find them convincing.</td>
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<tr>
<td>39. When I study for this class, I practice saying the material to myself over and over.</td>
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<tr>
<td>40. Even if I have trouble learning the material in this class, I try to do the work on my own, without help from anyone.</td>
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<td>41. When I become confused about something I'm reading for this class, I go back and try to figure it out.</td>
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<td>42. When I study for this course, I go through the readings and my class notes and try to find the most important ideas.</td>
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<td>43. I make good use of my study time for this course.</td>
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<td>44. If course readings are difficult to understand, I change the way I read the material.</td>
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<td>45. I try to work with other students from this class to complete the course assignments.</td>
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<td>46. When studying for this course, I read my class notes and the course</td>
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<td>readings over and over again.</td>
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<td>47. When a theory, interpretation, or conclusion is presented in class</td>
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<td>or in the readings, I try to decide if there is good supporting</td>
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<td>48. I work hard to do well in this class even if I don't like what we</td>
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<td>49. I make simple charts, diagrams, or tables to help me organize</td>
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<td>course material.</td>
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<td>50. When studying for this course, I often set aside time to discuss</td>
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<td>course material with a group of students for the class.</td>
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<td>51. I treat the course material as a starting point and try to develop</td>
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<td>52. I find it hard to stick to a study schedule.</td>
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<td>53. When I study for this class, I pull together information from</td>
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<td>different sources, such as lectures, readings, and discussions.</td>
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<td>54. Before I study new course material thoroughly, I often skim it to</td>
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<td>see how it is organized.</td>
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<td>55. I ask myself questions to make sure I understand the material I</td>
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<td>have been studying in this class.</td>
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<td>56. I try to change the way I study in order to fit the course</td>
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<td>requirements and the instructor's teaching style.</td>
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<td>57. I often find that I have been reading for this class but don't know</td>
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<td>what it was all about.</td>
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<td>58. I ask the instructor to clarify concepts I don't understand well.</td>
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<td>59. I memorize key words to remind me of important concepts in this</td>
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<td>60. When course work is difficult, I either give up or only study the</td>
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<td>61. I try to think through a topic and decide what I am supposed to</td>
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<td>learn from it rather than just reading it over when studying for this</td>
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<td>62. I try to relate ideas in this subject to those in other courses</td>
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<td>whenever possible.</td>
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<td>63. When I study for this course, I go over my class notes and make an</td>
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<td>outline of important concepts.</td>
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<tr>
<td>64. When reading for this class, I try to relate the material to what I already know.</td>
<td>Not at all true of me</td>
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<tr>
<td>65. I have a regular place set aside for studying.</td>
<td>Not at all true of me</td>
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<tr>
<td>66. I try to play around with ideas of my own related to what I am learning in this course.</td>
<td>Not at all true of me</td>
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<tr>
<td>67. When I study for this course, I write brief summaries of the main ideas from the readings and my class notes.</td>
<td>Not at all true of me</td>
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<tr>
<td>68. When I can't understand the material in this course, I ask another student in this class for help.</td>
<td>Not at all true of me</td>
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<tr>
<td>69. I try to understand the material in this class by making connections between the readings and the concepts from the lectures.</td>
<td>Not at all true of me</td>
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<tr>
<td>70. When I study for this course, I write brief summaries of the main ideas from the readings and my class notes.</td>
<td>Very true of me</td>
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<td>71. Whenever I read or hear an assertion or conclusion in this class, I think about possible alternatives.</td>
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<tr>
<td>72. I make lists of important items for this course and memorize the lists.</td>
<td>Very true of me</td>
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<td>73. I attend this class regularly.</td>
<td>Very true of me</td>
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<tr>
<td>74. Even when course materials are dull and uninteresting, I manage to keep working until I finish.</td>
<td>Very true of me</td>
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<tr>
<td>75. I try to identify students in this class whom I can ask for help if necessary.</td>
<td>Very true of me</td>
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<td>76. When studying for this course I try to determine which concepts I don't understand well.</td>
<td>Very true of me</td>
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<td>77. I often find that I don't spend very much time on this course because of other activities.</td>
<td>Very true of me</td>
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<tr>
<td>78. When I study for this class, I set goals for myself in order to direct my activities in each study period.</td>
<td>Very true of me</td>
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<td>79. If I get confused taking notes in class, I make sure I sort it out afterwards.</td>
<td>Very true of me</td>
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<td>80. I rarely find time to review my notes or readings before an exam.</td>
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<td>81. I try to apply ideas for course readings in other class activities such as lecture and discussion.</td>
<td>Very true of me</td>
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APPENDIX G

BIOLOGY SELF-EFFICACY INSTRUMENT FOR NON-MAJORS

(ADAPTED FROM BALDWIN, EBERT-MAY, & BURNS, 1999)
**Biology Self-efficacy Instrument for Non-majors**

This survey contains 15 statements about your confidence in doing things related to biology. For each question, think about how confident you would-be in carrying out a given task. There are no right or wrong answers. These are just your own thoughts and feelings about these topics. For each statement in the survey, circle the letter next to each question:

A. If you are **TOTALLY CONFIDENT** that you can do the task  
B. If you are **VERY CONFIDENT** that you can do the task  
C. If you are **FAIRLY CONFIDENT** that you can do the task  
D. If you are **ONLY A LITTLE CONFIDENT** that you can do the task  
E. If you are **NOT AT ALL CONFIDENT** that you can do the task

**Practice item**

How confident are you that you could give a presentation about birds in Florida?

Suppose that you were “fairly confident” that you could give a presentation about birds in Florida. You would circle the letter “C” in the box next to the question. Thank you for your participation!

<p>| | | | | |</p>
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>1.</td>
<td>How confident are you that after reading an article about a biology experiment, you could write a summary of its main points?</td>
<td>A</td>
<td>B</td>
<td>C</td>
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<tr>
<td>2.</td>
<td>How confident are you that after reading an article about a biology experiment, you could explain its main ideas to another person?</td>
<td>A</td>
<td>B</td>
<td>C</td>
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<td>3.</td>
<td>How confident are you that after watching a television documentary dealing with some aspect of biology, you could write a summary of its main points?</td>
<td>A</td>
<td>B</td>
<td>C</td>
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<td>4.</td>
<td>How confident are you that you will be successful in this biology course?</td>
<td>A</td>
<td>B</td>
<td>C</td>
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<td>5.</td>
<td>How confident are you that after watching a television documentary dealing with some aspect of biology, you could explain its main ideas to another person?</td>
<td>A</td>
<td>B</td>
<td>C</td>
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<td>6.</td>
<td>How confident are you that you will be successful in another biology course?</td>
<td>A</td>
<td>B</td>
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<td>7.</td>
<td>How confident are you that after listening to a public lecture regarding some biology topic, you could write a summary of its main points?</td>
<td>A</td>
<td>B</td>
<td>C</td>
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<td>8.</td>
<td>How confident are you that you would be successful in an ecology course?</td>
<td>A</td>
<td>B</td>
<td>C</td>
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<td>9.</td>
<td>How confident are you that you could analyze a set of data (i.e., look at the relationships between variables)</td>
<td>A</td>
<td>B</td>
<td>C</td>
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<td>10.</td>
<td>How confident are you that after listening to a public lecture regarding some biology topic, you could explain its main ideas to another person?</td>
<td>A</td>
<td>B</td>
<td>C</td>
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<tr>
<td>11.</td>
<td>How confident are you that you would be successful in a human physiology course?</td>
<td>A</td>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td>12.</td>
<td>How confident are you that you could tutor another student for this biology course?</td>
<td>A</td>
<td>B</td>
<td>C</td>
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<tr>
<td>13.</td>
<td>How confident are you that you could ask a meaningful question that could be answered experimentally?</td>
<td>A</td>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td>14.</td>
<td>How confident are you that you could explain something that you learned in this biology course to another person?</td>
<td>A</td>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td>15.</td>
<td>How confident are you that you could use a scientific approach to solve a problem at home?</td>
<td>A</td>
<td>B</td>
<td>C</td>
</tr>
</tbody>
</table>

APPENDIX H

HUMAN SYSTEMS KNOWLEDGE QUESTIONNAIRE
Knowledge Questionnaire

Circle the letter of the answer to the following questions.

1. What is the function of the epiglottis?
   a. close to prevent food from entering the lungs
   b. prevent stomach acids from entering the esophagus
   c. regulate the amount of food that enters the stomach
   d. swing in two directions to send food one way and air the other

2. What is the dome-shaped muscle that assists in breathing?
   a. diaphragm
   b. epiglottis
   c. thoracic cavity
   d. pleural sac

3. What are the bands that connect bones to bones?
   a. cartilage
   b. joints
   c. ligaments
   d. tendons

4. What is the small space across which neurotransmitters cross to other neurons?
   a. axon
   b. cell body
   c. dendrite
   d. synapse

5. Which of the following delivers oxygen and nutrients directly to cells?
   a. arteries
   b. capillaries
   c. plasma
   d. veins

6. What structure surrounds a maturing oocyte?
   a. corpus luteum
   b. chorion
   c. follicle
   d. interstitial cell

7. Where do kidney stones occur?
   a. distal tubule
   b. ureter
   c. urethra
   d. nephrons
8. Which hormone controls the absorption of salt?
   a. aldosterone
   b. antidiuretic hormone
   c. erythropoietin
   d. insulin

9. What type of cell fragment(s) is/are important in the initiation of blood clotting?
   a. plasma
   b. lymph
   c. platelets
   d. leukocytes

10. What is marrow responsible for manufacturing?
    a. blood cells
    b. calcium
    c. collagen
    d. phosphate

11. What is the fluid-filled cavity surrounding the lungs?
    a. diaphragm
    b. epiglottis
    c. thoracic cavity
    d. pleural sac

12. Which of the following secretes the substance that maintains uterine lining?
    a. corpus luteum
    b. chorion
    c. follicle
    d. interstitial cell

13. What are the nerves that regulate internal organs during times of stress?
    a. central nervous system
    b. parasympathetic nerves
    c. peripheral nervous system
    d. sympathetic nerves

14. Where is the primary place of water reabsorption?
    a. colon
    b. duodenum
    c. muscularis
    d. pyloric sphincter
15. What hormone produced by the small intestine produces a feeling of fullness after a meal?
   a. bile salts
   b. cholecystokinin
   c. gastrin
   d. pepsin

16. What portion of blood includes cells of the immune system?
   a. plasma
   b. lymph
   c. platelets
   d. leukocytes

17. What are the small airways within the lung?
   a. alveolus
   b. epiglottis
   c. bronchiole
   d. larynx

18. What is the tube where the contents of the bladder leave the body?
   a. distal tubule
   b. ureter
   c. urethra
   d. nephrons

19. Where is sperm produced?
   a. epididymis
   b. prostate
   c. testes
   d. vas deferens

20. What are the nerves that carry information from sense organs to the brain and from the brain to muscles?
   a. central nervous system
   b. motor neurons
   c. peripheral nervous system
   d. sensory neuron

21. What is the name of the sac within a joint?
   a. bursa
   b. cartilage
   c. marrow
   d. synovial membrane
22. Why are diseases carried on the X-chromosome more likely to affect men?
   a. Men only have one X-chromosome
   b. Only men have X-chromosomes
   c. The X-chromosome is inherited from the father
   d. There are fewer genes on the Y-chromosome

23. What is the name of the nerves that are composed of the brain and spinal cord?
   a. autonomic nervous system
   b. central nervous system
   c. peripheral nervous system
   d. sensory neuron

24. To what does the right side of the heart pump blood?
   a. body
   b. lungs
   c. veins
   d. left side of the heart

25. What is the function of tendons?
   a. act as a cushion at the joints
   b. connect bones to bones
   c. connect bones to muscles
   d. manufactures synovial fluid

26. Which of the following connects to the throat?
   a. esophagus
   b. caecum
   c. colon
   d. stomach

27. What are the vocal cords?
   a. alveolus
   b. epiglottis
   c. bronchiole
   d. larynx

28. In humans, urine carries what types of wastes out of the body?
   a. ammonia
   b. nitrogenous
   c. renin
   d. uric acid
29. Which of the following allow the bones in the vertebral column to move without pinching each other?
   a. cartilage discs
   b. processes
   c. spinal cord
   d. vertebrae

30. Which of the following carries blood away from the heart?
   a. arteries
   b. capillaries
   c. plasma
   d. veins

31. What is the name of the receiving end of a neuron?
   a. axon
   b. cell body
   c. dendrite
   d. synapse

32. Into what section of the small intestine does secretions from the liver and pancreas enter?
   a. colon
   b. duodenum
   c. muscularis
   d. pyloric sphincter

33. What are the air sacs within the lungs?
   a. alveoli
   b. bronchioles
   c. bronchi
   d. epiglottis

34. What is the primary organ responsible for filtering the liquids in the body?
   a. bladder
   b. kidney
   c. liver
   d. ureter

35. Ovulation occurs in response to an increase in which hormone?
   a. estrogen
   b. follicle stimulating hormone
   c. luteinizing hormone
   d. progesterone
APPENDIX I

SPECIES KNOWLEDGE QUESTIONNAIRE
Species Knowledge Questionnaire

Circle the answer to the following questions.

Fishes

1. What structure allows fish to control its depth in the water?
   a. Air sac
   b. Fins
   c. Gills
   d. Swim bladder

2. What structure(s) do fish use for respiration?
   a. Gills
   b. Lungs
   c. Skin
   d. Spiracles

3. What structure allowed some fish to become predators?
   a. Dorsal Fin
   b. Jaws
   c. Teeth
   d. Vertebrae

Amphibians

4. What type of fish resembles amphibians?
   a. Cartilaginous
   b. Lobe-finned
   c. Ray-finned
   d. Rays and skates

5. How many heart chambers do amphibians have?
   a. Two (2)
   b. Three (3)
   c. Four (4)
   d. Five (5)

6. What type of animal uses their skin for respiration?
   a. Amphibians
   b. Birds
   c. Mammals
   d. Reptiles
Reptiles

7. What is the purpose of a reptile’s scaly skin for living on land?
   a. Able to move quickly across land
   b. Able to move quickly between water and land
   c. Conserve heat
   d. Prevent loss of moisture

8. What characteristic restricts reptiles to living in the tropics or subtropics?
   a. Cannot store water
   b. Cold-blooded
   c. Hibernation
   d. Warm-blooded

9. What enables reptiles to breathe more easily on land than amphibians?
   a. Expandable ribcage
   b. Diaphragm
   c. Larger lungs
   d. 3-chambered heart

10. What characteristic allowed reptiles to be independent of water?
    a. Shelled eggs
    b. Legs
    c. Lungs
    d. Scaly skin

11. Why do alligators use their voices?
    a. Attract mates
    b. Frighten others
    c. Sonar in water
    d. Sonar on land

12. How are alligators able to select the sex of their offspring?
    a. Acidity of the female genitalia
    b. Humidity of the nest
    c. Point in the menstrual cycle at the time of conception
    d. Temperature of the nest

13. Why did snakes develop the adaptation of not having legs?
    a. Burrow underground
    b. Crush prey
    c. Molt skin
    d. Move quickly
14. Why are snakes able to eat prey that is larger than them?
   a. Crush the prey with constriction
   b. Jaw is loosely attached to the skull
   c. Long digestive tract
   d. Paralyze the prey with venom

15. Why does a snake flick its tongue?
   a. Breathe
   b. Check for movement vibrations
   c. Frighten others
   d. Test chemicals in the air

16. What do turtles have to make up for not having teeth?
   a. Sharp beak
   b. Hard Shell
   c. Strong legs
   d. Gizzard

17. When compared to land tortoises, what structure(s) do sea turtles have to adapt to the sea?
   a. Pointed beak
   b. Paddle-like legs
   c. Rounded shells
   d. Smaller eyes

Birds

18. What characteristic allows some animals to inhabit the same climate year-round?
   a. Cold-blooded
   b. Hibernation
   c. Migration
   d. Warm-blooded

19. When compared to other vertebrates, what is one of the unique structures of a bird’s digestive system?
   a. Esophagus
   b. Gizzard
   c. Pancreas
   d. Trachea

20. What characteristic is unique to birds?
   a. Beaks
   b. Feathers
   c. Scaly legs
   d. Shelled eggs
21. Along with foot type, what characteristic of birds is related to adaptations to their environment and is one of the main ways that scientists classify birds?
   a. Beak type
   b. Coloring
   c. Feather type
   d. Wing span

22. Besides flight, what is the main purpose of a bird’s feathers?
   a. Attract mates
   b. Camouflage
   c. Frighten others
   d. Warmth

23. What is the main structure to which the flight muscles are attached?
   a. Feathers
   b. Rib cage
   c. Sternum
   d. Wing

24. To what type of animals are birds closely related?
   a. Amphibians
   b. Invertebrates
   c. Mammals
   d. Reptiles

25. Why do eagles have large nests?
   a. Have enough room to bring their food back to eat
   b. Many babies
   c. Return to the same nest every year
   d. To hide inside

26. What part of a bird of prey’s body is the talon?
   a. Beak
   b. Feet
   c. Tail feathers
   d. Wing

27. Why do shorebirds, such as the egret, have long, slender beaks?
   a. Catch larger prey
   b. Make loud calling sounds
   c. Pick insects out of trees
   d. Sift water for food
28. Why do shorebirds, such as the egret, have long legs?
   a. Camouflage itself
   b. Launch into flight quickly
   c. Provide balance when wading
   d. Run quickly

Mammals

29. What is the purpose for mammals having hair?
   a. Move water across the body
   b. Protect the skin
   c. Sense touch
   d. Warmth

30. Along with having hair, what is the defining characteristic of mammals?
   a. Internal fertilization
   b. Live births (does not lay eggs)
   c. Live in groups to raise young
   d. Produce milk for young

31. What advantage do placental mammals have over other animals?
   a. Lengthy infancy time
   b. Mother does not leave young to hunt for food
   c. Mother has independence during pregnancy
   d. Young learn behavioral adaptation from mother

32. What enables mammals to breathe more easily on land than reptiles?
   a. Expandable ribcage
   b. Diaphragm
   c. Larger lungs
   d. 3-chambered heart

33. What type of animal has teeth that are differentiated according to diet?
   a. Birds
   b. Fish
   c. Mammals
   d. Reptiles

34. Bats are considered what type of animal?
   a. Birds
   b. Invertebrates
   c. Mammals
   d. Reptiles
35. What sense do bats use to navigate?
   a. Hearing
   b. Smell
   c. Touch
   d. Vision
<table>
<thead>
<tr>
<th>Activity</th>
<th>Available Points</th>
<th>Points</th>
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<tr>
<td><strong>Presentation (Group Grade)</strong></td>
<td></td>
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<tr>
<td>Describe the purpose and function of the system with replicas</td>
<td>2</td>
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</tr>
<tr>
<td>Describe the purpose and function of each organ or component</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Describe how the components of the system work together to perform the system’s function</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Describe diseases related to the system: symptoms</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Describe diseases related to the system: causes</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Describe diseases related to the system: treatments</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Describe diseases related to the system: prevention methods</td>
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<td><strong>Paper (Group Grade)</strong></td>
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<td>Describe the purpose and function of the system</td>
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<tr>
<td>Describe the purpose and function of each organ or component</td>
<td>3</td>
<td></td>
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<tr>
<td>Describe how the components of the system work together to perform the system’s function</td>
<td>3</td>
<td></td>
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<tr>
<td>Describe diseases related to the system: symptoms</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Describe diseases related to the system: causes</td>
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<td>Describe diseases related to the system: treatments</td>
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<td>Describe diseases related to the system: prevention methods</td>
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<td><strong>System (Individual Grade)</strong></td>
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<td>Explain your section of the system</td>
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<tr>
<td>Explain how the system works together</td>
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<tr>
<td>Others in the group are able to explain your section</td>
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<td>System Total</td>
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<td><strong>Overall Total</strong></td>
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APPENDIX K

RUBRIC FOR FLORIDA ENDANGERED SPECIES PROJECT
Endangered Species Rubric

<table>
<thead>
<tr>
<th>Taxonomy of the organism</th>
<th>Organization</th>
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<tbody>
<tr>
<td>External morphology with visuals</td>
<td>Originality</td>
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<tr>
<td>Internal morphology with reference to specific organ systems studied</td>
<td>Context</td>
</tr>
<tr>
<td>Reproductive strategy</td>
<td>Grammar</td>
</tr>
<tr>
<td>Nutritional requirements and feeding behavior</td>
<td>Reference Page</td>
</tr>
<tr>
<td>Role in the food web</td>
<td></td>
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<tr>
<td>Symbiotic relationships and competitive relationships</td>
<td></td>
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<tr>
<td>Role in nutrient cycling</td>
<td></td>
</tr>
<tr>
<td>Special adaptations, making it unique and interesting</td>
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<tr>
<td>Reasons for its endangerment, and</td>
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<tr>
<td>Steps being taken to avoid extinction</td>
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</table>

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<tr>
<th>Title</th>
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<td>Y/N</td>
<td>Y/N</td>
<td>Y/N</td>
<td>Y/N</td>
</tr>
</tbody>
</table>

1 – 11 = Topics in presentation (5 points off for each missing topic)
12-16 = Paper criteria
P = Presentation (5 points off for each of the topics in 1 – 11)
APPENDIX L

RESPONSIBILITIES CHART
### Responsibilities Chart

In the chart below, write the activities that each group member completed during this project. In the first column, list the name of each member of the group. In the second column, list the role(s) that each group member played, such as leader, editor, artist, and writer. In the third column, write the topic(s) that each group member studied and taught to the rest of the group. In the fourth column, write the tasks that each group member completed to help the group develop the presentation and paper.

<table>
<thead>
<tr>
<th>Group Member</th>
<th>Role(s)</th>
<th>Topics Researched</th>
<th>Tasks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Responsibilities Chart Example

In the chart below, write the activities that each group member completed during this project. In the first column, list the name of each member of the group. In the second column, list the role(s) that each group member played, such as leader, editor, artist, writer, and slideshow creator. In the third column, write the topic(s) that each group member studied and taught to the rest of the group. In the fourth column, write, the tasks that each group member completed to help the group develop the presentation and paper.

<table>
<thead>
<tr>
<th>Group Member</th>
<th>Role(s)</th>
<th>Topics Researched</th>
<th>Tasks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wanda</td>
<td>Leader</td>
<td>• Pituitary gland</td>
<td>• Wrote pituitary gland and acromegaly sections for summary paper and highlights for slideshow</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Acromegaly</td>
<td>• Encouraged group members to turn in their sections on time</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Ensured that all materials were ready for the presentation</td>
</tr>
<tr>
<td>Victor</td>
<td>Editor</td>
<td>• Thyroid</td>
<td>• Wrote thyroid and goiters sections for summary paper and highlights for slideshow</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Goiters</td>
<td>• Encouraged group members to topic area papers on time</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Reviewed summary paper for smooth transitions between sections</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Reviewed summary paper for grammar</td>
</tr>
<tr>
<td>Teresa</td>
<td>Artist</td>
<td>• Pineal gland</td>
<td>• Wrote pineal gland and Seasonal Affective Disorder sections for summary paper and highlights for slideshow</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Seasonal Affective Disorder</td>
<td>• Created the organs to place on Biology Belle</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>• Drew diagrams for slideshow</td>
</tr>
<tr>
<td>Sam</td>
<td>Director</td>
<td>• Adrenal gland</td>
<td>• Wrote adrenal gland and Cushing’s Syndrome sections for summary paper and highlights for slideshow</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Cushing’s Syndrome</td>
<td>• Directed presenters so that transitions between them would be smooth</td>
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<td></td>
<td></td>
<td></td>
<td>• Ensured that all content was covered</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Ensured that presentation was within timeframe</td>
</tr>
<tr>
<td>Rose</td>
<td>Slideshow creator</td>
<td>• Thymus</td>
<td>• Wrote thymus and cancer sections for summary paper and highlights for slideshow</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Cancer</td>
<td>• Organize content for slideshow</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Scan diagrams drawn by artist into the slideshow</td>
</tr>
</tbody>
</table>

NOTE: These roles are suggestions only. Select roles that will work best for your project.
Responsibilities Chart Example

In the chart below, write the activities that each group member completed during this project. In the first column, list the name of each member of the group. In the second column, list the role(s) that each group member played, such as leader/director, paper editor, artist, and slideshow editor. In the third column, write the topic(s) that each group member studied and taught to the rest of the group. In the fourth column, write the tasks that each group member completed to help the group develop the presentation and paper.

<table>
<thead>
<tr>
<th>Group Member</th>
<th>Role(s)</th>
<th>Topics Researched</th>
<th>Tasks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wanda</td>
<td>Artist</td>
<td>• Taxonomy of the organism</td>
<td>• Wrote sections of the paper and slideshow related to the taxonomy of the organism and the internal and external morphology&lt;br&gt;• Drew diagrams for slideshow for various sections of the report</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• External morphology with visuals</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Internal morphology with reference to specific organ systems studied</td>
<td></td>
</tr>
<tr>
<td>Victor</td>
<td>Paper Editor</td>
<td>• Reproductive strategy</td>
<td>• Wrote section of the paper and slideshow related to reproduction, feeding behavior, and role in food web&lt;br&gt;• Reviewed paper for smooth transitions between sections&lt;br&gt;• Reviewed paper for grammar</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Nutritional requirements and feeding behavior</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Role in the food web</td>
<td></td>
</tr>
<tr>
<td>Teresa</td>
<td>Slideshow Editor</td>
<td>• Symbiotic relationships and competitive relationships</td>
<td>• Wrote section of the paper and slideshow related to relationships with environment, role in nutrient cycling, and special adaptations&lt;br&gt;• Organize content for slideshow&lt;br&gt;• Scan diagrams drawn by artist into the slideshow&lt;br&gt;• Ensured that all materials were ready for the presentation&lt;br&gt;• Ensured that all content was covered</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Role in nutrient cycling</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Special adaptations, making it unique and interesting</td>
<td></td>
</tr>
<tr>
<td>Sam</td>
<td>Leader</td>
<td>• Reasons for its endangerment, and</td>
<td>• Wrote section of the paper and slideshow related to reasons for endangerment, steps being taken to avoid extinction, and habitat&lt;br&gt;• Encouraged group members to turn in their sections on time&lt;br&gt;• Directed presenters so that transitions would be smooth&lt;br&gt;• Ensured that presentation was within timeframe</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Steps being taken to avoid extinction.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Habitat location within a specific biome</td>
<td></td>
</tr>
</tbody>
</table>

NOTE: These roles are suggestions only. Select roles that will work best for your project.
Suggestions for Developing the Project

The information in this handout provides suggestions for developing the project. The first page is related to organizing the project and presenting information to others, whether in your group or for the whole class. The second page is related to learning from others and working in groups.

Organizing the Project
- Determine what you will do for the presentation
- Determine all of the tasks needed to develop the presentation
- Determine the timeline for each task to be completed
- Determine who is responsible for each task
- Set interim goals to be accomplished at regular intervals during the project (such as each week)
- Evaluate the interim goals at regular intervals

Setting Goals
- Be specific – describe exactly what will be accomplished (quality, quantity, rate, and originality)
- Review the goals and accomplishments on a frequent basis
- Develop goals that are realistic, but not too easy

Dividing the Topics and Learning from Group Members
- Learn about a particular part of the system
- Help other group members to understand your part of the system
- Connect the information from each members’ section to the other sections

Presenting Information to Others
- Be willing to give explanations to your classmates. Not only will you help your classmates learn the material, you will remember the material better.
- Relate new material to what students already know
  - Example: This is similar to what we studied about ___.
- Use multiple instructional methods to present the material
  - Example: Diagrams and videos, phrasing the concept in different ways
- Show the relationships between the information in each of the instructional methods
  - Example: Point out the same component in two different diagrams
- When solving a problem or showing steps, provide justifications or explanations for each step
  - Example: This happens first because ___. This happens next because ___.
- Use specific examples
  - Example: Here is where ___ happens.
- Explain unfamiliar terms ideas in more familiar terms
  - Example: This organ is commonly called the ___.
- Answer your classmates’ questions as soon as possible.
  - Example: You may have to do more research, but come back with an answer as soon as possible.
Working Together in Teams
- Recognize that what helps you will also help the other group members and what will help
  the other group members will also help you
- Recognize that all group members will gain or lose based on the overall performance of
  the group
- Help each other to make progress. The success of the group is dependent on the group
  encouraging and helping each other with the tasks. Each member of the group is
  responsible for the success of the other group members.
- Develop a feeling of being a team and that each person is a part of the group.
- Show sincere respect, praise, and appreciation for the individual accomplishments of the
  group members.

Giving Feedback to Group Members (Praise or suggestions for improvement)
- Feedback helps each group member to learn what he/she does well and what he/she can
  do to improve.
- Give the feedback as soon as possible
- Be specific about what they did that was effective or not
- Be instructive - Provide suggestions or methods that will help in the future.
- Be positive (Have more praise than suggestions for improvement)
- Forgive past mistakes
- Encourage those who have taken risks and failed to try again

Dealing with Disagreements
- Disagreements can help the learning process, because new and different ideas can be
  explored.
- Speak up – You may give the group new and better ideas to help the situation
- Recognize that your beliefs or ideas may be different from others
- Provide a justification or explanation to others about your belief or ideas
- Question your own beliefs or ideas – Think about them to determine if they have good
  reasoning
- Seek information to resolve the disagreement
- Allow others to speak their ideas – Don’t dominate
- Don’t spend too much time arguing that your task does not get completed

Learning from Others
- Be willing to ask for help
- Relate the information that your classmate(s) have told you to your own topic area.
- Check your own understanding of what you have learned from your classmate(s).
- Explain what you have learned to the one(s) who taught you to be sure that you
  understand the concept correctly.
- Explain what you have learned to others. This will help you to understand and remember
  it.
APPENDIX N

FOLLOW-UP QUESTIONNAIRE
Follow-up Questionnaire

1. How many credit hours did you take this semester? _____________

2. On average, how many hours a week do you spend working at a paid job? ________

3. On average, how many hours a week do you spend with other responsibilities (family, community organizations, etc.)? _____________

4. What is your major? _____________________________________________

5. How well are you satisfied with your choice of major?*

   Well satisfied with choice  Dissatisfied, but intend to remain
   Satisfied, but have a few doubts  Very dissatisfied and intend to change
   Not sure  Undecided about my future career

6. Rate the following activities according to how interested you are in participating in them:

   1 = Not at all interested  3 = Very interested
   2 = Somewhat interested  4 = Extremely interested

   Pursue a career in science  1  2  3  4
   Read scientific articles  1  2  3  4
   Solve problems using a scientific method  1  2  3  4
   Take more science courses  1  2  3  4

*Satisfaction with Choice Item from Holland, Gottfredson, & Nafziger (1973)
APPENDIX O

INDIVIDUAL ASSESSMENT OF PROJECT ACTIVITIES
Individual Assessment of Project Activities

Describe your experience with the instructional activities, particularly in terms of their usefulness in the learning processes of you and your group. Only the researcher will see this questionnaire. Specific concerns about your group’s activities should be shared with your instructor.

1. Describe your experience of using group work to complete this project.

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

2. Describe your experience of using prompts to complete this project.

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

3. Other comments

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
APPENDIX P

FOLLOW-UP INTERVIEW STARTER QUESTIONS
Follow-up Interview Starter Questions

• What aspects of this activity helped or hindered you in learning about biology?

• What aspects of this activity helped or hindered you in being self-regulated?

• How did interacting with others affect the way that you regulate your learning process?

• How do you feel about your ability to examine and explain to others about biology topics?

• How did this activity affect the way you feel about your ability for biology-related activities?

• What were the positive aspects of this activity?

• What were the negative aspects of this activity?

• How would you describe the way that your group interacted to accomplish the goals of the project?
APPENDIX Q

PROJECT TIMELINE – WEEKS IN STUDY
<table>
<thead>
<tr>
<th>Activities</th>
<th>Weeks Before Intervention</th>
<th>Weeks During Intervention</th>
<th>Weeks After Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Introduce Researcher to Class</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>- Time elapsed between introduction and pre-assessments</td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>- Time elapsed between pre-assessments and first day of intervention</td>
<td></td>
<td></td>
<td>Same Day</td>
</tr>
<tr>
<td>- Receive remainder of pre-intervention Assessments</td>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>- Activity Instructions/Planning Prompts</td>
<td>5</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>- Monitoring 1 Prompts</td>
<td></td>
<td></td>
<td>7</td>
</tr>
<tr>
<td>- Monitoring 2 Prompts</td>
<td></td>
<td></td>
<td>8</td>
</tr>
<tr>
<td>- Submit Paper</td>
<td></td>
<td></td>
<td>9</td>
</tr>
<tr>
<td>- Conduct Presentations</td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>- Evaluating Prompts</td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>- Administer Post-intervention Assessments</td>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>- Receive Remainder of Post-intervention Assessments</td>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>- Interview Selected Group Members</td>
<td></td>
<td></td>
<td>5</td>
</tr>
</tbody>
</table>

**Course Section 1**
- Spring Break for Course Section 1 occurs during Week 6 of the Study

**Course Section 2**
- Spring Break for Course Section 1 occurs during Week 3 of the Study
APPENDIX R

PROJECT TIMELINE – WEEKS OF SEMESTER
<table>
<thead>
<tr>
<th>Activity</th>
<th>Week in Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduce Researcher to Class</td>
<td></td>
</tr>
<tr>
<td>Obtain Informed Consent</td>
<td></td>
</tr>
<tr>
<td>Administer Pre-Intervention Assessments</td>
<td></td>
</tr>
<tr>
<td>Receive Remainder of Pre-intervention Assessments</td>
<td></td>
</tr>
<tr>
<td>Planning Prompts</td>
<td></td>
</tr>
<tr>
<td>Monitoring 1 Prompts</td>
<td></td>
</tr>
<tr>
<td>Monitoring 2 Prompts</td>
<td></td>
</tr>
<tr>
<td>Submit Paper/Presentations</td>
<td></td>
</tr>
<tr>
<td>Evaluating Prompts</td>
<td></td>
</tr>
<tr>
<td>Administer Post-intervention Assessments</td>
<td></td>
</tr>
<tr>
<td>Receive Remainder of Post-intervention Assessments</td>
<td></td>
</tr>
<tr>
<td>Interview Selected Group Members</td>
<td></td>
</tr>
<tr>
<td>Course Section 1</td>
<td></td>
</tr>
<tr>
<td>Course Section 2</td>
<td></td>
</tr>
</tbody>
</table>

The image contains a table with weeks in a semester and activities listed. The activities include tasks such as introducing a researcher to the class, obtaining informed consent, administering pre-intervention assessments, receiving the remainder of pre-intervention assessments, planning prompts, monitoring 1 prompts, monitoring 2 prompts, submitting paper/presentations, evaluating prompts, administering post-intervention assessments, receiving the remainder of post-intervention assessments, and interviewing selected group members. The table spans from Week 1 to Week 20, covering Spring Break and the End of Semester.
APPENDIX S

EXAMINATION OF ASSUMPTIONS OF TESTS USED TO CONDUCT PRELIMINARY ANALYSES
Examination of Assumptions to Compare Missing Participants with Participants

To examine the differences between those who completed the project and those who did not, the assumptions for an analysis of variance (ANOVA) and two-way analysis of variance (2-way ANOVA) were performed for the pre-interventions scores on the following assessments: topic-specific competency test, Motivated Strategies for Learning Questionnaire (MSLQ; Pintrich et al., 1991), and College Biology Self-Efficacy Instrument for Non-Majors (Baldwin et al., 1999). The assumptions related to the ANOVA and 2-way ANOVA are independence of samples, independence of scores, interval and continuous level of measurement, normality, and homogeneity of variance.

Topic-Specific Competency Test

Independence of samples and scores. Students completed the topic-specific competency tests individually. There was no interaction effect among the scores of each participant. Therefore, the assumptions of independence of samples and independence of scores were met.

Interval and continuous level of measurement. The possible range of scores was 0 to 35 for the topic-specific competency test. Therefore, the assumption of interval and continuous level of measurement was met.

Normality. A review of the histogram of the distribution of the scores for prior knowledge did not reveal a violation of the normality assumption, as noted in Figure S.1. Based on the Kolmogorov-Smirnov result for the normality assumption, the p-value of the variable of prior knowledge for all initial participants was not significant (F=.076, p = .200, p > .05). Similarly, the Shapiro-Wilk result for the normality assumption, the p-value of the dependent variable of prior knowledge for all initial participants was not significant (W=.981, p = .386, p > .05). The assumption of normality was met.
Homogeneity of variance. When examining Levene’s Test, the F-test value for the total scores (F = (1, 64) = .018, p = 0.895) did not demonstrate a violation of the assumption of the homogeneity of variance.

Motivated Strategies for Learning Questionnaire

Independence of samples and scores. Students completed the Motivated Strategies for Learning Questionnaire (MSLQ) individually. There was no interaction effect among the scores of each participant. Therefore, the assumptions of independence of samples and independence of scores were met.

Interval and continuous level of measurement. The possible range of scores was 0 to 567 for the MSLQ. Therefore, the assumption of interval and continuous level of measurement was met.

Normality. A review of the histogram of the distribution of the scores for pre-intervention self-regulation for all initial participants did not reveal a violation of the normality assumption, as noted in Figure S.2. Based on the Kolmogorov-Smirnov result for the normality assumption, the p-value of the variable of pre-intervention self-regulation for all initial participants was not significant (F= .086, p = .200, p > .05). Similarly, the Shapiro-Wilk result for the normality assumption, the p-value of the variable of pre-intervention self-regulation for all initial participants was not significant (W=.985, p=.606, p > .05). The assumption of normality was met.
Homogeneity of variance. When examining Levene’s Test, the F-test value for the total scores \( F = (1, 64) = .509, \ p = 0.478 \) did not demonstrate a violation of the assumption of the homogeneity of variance.

**College Biology Self-Efficacy Instrument for Non-Majors**

*Independence of samples and scores.* Students completed the *College Biology Self-Efficacy Instrument for Non-Majors* individually. There was no interaction effect among the scores of each participant. Therefore, the assumptions of independence of samples and independence of scores were met.

*Interval and continuous level of measurement.* The possible range of scores was 0 to 75 for the *College Biology Self-Efficacy Instrument for Non-Majors*. Therefore, the assumption of interval and continuous level of measurement was met.

*Normality.* A review of the histogram of the distribution of the scores for pre-intervention biology self-efficacy for all initial participants did not reveal a violation of the normality assumption, as noted in Figure S.3. Based on the *Kolmogorov-Smirnov* result for the normality assumption, the p-value of the variable of pre-intervention biology self-efficacy for all initial participants was not significant \( F = .067, \ p = .200, \ p > .05 \). Similarly, the *Shapiro-Wilk* result for the normality assumption, the p-value of the variable of pre-intervention self-regulation for all initial participants was not significant \( W = .984, \ p = .565, \ p > .05 \). The assumption of normality was met.
Homogeneity of variance. When examining Levene’s Test, the F-test value for the total scores ($F = (1, 64) = .479, p = 0.492$) did not demonstrate a violation of the assumption of the homogeneity of variance.

Figure S.3: Test of Normality for Pre-Intervention Biology Self-Efficacy of All Initial Participants
APPENDIX T

EXAMINATION OF ASSUMPTIONS FOR PARAMETRIC TESTS
Examination of Assumptions for Hypothesis 1

Assumption Tests Related to Hypothesis 1a (t-test)

The assumptions related to the t-test are independence of samples, independence of scores, interval and continuous level of measurement, normality, and homogeneity of variance.

Independence of samples. Participants were randomly assigned to one of two treatments and their learning activities were placed in folders for each group. In this manner, their activities were separate from each other. Therefore, the assumption of independence of samples was met.

Independence of scores. Each cooperative learning group was measured independently of the other cooperative learning groups. The instructor did not know which cooperative learning group was assigned to which treatment. Therefore, the assumption of independence of scores was met for the dependent variable of group project performance.

Interval and continuous level of measurement. The possible range of scores for the project grades were 0 to 100. Therefore, the assumption of interval and continuous level of measurement was met.

Normality. A review of the histogram of the distribution of the scores for Hypothesis 1a revealed a violation of the normality assumption, exhibiting a negative skew, as noted in Figure T.1. Based on the Kolmogorov-Smirnov (KS) result for the normality assumption, the p-value of the dependent variable of group project performance was significant (F=.164, p=.014). Similarly, the Shapiro-Wilk (S-W) result for the normality assumption, the p-value of the dependent variable of group project performance was significant (F=.857, p=.000). Examination of the distribution and results of the KS and S-W tests showed that the assumption of normality was not met. This may be due to the outliers discussed in the section, “Analysis of Individual Cases,” in which it was noted that there was one group of three students in the MGQP group who was displayed as an outlier.
Homogeneity of variance. When examining Levene’s Test, the F-test value for the total scores (F = (1, 35) = .000, p = 0.983) did not demonstrate a violation of the assumption of the homogeneity of variance. Due to the violation of the normality assumption, the Kruskal-Wallis, a non-parametric equivalent of the t-test, was used to test this hypothesis.

Assumption Tests Related to Hypothesis 1b - Content Area – Course Section A (ANCOVA)

The assumptions related to the analysis of covariance (ANCOVA) are independence of samples, independence of scores, interval and continuous level of measurement, normality, and homogeneity of variance, linearity of the covariate(s) and dependent variable(s), equality of slopes, and reliability of the covariate.

Independence of samples and scores. Students completed the topic-specific competency tests assessments individually. There was no interaction effect among the scores of each participant. Therefore, the assumptions of independence of samples and independence of scores were met.

Interval and continuous level of measurement. The possible range of scores for the topic-specific competency test was 0 to 35. Therefore, the assumption of interval and continuous level of measurement was met.

Normality. A review of the histogram of the distribution of the scores for Hypothesis 1b: Content Area for Course Section A did not reveal a violation of the normality assumption, as noted in Figure T.2. Based on the Kolmogorov-Smirnov result
for the normality assumption, the p-value of the dependent variable of individual academic achievement was not significant (F = .130, p = .200, p > .05). Similarly, the Shapiro-Wilk result for the normality assumption, the p-value of the dependent variable of individual academic achievement was not significant (W = .970, p = .861, p > .05). The assumption of normality was met.

![Figure T.2: Test of Normality for Hypothesis 1b – Content Area: Course Section A](image)

**Homogeneity of variance.** When examining Levene’s Test, the F-test value for the total scores (F = (1, 13) = 10.841, p = 0.006, p < .05) was significant, demonstrating a violation of the assumption of the homogeneity of variance.

**Linearity of covariate and dependent variable.** To determine whether the covariate was linearly related to the dependent variable for the content area for Course Section A, a scatterplot was examined. Examination of the result showed that the relationship appeared to be non-linear, as noted in Figure T.3. The Pearson correlation between the covariate and dependent was low (P = .191, p = .494). Similar results from the non-parametric correlation measures were found: Kendall’s tau (b = .101, p = .615) and Spearman’s rho (r = .160, p = .569).
Equality of slopes. It was found that the slopes of the regression lines of the two treatment groups were not parallel as noted in Figure T.4. The standardized beta coefficients ($\beta$) were not equal (MGQP $\beta = .375$; LGQP $\beta = -.336$). In addition, the F-statistic denoting the fit for each model was not significant. (MGQP $F = .980, p = .360$; LGQP $F = .636, p = .461$; combined model $F = .495, p = .464$).
Reliability of covariate. Based on the Cronbach’s alpha (.4033), the pre-intervention topic-specific competency test of the content area for Course Section A did not meet the “no measurement error” assumption.

Assumption Tests Related to Hypothesis 1b-Content Area- Course Section B (ANCOVA)

Independence of samples and scores. Students completed the topic-specific competency tests assessments individually. There was no interaction effect among the scores of each participant. Therefore, the assumptions of independence of samples and independence of scores were met.

Interval and continuous level of measurement. The possible range of scores for the topic-specific competency test was 0 to 35. Therefore, the assumption of interval and continuous level of measurement was met.

Normality. A review of the histogram of the distribution of the scores for Hypothesis 1a for the content area for Course Section A did not reveal a violation of the normality assumption, as noted in Figure T.5. Based on the Kolmogorov-Smirnov result for the normality assumption, the p-value of the dependent variable of individual academic achievement was not significant (F= .166, p = .118 p > .05). Similarly, the Shapiro-Wilk result for the normality assumption, the p-value of the dependent variable of individual academic achievement was not significant (F= .955, p= .389, p > .05). The assumption of normality was met.

Figure T.5: Test of Normality for Hypothesis 1b – Content Area: Course Section B
Homogeneity of variance. When examining Levene’s Test, the F-test value for the total scores ($F = (1, 20) = .041, p = 0.841$) did not demonstrate a violation of the assumption of the homogeneity of variance.

Linearity of covariate and dependent variable. To determine whether the covariate was linearly related to the dependent variable for the content area for Course Section B, a scatterplot was examined. Examination of the result showed that the relationship appeared to be linear, as noted in Figure T.6. The Pearson correlation between the covariate and dependent was high ($r = .724, p< .05$). Similar results from the non-parametric correlation measures were found: Kendall’s tau ($b = .513, p = .001$) and Spearman’s rho ($r = .680, p = .000$).

Equality of slopes. The slopes of the regression lines did not appear to be parallel, as noted in Figure T.7. The standardized beta coefficients ($\beta$) were not equal (MGQP $\beta = .625$; LGQP $\beta = .793$). However, the F-statistic denoting the fit for each model was significant (MGQP $F = 8.340, p = .013$; LGQP $F = .8.451, p = .034$; combined model $F = 22.033, p = .000$). Though the slopes appear to be unequal, there is not a significant difference between them.
Reliability of covariate. Based on the Cronbach’s alpha (.7643), the pre-intervention topic-specific competency test for the content area for Course Section B met the “no measurement error” assumption. According to Cohen and Cohen (1983), an instrument may be considered reliable when the Cronbach alpha is .8 or higher. When the Cronbach alpha of the pre-intervention topic-specific competency test for the content area for Course Section B is rounded, it meets Cohen and Cohen’s (1983) criteria. Therefore, this assumption was met.

Assumption Tests Related to Hypothesis 1c (ANCOVA)

The assumptions related to the analysis of covariance (ANCOVA) are independence of samples, independence of scores, interval and continuous level of measurement, normality, and homogeneity of variance, linearity of the covariate(s) and dependent variable(s), equality of slopes, and reliability of the covariate.

Independence of samples and scores. Students completed the Motivated Strategies for Learning Questionnaire (MSLQ) (Pintrich et al., 1991) individually. There was no interaction effect among the scores of each participant. Therefore, the assumptions of independence of samples and independence of scores were met.

Interval and continuous level of measurement. The possible range of scores for the Motivated Strategies for Learning Questionnaire (MSLQ) (Pintrich et al., 1991) was 0 to 567. The assumption of interval and continuous level of measurement was met.
Normality. A review of the histogram of the distribution of the scores for Hypothesis 1c did not reveal a violation of the normality assumption, as noted in Figure T.8. Based on the Kolmogorov-Smirnov result for the normality assumption, the p-value of the dependent variable of self-perceived post-intervention self-regulatory behavior was not significant (F= .126, p = .145 p > .05). Similarly, the Shapiro-Wilk result for the normality assumption, the p-value of the dependent variable of self-perceived post-intervention self-regulatory behavior was not significant (F= .962, p= .241, p > .05). The assumption of normality was met.

![Figure T.8: Test of Normality for Hypothesis 1c](image)

Homogeneity of variance. When examining Levene’s Test, the F-test value for the total scores (F = (1, 35) = .080, p = 0.780) did not demonstrate a violation of the assumption of the homogeneity of variance.

Linearity of covariate and dependent variable. To determine whether the covariate was linearly related to the dependent variable, a scatterplot was examined. Examination of the result showed that the relationship appeared to be linear, as noted in Figure T.9. The Pearson correlation between the covariate and dependent was high (P=.829 p= .000, p<.05). Similar results from the non-parametric correlation measures were found: Kendall’s tau (b=.626, p=.000) and Spearman’s rho (r=.785, p=.000).
Equality of slopes. It was found that the slopes of the regression lines of the two treatment groups were not parallel as noted in Figure T.10. The standardized beta coefficients ($\beta$) were not equal (MGQP $\beta = .807$; LGQP $\beta = .903$). However, the F-statistic denoting the fit for each model was significant (MGQP $F = 39.246$, $p= .000$; LGQP $F = 52.927$, $p= .000$; combined model $F = 76.738$, $p= .000$). Though the slopes appear to be unequal, there is not a significant difference between them.
Reliability of covariate. Based on the Cronbach’s alpha (.9535), the pre-intervention administration of the Motivated Strategies for Learning Questionnaire (MSLQ) (Pintrich et al., 1991) met the “no measurement error” assumption.

Assumption Tests Related to Hypothesis 1d (ANCOVA)

The assumptions related to the analysis of covariance (ANCOVA) are independence of samples, independence of scores, interval and continuous level of measurement, normality, and homogeneity of variance, linearity of the covariate(s) and dependent variable(s), equality of slopes, and reliability of the covariate.

Independence of samples and scores. Students completed the College Biology Self-Efficacy Instrument for Non-Majors (Baldwin et al., 1999) individually. There was no interaction effect among the scores of each participant. Therefore, the assumptions of independence of samples and independence of scores were met.

Interval and continuous level of measurement. The possible range of scores for the College Biology Self-Efficacy Instrument for Non-Majors (Baldwin et al., 1999) was 0 to 75. Therefore, the assumption of interval and continuous level of measurement was met.

Normality. A review of the histogram of the distribution of the scores for Hypothesis 1c did not reveal a violation of the normality assumption, as noted in Figure T.11. Based on the Kolmogorov-Smirnov result for the normality assumption, the p-value of the dependent variable of post-intervention biology self-efficacy was not significant (F= .088, p = .200 p > .05). Similarly, the Shapiro-Wilk result for the normality assumption, the p-value of the dependent variable of post-intervention biology self-efficacy was not significant (F= .977, p= .615, p > .05). The assumption of normality was met.
Homogeneity of variance. When examining Levene’s Test, the F-test value for the total scores (F = (1, 35) = 2.305, p = .138) did not demonstrate a violation of the assumption of the homogeneity of variance.

Linearity of covariate and dependent variable. To determine whether the covariate was linearly related to the dependent variable, a scatterplot was examined. Examination of the result showed that the relationship appeared to be linear, as noted in Figure T.12. The Pearson correlation between the covariate and dependent was high (P=.772, p=.000, p<.05). Similar results from the non-parametric correlation measures were found: Kendall’s tau (b=.614, p=.000) and Spearman’s rho (r=.803, p=.000).
Equality of slopes. It was found that the slopes of the regression lines of the two treatment groups were not parallel as noted in Figure T.13. The standardized beta coefficients ($\beta$) were not equal (MGQP $\beta = .693$; LGQP $\beta = .874$). However, the F-statistic denoting the fit for each model was significant (MGQP $F = 19.353$, $p = .000$; LGQP $F = 38.738$, $p = .000$; combined model $F = 51.507$, $p = .000$). Though the slopes appear to be unequal, there is not a significant difference between them.
Reliability of covariate. Based on the Cronbach’s alpha (.9263), the pre-
intervention administration of the College Biology Self-Efficacy Instrument for Non-
Majors (Baldwin et al., 1999), met the “no measurement error” assumption.

Examination of Assumptions for Hypothesis 2
Assumption Tests Related to Hypothesis 2a- Content Area for Course Section A (ATI)

The assumptions related to the moderated multiple regression are: independence
of samples, independence of scores, interval and continuous level of measurement,
normality, and homogeneity of variance, linearity of the predictor(s) and dependent
variable(s), and less than complete multicollinearity.

Independence of samples and scores. These assumptions were met as discussed
previously in Hypothesis 1b-Content Area for Course Section A.

Interval and continuous level of measurement. This assumption was met as
discussed previously in Hypothesis 1b-Content Area for Course Section A.

Normality. This assumption was not met as discussed previously in Hypothesis
1b-Content Area for Course Section A.

Homogeneity of variance. When examining Levene’s Test, the F-test value for the
total scores (F = (3, 11) = 3.459, p = 0.055) showed a slight violation of the assumption
of the homogeneity of variance. However, the number of participants (Ns) in each group
was equal. Hence, a violation of the homogeneity of variance assumption would have had
negligible consequences on the accuracy of the probability statement (Type I error or α
value).

Linearity of predictor and dependent variable. The relationship between the
predictor and the dependent variable is linear. To determine whether the predictor was
linearly related to the dependent variable, a scatterplot was examined. Examination of the
result showed that the relationship appeared to be linear, as noted in Figure T.14. The
Pearson correlation between the covariate and dependent was low (P= -.197 p= .241, p>.05). Similar results from the non-parametric correlation measures were found: Kendall’s
tau (b= -.165, p=.398) and Spearman’s rho (r= -.226, p= .418).
Less than complete multicollinearity. To determine whether the independent variable (intervention), predictor (initial self-regulation), and the dependent variable (individual academic achievement for Content Area for Course Section A) exhibit multicollinearity, correlation data between each variable were obtained. The relationship between the independent variable and predictor was not significant (Pearson: \( P = -.310, p = .262; \) Kendall’s tau: \( b = -.183, p = .418; \) Spearman’s rho: \( r = -.217, p = .438 \)). The relationship between the independent variable and dependent variable was not significant (Pearson: \( P = .221, p = .429; \) Kendall’s tau: \( b = .199, p = .384; \) Spearman’s rho: \( r = .233, p = .404 \)). As discussed in a previous assumption, the relationship between the predictor and the dependent variable was not significant (Pearson: \( P = -.197, p = .483; \) Kendall’s tau: \( b = -.165, p = .398; \) Spearman’s rho: \( r = -.226, p = .418 \)). Each relationship was not significantly correlated. Therefore, the assumption of “less than complete multicollinearity” was met.

Assumption Tests Related to Hypothesis 2a-Content Area for Course Section B (ATI)

The assumptions related to the moderated multiple regression are: independence of samples, independence of scores, interval and continuous level of measurement, normality, and homogeneity of variance, linearity of the predictor(s) and dependent variable(s), and less than complete multicollinearity.
Independence of samples and scores. These assumptions were met as discussed previously in Hypothesis 1b-Content Area for Course Section B.

Interval and continuous level of measurement. This assumption was met as discussed previously in Hypothesis 1b-Content Area for Course Section B.

Normality. This assumption was not met as discussed previously in Hypothesis 1b-Content Area for Course Section B.

Homogeneity of variance. When examining Levene’s Test, the F-test value for the total scores (F = (3, 18) = .703, p = .563) did not demonstrate a violation of the assumption of the homogeneity of variance.

Linearity of predictor and dependent variable. The relationship between the predictor and the dependent variable is linear. To determine whether the predictor was linearly related to the dependent variable, a scatterplot was examined. To determine whether the predictor was linearly related to the dependent variable, a scatterplot was examined. Examination of the result showed that the relationship appeared to be linear, as noted in Figure T.15. The Pearson correlation between the covariate and dependent was low (P= -.197, p= .483). Similar results from the non-parametric correlation measures were found: Kendall’s tau (b= -.165, p= .398) and Spearman’s rho (r= -.226, p= .418.).

![Figure T.15: Test of Linear Relationship of Predictor and DV for Hypothesis 2a- Content Area: Course Section B](image)
Less than complete multicollinearity. To determine whether the independent variable (intervention), predictor (initial self-regulation), and the dependent variable (individual academic achievement for the content area for Course Section B) exhibit multicollinearity, correlation data between each variable were obtained. The relationship between the independent variable and predictor was not significant (Pearson: $P = -.310$, $p = .262$; Kendall’s tau: $b = -.183$, $p = .418$; Spearman’s rho: $r = -.217$, $p = .438$). The relationship between the independent variable and dependent variable was not significant (Pearson: $P = .221$, $p = .429$; Kendall’s tau: $b = .199$, $p = .384$; Spearman’s rho: $r = .233$, $p = .404$). As discussed in a previous assumption, the relationship between the predictor and the dependent variable was not significant (Pearson: $P = -.197$, $p = .483$; Kendall’s tau: $b = -.165$, $p = .398$; Spearman’s rho: $r = -.226$, $p = .418$). Each relationship was not significantly correlated. Therefore, the assumption of “less than complete multicollinearity” was met.

Assumption Tests Related to Hypothesis 2b-Content Area for Course Section A (ATI)

The assumptions related to the moderated multiple regression are: independence of samples, independence of scores, interval and continuous level of measurement, normality, and homogeneity of variance, linearity of the predictor(s) and dependent variable(s), and less than complete multicollinearity.

Independence of samples and scores. These assumptions were met as discussed previously in Hypothesis 1b-Content Area for Course Section A.

Interval and continuous level of measurement. This assumption was met as discussed previously in Hypothesis 1b-Content Area for Course Section A.

Normality. This assumption was met as discussed previously in Hypothesis 1b-Content Area for Course Section A.

Homogeneity of variance. The variances of the two random samples are equal, but unknown. When examining Levene’s Test, the $F$-test value for the total scores ($F = (3,11) = 2.242$, $p = .140$) did not demonstrate a violation of the assumption of the homogeneity of variance.

Linearity of predictor and dependent variable. The relationship between the predictor and the dependent variable is linear. To determine whether the predictor was linearly related to the dependent variable, a scatterplot was examined. To determine
whether the predictor was linearly related to the dependent variable, a scatterplot was examined. Examination of the result showed that the relationship appeared to be linear, as noted in Figure T.16. The Pearson correlation between the covariate and dependent was low (b = .121, p = .668). Similar results from the non-parametric correlation measures were found: Kendall’s tau (P = .079, p = .689) and Spearman’s rho (r = .122, p = .664).

![Figure T.16: Test of Linear Relationship of Predictor and DV for Hypothesis 2b- Content Area: Course Section A](image)

**Less than complete multicollinearity.** To determine whether the independent variable (intervention), predictor (initial biology self-efficacy), and the dependent variable (individual academic achievement for Content Area for Course Section A) exhibit multicollinearity, correlation data between each variable were obtained. The relationship between the independent variable and predictor was not significant (Pearson: P = .054, p = .848; Kendall’s tau: b = .026, p = .908; Spearman’s rho: r = .031, p = .913). The relationship between the independent variable and dependent variable was not significant (Pearson: P = .221, p = .429; Kendall’s tau: b = .199, p = .384; Spearman’s rho: r = .233, p = .404). As discussed in a previous assumption, the relationship between the predictor and the dependent variable was not significant (Pearson: b = .121, p = .668; Kendall’s tau: P = .079, p = .689; Spearman’s rho: r = .122, p = .664).
Assumption Tests Related to Hypothesis 2b-Content Area for Course Section B (ATI)

The assumptions related to the moderated multiple regression are: independence of samples, independence of scores, interval and continuous level of measurement, normality, and homogeneity of variance, linearity of the predictor(s) and dependent variable(s), and less than complete multicollinearity.

**Independence of samples and scores.** These assumptions were met as discussed previously in Hypothesis 1b-Content Area for Course Section B.

**Interval and continuous level of measurement.** This assumption was met as discussed previously in Hypothesis 1b-Content Area for Course Section B.

**Normality.** This assumption was met as discussed previously in Hypothesis 1b-Content Area for Course Section B.

**Homogeneity of variance.** When examining Levene’s Test, the F-test value for the total scores \((F = (3, 18) = .704, p = .562)\) did not demonstrate a violation of the assumption of the homogeneity of variance.

**Linearity of predictor and dependent variable.** To determine whether the predictor was linearly related to the dependent variable, a scatterplot was examined. To determine whether the predictor was linearly related to the dependent variable, a scatterplot was examined. Examination of the result showed that the relationship appeared to be linear, as noted in Figure T.17. The Pearson correlation between the covariate and dependent was low \((r= .164, p= .465)\). Similar results from the non-parametric correlation measures were found: Kendall’s tau \((b=.032, p=.842)\) and Spearman’s rho \((r=.052, p=.818)\).
Less than complete multicollinearity. To determine whether the independent variable (intervention), predictor (initial biology self-efficacy), and the dependent variable (individual academic achievement for the content area for Course Section B) exhibit multicollinearity, correlation data between each variable were obtained. The relationship between the independent variable and predictor was not significant (Pearson: P = .198, p = .377; Kendall’s tau: b = .233, p = .204; Spearman’s rho: r = .277, p = .212). The relationship between the independent variable and dependent variable was not significant (Pearson: P = -.330, p = .134; Kendall’s tau: b = -.274, p = .145; Spearman’s rho: r = -.318, p = .150). As discussed in a previous assumption, the relationship between the predictor and the dependent variable was not significant (Pearson: P = .164, p = .465; Kendall’s tau: b = .032, p = .842; Spearman’s rho: r = .052, p = .818).
APPENDIX U

GROUP COMPOSITION
## Table U.1: Group Composition

<table>
<thead>
<tr>
<th>Score</th>
<th>Human Systems</th>
<th>MGQP</th>
<th>Endangered Species</th>
<th>LGQP</th>
<th>Endangered Species</th>
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<tr>
<td>Project Grade</td>
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<td>100</td>
<td>86</td>
<td>93</td>
<td>70</td>
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<tr>
<td>Final number of group members</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>3</td>
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<tr>
<td>Pre - Intervention Scores</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prior Knowledge</td>
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<tr>
<td>Mean</td>
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<td>13.67</td>
<td>13.50</td>
<td>16.67</td>
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<td>Self - Regulation</td>
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<td>Mean</td>
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<td>Biology Self - Efficacy</td>
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<tr>
<td>Mean</td>
<td>41.19</td>
<td>52.33</td>
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<td>Post - Intervention Scores</td>
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<td>Academic Achievement</td>
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<tr>
<td>Mean</td>
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<td>16.67</td>
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<td>Standard Deviation</td>
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<td>7.767</td>
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<tr>
<td>Mean</td>
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<td>Standard Deviation</td>
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<td>Biology Self - Efficacy</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>43.50</td>
<td>53.67</td>
<td>62.67</td>
<td>51.25</td>
<td>45.33</td>
</tr>
</tbody>
</table>
REFERENCES


Young, D. B., & Ley, K. (2001). Developmental students don't know that they don't know - Part II: Bridging the gap. *Journal of College Reading and Learning, 31*(2). 171-178.


BIOGRAPHICAL SKETCH

Education and Certifications

- B.S., Special Education, Minor in Art, Brigham Young University, 1993.

Employment History

May 2005 to Present. IBM Corporation, Atlanta, GA.
- Nov. 2006 to present. IBM Learning Global Strategic Measurements and Reporting, Specialist, Global learning effectiveness measurement tool manager, learning measurement plan advisor, and team training coordinator.
- May 2005 to Nov. 2006. Global Business Services, Senior Consultant, Enterprise-wide Learning Management System implementation business requirements analyst, user acceptance test support coordinator, training reviewer.

- Jan. 2005 to May 2005, Research Assistant, Center for the Study of Technology in Counseling and Career Development (Tech Center), Content Analysis of Counseling Competencies.


- August 2000 to August 2002. FSU Project Manager, Association of Educational Communication and Technology Project-Preparing Tomorrow’s Teachers to Use Technology (AECT-PT3) multi-university project.
- August 2001 to December 2001. Teaching Assistant, Principles of Instructional Design.
- July 2001 to December 2001. Assistant Researcher, Self-Efficacy of Preservice Teachers to Teach in Diverse Classrooms.

Jan. 1999 to Aug. 2000. FSU Office of Distance and Distributed Learning, Tallahassee, FL.

- Resource Teacher. 3rd to 5th grades.

- Resource Teacher/School to Work Transition Coordinator, 9th to 12th grades.

Non-Paid Activities

- Feb. to May 2001. Qualitative Researcher, Methods of Non-profit organizations to partner with business.

Publications


Presentations/Speeches


*Professional Affiliations*

- National Career Development Association, former member.
- Association of Educational Communication and Technology, former member.
- National Education Association, former member, county treasurer, and regional secretary.