THE IMPACT OF COOPERATIVE LEARNING ON THE AFFECTIVE DIMENSIONS OF LEARNING SCIENCE IN HIGH SCHOOL BIOLOGY

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ABSTRACT

This study explored the effectiveness of a cooperative group learning treatment (Kagan's *Co-op Co-op* approach) on sophomore students enrolled in high school biology classes. Forty-six students were randomly assigned to either a cooperative learning biology class or a traditional biology class with lecture-based instruction. The treatment group met daily for 12 weeks for a 120-minute session and the control group met daily for 12 weeks for a 55-minute class session. The treatment group performed *Co-op Co-op* on eight chapters of biology while the control group received traditional lecture instruction throughout the trimester. The treatment group was compared to the control group receiving traditional lecture instruction. A 38-item questionnaire was used as a pretest, posttest, and post-posttest assessment. Three dependent variables were measured: learning goal orientation, intrinsic motivation, and self-efficacy. Two students in the treatment group and two students in the control group who had scores at opposite ends of the survey scale were selected to be interviewed the following trimester. The students were asked to describe their personal attitudes, opinions, and experiences during cooperative learning instruction or traditional learning instruction in biology class.

Students in the cooperative learning instruction group did not exhibit significantly greater gains than the control group in learning goal orientation, intrinsic motivation, and self-efficacy. Cooperative learning instruction increased social interactions among the students. The students agreed that a variety of teaching methods must be implemented in the classroom for motivational learning to occur. The implications these findings have on student learning and motivation in high school biology, practical applications for the high school biology teacher, and suggestions for future research are discussed.

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INTRODUCTION

SIGNIFICANCE OF THE STUDY

The vast majority of research comparing student-student interaction patterns states that students learn more effectively when they work cooperatively. The results of hundreds of studies make it clear that cooperative learning has a number of very positive outcomes such as academic gains[1-3], improved race-relations among students[1, 3], and improved social and affective development among all students.[1, 3] Educators want to and need to teach effectively using new and improved approaches to promote effective student learning and student relations.

This research study will examine the impact of two different instructional techniques on the affective dimensions of learning science. Specifically, the research question to be investigated is *what impact does cooperative learning in high school biology have on the goal orientation, motivation, and self-efficacy of learning science?*

In a traditional, competitive classroom, presentation of the curriculum is very lecture oriented followed by individual student assignments and laboratories to confirm the concepts being presented. Students are expected to do their own work with little or no interaction with other students. This can create tension, self-doubt, and anxiety in students.[4, 5] Learning involves progress toward predetermined teacher-defined goals in which knowledge is transferred from teacher to students. Students are passive learners and thus have impersonal relationships with the teacher and other students.[4, 5]

In a cooperative learning classroom, presentation of the curriculum is a process that flows out of the interests of the students. One type of cooperative learning approach,

Co-op Co-op[1, 6], is structured so that students collaborate as teams in order to cooperate with the whole class in reaching the learning goals of the class. The students are active learners and they are encouraged to discover and express their own interests in the topic(s). Cooperative student interaction over the subject matter, therefore, becomes an integral part of learning.

VARIABLES TO BE INVESTIGATED

Many studies have been done relating the effects of cooperative learning to the cognitive domain in the field of science education. The cognitive domain involves problem-solving, reasoning skills, and the acquisition of facts and concepts. This study, on the other hand, examined the impact of cooperative learning on the affective dimensions in science education. The affective domain involves constructs such as attitudes, values, beliefs, interests, opinions, and motivation. Each affective dimension was examined by comparing the two modes of learning instruction. The students' learning goal orientation[7, 8] refers to the degree to which they seek challenges and persist under adversity. Intrinsic motivation[7, 9] involves the enjoyment in learning the subject matter they are studying for its own sake. Self-efficacy[10, 11], also known as locus of control[4], refers to the degree of academic success which depends on the students' own efforts and their self-perception of ability. The students' efforts can thus lead to success. The type of instruction may also impact the students' liking of science[1, 5, 12, 13], as well as the willingness to take additional science classes beyond those that are required.[5] The impact of cooperative learning on these motivational variables in learning science was examined to determine the degree of success of each of the affective dimensions.

CHAPTER II

Literature Review

BACKGROUND

How students perceive and interact with one another is a neglected aspect of teacher instruction.[14] More teacher training time should be devoted to how students interact with one another, because how teachers structure student-student interaction patterns will have an impact on student learning, and the inter-relationships among the students, the teacher, and the school.

Researchers categorize student learning into three types: competitive, individualistic, and cooperative.[15-18] The two dominant interaction patterns among students are competition for grades and individual learning to reach a set criteria. When students compete with each other for grades, they work against one another to achieve a goal that only a few students can attain. Graded on a norm-referenced basis, students must work faster and more accurately than their peers. These students strive to be the best and their work may deprive others. A negative interdependence among goal achievements exists in competitive situations; students perceive that they can obtain their goals in class if, and only if, the other students fail to obtain their goals. Students who work individualistically work by themselves to accomplish learning goals unrelated to all other students. Individual goals are assigned and evaluated on a criteria-referenced basis. Each student works at his/her own speed and is encouraged to focus on his/her self-interest, efforts, and success. The success of other students in the class is irrelevant. Students who learn individualistically have independent goal attainments; their learning goal achievements are unrelated to those of the other students.

COOPERATIVE GROUP INSTRUCTION

Cooperation involves students working together to accomplish shared goals. Students performing cooperative activities seek outcomes that are beneficial to themselves as well as all other group members. Cooperative learning is an instructional technique which allows small groups of students to work together to maximize each other's learning. Therefore, positive interdependence exists among students' goal attainments; students are able to reach their learning goals if and only if the other students in their group also reach their goals.[15-18]

To prepare students for a full range of social situations, teachers must decide which of the three learning styles should be implemented within each lesson. Most research comparing student interaction patterns states that students learn most effectively when they cooperate with each other in the classroom.[14] A universal, accepted method of cooperative learning does not exist; nor is there a single researcher or research study who can speak for the many types of cooperative learning techniques being implemented in classrooms worldwide.

Cooperative learning involves much more than simply placing students in groups to complete activities. Cooperative learning techniques are designed to actively engage students in the learning process via inquiry and discussion with their peers in small groups. Group cooperative learning is structured to promote participation and learning of all students. For cooperation to work well, Johnson & Johnson require that the following five elements must be incorporated into each lesson: positive interdependence, individual accountability/personal responsibility, face-to-face promotive interaction, interpersonal and small-group skills, and group processing.[18] Positive interdependence can be

structured in many different ways and follows the notion of "sink or swim together." For example, the instructor has each group of students learn a different section in the chapter, and all members of each group must learn the assigned material. Each student of a group can also be assigned a complementary role such as reader, recorder, checker, encourager, and elaborator. Individual accountability and personal responsibility involve assessment of each student in the group and results are given back to each individual and group. Each student is held responsible by all other group members for contributing a fair share to the group's success; therefore, no "free-riders" should exist in the group. Individual accountability can be structured in a science classroom by keeping the group size small with two to four students, providing individual exams to each student, observing each group and recording the amount of contribution of each member within the group, and also having students teach what they learned to someone else and to the entire class. Face-to-face promotive interaction involves students encouraging and assisting each other's efforts to achieve, complete, and produce the group's goals. For example, students in each group help each other learn the material by explaining ideas and concepts in their own way, embellishing trust and confidence in each other. They also share resources with each other to process the information more effectively and efficiently. Each student provides feedback with one another to improve their performance on their tasks and responsibilities. Interpersonal and small-group skills include trust, accurate communication, support, and conflict resolution within each group. Discussions, activities, and games among the heterogeneous student groups allow the students to define social skills by providing examples and behaviors of the skills to each other and to the rest of the class. Group processing is reflecting on a group session to

describe what actions among each student of a group were helpful or unhelpful and to decide what actions/skills to continue to use or modify. This will improve the effectiveness of all group members in contributing to the cooperative efforts to achieve the group's goals. An example of group processing in a science classroom is the use of evaluations. A within-group small evaluation can take place within a group after they have presented their information to the rest of the class. Each group member describes the strengths and the weaknesses of both the presentation and each other in a positive and meaningful manner. Everyone can provide positive feedback on one another and ultimately strive for improvement for the next presentation. In addition to within group processing, the instructor engages in whole-class processing by observing the groups, analyzing the problems groups have when working together, and providing feedback to each group on how well they work together and accomplish their goals. Group processing allows the students to feel appreciated, successful, and respected; thus providing enthusiasm to learning and working in cooperative groups as well as a sense of self-efficacy in mastering the subject matter.

Cooperative learning is not a new learning style. Throughout the 1960s and 1970s, cooperative group learning had its greatest success improving social and inter-racial relationships while also mainstreaming students into the regular classroom[4]. More recent studies have shown that cooperative learning has been effective in increasing academic achievement.[4, 16] A meta-analysis[16] of 323 studies concludes that higher achievement occurs through cooperative learning as compared to competitive and individualistic learning across all subject areas and age levels.

CO-OP CO-OP APPROACH

Four areas of research are reviewed below as they relate to this research study: (1) cooperative group learning, specifically Kagan's[1] *Co-op Co-op* approach and its impact on the affective dimensions of learning science, (2) goal orientation theory, (3) self-efficacy theory, and (4) intrinsic motivation theory.

The flexible cooperative learning technique *Co-op Co-op* evolved[6] over a period of ten years. It originated as a way to increase the involvement of university psychology students by allowing them to explore in depth topics that were of interest to them. Not only were student teams more than a time-saving practical solution, but also the use of teams increased student learning and sharing of resources and ideas. Sharing what the students have learned with each other appeared to be a far more powerful motivational device than the traditional letter grade.[6]

Co-op Co-op was designed to incorporate both the cookbook approach by Slavin[4] and the basic principles approaches by Johnson and Johnson[17] and Sharan and Sharan.[19] The cookbook approach trains educators to rely on a very detailed set of instructions for setting up cooperative classrooms, assigning students to teams, and assigning grades to students. The basic principle approach trains educators to rely on fundamental principles that they can apply in a unique way to each class, providing greater flexibility, applicability, and opportunity for creative student and educator input into the learning process. *Co-op Co-op* was designed to incorporate the benefits of both approaches. Educators can learn the basic principles and philosophy associated with a set of specific steps involving critical elements within each step, all the while providing a great amount of flexibility for student and educator input.

Co-op Co-op is based on a philosophy of education as described by Dewey [6, 20] that assumes the goal of education is to provide conditions which allow the curiosity, intelligence, and expressiveness of students to emerge. This is quite opposite to traditional approaches, which assumes that the student is a hollow vessle which educators must fill with facts and theories. *Co-op Co-op* therefore maximizes the opportunity for small student groups to work together to further enhance their understanding via a group product. They then share this product with the class so everyone may benefit. Learning and cooperating are the goals in *Co-op Co-op*, unlike other cooperative learning techniques such as Student-Teams-Achievement-Divisions (STAD) or Teams-Games-Tournaments (TGT), where learning and cooperating are the means but the goal is winning.[6]

Co-op Co-op is designed to be simple and flexible, allowing an educator to use the technique in any subject area at any age level. The inclusion of the following steps[1, 6, 21] increases the success of *Co-op Co-op*:

Step 1: Student-centered class discussion,

Step 2: Selection of student learning teams,

Step 3: Team building/Cooperative skill development,

Step 4: Team topic selection,

Step 5: Minitopic selection,

Step 6: Minitopic preparation,

Step 7: Minitopic presentations,

Step 8: Preparation of team presentations,

Step 9: Team presentations, and

Step 10: Evaluation.

The incorporation of *Co-op Co-op* into a unit or chapter is very flexible. Mini-projects may be assigned in one day, with teams needing only 10-15 minutes to gather information and present it to the rest of the class. Projects may also be assigned that take a few days or even weeks for a chapter or unit before presenting it to the class. *Co-op Co-op* may be used concurrently with traditional instruction or another cooperative learning structure. The scoring and recognition are also flexible, depending on the purpose and type of the *Co-op Co-op* setup. Scoring is usually based on improvement scoring via weekly quizzes and the use of base scores. Improvement scoring allows below average students as much chance to better their scores as above average students. Base scores are the average percent on past quizzes or a previous percentage. These are considered initial scores upon which to base improvement. Improvement points can be calculated on a weekly basis and thus base scores are recomputed for a student grade. Individual and team accomplishments are recognized and can be presented by a class bulletin or chart.[1]

Although *Co-op Co-op* has been successful throughout the years, an empirical analysis of its effects has not been completed. Two sets of empirical data as reported by Kagan[6] are available for providing a preliminary, informal evaluation of the effects of this cooperative learning technique. The first set of data consists of both elicited and spontaneous written statements of upper-division undergraduate university students. Students were instructed to submit positive and negative aspects, as well as academic and social aspects, of the *Co-op Co-op* experience. Kagan concluded that most of the students experienced increased learning and beneficial social relations from the

cooperative learning experience. Many students also informally mentioned that the Co-op Co-op experience had reversed a negative opinion that they had envisioned about group work. This negative opinion of past group experiences revealed the "free-rider" problem, where a few students do most of the work and one group grade is given to everyone in the group. The students were astonished and delighted to find the majority of the students contributed in the *Co-op Co-op* format. Kagan also concluded that *Co-op Co-op* engendered a positive attitude toward the experience. *Co-op Co-op* had a crucial impact on how the students thought both of themselves and of learning, allowing for an environment in which social development, personal development, and academic learning were jointly supportive. According to Kagan, occasionally problems using *Co-op Co-op* at the university level may exist, especially issues of leadership and "free-riders" within the groups.

The second set of data consists of an analysis of high-school students following the use of traditional and *Co-op Co-op* learning techniques.[6] Kagan concluded that the high-school experience of implementing *Co-op Co-op* was not as uniformly positive as the university experience. Many problems that existed at the high-school level were not encountered at the university level. These problems included the lack of motivation by students to participate in group projects because they were turned off by traditional educational experiences, a high rate of absenteeism, poor race-relations, and too diverse achievement levels among students. Kagan emphasized that the success of *Co-op Co-op* at the high-school level was dependent on the creativity, commitment, and flexibility of the teacher. Even though there exists numerous examples of the successful use of *Co-op Co-op*, no formal evaluation at the high-school level has been conducted.

LEARNING GOAL ORIENTATION

With little or no competition, cooperative groups may direct students toward enhancing their knowledge to eventually pursue the team goal of achievement. If this is true, cooperative learning may also be altering the students' goal orientations. Goal orientation theory, developed by Dweck and cited by Nichols[22], provides the link between various motivational variables and the cognitive processes that influence achievement. Dweck believes that the goals an individual pursues create a paradigm within which the individual interprets and reacts to events. Dweck describes two types of goals relating to achievement: learning goals and performance goals. Students with learning goals want to increase competency at a task. They have an interest to acquire new skills and knowledge, to continue to persist when failures occur, and to accept challenges with persistence. Students with performance goals, on the other hand, tend to be concerned with favorable judgments of their competency. They would prefer positive evaluations on simple tasks rather than have negative reactions to their abilities. Therefore, according to Dweck's theory, the behavior of individuals with differing goal orientations depends on their self-perceived ability.

Recent studies support Dweck's goal orientation theory.[23, 24] These studies concluded that learning goal scores are positively correlated with persistence measures, while performance goals are not. A pilot research study by Nichols and Miller[7] reported not only the positive effect of cooperative learning on algebra achievement, but also the positive effect of cooperative learning on students' goal orientations. Furthermore, Nichols and Miller were surprised to discover a *reversal* of motivation and achievement when the students in the cooperative learning group were switched to a traditional lecture

class: achievement levels decreased, and the students switched their goal orientation from learning to a more performance goal focus.

INTRINSIC MOTIVATION

Effort and persistence at a task may also have an effect on the intrinsic desire to explore an activity. Csikszentmihalyi and Nakamura[9] define intrinsic motivation as a desire to perform an activity because of the reward from doing the activity itself. Extrinsic motivation, on the other hand, is the desire to perform an activity because a separate reward is likely to follow. Intrinsic motivation declines in students as they progress from the third to the ninth grade.[25] Studies have also shown a positive relationship between the students' self-efficacy scores and their views of the intrinsic task value.[8, 24, 26] Moderate correlations were found in these studies between effort and intrinsic valuing of a task. These studies also support Dweck's theory that students who adopted a goal for learning for its own sake are more inclined to value a learning task.

SELF-EFFICACY

Self-efficacy can be defined as an individual's self-perception of ability. Self-efficacy highly influences motivation. A positive relationship exists between self-efficacy and persistence; the higher an individual's self-efficacy, the higher his/her persistence at a difficult task. According to Bandura, as cited in Nichols[22], self-efficacy affects motivation in many ways. If an individual believes an activity is beyond his/her capability, he/she will tend to avoid the activity. As self-efficacy increases in an individual, so does his/her effort and persistence. Bandura also states that self-efficacy for a task and experiencing intrinsic rewards for the task have a positive relationship.[26]

Ames[10] has written that cooperative learning increases student self-efficacy when the group team is successful, consisting of either high-achievers or low-achievers. Therefore, according to Ames, students in a cooperative learning classroom should have greater self-efficacy than those students in a traditional classroom.

RELATIONSHIP TO TEACHING BIOLOGY

When planned carefully and properly implemented, cooperative learning has been shown to be effective in increasing motivational variables as well as achievement.[27] Cooperative learning can also promote positive attitudes toward a learning task.[4, 16] Lord[5] summarized many studies and described 101 positive reasons for using cooperative learning in biology teaching. He explored and designed cooperative learning activities in the college classroom and found students were eager and interested in learning biology. Teaming students in small groups and having them perform challenging tasks together enhanced the thinking and learning of biology. The students in teams spoke more often, asked more questions, and were more engaged in biology than those in traditional, teacher-centered instruction. This interaction with peers in cooperative learning corrected misconceptions and uncovered inconsistencies as the students explained and listened to the concepts being presented. Cooperative learning has also enhanced the attitudes of biology students. Lord described studies that found when biology students are actively interacting with classmates and instructors, the students were happier, more satisfied with their learning experiences, and enjoyed biology more than students taught exclusively by lecture. Social skills and student values were enhanced by cooperative learning instruction. In biology, students learned how to challenge ideas and advocate for their positions without personalizing their statements and providing negative feedback to

one another. They learned conflict resolution methods important to real life situations. Students developed wholesome educational values and began to improve their attitude and build self-confidence in biology and the importance of education. Lord described a variety of positive reasons on all three educational domains (cognitive, affective, and psychomotor) for using cooperative learning in biology teaching. Lazarowitz and Karsenty[2] used the jigsaw cooperative learning approach to study students' achievement, process skills, learning environment, and self-esteem in tenth-grade biology classrooms. The jigsaw method involves interdependent students who rely on one another in a group to complete a task. Each student in a group researches part of the necessary information to complete a task. Each group in the classroom has the same task, so classmates in different groups who have the same section of material to complete the task can pair up and share ideas and information. Group members are responsible for mastering their information and teaching it to the rest of the group. Each student must also learn the information presented by other members within the group. Results indicated superior achievement and higher scores on measures of process skills, learning environment, affective domain, and self-esteem. The cooperative mode of instruction has potential for promoting a better quality of instruction and learning in high schools. According to Lazarowitz et al.[12], in high school biology it has been found that cooperative learning influenced three aspects of learning environment: 1) positive attitudes toward science, 2) students' cooperation, and 3) active involvement in learning. The learning environment is related to motivation to learn, academic achievement, and the student enjoyment of the subject matter leading to the study of more science. Lazarowitz[13] also reviewed 21 studies on cooperative learning and science education in junior- and senior-

high school classrooms with similar results. Newmann and Thompson[3] comprised a summary of research on the effects of five major techniques of cooperative learning on achievement in secondary schools. Each of these techniques served as an alternative to "frontal teaching" such as traditional teaching in the classroom or individual work by students.

How is cooperative learning beneficial to biology teaching? In the discipline of biology, researchers increasingly need to communicate and collaborate with one another, and access the skills and knowledge of diverse scientists to promote lines of inquiry in fields such as informatics, nanotechnology, and neuroscience. However, most of today's scientists do not learn collaborative skills until they are forced into a laboratory in graduate school.[28] According to *Science for All Americans, Project 2061*[29], the teaching of science and technology should be consistent with the nature of scientific inquiry, and that an indispensable part of scientific inquiry is collaboration. Performing group activities in the classroom strongly models the collaboration of scientific and technological research as students share responsibility, inform others about procedures and meanings, argue over findings, and assess each other on how the task is progressing. All these duties constitute team responsibility and provide positive feedback on their learning.[29] The objective of this study is to investigate the following research questions as they relate to the teaching and learning of high school biology:

1. Will cooperative group instruction enhance student learning goal orientation?
2. Will cooperative group instruction increase students' intrinsic motivation in learning the subject matter?
3. Will cooperative group instruction increase self-efficacy in students?

CHAPTER THREE

METHODOLOGY

SAMPLE

Forty-six students (43 tenth grade, 3 eleventh grade) were enrolled in two sections of the second trimester of biology at a suburban school in Northeast Ohio. Students were enrolled randomly by computer via their academic pathway, and at the time of enrollment, counselors and students had no knowledge that one class would be a lecture format class (control) and the other a cooperative group format (treatment). The treatment group met daily for 12 weeks for a 120-minute session and the control group met daily for 12 weeks for a 55-minute class session.

PROCEDURE

The treatment group performed *Co-op Co-op* on eight chapters of biology (Appendix A) while the control group received traditional lecture instruction throughout the 12 weeks of the trimester on these chapters. The same instructor was involved for both groups to minimize teacher variability.

INSTRUMENT

Three dependent variables were measured: goal orientation, self-efficacy, and intrinsic motivation toward biology, using a 38-item questionnaire (Appendix B) developed to assess these affective dimensions. Variations of this questionnaire on related research projects have been used by Miller and his colleagues.[7, 22, 24]

The Likert-type questions were intended to measure 1) the degree to which students have reasons for doing the work in biology class, 2) how students view the

material taught in biology class, and 3) the ability of the students to engage in thinking/processing skills in biology class. These questions measured student learning and performance goal orientation (12 items), perceived intrinsic (5 items) and extrinsic valuing of a task (4 items), and self-efficacy (9 items). Although the questionnaire included items involving other motivational variables, only those mentioned above were analyzed for this project.

Learning Goal Orientation Items

2. I do the work assigned in this class because I like to understand really complicated ideas.

5. I do the work assigned in this class because I like to work hard to solve challenging problems.

7. I do the work assigned in this class because I like learning interesting things.

10. I do the work assigned in this class because I like to understand the material I study.

Performance Goal Orientation Items

1. I do the work assigned in this class because I like to score higher than other students.

3. I do the work assigned in this class because I want to look smart to my friends.

4. I do the work assigned in this class because I don't want to look foolish or stupid to my friends, family, or teachers.

6. I do the work assigned in this class because I can show people that I am smart.

8. I do the work assigned in this class because I don't want others to think I'm not smart.

9. I do the work assigned in this class because I don't want to be embarrassed about not being able to do the work.

11. I do the work assigned in this class because I like to do better than other students.

12. I do the work assigned in this class because I don't want to be the only one who cannot do the work well.

Intrinsic Motivation Items

13. I enjoy the challenge of learning biology.

16. I find learning biology interesting.

19. I find working with biology enjoyable.

21. I find working with other students in my biology class beneficial to my learning.

30. I think working with biology is personally satisfying.

Extrinsic Motivation Items

18. Being knowledgeable about biology will be of little value to me in the future.

24. Being able to use biology will help me in the future.

26. Learning biology has little to do with my future work.

27. I will need to know biology for my future work.

Self-Efficacy Items

15. I am confident about my ability to do biological (scientific) problem-solving in this class.

17. I am certain I can understand the biological concepts presented in this class.

20. I think I am doing better than other students in this class.

23. I am confident I have the ability to understand the ideas taught in this course.

25. I am confident I can perform as well or better than others in this class.

29. Relative to others in this class, I think I am good at biology.

31. Compared with other students in this class my biology skills are weak.

32. I have a good understanding of the biological concepts I've been taught.

33. I am confident I can help others in the class achieve their best in biology.

The items were randomly ordered using a 5-point scale ranging from "strongly disagree" to "strongly agree" at the extremes and "undecided" at the midpoint. The questionnaire scoring key and scoring analysis can be found in Appendix C.

Five additional items on the questionnaire probed the students' views of what grade they wanted in biology, the lowest acceptable grade they would take in biology, and how they rated their effort in biology as compared to other classes. The questionnaire was administered three times to all students in both the treatment group and the control group: during the second week of the trimester, halfway (6^{th} week) into the trimester, and again at the end (12^{th} week) of the trimester. Students completed the questionnaire at each phase of the research in approximately 15 minutes.

DELIMITATIONS

There are a few delimitations in this study. Three affective variables are being studied for both the control and treatment groups. This research involves an approach called *Co-op Co-op*[1, 6], which is a modified approach of one of the main types, *Group Investigation*[19]. No research has ever been done in a high school biology class using this cooperative learning approach. There are additional variables one could research, as well as different types of cooperative learning approaches.

An underlying assumption in this research is that the investigator is an experienced, effective biology teacher. Interviews will take place the trimester following

instruction, when the investigator is no longer directly teaching the students; therefore, the student will not feel coerced to respond.

TREATMENT

The goal for both styles of instruction (traditional lecture and *Co-op Co-op*) was to have students gain an equal balance of conceptual and factual understanding of biology. A standard curriculum was followed with the cooperative group students covering the same course objectives as the lecture group.

The cooperative learning treatment was based on the previous work by Kagan[1] on *Co-op Co-op.* A review of the ten steps of *Co-op Co-op* learning was provided to the students and discussed prior to cooperative learning instruction (Appendix D). Students in the treatment group were placed in heterogeneous groups of four based on student interest of topics within the chapter. Students designed and completed a within-group evaluation form (Appendix E) to assess themselves on how well they prepared/researched their topic using a 5-point rubric of five categories. The following day(s) each group presented to the other groups in the classroom. Each student evaluated each group's presentation using a cooperative learning group evaluation form designed by the students in the class which is based on a 5-point rubric of seven categories (Appendix E).

Students in the traditional lecture group received more detailed instruction from the teacher than those students in the cooperative treatment group. Students in the traditional lecture group covered the same material and in-class assignments as those in the treatment group. Students worked independently on assignments rather than in teams and received individual grades. Both groups took the same teacher-prepared chapter exams.

DATA ANALYSIS

The data included a summary of the total Likert scale scores and also the subscores for each dependent variable (affective dimension). The scores reflected the degree of motivation and ability students have in learning biology. SPSS, a statistical program (Statistical Package for the Social Sciences), was used to analyze the data and look for meaningful correlations. A codebook was formulated to serve as a summary of the instructions used to convert information obtained from each student into a format SPSS can understand. The codebook included definitions and labels of the variables in question. The codebook for this study can be found in Appendix F. Possible correlations included: 1) the correlation between learning goal orientation and intrinsic motivation, 2) the correlation between learning goal orientation and self-efficacy, and 3) the correlation between intrinsic motivation and self-efficacy. Differences were also explored between the two groups in goal orientation, motivation, and self-efficacy. To look for any significant differences among the three sets of scores for each of the three dependent variables, repeated measures of a change in goal orientation scores, motivation scores, and self-efficacy scores will be analyzed. A mixed between-within subjects analysis of variance[30] is a statistical analysis that combines two approaches in one study. One approach is the between-subjects design (comparing two or more different groups), and the second approach is the within-subjects or repeated measures design (one group of subjects exposed to two or more conditions). A mixed between-within analysis of variance on which type of learning instruction (traditional vs. cooperative) is more effective in increasing learning goal orientation, intrinsic motivation, and self-efficacy measured across three time periods was analyzed. It also determined if the change in

learning goal orientation scores, intrinsic motivation scores, and self-efficacy scores over time was different for the two groups. Total survey scores between the control and treatment group were compared.

The reliability and validity of the scale were also examined. Reliability involves reducing random error and ensuring responses do not vary from one administration to the next. Reliability was assessed using Cronbach's coefficient alpha test for internal consistency. This statistical test provided an indication of the average correlation among all the items that make up a scale. Values ranged from 0 to 1, with higher values indicating greater reliability. The Cronbach alpha coefficient of a scale should be above 0.7, indicating excellent reliability. The alphas for each variable of interest examined in this study were all above 0.7. Validity measures the accuracy and meaningfulness of the data. To examine the validity of the scales used, the researcher focused on the factor analysis to look for intercorrelations within the scales. This test was completed in two parts, first by looking to see if the data is suitable for factor analysis and then by showing correlations. The significant correlations between each of the motivational variables in question were consistent with theoretical predictions and previous findings, providing support for the construct validity of the subscales.

Once the data is analyzed, four students were chosen for interviews based upon their responses to the survey questions. Two students in both the treatment group and the control group who have scores at opposite ends of the survey scale were selected. Interviews were used for future enhancement and understanding of the survey responses. The interview questions involved background information, personal attitudes, opinions, and personal experiences in the classroom on the types of teaching and learning styles.

The goal of the interviews was to determine how much of an impact cooperative learning or traditional learning had on some affective dimensions of learning science. The interview guide can be found in Appendix G. All four interviews took place in the third trimester when the researcher no longer has the students in class. Each interview was tape-recorded and transcribed. A sample transcribed interview can be found in Appendix H. Each interview lasted approximately 20-30 minutes.

For the collection of the qualitative data, analytical fieldnotes were written at the end of each interview. The fieldnote format consists of a log, data, summary/highlights, methodological comments, and analytical comments. A sample interpretivist qualitative fieldnote can be found in Appendix I. For organizing and reporting the data, inductive analysis was used for open coding, finding patterns, labeling themes, and developing category systems among all the data collected. The findings will emerge out of the data through the researcher's interactions with the data.[31, 32]

One aspect of verification and validity in qualitative data is truth value, which was represented by credibility. Credibility is the extent to which reconstructions are credible to people of the original multiple realities. That is, to the people who were working with the analyst. Techniques used for credibility include triangulation of methods and sources, and member checking.[31] Triangulation of the methods was used in this study by obtaining the data from different sources such as the students, observations, and other instructors. This data was then compared with data from other researchers to determine if any of the findings converge. Two methods of data collection were used in this study, the questionnaire responses as well as the interview responses. Member checking was implemented at the end of each interview to make sure the researcher understood the

responses and to clarify any questionable responses. Another aspect of verification and validity of interpreting qualitative data is transferability.[33] This is when the investigator knows only the "sending context"; inferences cannot be made about the "receiving context." Techniques used for transferability used in this study were purposeful sampling and thick description.[31] Purposeful sampling involved information-rich biology students who were purposefully selected based on highest and lowest scores on the survey between the groups. Thick description promoted rich, detailed, and concrete descriptions of the students' experiences in biology, which were applicable to the researcher and thus allowed the researcher to draw interpretations about meanings and significance of the data.

HUMAN SUBJECTS

Since this study involves students, a human subjects form was submitted and approved by the Institutional Review Board at Youngstown State University prior to beginning any data collection (Appendix J). This ensured compliance with informed consent by the researchers, institution, parents, and school board.

Permission to incorporate this project in the biology curriculum was obtained from the superintendent and school board. In addition, letters explaining the project and method of instruction (Appendix K) as well as an informed consent form (Appendix L) were sent home with students the first week of class so the parental signature for participation could be filed. All students in the two classes chose to participate.

CHAPTER FOUR

RESULTS

This project was designed to determine if a specific method of cooperative group instruction could have a positive influence on student learning goals and motivation. Specifically, the question of interest was do students receiving cooperative group instruction have higher scores in learning goal orientation, intrinsic motivation of learning material, and self-efficacy? Cooperative group instruction, *Co-op Co-op*, was the treatment group in this study and data were collected at three separate phases of the project on two separate classes of Biology I (a control group and treatment group) using a within and between groups repeated measures design.

The results of this research are discussed below in two major sections. The first section consists of the quantitative results divided into subsections based on the type of data and the statistics used to analyze the data. The second section consists of the qualitative results divided into subsections based on the methods of inductive analysis[31], which involved discovering patterns, themes, and categories in the data of the four interviews.

QUANTITATIVE RESULTS

The first subsection of the quantitative results includes the reliability analysis. The reliability analysis is reported on the 2 week pretest, the 6 week posttest, and the 12 week post-posttest questionnaire as a check on the validity of each subscale. Results reflect the data collected at the above-mentioned three time intervals of the project. Correlational analyses of the three variables of interest at each time interval are included

as preliminary checks based on the predictions from the theories on which the questionnaire instrument was based.

The second subsection includes the descriptive statistics of means and standard deviations of each variable studied broken down by group at the pretest phase of the project to help establish possible differences in the two groups at the onset of the project. A complete table of means and standard deviations for each variable by group and time are listed in Appendix M.

The third subsection includes a detailed analysis of significant group differences on each of the three variables at each of the three phases of the project. Also included in this section are initial independent samples t-tests on the variables of interest among the two groups on the 2week pretest measures.

The final subsection of the quantitative results includes mixed between-within subjects analysis of variance for each of the three variables of interest. This analysis was used to test whether there are main effects for each of the independent variables (time and group) and whether the interaction between the two variables of interest is significant.

RELIABILITIES

The survey questionnaire on learning biology was administered to students in both classes in the second week of the trimester, during the sixth week of the trimester, and finally during the twelfth week of the trimester. The survey contained a total of 38 items; however, only the items that correspond to the variables of interest were analyzed: learning goals (abbreviated as "lgo", 4 items), performance goals (abbreviated as "pgo", 8 items), intrinsic motivation (abbreviated as "inmo", 5 items), extrinsic motivation (abbreviated as "exmo", 4 items), and self-efficacy (abbreviated as "sleff", 9 items).

Modifications on the survey were made for this project. Self-efficacy item #20 and intrinsic motivation item #21 on the survey questionnaire were removed. Upon completion of factor analyses on the variables of interest, these two items showed weak correlations with most of the items on the self-efficacy subscale and intrinsic motivation subscale, respectively. Sample size was also modified for this project. Originally, 37 students participated in the 2nd week pre-test survey, 44 students participated in the 6th week posttest survey, and 43 students participated in the 12th week post-posttest survey. The sample sizes of the 6th week posttest (n = 44) and the 12th week post-posttest (n = 43) were both reduced to a sample size of n = 36, keeping the sample size consistent with the number of students during the 2nd week pretest survey. Reliabilities for each variable of interest are shown in Table I.

Table I

Reliability Analysis For Variables of Interest

Variables	2nd week pre-alpha	6th week post-alpha	12th week post-post-alpha
LGO	0.8717	0.7372	0.7842
PGO	0.9036	0.8937	0.9409
INTMO	0.8412	0.8236	0.8226
EXTMO	0.7613	0.8874	0.9161
SELEFF	0.8020	0.8517	0.8781

These reliabilities are consistent and even somewhat higher with previous analyses of this instrument when similar items were analyzed by Miller and his

colleagues.[7, 22, 24] On an absolute scale, these reliabilities are very good, with all alpha values greater than 0.7.[30]

VALIDITY OF SUBSCALES

Complete correlational analyses are shown for the 2nd week pretest (Table III), 6th week posttest (Table IV), and 12th week post-posttest (Table V) in Appendix N. These correlations were consistent with theoretical predictions and previous findings; therefore providing support for the construct validity of the subscales. There are significant[30] correlations throughout the project between learning goal orientation and intrinsic motivation (0.58, 0.53, 0.65), learning goal orientation and self-efficacy (0.24, 0.31, 0.60). Intrinsic motivation and self-efficacy were also significantly correlated throughout the study (0.35, 0.34, 0.52). The three values for each correlation represent the correlation at each of the three time periods the questionnaire was administered.

DESCRIPTIVE STATISTICS

It is important to note that the two groups in this study did not differ significantly on the variables of interest at the beginning of the project. Table II gives the means and standard deviations for each variable of interest separated by group during the 2nd week pretest phase of the project. A complete description of means and standard deviations for each variable of interest by time and group can be found in Appendix M, Tables VI to X.

Table II

2nd week Pretest Means and Standard Deviations By Group

	CONTROL GROUP		TREATMENT GROUP	
Variable	**Mean**	**SD**	**Mean**	**SD**
LGO	16.18	2.90	15.30	3.25
PGO	19.82	6.77	23.30	7.09
INMO	14.41	3.16	15.60	2.74
EXMO	13.47	3.62	13.45	2.95
SLEFF	30.41	5.04	29.95	3.24

INDEPENDENT SAMPLES T-TESTS

To confirm the assumption that the two groups did not differ significantly at the onset of the project, independent-samples t-test results on the variables of interest are included in Tables XI to XV in Appendix O.

An independent samples t-test was conducted to compare the 2nd week learning goal orientation scores for the treatment group and the control group. There was no significant difference between scores for the treatment group (mean = 15.30, SD = 3.25), and the control group [mean = 16.18, SD = 2.90; $t(35) = -0.859$, $p = 0.40$]. The magnitude of the differences in the means was very small (eta squared = 0.021).

An independent samples t-test was conducted to compare the 2nd week performance goal orientation scores for the treatment group and the control group. There was no significant difference between scores for the treatment group (mean = 23.30, SD = 7.09), and the control group [mean = 19.82, SD = 6.77; $t(35) = 1.517$, $p = 0.14$]. The

magnitude of the differences in the means was moderate (eta squared = 0.062). The desired threshold value of eta squared for a large effect size is less than one but greater or equal to 0.14.[30]

An independent samples t-test was conducted to compare the 2nd week total intrinsic motivation scores for the treatment group and the control group. There was no significant difference between scores for the treatment group (mean = 15.60, SD = 2.74), and the control group [mean = 14.41, SD = 3.16, $t(35) = 1.224$, $p = 0.23$]. The magnitude of the differences in the means was small (eta squared = 0.041).

An independent samples t-test was conducted to compare the 2nd week total extrinsic motivation scores for the treatment group and the control group. There was no significant difference between scores for the treatment group (mean = 13.45, SD = 2.95), and the control group [mean = 13.47, SD = 3.62; $t(35) = -0.019$, $p = 0.98$]. The magnitude of the differences in the means was very small (eta squared = 1.03E-05).

An independent samples t-test was conducted to compare the 2nd week self-efficacy scores for the treatment group and the control group. There was no significant difference between scores for the treatment group (mean = 29.95, SD = 3.24), and the control group [mean = 30.41, SD = 5.04; $t(35) = -0.337$, $p = 0.74$]. The magnitude of the difference in the means was very small (eta squared = 0.003). These findings of no significant difference at 2 weeks on all motivational variables provided evidence that the two groups did not differ significantly at the onset of the study.

MIXED BETWEEN-WITHIN SUBJECTS ANOVA

A mixed between-within subjects analysis of variance was conducted to determine if there is a change in learning goal orientation scores over the three time periods of 2 week (Pretest), 6 week (Posttest), and 12 week (Post-posttest). The means and standard deviations are presented in Table VI. There was not a significant effect for time, Wilks' Lambda = 0.906. Wilks' Lambda is one of the most commonly reported statistics used in multivariate tests of significance. If the associated significance level of the Wilks' Lambda value is less than 0.05, then there is a statistically significant difference between the groups.[30] The effect size was moderate. Therefore, there was not a change in total learning goal scores across the three different phases of the project. The tables of mixed within-between groups ANOVA for learning goal orientation can be found in Table XVI of Appendix P. The mean learning goal orientation scores over time between the two groups are shown in Figure 1.

The two groups (control-traditional instruction, treatment- cooperative learning instruction) were compared in terms of their learning goal orientation scores. There was not a significant main effect for group [$F(1,33) = 0.998$, $p = 0.325$]. The effect size was small (eta squared = 0.029). Therefore, no significant difference at any of the three time periods existed in total learning goal orientation scores between traditional lecture instruction and cooperative learning instruction. An interaction effect was also conducted to determine if there is the same change in scores over time for the two different groups. The interaction effect did not reach statistical significance of less than or equal to 0.05, Wilks' Lambda = 0.987, [$F(2,32) = 0.209$, $p = 0.812$].

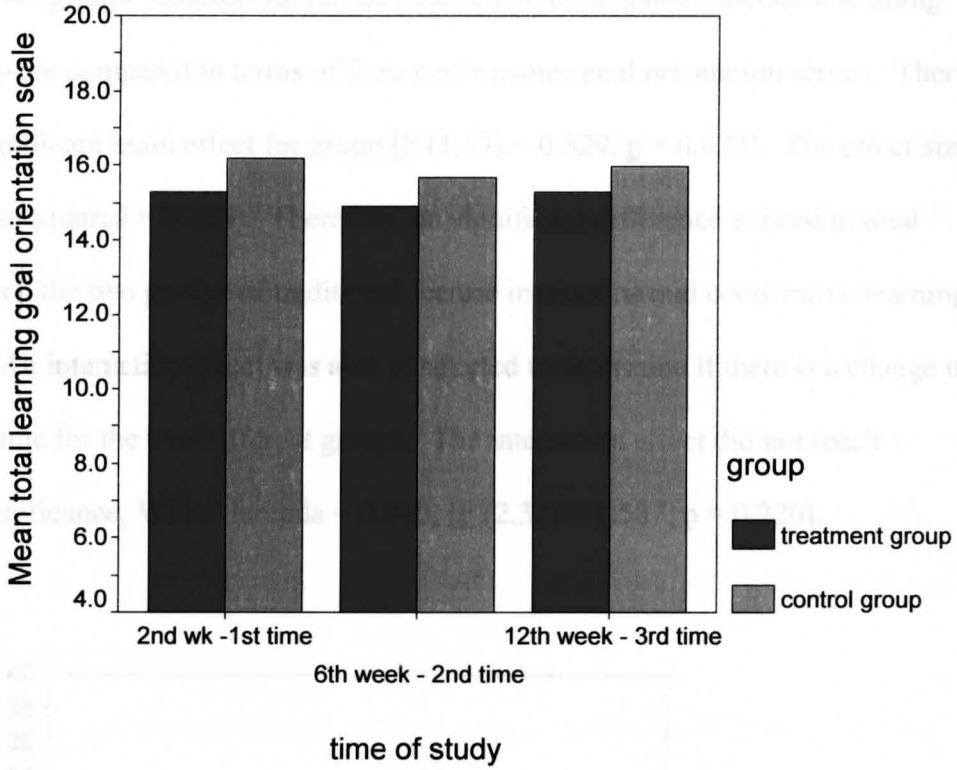

Figure 1. **Learning Goal Orientation Scores Over Time**

A mixed between-within subjects analysis of variance was conducted to determine if there was a change in performance goal orientation scores over the three time periods of 2 week (Pretest), 6 week (Posttest), and 12 week (Post-posttest). The means and standard deviations are presented in Table VII. There was not a significant effect for time, Wilks' Lambda = 0.988. The effect size was small. Therefore, there was not a change in total performance goal orientation scores across the three different phases of the project. The tables of mixed within-between groups ANOVA for performance goal orientation can be found in Table XVII of Appendix P. The mean performance goal orientation scores over time between the two groups are shown in Figure 2.

The two groups (control-traditional instruction, treatment-cooperative learning instruction) were compared in terms of their performance goal orientation scores. There was not a significant main effect for group [F (1,33) = 0.529, p = 0.472]. The effect size was small (eta squared = 0.016). Therefore, no significant difference existed in total scores between the two groups of traditional lecture instruction and cooperative learning instruction. An interaction effect was also conducted to determine if there is a change in scores over time for the two different groups. The interaction effect did not reach statistical significance, Wilks' lambda = 0.910, [F (2,32) = 1.587, p = 0.220].

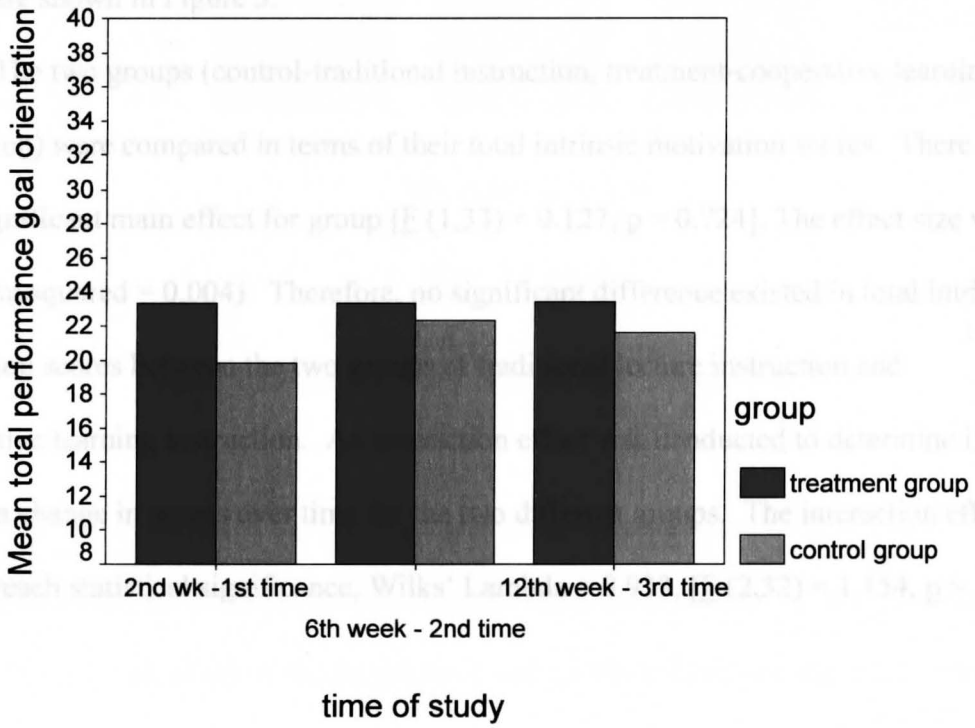

Figure 2. **Performance Goal Orientation Scores Over Time**

A mixed between-within subjects analysis of variance was conducted to determine if there is a change in total intrinsic motivation scores over the three time periods of 2 week (Pretest), 6 week (Posttest), and 12 week (Post-posttest). The means and standard deviations are presented in Table VIII. There was not a significant effect for time, Wilks' Lambda = 0.830. Although the effect size was large, no significant difference existed over time. Therefore, there was not a statistical change in total intrinsic motivation scores across the three different phases of the project. The tables of mixed within-between groups ANOVA for intrinsic motivation can be found in Table XVIII of Appendix P. The mean intrinsic motivation scores over time between the two groups are shown in Figure 3.

The two groups (control-traditional instruction, treatment-cooperative learning instruction) were compared in terms of their total intrinsic motivation scores. There was not a significant main effect for group [$\underline{F}$ (1,33) = 0.127, $\underline{p}$ = 0.724]. The effect size was small (eta squared = 0.004). Therefore, no significant difference existed in total intrinsic motivation scores between the two groups of traditional lecture instruction and cooperative learning instruction. An interaction effect was conducted to determine if there is a change in scores over time for the two different groups. The interaction effect did not reach statistical significance, Wilks' Lambda = 0.933, [$\underline{F}$ (2,32) = 1.154, $\underline{p}$ = 0.328].

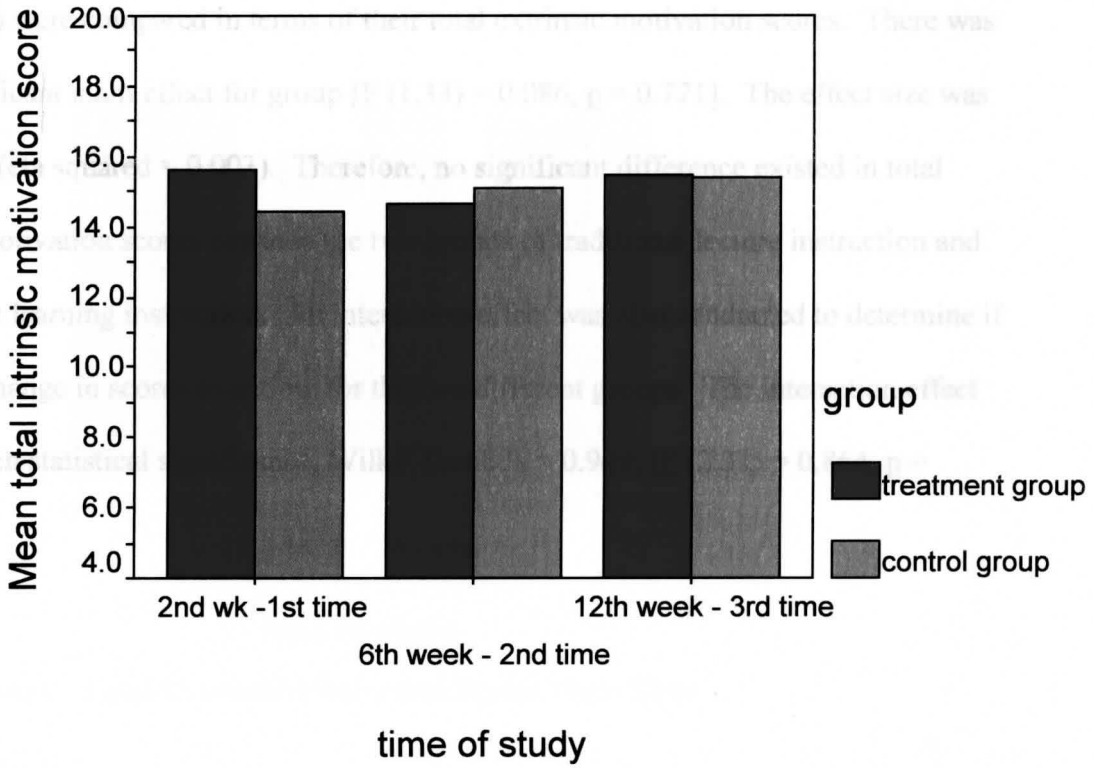

Figure 3. **Total Intrinsic Motivation Scores Over Time**

A mixed between-within subjects analysis of variance was conducted to determine if there was a change in total extrinsic motivation scores over the three time periods of 2 week (Pretest), 6 week (Posttest), and 12 week (Post-posttest). The means and standard deviations are presented in Table IX. There was not a significant effect for time, Wilks' Lambda = 0.879. The effect size was moderate. The tables of mixed within-between groups ANOVA for extrinsic motivation can be found in Table XIX of Appendix P. Therefore, there was not a significant change in total extrinsic motivation

scores across the three different phases of the project. The mean extrinsic motivation scores over time between the two groups are shown in Figure 4.

The two groups (control-traditional instruction, treatment – cooperative learning instruction) were compared in terms of their total extrinsic motivation scores. There was not a significant main effect for group [F (1,33) = 0.086, p = 0.771]. The effect size was very small (eta squared = 0.003). Therefore, no significant difference existed in total extrinsic motivation scores bewteen the two groups of traditional lecture instruction and cooperative learning instruction. An interaction effect was also conducted to determine if there is a change in scores over time for the two different groups. The interaction effect did not reach statistical significance, Wilks' Lambda = 0.949, [F (2,32) = 0.864, p = 0.431].

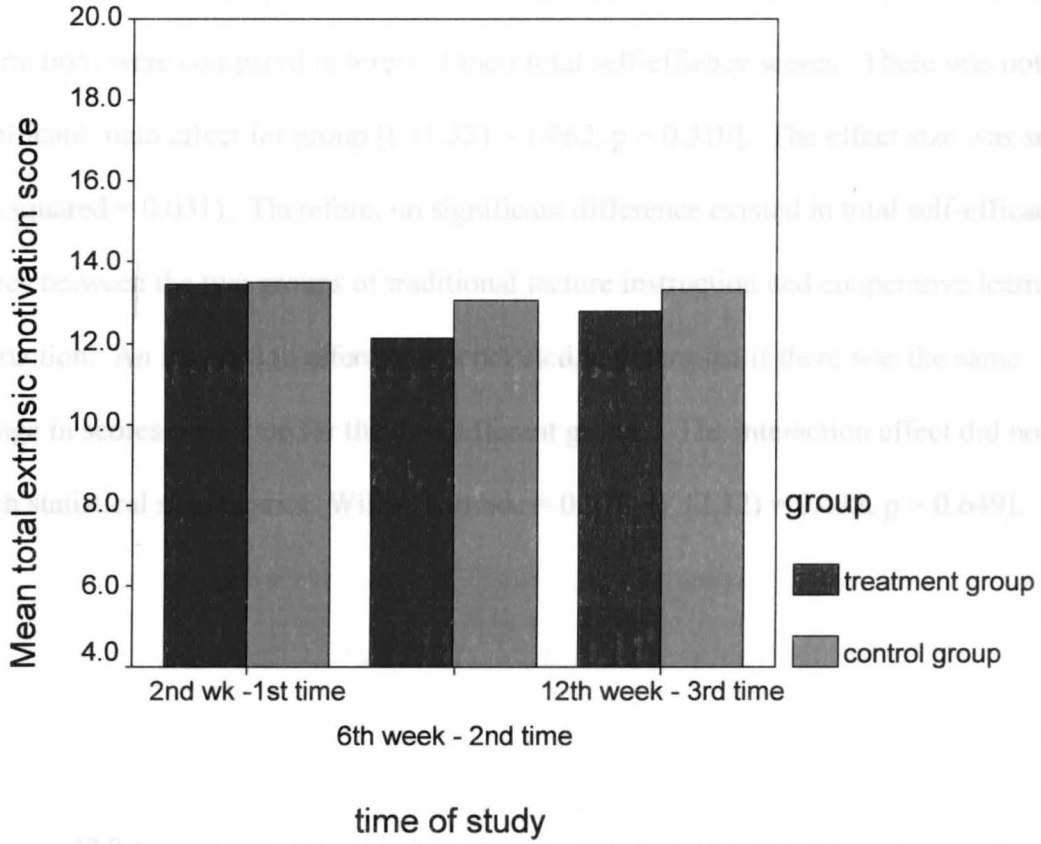

Figure 4. **Total Extrinsic Motivation Scores Over Time**

A mixed between-within subjects analysis of variance was conducted to determine if there was a change in total self-efficacy scores over the three time periods of 2 week (Pretest), 6 week (Posttest), and 12 week (Post-posttest). The means and standard deviations are presented in Table X. There was not a significant effect for time, Wilks' Lambda = 0.881. The effect size was moderate. Therefore, there was not a significant change in total self-efficacy scores across the three different phases of the project. The tables of mixed within-between groups ANOVA for self-efficacy can be found in Table XX of Appendix P. The mean self-efficacy scores over time between the two groups are shown in Figure 5.

The two groups (control – traditional instruction, treatment – cooperative learning instruction) were compared in terms of their total self-efficacy scores. There was not a significant main effect for group [$\underline{F}$ (1,33) = 1.062, $\underline{p}$ = 0.310]. The effect size was small (eta squared = 0.031). Therefore, no significant difference existed in total self-efficacy scores between the two groups of traditional lecture instruction and cooperative learning instruction. An interaction effect was conducted to determine if there was the same change in scores over time for the two different groups. The interaction effect did not reach statistical significance, Wilks' Lambda = 0.973, [$\underline{F}$ (2,32) = 0.438, $\underline{p}$ = 0.649].

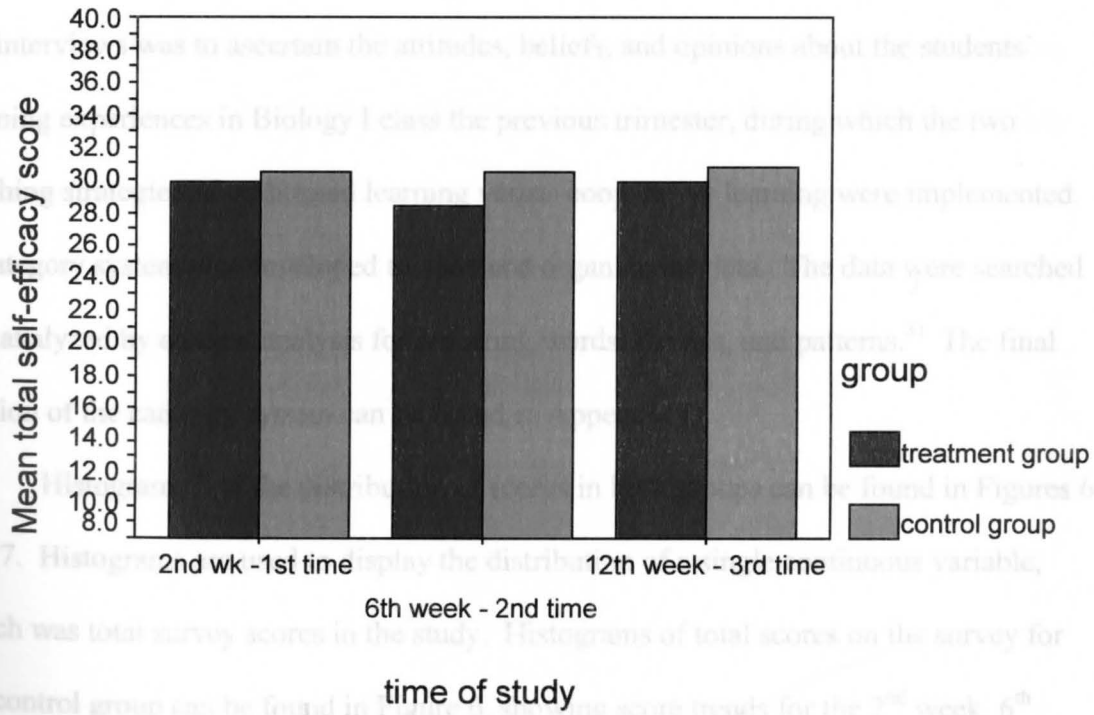

Figure 5: **Total Self-efficacy Scores Over Time**

QUALITATIVE RESULTS

Structured interviews were conducted with four sophomore students enrolled in Biology I during the last trimester of the school year. These four students were selected based on highest and lowest scores on the survey. The maximum score possible on the survey (with items #20 and #21 omitted) was 155, and the lowest possible score was 31. In the control group, the highest score was 141 and the lowest score 78. In the treatment group, the highest score was 137 and the lowest score 78. During the last trimester of the school year, two students in the control group had Biology I for two hours, and the other two students in the treatment group had Biology I for only one hour, all having another biology teacher who taught using the traditional learning approach, in which the presentation of the curriculum is very lecture-oriented followed by individual student assignments and lab exercises to confirm the concepts being presented. The purpose of the interviews was to ascertain the attitudes, beliefs, and opinions about the students' learning experiences in Biology I class the previous trimester, during which the two teaching strategies of traditional learning versus cooperative learning were implemented. A category system was developed to code and organize the data. The data were searched and analyzed by content analysis for recurring words, themes, and patterns.[31] The final version of the category system can be found in Appendix Q.

Histograms[30] of the distribution of scores in both groups can be found in Figures 6 and 7. Histograms are used to display the distribution of a single continuous variable, which was total survey scores in the study. Histograms of total scores on the survey for the control group can be found in Figure 6, showing score trends for the 2nd week, 6th week, and 12th week, respectively. Across the three time periods, the scores were

normally distributed showing a symmetrical bell-shaped curve. Most of the scores for each time period occurred in the center, tapering out towards the extremes. At the onset of the study, scores ranged from approximately 80 to 130 with the mean of 105.3. The score distribution spread out during the 6th and 12th week with scores ranging from approximately 75 to 142. Although not significant, the mean increased to 107.7 at the end of the study. Histograms of total scores on the survey for the treatment group can be found in Figure 7, showing score trends for the 2nd week, 6th week, and 12th week, respectively. Across the three time periods, the scores were also pretty much normally distributed. Most of the scores for each time period occurred in the center, tapering out towards the extremes. At the onset of the study, scores ranged from approximately 80 to 130 with a mean of 109.6. This mean was about four points higher than the control group at the onset of the study. At the 6th week time period, the total mean score slightly decreased to 105.4 and the scores spread out at the extremes to values of approximately 75 to 135. Although not significant, the mean increased to 108.7 at the end of the study. The score distribution spread out wider at the extremes with values ranging from approximately 75 to 142. More students scored higher and the lower scores remained constant for the treatment group at the end of the study.

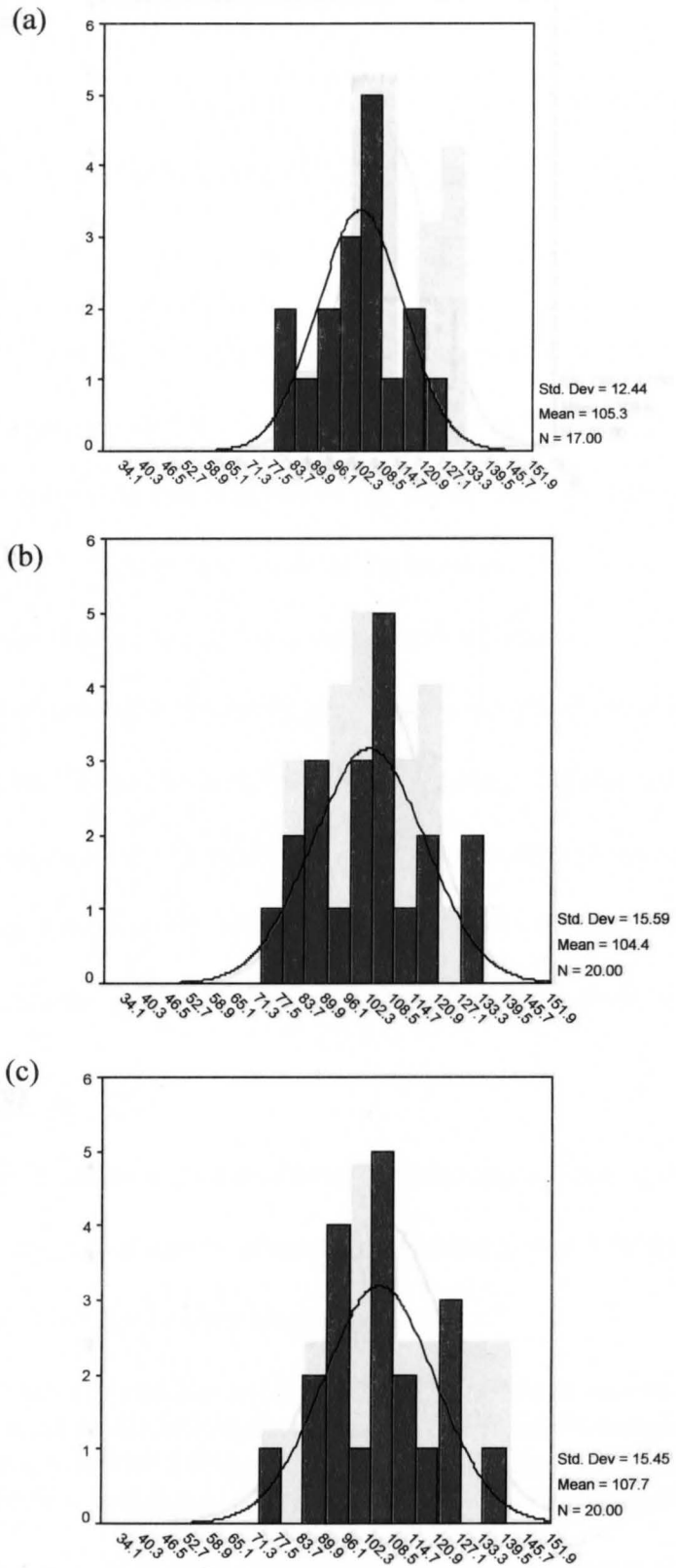

Figure 6. Histograms of total scores on surveys administered in (a) the 2nd week, (b) the 6th week, and (c) the 12th week of class for the control group.

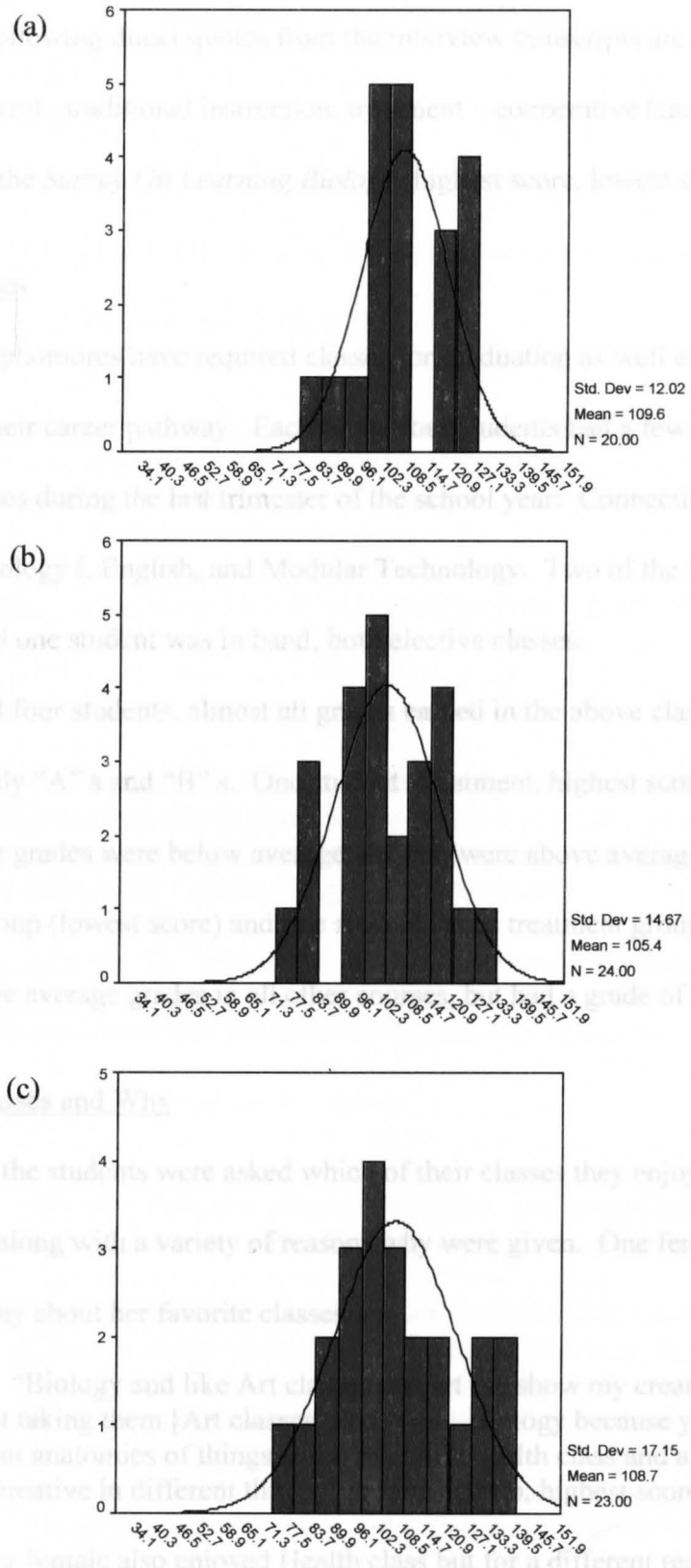

Figure 7. Histograms of total scores on surveys administered in (a) the 2nd week, (b) the 6th week, and (c) the 12th week of class for the treatment group.

The following direct quotes from the interview transcripts are identified according to group (control –traditional instruction, treatment – cooperative learning instruction) and score on the *Survey On Learning Biology* (highest score, lowest score).

Current Classes

All sophomores have required classes for graduation as well elective classes based upon their career pathway. Each of the four students had a few of the following required classes during the last trimester of the school year: Connections, Health, Geometry, Biology I, English, and Modular Technology. Two of the four students had Spanish II and one student was in band, both elective classes.

For all four students, almost all grades earned in the above classes were above average, mainly "A" s and "B" s. One student (treatment, highest score) explained two out of his four grades were below average and two were above average. One student in the control group (lowest score) and one student in the treatment group (lowest score) both had above average grades in all other courses, but had a grade of "C" in Biology I.

Enjoyable Classes and Why

When the students were asked which of their classes they enjoyed, a multitude of responses along with a variety of reasons why were given. One female had the following to say about her favorite classes:

> "Biology and like Art classes that let me show my creativity, even though I'm not taking them [Art classes] this year…Biology because you get to learn the different anatomies of things and a scientific health class and art because I like being creative in different things." (control group, highest score)

Another female also enjoyed Health class but for a different reason, the content:

"It's something I can understand, unlike Biology." (control group, lowest score)

A male responded in yet a totally different manner. He enjoyed classes not for the sake of his personal enjoyment, but only enjoyed classes for extrinsic reasons of needing to know the information for future education:

"Spanish II and Bio….Because they give a, give a good output on what I'm going to expect in the future, like in college, collegewise." (treatment group, highest score)

One female only enjoyed her English class because it involved fun and participation:

"Um. Because we do a lot of like the fun stuff, like last week we did like a play thing we picked a TV show and we acted it out using English lingo. We do a lot of play things…Yeh. We don't just sit there and like, listen to him. We're actually doing stuff." (treatment group, lowest score)

Interestingly enough, when asked what types or kinds of teaching methods the teachers used in the classes that the students enjoyed very much, all four students responded with one key word in mind – *variety*:

"Ah, well, like, she writes on the board, and group work, and also ah, I forget what I was going to say…Yeh, projects." (control group, lowest score)

"They break down the concepts and how they like, explain examples that are on the board… Ahh, it's more, it's more, both actually. It's more both teaching and doing group work. It makes it more easier for the student to get well, involved and more, understand more." (treatment group, highest score)

"The group, the different projects that we do." (treatment group, lowest score)

"Mostly like traditional teaching. Like putting notes on the board and then showing us how to do the problems or how to learn the different things… I like learning visually but I also like when the teachers explain it too because then they might describe it in a different way then it's on the board, a little more in detail or something." (control group, highest score)

This one female student (control group, highest score) later explained in the Interview what she meant by traditional method:

"Um, when I say traditional method I kind of look at it with you have some group work in there and experiments, and different hands-on stuff, but you still have the half hour to an hour of notes and the teacher talking too and explaining things."

Similarities in the responses include explanation of notes on the board, "broken down" or the use of detailed notes, and a variety of teaching methods such as lecture, experiments, group work, and projects.

Not Enjoyable Classes and Why

Classes that the students did not seem to enjoy at all involved effort and problem-solving. Three out of the four students chose Biology and/or Geometry as the classes that were not enjoyable to them. One male had this to say about Geometry class:

"Because it's a lot of quick steps and you have to think quick and it's like a lot of confusion…Proofs and some, some problem-solving is hard." (treatment group, highest score)

Another female also agreed that problem-solving makes Geometry difficult and mentioned related comments about Geometry as well as Biology:

"Those are my bad subjects… Well, you have to put more work into them. I mean, Biology I study a lot for and Geometry, I don't study for that but

it's just it bugs me that other people it comes naturally and for me, it doesn't." (control group, lowest score)

Therefore, all students either liked or disliked classes for various reasons, irrelevant of whether or not they were in the control group or the treatment group in Biology I class in the previous trimester.

Writing/taking notes from the board or via Powerpoint presentations seemed to be the main method of transferring information from the teacher to the students in most high school classrooms. It was not really the note-taking that the students disliked, but how the notes were written and how they were presented to them. Three out of the four students responded in frustration about their feelings and attitudes about the teaching methods used in Geometry:

> "I guess because my teacher is a little monotonic [sic] and I'm not…Math isn't one of my favorite subjects…Um, I really don't dislike any other classes because I like learning Geometry and I like math, it's just it's not what you call 'fun' to learn. It's just something you are kind of required to learn." (control group, highest score)

> "She writes them and then she goes through them. But, not so I could understand, I don't know." (control group, lowest score)

> "She doesn't really break it down, like, piece by piece a lot. She usually just, just like write it up on the board and explains it, then like, that's that. You'll like try to break it down, but it's not broken down to a certain point." (treatment group, highest score)

These students emphasized the importance of the presentation of the material they were required to know. Teacher personality and tone of voice were important to the students' understanding of the material as well as the speed and manner at which the notes were explained. Again, the same feelings about the importance of the presentation of the material from each group emerged when they were describing Biology I:

"O.K. Um, biology, 'cause well this is a different teacher that I have now. Um, he's like, he's so mean. He'll like, he'll, it's like we try to have fun in the class and he ruins it. It's like we'll be talking about something and then he'll go off and you know, be talking about it and then he's like, O.K., I had better get back on the subject and back to teaching and everything is just strictly off the board and you know and then if he says something and someone doesn't seem to write it down, he's like write this down because I don't feel like writing it down. And it's very, it's extremely traditional…" (treatment group, lowest score)

"Oh, he doesn't get into detail. Like, he'll put stuff on the board and then he'll like talk about the whole chapter but then some people just don't understand it."(control group, lowest score)

The speed and presentation of the material, a chapter every one or two days, and lack of detailed notes greatly affected their comprehension and thus their enthusiasm about learning biology.

Grade Point Average (GPA)

All four students had an above average GPA. The highest and the lowest score of the control group had GPAs of 3.9 and 3.5, respectively. The highest and the lowest score of the treatment group had GPAs of 2.7 and 3.7, respectively.

The GPAs of all four students were all mainly self-driven. That is, all the students were, for the most part, intrinsically motivated to keep a high GPA because they all wanted good grades and they liked seeing "As" and "Bs" on their report cards. But, extrinsic motivational factors did play a role in their overall GPA and existed in all four students. When asked if this GPA was self-driven or pressured by friends or family, the students responded with both in mind:

"It's self-driven because I like seeing when I get 'A's and 'B's on my report card. Even though I always strive for straight A's, usually a 'B' pops in somehow…But I do know like when I want to go to a university or college. I want to get in to one of the schools that has a low student to teacher ratio and those ones you usually have to have the higher scores and the higher GPAs to get

in, so, I know if I want to get what I want, I have to work for it. So, it's, what is it, self-achieved? Yeh." (control group, highest score)

"I would say both. Because myself I want to get good grades and my parents want good grades from me also." (control group, lowest score)

When asked what would happen to her (control group, lowest score) if she didn't get good grades she replied that she would be grounded and also have something taken away from her.

"Um, it's self driven, but I wish to bring it up more as…as I go on into my last, my last two years of school….I think it's pretty much myself, but like, the pressure is there. I want to try to like, um, make ends meet with all my friends. Like some of my friends have like a 3.0. I'm stuck being the, the, like the scapegoat [sic] and have like a 2.7. So." (treatment group, highest score)

"Um. Honestly, I'd say myself. I'd rather like, I want a good GPA, my goal is to get at least a 3.9 something by the time I graduate, and I am taking AP next year so I can get it up, and it's more self-driven, but like if I get a bad grade, my mom will be like… Yeh, she gets mad at me. She'll tell me that I'm not able to go to college with bad grades. So… Yes, but it's more self-driven than anything, because it's my goal to get good grades." (treatment group, lowest score)

Despite their scores on the survey, all four students strived for achievement and a high GPA for self-fulfillment, as well as the external rewards of attending college and pleasing friends and family.

Assignments That Students Enjoyed

When the two students from the control group (traditional lecture) were asked what assignments they had enjoyed, they replied:

"Like the way you would give the notes on the board and explain the notes to us for one of the sections in the chapter and then make us do that section before we moved on to the next one and made sure everybody understood it. Unlike the

teacher I have now that goes over all the notes at once and then says do the sections and goes from there…doesn't really elaborate on certain stuff." (control group, highest score)

She gave the following specific example from a biochemistry chapter:

"Um. Like when we were learning the stuff with the monosaccharides and the disaccharides in Chapter Four and trying to match up like what fatty acids was [sic] and what proteins were and trying to match up the groups and what different things were in each group and to learn the different aspects of the health of a human and animals and that kind of thing."

The other student in the control group responded differently as to what she enjoyed about the traditional learning assignments:

"Um, I had to study more often and work harder….Um, and how we did group work. I liked that." (control group, lowest score)

She gave the following specific example of a group activity from a chapter on classification:

"Um, that one little puzzle that we did…how we had to figure out…um."

Turning now to the personal experiences of the students in the treatment group (recall that this is the group whose method of learning was the cooperative learning technique called *Co-op Co-op*), when the two students in this group were asked what assignments they had enjoyed, they replied:

"I enjoyed like, like the group work, a lot of like, explain references on the board, tests, and basically just like, I don't know, like regular concepts and topics that you talked about." (treatment group, highest score)

When asked to think of a specific example or chapter that he liked best, he replied:

"Um, specific topics. It would probably have to be all of them, from all chapters, 'cause you explained them and broke them down to the point where they were a little easier, and they could understand…I've picked it up both ways because like, you can, you can hear like, what like, the student has to say, or like

his/her point of view and you can hear what the teacher says, but I, you know, I liked both ways." (treatment group, highest score)

"I thought it was interesting to see the ways that my peers presented some of the lessons. It was just hilarious. It like, in ways, like um, oh like Mike and Paco, and he'd be like yeh, Paco is this, and Paco is strong because he eats his meat and you know what I mean and it was funny to see that. And then , I don't know, it was kind of funny to see some of these people actually be serious about something because we laid out some of the things and if you messed around up there while your friends were teaching then we marked off points. So, that was like really interesting to see." (treatment group, lowest score)

When asked to think of a specific example or chapter that she liked best, she replied:

"Yeh, the first time that we did the things all together. For some reason, I, like, we all brought up food for I think it was we did the different food groups and like things that we should know, and we all brought in food. So, it's a fun thing. And um, like Sean, every single thing he did was like hilarious…" (treatment group, lowest score)

When asked if this type of presentation helped her or the other students, she responded with a different point of view:

"Yes, um but then that gets me into like in a way, I kind of like hated it sometimes because like, when people like, didn't know what they were talking about or they did it right out of the book, then you didn't get anything from it because obviously they didn't get anything from it, then we couldn't get anything from it." (treatment group, lowest score)

The students in the control group enjoyed assignments that involve detailed notes along with explanation of these notes broken down in sections as the chapter progresses. Detailed notes provided confidence, increased study time, and effort in the understanding of the material. The students in the treatment group enjoyed assignments that allowed their peers and the instructor to present the information, allowing different viewpoints to be shared, although the concern of peers knowing and presenting correct

information lingered in their minds.

Assignments That Students Least Enjoyed

When the two control group students were asked what assignments they least enjoyed, they again responded differently from one another:

> "I enjoyed pretty much everything 'cause I like the way traditional learning is with putting the notes on the board and then the teacher explains them compared to saying just read the book and learn yourself 'cause I can understand through reading the notes on the board and then the teacher can give an example or something that will maybe make you understand it more." (control group, highest score)

The other female in the control group enjoyed detailed notes, but had this to say about notes in general:

> "Yeh. They make me nervous…Trying to study them…" (control group, lowest score)

When the treatment group students were asked what assignments they least enjoyed, one student was satisfied and the other had many comments:

> "No, nothing. Everything was great." (treatment group, highest score)

> "Um, I kind of felt like um, on some people on how they did the score sheets. They'd mark off like, and they'd give you bad grades and I don't know exactly how we put everything together, but I felt like there's no way that I was going to get a perfect score, because like nobody gets a perfect score when they do a presentation. But like, people will always like round up, and they'll be like you know, there's no way, nobody can get a perfect score and like there's me, I would get like a 34 out of 35, I would think about like that's not a 100%. You know what I mean. If it wasn't a 100%, then I wasn't happy with it. But there was a couple times that like… but that made me strive, too. Like there were times when I would come up and ask you and I would be like do you think this is creative, you know, the things that I would do bad on, that actually helped me in my public speaking because I do a lot of that in Robotics and stuff. But, um… and then the part where like the people, they didn't know what they were talking about, they took it right out of the book, and I didn't like that either because I didn't get anything from it…Yeh, it's like on the student part
> I hated it, like because it brought my grade down. But, other than that, like it was O.K. because that made me get better at it." (treatment group, lowest score)

The students in the control group again enjoyed traditional teaching along with elaborate, detailed notes. Teacher explanation of notes was preferred over assignments involving reading the text for homework. Although the other female enjoyed detailed notes, the notes gave her difficulty in comprehending and memorizing the information, especially if the notes were not detailed. One female in the treatment group least enjoyed the evaluation scores of her presentations from the classmates. She strived for perfect scores each time she presented, and was determined to improve each time she presented to keep her grades high. She also disliked groups that were not prepared to present because she did not receive beneficial information from them to enhance her learning.

Advantages Of Classroom Instruction

Note-Taking

As to the advantages of the way the content is presented during traditional classroom instruction, the two students gave positive comments in regards to the notes on the board:

> "Maybe, like some people I know, don't listen to what the teacher has to say because they dislike the teacher or something else. You can read the notes on the board and kind of have an idea what the teacher is saying, but maybe just not to the exact detail…you might miss some details, but you still have an idea of what's going on in class if you have the notes." (control group, highest score)

> "Yeh, because they have to educate themselves more and which makes them strive more for a good grade." (control group, lowest score)

> "Um. If you were listening to the teacher and you kind of didn't get all of the notes for the next day, the teacher would have some of them still on the board if you missed any from the day before, you could copy them down the next day at the beginning of class and it wouldn't be any disruption or a problem in class." (control group, highest score)

"Yeh. I guess. It puts more pressure on me to do better." (control group, lowest score)

Both females in the control group considered note-taking the main advantage of classroom instruction. The detailed notes provided the information they were required to learn, increasing the amount of pressure and determination to strive for and maintain a high grade in biology.

Student Presentation Of Material

As to the advantages of the way the content is presented during cooperative learning instruction, the two students gave positive comments in regards to the students presenting the information:

"Advantages are it gives you more time to like assess what other students give like other opinions, um, and, and basically just know what to expect when you're in the outer world doing these cooperative learning activities." (treatment group, highest score)

He (treatment group, highest score) also enjoyed the initial set up of the cooperative learning group instruction when all the students discussed among themselves and with the teacher and thus decided on the rubric and categories of which they were to be evaluated and graded.

"Um, I would have to say that sometimes like, like not 'cause, you know, you're a teacher, but sometimes you actually get more if you're hearing like something that someone like me understands, even though it's like, 'cause you're above my level, according to me obviously, 'cause you're a teacher and you went to college and I haven't been there yet, but like my peers and somebody like that, they're on my level, and most of them are, in my class at least and it was like you get more, 'cause they can explain it in a way that you might understand and use examples you might understand rather than like some of the teachers have no idea you know like, I'd be like, "What are you talking about?" and they can't explain it to me because they don't like know. You know what I mean? Like, you learn better sometimes from on your level." (treatment group, lowest score)

Because this female feels it is an advantage to learn from other students who are "on the same level" as her, she was then asked if she felt that the students were more attentive and more motivated during class when their peers were teaching. She replied with the following comment:

> "Yeh, because it's a variety. It's not one person standing up there teaching all the time. And then some things that like we made up and stuff like that but like for some people like I just sit there and be like, you know, just sit down, you know, but… Or the door, get out. But, yeh, it was a very different variety, especially in the beginning; it was a lot of fun." (treatment group, lowest score)

When asked if they personally gained anything from cooperative learning, one student included the other students in his comment while the female student focused on herself:

> "I gained maybe like, maybe trust from other friends. Like, I've also gained, like maybe access of them sharing their ideas to me and vice versa switching ideas to them." (treatment group, highest score)

> "Um. I don't know. Like, I learned something, obviously, 'cause I wouldn't have gotten a decent grade in this class. Um…O.K. Yeh, my like my public speaking skills got a ton better, 'cause like, I don't know like the being in the show after the end of the last tri, I tried a lot of public speaking for Robotics, and I noticed like when I talked to people, I was a lot more open and I was able to like use creativity, 'cause I noticed that was my total weakness, you know, like, I just want people, I would take it right out of the book. You know, like I could never reword things for myself, and after taking this class, like I tend to put things, like I'll read over a paragraph in a sentence and I'll reword it so then I understand it better, too, at the same time. You know what I mean, like, 'cause you just can't take it out of the book, I like that's why you cannot do that, like the book is so stupid, it's old and it's, it's I hate it, and like we often tend not to use the book as much, and we made the posters, and the posters were the best thing of all, but, yeh." (treatment group, lowest score)

Both students in the treatment group responded positively to the cooperative learning instruction. The students felt more in control of learning biology by creating the rubric and categories of which they were evaluated, assessing one another and sharing ideas with one another. They were more interested and motivated with the subject matter

when it was presented by students "on the same level" of thinking as them. Cooperative learning instruction in biology also enhanced communication and public speaking skills in the female's extracurricular activities and allowed the male to gain an increased amount of trust from his friends and classmates.

Disadvantages Of Classroom Instruction

Peers Presenting Incorrect Information

When the students in the control group were asked what they felt the disadvantages of traditional classroom instruction were, they responded with two opposite viewpoints:

> "There really don't seem to be any unless you're one of those people that kind of falls asleep during class, but there's really no disadvantages to it if you pay attention in class." (control group, highest score)

> "Um. You don't get to be educated from other class members…Some teachers don't bring it down to the student's level and some teachers do." (control group, lowest score)

This female (lowest score) found student involvement such as peers presenting the information important. The first female (highest score) was comfortable and pleased with the teacher presenting the material because this (traditional instruction) was her favorite type of learning.

Both students in the control group were worried about the other students giving them the correct information when asked how they felt about cooperative learning in the classroom. They both responded similarly:

> "Like students teaching students? I wouldn't like that because knowing the students that are teaching, some of them you don't know if they're giving the exact, correct information and with the teacher teaching the subject, you know that he/she specialized in that subject and they know all the things about that

subject unlike a student that could have possibly just wrote stuff down, not even knowing what was what." (control group, highest score)

"At a point. I mean they can also confuse you, too…Because if they don't know the information then how can we learn." (control group, lowest score)

Both students in the treatment responded with similar concerns involving cooperative learning with peers presenting the information:

"Disadvantages, um, slim to none. But, like, some my disadvantages are the, the, like, um, whether, whether, that like the presentation that we are going to present is accurate or not, is not like, you know, all just clumped around, mumbo jumbo stuff that's, it doesn't make sense." (treatment group, highest score)

After this comment he was asked if it would be difficult for him to understand what the students were teaching if they were unprepared or confused, he replied the following:

"No. 'cause no, 'cause I can just basically just ask them questions, you know, but each question at a time to try to, try to not make myself confused, make it question by question." (treatment group, highest score)

"Um, a lot of times the students don't really understand totally what is going on in the book, and I think they would be better if, like, say you taught and then we took it from whatever we learned from you and then we split up into groups for what we thought we learned the most in the chapter, because like some of the people I know knew what they were talking about, and then they still picked the groups 'cause it was the surest thing, or something like that. But, it was, like, I think that you should teach it first and then us teach it to the class." (treatment group, lowest score)

This female would rather have the subject matter explained by the teacher first and then by the students. This would guarantee her accurate information explained in a variety of ways.

Self-Efficacy: Personal Ability To Achieve

All four students were asked how much of their academic success in biology they felt came from their own efforts and abilities, or how they felt about their ability to

achieve in biology. The students responded, relating personal achievement with both intrinsic and extrinsic motivational factors in mind:

> "I feel pretty good because it's like when I enjoy learning something, I'll put more effort into it and it'll make me enjoy it more. But usually when I dislike learning something, you want to put less effort into it, but you still force yourself to put more into it so you can still keep your grades up and that kind of thing." (control group, highest score)
>
> "Some, but I could put more… Yeh, half (the effort) probably." (control group, lowest score)
>
> "Um, 'cause I know that, I'm, well since, since I'm going to college after high school, I know that, like, like academically wise I can feel that some of the topics that the teacher is going to teach, some of them may be like, reappearing on the board to, like, re-glance my memory." (treatment group, highest score)
>
> "Um, I think that, well this is just my opinion. I think that if everybody does their work and everybody actually does the homework and goes home and reads over the chapter and studies everything, then there's no way that you can get below a "B" in this class. And so, me myself, I think that everybody, there's just no excuse for getting bad grades, but then I see there are some people that do have learning disabilities, they can't do that. Like, that's just, yeh, just that's how I think. But I think that it's totally self-driven, if you sit there and you sleep during class, how are you going to expect to know it unless you're like until last year, I knew everything, like, I did, just 'cause like my mom taught me when I was younger, and it was all basic." (treatment group, lowest score)

Motivational Aspects of Learning Content

When asked what factors motivate them to learn the content in biology, students responded with a combination of both intrinsic and extrinsic motivation factors for wanting and or needing to learn the content:

> "The dissections of different animals and learning things you probably wouldn't have learned otherwise in different classes if you would have took something else instead of biology, like you wouldn't learn how to dissect a frog usually in environmental science." (control group, highest score)

"Um. My other classmates getting good grades and I'm not… And me. Like I want to get good grades just because I want to keep my GPA up…Yeh, because my brother, he's in college right now and he says he has biology classes." (control group, lowest score)

"Yeh, going to college and basically working, you know, working in the outer world." (treatment group, highest score)

"Genetics, that was my favorite thing. It was just like, it was the way that things get put together and like O.K. so you know dad's this and mom's this, and like if they had babies, then you know the "peanuts" or "peanuts" squares [She laughs since she knows she can't pronounce Punnett squares.] I did say peanuts but peanuts squares…Yeh, certain chapters are more interesting than others and anything but plants, I hate plants… Um, the labs that we did were fun. Like with the, you know, how we used microscopes, but other than that, I don't know, it's just, 'cause we didn't do the talks in the beginning." (treatment group, lowest score)

Enjoyment In Learning Biology

All four students provided different reasons as to why they enjoy learning biology. Some enjoyed it for the personal enjoyment of learning the content, others enjoyed it because they may need to know the information for the future, and one student mentioned teacher personality as an important factor in the enjoyment of learning biology. The following comments provide reasons of why these students enjoyed learning biology:

"Yes, because it's very interesting and there's many different aspects of it that you can learn and you can really never be bored kind of with it… Um. I had an interest in animals since I was a little kid and now getting to learn about them more and more in depth and learning how they have certain behaviors makes you understand them more than you thought you did." (control group, highest score)

"Some of it… the personal… like the health topics… I liked the dissecting…Not plants. I like learning about like the actual stuff that you need to know if you're, like it's more important to know, I don't know , I just don't understand why we need to know plants and all that… Yeh. Those were boring." (control group, lowest score)

"Yes. Because it gives a good sensation, it gives, it gives a good, like, like a good outlook on what can I expect for the future 'cause like, biology, it, it like, it follows you throughout high school and college and like throughout your regular bookwork life so, it tends to be a good observation…'Cause like, maybe, maybe just, let's just say if like a specific chapter was on the board, and like you say that it may not ever appear again, but during like the future, it probably will, so, you know what to expect." (treatment group, highest score)

"Certain parts I enjoy, like the genetics, I loved that. But, like now, like it's all plants and we're going over animals, but… O.K. Um, like now, it's just like I hate it. It's like I go to class and it's like, oh man I'm going to [other teacher]. You know, you try to make jokes in the class, and he's like "reeeeeeeer" [cat sound] It's just not fun, it's so boring. It like, for me to get bored in class is kind of weird, but, I think he's boring…We laughed and that kind of just made the day. O.K. But, it's like, geez, I mean, he has no personality. You know, at least you have personality and we enjoyed being in your class. It's like, yeah, you know, Mrs. L., we wouldn't mind having biology first and second period, but, it's like, [other teacher], we only have him for an hour, and we all hate it… Yeh, because, I mean, honestly if you're a boring teacher like some teachers thatwe have, I mean, Geometry, I hate to talk about teachers but I like to, but it's O.K…Um, she had no personality when she taught. Um like, she tried, I mean, but she just didn't have the personality, you know, and then if we were having fun in the class, she would stop it, you know, so we didn't learn anything in that class, and the grades showed in that class as well. And I've never gotten below a "B" or even a "B" in anything math related." (treatment group, lowest group)

Descriptive Information

Memorable Experience In Enjoying Life Science

When asked if any of the students had previous memorable experiences in enjoying any type of life science, it was interesting to hear the very few that they mentioned:

"Um. I had an interest in animals since I was a little kid and now getting to learn about them more and more in depth and learning how they have certain behaviors makes you understand them more than you thought you did… Um. Kind of between, a little bit of eighth grade, but more so tenth." (control group, highest score)

"I don't know. Not really. I didn't really like it." (control group, lowest score)

"It was in the tenth, tenth-grade, tenth-grade… Ah yeh, concepts." (treatment group, highest score)

"Um, it was, it was in eighth-grade… 'Cause I took um, I took the, life, I took it twice, because you know like how you take seventh-grade, and then you, but this class, this school is opposite, so I took it in eighth-grade." (treatment group, lowest score)

Teaching Method Used In Memorable Experience

For each of the three memorable experiences mentioned above, the students mentioned the following teaching methods used in their experiences:

"Both teachers used hands-on stuff and traditional learning too. They kind of combined the two." (control group, highest score)

"Um, um, she basically brought it down to the point, like each piece by piece and how it was…" (treatment group, highest score)

"He was old. Um, he was what like, pretty much we really didn't do too much in the class. We would like, we were totally interested and when we did a bug thing and we learned about bugs and stuff. We had, like pretty much everything was homework and projects, but we didn't do anything in class. We dissected, oh, we dissected an earthworm, and that's it. Like, he had these little dissected things, like these big things. We didn't do anything in class that I remember, really, besides, we would do experiments with chemicals and more, because he had a chemistry room before, and all the chemicals were supposed to be out, and he was like do the experiments for us. And then for the test, he'd they'd be open book. I mean, it was really stupid… Um, it was teacher-based because he did everything for us. You know what I mean, like if we didn't understand something, we would go up to him and ask him, and he would tell us the answer. That's how I learned, but… Yeh, like the bug lab that we did was totally on our own. Like we had class time, but we weren't allowed to work with anybody." (treatment group, lowest score)

Challenging Topics

Personal Effort In Reviewing

When asked how they would handle a challenging topic in biology, they all responded very similarly:

"Um. By first going over it by myself trying to understand it and then I would ask the teacher for help…Yeh, but I would try if I didn't understand it from them (peers and friends), though; I would still go to the teachers to get to try to get a better explanation." (control group, highest score)

"I'd probably research more about like the topic of it and work harder… I'd probably do both (ask friends or teacher)." (control group, lowest score)

"Ah, I would probably basically just have to challenge that chapter. If I can't redo it, then I would probably ask the teacher for help or maybe just try like, to do like, a little experiment to try to help, help me out." (treatment group, highest score)

"Come and ask you. Um, read over the chapter and then sometimes we still don't understand then we come and ask you… Like, we'd ask you, the other teachers, obviously, 'cause, you know. But, um, like sometimes we can go to the teacher that we are having problems with and then if he still can't help you then, you know, you read over the chapter and then hopefully by then you understand it. I really never had that much problems with something and if I did I just…" (treatment group, lowest score)

Challenging Lab Exercises Or Problems

All four students again responded similarly as to how they would handle a lab exercise or problem that they found to be difficult or challenging:

"I would ask the members of my group first that were working with me on that assignment, and if they couldn't make me understand it then I'd go to the teacher who assigned us the lab and have he/she explain it." (control group, highest score)

"Um. I would ask other classmates or the teacher." (control group, lowest score)

"I would basically just like I said last question, I was glad to just, maybe, maybe just go for it or just try to like to, make , make like sense and break it down to the point where I can understand it, and I can, you know, go after it and just complete the exercise… I would try to handle it myself and if I can't handle it, I always have help from friends and teachers." (treatment group, highest score)

"Um, I would ask for help, probably like in lab exercises, probably from my peers first and then if I still couldn't get it then I would go to the teacher." (treatment group, lowest score)

Aspects To Change The Way Biology Is Taught

Teaching Methods

With regard to what aspects of teaching biology the students would change if they had the power to change how it was currently taught to them, all four students responded differently:

> "I really wouldn't change any. Just stick with the traditional methods… Because it's easier for me to learn that way and even for people that don't like a class, you could learn stuff in that class through the traditional method by taking the notes and stuff and at least get through the class that way, instead of it being miserable." (control group, highest score)

> "The part where like it didn't get into much detail. I don't know… There should be more detail into it. Like, 'cause if there's just general things about the chapter, it's not really that…Yeh. Take more time on the topic…going over the chapter more. We might review on a Monday and have a test on Thursday. That's not enough time for me… Probably a variety. I mean lectures get boring after a while. Like the class gets bored with it and doesn't want to learn it. So, then if you get more interest in the students, then I think that would get them more interested." (control group, lowest score)

> "No, because it's important for me to know it now, than rather for me to know it at, at like ahead of time in college, so, I can just already know it and be ready… Oh, man, I would change a lot of aspects to the way he's teaching because like… Like, homework, homework he only gives us like, rare points, and like a test, test now, I'm really struggling on tests. I'm getting like "B"s, maybe a mere "D" on tests, but like the tests, like, it's doesn't really break down to like, basic stuff. It just gives like, the question, and then you have to answer it automatically." (treatment group, highest score)

> "Oh, O.K. My opinion is I think that like, in the beginning, you know, we have one day or like when we have you for two hours like you take, you know, we go over like briefly everything so we understand, get a grip on it, everything. Then the people, like we would split into groups and then, or, you would have to like have groups, you would choose the groups, not us. Because we choose, we chat as much as we group. And then you'd be like you know, like, whoever understands like the Kingdom Animalia, you know, then you get into this group here, and then like the same for you, in short, wait, if you understood plants, so you would be in the plants group, instead of, you know, everybody being, um, you know, like, everybody's like oh, O.K., I'm friends with this person. I'm going

to be in this group with them and do it by how you understand things, and then we teach it to the class, 'cause a lot of times we don't understand everything, that you know, that the teacher says the first time, and if we go over it briefly, it won't take that much time of class… Because, like, sometimes when the teachers go over things in class, you don't understand everything. And then when we were teaching it, you didn't understand something, though, if you just take, if you take like a mixture of the two, you put them together, that should work more. And a lot of times, like, even like, when I was in my group and I forgot like, I know one time you had to come over and explain something to us. And of course, we didn't understand, we were going to take it right out of the book and say whatever it says. And, then you came over and we actually understood what it was talking about... it just depends on the topic, if the people know it, or they don't know it. But if you put a group of like people that totally cannot get anything from reading, then you put them in a group, they're going to take whatever's in the book, write it down on a piece of paper, write in on the board. O.K., that's just how like people like that work. But, if you take somebody like, if you put like, say, me, Lauren, Kayla, and somebody else that's like extremely smart, Luke, put us three in a group. Then you would have this highly complex thing that nobody else in the class would understand and so in a way it would, and in a way it wouldn't. So, just like, I, like, then yeh, you should randomly pick the groups and put the people together, but I think maybe more on like the grades or something. So that like, then people who are really smart, you know they're obviously not going to do bad. People who that, like, aren't doing so well would work to get better so they can be in the group with smart people." (treatment group, lowest score)

How Feelings and Attitudes Are Affected By Changes In Learning Biology

If the changes that the students wanted were implemented, three of the four students' feelings and attitudes would become less stressful and the content more easily understood. The following is how they responded about learning biology:

"Instead of it being overwhelming you could understand it better and not get stressed out with it…It's a little easier on the person than like kids teaching kids because then you don't know. With the teacher you're assured that it's the right information, unlike with kids teaching kids, you have to, you kind of stress out more 'cause your trying to figure out if it is the right information." (control group, highest score)

"Everyone would understand it better. Um, working with other people and also listening to the lectures and asking the teacher questions will help me understand it." (control group, lowest score)

"It would make it a lot more fun, 'cause like, I don't even know, it's so bad. Like, you go to class, and it's like, oh, poo [sic]. You know what I mean. You have to go to biology class again today. And then, you know, it's like, "Oh Mrs. L's class, you know, what are we doing today?" We like, we always knew what we were doing, and it's just, it was a lot more fun. We had actually enjoyed school at that time, and now it's just like crap." (treatment group, lowest score)

Additional Science Courses

List Of Additional Science Courses and Why

Since all four of these students were sophomores, they were asked if they would be interested in taking additional science courses either their junior or senior year in high school. All of them were planning to take at least one additional science course for various reasons. The following responses indicate their chosen classes and the reasons of why they would choose these classes:

"Um. The only one I really been thinking of other than Biology II for next year it would be vertebrate zoology…Because I like learning about animals and stuff and learning about their anatomy and like how fins function on a shark and that kind of thing 'cause you wouldn't know that if you just like went to the zoo and seen[sic] a shark in the aquarium." (control group, highest score)

"Well I am next year. I'm taking Biology II. So, yeh, I guess… Because my brother told me I'd use it." (control group, lowest score)

"Chemistry, yeh. Biology II, I would take…'Cause like, even though, like I can pass Chemistry and Biology and science was all my favorite topics, but since, but since I started knowing, I started hanging, you know, to get the hang of it and starting realizing that, you know, it is important to know all this stuff before you graduate." (treatment group, highest score)

"I signed up for genetics next year and chemistry. But, I didn't take Biology II yet. Genetics because what we learned in here, and not because of the other teachers that other people that chose it because of the other teacher. But, I choose them because like, that's really what interests me, like, if I was to be a doctor of some sort, I would be somebody that dealt with, like, the people, like, before they're born, or when they're first born, the genetic diseases that they have and like, just like, when all the posters that used to be around, where are they at? O.K. They're back there. But, the posters that are around your room about the diseases that the babies get when they're younger, you know, like, I like, I

actually, that's more of what I learned in the class because that interests me. And then like, the one time at dinner, we had gotten Kentucky Fried Chicken and then I was telling them about how it's not KFC anymore and then I explained the whole genetically modified animals. You know like, that's really what I learned. And Chemistry, it's either Chemistry or Bio II, so I like say Chemistry because my mom told me she thought it was a lot more fun, but genetics is my choice." (treatment group, lowest score)

Ways Students Want Additional Classes To Be Taught

When asked how would the students what these additional science classes to be taught, all four students responded with a variety of teaching methods in mind:

"Um. With like the traditional method along with having experiments mixed in and not having to sit here for like two hours hearing a lecture with the notes on the board but still having hands-on and group work mixed in so you still have a variety of ways to learn but all in one kind of style of teaching… Like if we had lab questions, to do the lab with one or two other people, and then be able to go over the questions with them and check the answers and that kind of thing." (control group, highest score)

"Um…taking more time on the chapters, reviewing more…Both (lecture-based with detailed information and student-centered with a lot of information)" (control group, lowest score)

"Yeh, more, more, more of group activities and cooperative learning because it gives a good, like, it gives, it gives the student a good advantage on what, like, you know, like all lecture classes isn't all that important." (treatment group, highest score)

"I hope that we actually get involved in his (Chemistry) class, 'cause well, I don't know, it just seems. I've never really talked to him. It just seems like he's just going to be one of the two that just gets up in front of the class and starts teaching, and like doesn't care if we're paying attention or not. And, I don't know, he just doesn't seem like he's going to have very much class involvement at all…but like I would want you to teach it (Genetics) first, you know, and then we ask questions to be like, you know, so what causes this and it like, 'cause seriously like when we're going over genetics like I had a question like every five minutes because like I was interested and you know, that's just how I am. And when I have a question, I have a question and you're going to answer it. You know what I mean? And, so, if O.K., I'd like, I'd rather you teach the class than us teach ourselves that…Um, I can see couple of the things that students presentations for, but that's a class where I would definitely want you to teach it because I would have so many questions and I mean, maybe if somebody's not, if

that's not of interest to them in it, they might enjoy it more if they got to teach it. Like what we did, but that's just my opinion, you know." (treatment group, lowest score)

Challenging Science Courses

When asked if they wanted the additional science courses to be challenging, all the students wanted their chosen courses to be "slightly challenging." The following student responses explain why they wanted some challenge:

"A little. Just to make it a little more interesting and that way it could be fun, too, the work up to a challenge, but not making it too hard that you're stressing out and overwhelmed with homework and different assignments that you have to get done." (control group, highest score)

"Or, maybe yeh, 'cause then it would make me strive more for a good grade… if the class was too easy) Then people would just be like, ah, I could get a good grade in that class and just not try as hard." (control group, lowest score)

" …to be complex, I would like them to be complex, but challenging, challenging is good, but not like to the point where it gets too challenging and I can't understand it." (treatment group, highest score)

"No. Nobody wants, like, in school I don't want challenged because then I actually have to work to get it, but in a way, challenges are good…Because then it makes you get better at things. But like, sometimes, I don't have time to sit home and do three hours of homework or three hours of studying. I just don't have the time to do it. But, you know, school is a challenge, so like, biology is a challenge and Spanish is a challenge. Everything else is just a piece of cake. You know, it is a cake walk. You know, you get in, and then you walk around, start going, you go home and you study if you have too. Then you go back to school and walk around the classes. It's cake walk." (treatment group, lowest score)

The Most Important Challenge With Respect To Learning Biology

The students were then asked what they thought the most important challenge was with respect to learning biology. After a long pause, one female stated the following:

"When you're, like when you see something really complex written on the board. When like when you walk into class and you seen a dihybrid cross on the board and you're like, what do I do with this and until the teacher explains it,

you'll understand it more. Or like the different diagrams that were for the chapter seven photosynthesis chapter because some of them were complicated to understand even though we learned about photosynthesis and other processes in the past." (control group, highest score)

For another female, her most important challenge with respect to learning biology had nothing to do with content or presentation, but simply time:

"Well, I need to get a good grade. Well, I want to get a good grade so then, studying more is a challenge for me because it's hard to just…I don't know… Not having time to study and, um…" (control group, lowest score)

One student's most important challenge with respect to learning biology was the fact that the origins of biology and life consist of many theories each with their own concepts.

"Concepts of life, concepts of maybe, of how, like everything was made in the past, and how everything was discovered….understanding the past.." (treatment group, highest score)

He finds it difficult to understand and learn biology when its beginnings are not 100% truth or fact.

One student's most important challenge with respect to learning biology consisted of a combination of switching biology teachers and thus a change in teaching style and how the information was presented to her. She responded with much comment:

"O.K., um, if I missed one day of class, I felt like I was totally behind, 'cause you, like you're afraid to go up to the guy and ask him things, he'd be like, "Yeh, get the information from somebody else, you know, and it's just like, you know, you're totally behind, and you're behind anyways because you don't learn anything in class because he's stupid, but I don't know, it's hard to explain. Um… You know, it's like, I go to class, I take the notes, I go home, and I still feel like I'm not learning anything… I don't know, probably because you're not my teacher. You know, like, I say O.K. you know, maybe I'd rather have a teacher like Mr. K. because last tri , because like I got so mad at some people 'cause they would get up there and I 'd be so mad at them because, you know, like, I just hate the way that they taught. But, if it was you up there teaching, then I think that I would like it more, because I don't know, I feel like, I really, I truly like enjoyed like, I had you last year for Integrated Science, and I did pretty well in that class.

Um, I mean, I could have done better, but I still did pretty well…: It kind of is his teaching style. 'Cause it's like, he, whatever I take notes on, then I go home and if I look over them, then it's like, O.K., how am I supposed to memorize all this in one day? And then, because like, yeh, you're supposed to go over a section every day and I understand that, but, you know, it's like I go through, like oh, man. You know, like, it's like, 'cause right now we're doing the phylum. So, we go over the phylum, we go over the class, and then we go over all the classes, and then, you know, then we go over the next class, and you know, it's like, you know, I understand that it's a lot of information, but… Yeh, I then you want to go over and try to read the book and it still doesn't work, trust me." (treatment group, lowest score)

Overcoming These Challenges

The students were then asked how they felt they could overcome these challenges that provided difficulty for them learning biology, and all of their responses pertained to an increased amount of self-efficacy in various forms. They responded as follows:

"By like paying attention in class, taking one thing at a time, and learning it that way. Because if you try to take all the information in at one time, you [sic] gonna get overwhelmed and definitely stress out." (control group, highest score)

"Yeh, it is. If I don't procrastinate and um…" (control group, lowest score)

"By going, like, studying more about the past, about the certain like event that happened… Yes, Research a little more." (treatment group, highest score)

"Um, I can go to you and ask you. I mean you can just take the test and hope that you did good on it like I did. Um, you can, you can ask somebody in a different…oh, I asked Casey and she gave me like a little. She made me, um, like a study sheet, and it said, you know, like phylum, and you know like all the information that she thought that would be important for the test, stuff that she got from the class, and then I took whatever I knew and put that with it, so O.K." (treatment group, lowest score)

Summary

Sophomore students from Biology I class were interviewed based on the highest and lowest scores on the survey on learning biology. Four interviews were collected and

analyzed, two from the control group taught via traditional learning instruction, and two from the treatment group taught via cooperative learning instruction. The students discussed current classes they were taking, which classes they enjoyed and why, and what types of teaching methods were being used in the classes they enjoyed.

The students also discussed their current GPAs and whether the GPAs were self-driven or achieved by the pressure of friends or family. Similarities existed in all four responses; GPAs were mainly self-driven, but all the students also had extrinsic factors placed on them to also keep up their GPA.

The students in each group also described their personal experiences as a student in biology class. They were asked what they enjoyed about the learning instruction (traditional learning instruction or cooperative group learning instruction), what they least enjoyed, and what they felt were the advantages and disadvantages of the learning instruction.

All students interviewed had above average grades and maintained a high GPA for mainly self-driven reasons. Extrinsic factors such as pressure by friends and family and college selection also played a role in their GPA.

The students enjoyed classes that were creative, fun, easily understood, and necessary for future education. One main theme that emerged from all the students was that the classes they enjoyed included a variety of teaching techniques such as lecture, group work, projects, activities, lab exercises, and presentations. During lecture, all the students preferred detailed notes that were explained in sections. Although detailed notes were enjoyable, they also provided stress and nervousness when studied. This allowed

the students to educate themselves independently and increased their effort to strive harder to do better in class.

Students least enjoyed classes that involved too much effort and problem-solving such as Geometry. This increased effort was a result of rapid presentation of the material as well as lack of teacher personality.

Advantages of classroom instruction included traditional note-taking as a tool for comprehending the learning material to strive for a better grade as well as the students presenting the information to classmates. Positive outcomes from the cooperative learning instruction included the following: sharing ideas, increased trust in peers, enhanced communication and social skills, transferring of information "on the same level" as the students, and actively participating in the development of the rubric and categories for within group and team evaluations.

The emerging theme regarding the disadvantage of cooperative group instruction was the fear of students presenting incorrect information. This fear caused more stress, confusion, and self-doubt in the students as to whether or not they understand the information being presented.

Both intrinsic and extrinsic motivational factors played a role in the students' self-efficacy regarding personal achievement and learning the content in biology. Intrinsic factors included personal interest in the subject matter and the personal drive to get good grades. Extrinsic factors included classmates getting good grades and needing the information for future education.

When handling challenging topics, all the students mentioned that they will try to solve the problem or answer the question on their own first. Afterwards, if they did not succeed, then they will ask their peers and the teacher.

All of the students want to take additional science courses after their sophomore year. The students desired courses that employ a variety of teaching methods and are intellectually challenging. They felt that these changes would increase their interest and effort in order to do well and obtain a good grade.

The most important challenge with respect to learning biology differed in each student. Challenges to learning biology included complex terminology, study time constraints, understanding past concepts, and teaching style. All students responded with the same theme in mind when asked how they would overcome this challenge: an increase in the amount of self-efficacy, effort, and persistence to better understand biology.

Finally, the students answered questions about their amount of self-efficacy, motivation, and learning goals in learning biology. Interpretations of the differences between the personal experiences of the students in Biology I for the control group and the treatment group, as well as a discussion of future implications for designing a biology curriculum that fits the needs of all students are discussed in the next chapter.

CHAPTER FIVE

DISCUSSION AND CONCLUSIONS

SIGNIFICANCE OF RESULTS

The results of this investigation on the impact of cooperative learning as it influenced the affective dimensions of learning science provided direct answers for each of the research questions that initiated this study. The research questions focused on the impact that cooperative learning may have on the goal orientation, motivation, and self-efficacy of learning science.

The reliabilities of the survey questionnaire items for this study were consistently acceptable and even somewhat higher than with previous studies by Miller and his colleagues.[5, 22, 24] The correlations among the variables of interest support theoretical predictions of positive, significant correlations and previous findings from other researchers.[5, 6, 23-25] With the consistency of these items established, this chapter will focus on the specific impact of cooperative learning instruction on the three variables of interest as well as interpretations of the interviews, followed by a discussion of the implications these findings have on student learning and motivation in high school biology and practical applications for the high school biology teacher, and finally suggestions for future research.

As previously stated, there were significant correlations throughout the project between learning goal orientation and intrinsic motivation, learning goal orientation and self-efficacy, and intrinsic motivation and self-efficacy. These are consistent with previous studies. However, when testing the statistical significance of the difference between correlation coefficients for the two groups at all three time periods, in no case

was there a statistically significantly difference between the treatment group and the control group, except for one instance. After examining the effect of learning goal orientation on intrinsic motivation at the 12 week (Post-posttest) time period, there was a statistically significant difference in the strength of the correlation between learning goal orientation and intrinsic motivation between the treatment group and control group. Learning goal orientation explains significantly more of the variance in intrinsic motivation for the control group than for the treatment group.

Learning goal orientation results showed no significant change across the three different time periods of the project, and when comparing the two groups in terms of their total learning goal orientation scores, no significant difference exists for the two groups of traditional learning instruction and cooperative learning instruction. These findings do not support previous studies supporting increased learning goal orientation and other motivational variables with cooperative learning instruction.[5, 23, 24] Both groups averaged a score of 15-16 out of a possible 20 on the learning goal subscale. This indicates a high learning goal orientation in which both groups seek challenges and will persist under adversity.

Performance goal orientation results showed no significant change across the three different time periods of the project. When the control and treatment groups were compared in terms of their total performance goal orientation scores, no significant difference exists in total scores for the two groups of traditional learning instruction and cooperative learning instruction. Both groups averaged a score of 19-23 out of a possible 40 on the performance goal subscale. This is the lower end of the mid-range scores, thus indicating a mixture of both performance and learning goal orientation. The students

seek challenges, but yet they are unsure about some of the challenges; for them it depends on the degree of difficulty of the challenges that they decide to take on. The students also seem to have somewhat low persistence when difficulties arise and will therefore try to solve their difficulties by asking peers or the teacher for assistance.

Intrinsic motivation in learning biology showed results similar to learning goal orientation. No significant change in total intrinsic motivation scores existed across the three time periods of the project. When the control and treatment groups were compared in terms of their total intrinsic motivation scores, no significant difference exists in total scores between the traditional learning instruction and cooperative learning instruction. Once again these findings do not support previous studies.[5, 22] Both groups averaged a score of 14-16 out of a possible 20 on the intrinsic motivation subscale. This score for both groups indicates a high intrinsic motivation for learning biology. The students for the most part enjoy learning the subject matter for his/her own sake and find most of the biology topics interesting.

Extrinsic motivation results showed no significant change across the three different time periods of the project. When the control and treatment groups were compared in terms of their total extrinsic motivation scores, no significant difference exists in total scores between the traditional learning instruction and cooperative learning instruction. Both groups averaged a score of 12-14 out of a possible 20 on the extrinsic motivation subscale. This midway score shows that extrinsic motivation does exist along with intrinsic motivation mentioned above. The students may find biology interesting and enjoy it very much, but the subject matter is also valued primarily for its utility or the external rewards it brings.

Self-efficacy results showed no significant change across the three different time periods of the project. When the control and treatment groups were compared in terms of their total self-efficacy scores, no significant difference exists in total scores between the traditional instruction and cooperative learning instruction. Again, these findings do not support previous studies by Ames[8] and Nichols[22]. Both groups average a score of 28-30 out of a possible 40 on the self-efficacy subscale. This score is considered the upper end of a mid-range score (20-30). The students in both groups have a somewhat high amount of self-perception of their ability to succeed. A modest amount of their academic success depends on their own efforts.

INTERPRETATIONS OF THE INTERVIEWS

Line-by- line and word analyses among the four interview transcripts were performed to assess the attitudes, beliefs, and opinions of the sophomores in two different biology classes for one trimester (12 weeks). Descriptive information about current classes, GPA, personal experiences in biology class (traditional learning approach vs. cooperative learning approach), and questions relating to learning goals, motivation, and self-efficacy were also analyzed among the four students. Even though two of the students (highest and lowest scores on the survey) were interviewed in the control group of traditional learning instruction and two of the students (highest and lowest scores on the survey) were interviewed in the treatment group of cooperative learning instruction with some similar questions, relationships in categories and descriptors exist among them. Analysis revealed both similarities and differences among the four interviews. After analyzing and interpreting the thick description of the data, axial coding[32] relationships were created among my categories and descriptors. The purpose of axial

coding is to relate categories and themes that developed from analyzing thick description of the data and to continue developing these categories and themes into their specific properties or descriptors. After axial coding was completed, the data became clearer, allowing patterns and themes to emerge and relationships among the data to be interpreted.

Descriptive Information

Many similarities existed for the four sophomore students in regards to the classes they have taken and are currently taking. All of the students needed to take required classes as part of their career pathway and graduation requirements for a specific number of credits. Some required classes for sophomores included English, Biology I, Geometry, Health, Connections, and Modular Technology. Two of the four students were in the elective classes of Spanish II and/or Band. All four students had mostly above average grades; however, one student in the control group (lowest score) and one student in the treatment group (lowest score) had all above average grades in all subjects and a "C" in Biology.

All four students had differences in their responses as to classes they enjoyed taking and the reasons why they enjoyed them. Both students in the control group had intrinsic reasons for enjoying the classes that they had selected. One female (lowest score) enjoyed Health class because she understood the content very well. The other female (highest score) enjoyed Biology, Art, and Health class because she enjoyed being creative in different things and learned the different anatomies of organisms as well as enjoyed the dissections. By comparison, both students in the treatment group had extrinsic reasons of why they enjoyed classes. One student (lowest score) enjoyed

English only because the class consisted of "a lot of play things" and fun activities such acting out plays and television shows. The male student (highest score) enjoyed Spanish II and Biology I because they were important for the future and going to college.

All students had class likes and dislikes for various reasons; irrelevant of the group they were in during this study. These findings were coincidental in which the treatment group students provided extrinsic reasons for enjoying classes while the control group provided intrinsic reasons for enjoying classes. Student personality and the degree of interest in the subject matter of these enjoyable classes played a large role in the findings.

There were also some differences in the students' responses of classes they least enjoyed and the reasons of why they did not enjoy them, but one similarity emerged. One student in each group disliked Geometry for the same reasons: difficult problem-solving, many quick steps, more effort in studying, and confusing proofs. One student (treatment group, lowest score) disliked Spanish II and Biology because of the mean personality of the teachers and the way they presented the material. Another student (control group, highest score) disliked Modular Technology assignments involving partners, but her partner never wanted to assist her and became a "free rider."

The students were very low goal-oriented, or high performance goal-oriented, in Geometry. They tended to avoid the challenging tasks of completing and explaining proofs and problem-solving. The students displayed low persistence when difficulties arise, quickly asking friends and peers first for assistance instead of personally trying to figure out the problems. These actions supported Dweck's goal orientation theory[23, 24] that learning goal measures are positively correlated with persistence measures, while

performance goals are not. Because they were low goal-oriented in Geometry, they displayed low persistence in accepting challenges and did not try to solve the problems on their own. Low effort and persistence at the tasks implemented in Geometry also had an effect on the students' desire to explore the problems and subject matter of Geometry. This was supported by studies finding positive, moderate correlations between effort and intrinsic valuing of a task[8, 24, 26], which, in turn, also supports Dweck's theory[23, 24] that students who adopted a goal for learning for its own sake are more inclined to value a learning task. These students displayed low motivation in learning the subject matter due to the degree of difficulty and the weak self-perception of the ability to succeed. Self-efficacy highly influences motivation. The students felt that Geometry was beyond their capability, so they tried to personally avoid the problems and exercises. This supported the work of Bandura, as cited in Nichols.[22]

Interestingly enough, even though there were differences in the students' selection of enjoyable classes and the reasons why they enjoyed them, one similarity existed in all the enjoyable classes mentioned by all four students - the types/kinds of teaching methods used in these classes. Both groups of students explained the importance of notes on the board. Not just generalized and simplified notes or words scattered on the board, but the importance of detailed notes with examples broken down in sections by the topic or chapter. All four students also mentioned that too many notes and too much lecture are not enjoyable, there needs to be a variety of teaching methods for a class to be enjoyable. This variety of teaching methods includes lecture with detailed notes, explanation of notes, group work, projects, labs, etc.

A similar pattern also existed when the students described the types/kinds of teaching methods used in the classes they did not enjoy. Both students in the control group and one student in the treatment group (highest score) had the same negative feelings and attitudes about Geometry. These students did not like the way the teacher presented the notes and proofs that were written on the board. The male in the treatment group (highest score) disliked the notes on the board because they were not "broken down piece by piece." This Geometry teacher, also described as monotonic, apparently goes through the notes quite quickly and the students therefore have a difficult time understanding the proofs and problem-solving, therefore not enjoying the class. Again, the students did not enjoy the teaching methods used in Geometry for the same reasons that they least enjoyed the class. They displayed low goal orientation to seek challenges and persistence when difficulties arise, low self-efficacy to succeed, and low intrinsic valuing of the subject matter. One student in the control group (lowest score) and one student in the treatment group (lowest score) also had the same feelings about the way the information was presented in the last trimester of Biology I with a different teacher. Again these two females did not enjoy the other teacher's brief, vague notes on the board or the way he presented the material to the class. Instead of breaking the notes down section by section, this teacher talks about the whole chapter at once and spends approximately 1-2 days on a chapter. The only group work he does with his students are labs. For the most part, the students are passive learners, not active learners in this classroom. This biology class was a very traditional, competitive classroom that involved the lack of detailed notes, which were very important to the students for success. After lecture, individual student assignments and labs confirmed the concepts being presented.

Students were expected to do most of the work independently. The low self-efficacy of the students may have caused the tension, self-doubt, and anxiety in the students in his biology class, which supports studies[4, 5] of these feelings in a traditional, competitive classroom. Learning involves progress toward predetermined teacher-defined goals in which knowledge is transferred from teacher to students. The students were passive, impersonal learners in his classroom.

All four students had an above average GPA, ranging from 2.7 to 3.9. This GPA was self-driven in all four students, indicating a high amount of intrinsic motivation to keep their GPAs high because they want to see the "A"s and "B"s on their report cards and they want to do well for themselves. But of course, in each of the four students, there existed some extrinsic motivation factors from the pressure of friends or family to also want them do well and also the pressure of entrance requirements of colleges and universities.

Personal Experiences

Enjoyable Assignments

Both females in the control group made reference to the notes as being the enjoyable part of this approach. The theme of enjoying detailed notes and explaining the notes section by section was mentioned once again. One female compared the notes from the second trimester during this research to the current third trimester with a different teacher with the following comment:

> "Like the way you would give the notes on the board and explain the notes to us for one of the sections in the chapter and then make us do that section before we moved on to the next one and made sure everybody understood it. Unlike the

> teacher I have now that goes over all the notes at once and then says do the sections and goes from there…doesn't really elaborate on certain stuff." (highest score)

The other female (lowest score) enjoyed the detailed notes because they made her study more often and with increased effort to work harder. Both students depended on detailed notes for success and understanding of the material. The self-efficacy and learning goal orientation of these students remained low because of their dependency on elaborately explained, detailed notes. Without this kind of notes, they persisted with little challenge and effort. This also could explain why they disliked his teaching methods in a class that they least enjoy.

Both students in the treatment group enjoyed the group work and working with their peers in the classroom. One student (highest score) found it beneficial to hear different viewpoints of what the students had to say about the topic as well as what the teacher had to say. One female in the treatment group (lowest score) enjoyed it because it was fun and some of the students would act hilarious in front of the classroom. These comments supported Lord's findings[5] on reasons for using cooperative learning in biology teaching. Some of his findings concluded that cooperative learning: 1) enhances thinking and learning in science, 2) enhances the learning environment in science, 3) enhances the attitudes of science students, 4) enhances science learning, 5) enhances social skills, and 6) enhances student values. Some groups just wanted to provide a comedy act and gave general information about their topic instead of getting into detail and explaining information that is found in the corresponding section in the text. She also added how she hated it sometimes when students did not know what they were talking about or just read it out of the book in front of the classroom. Her comment

matched what the female in the control group (lowest score) had said about cooperative learning in that, if the student presenters did not get anything from the text or information, then how could the rest of the class get anything from their presentation or lack of information.

Least Enjoyable Assignments

The two females in the control group enjoyed pretty much everything during the traditional learning approach. One female (lowest score) again enjoyed detailed notes, but too many notes made her nervous.

The male student (highest score) had no complaints and thought everything was great. The female (lowest score), on the other hand, did not enjoy the evaluation scoring sheets because it was very difficult to get a perfect score by her classmates. If it was not a score of 100%, then she was not happy. This forced her to improve on her weaknesses and strive to do better the next time she presented. She also mentioned once again her dislike when other students would present and not have a clue as to what they were talking about because she did not get anything form the presentations. The responses of this student supported work by Collins, Langer & Beneventi, and Hill, as cited in Lord[5], that indicated cooperative learning is too time-consuming, too diffuse in responsibility, and too informal to bring about high level learning of complicated material that older students need to know.

Advantages Of Classroom Instruction

Once again both students in the control group brought up the theme of notes. Each female gave a different advantage for having detailed notes written on the board.

One advantage (given by highest score) was the fact that some students may not be attentive due to various reasons, but the notes would still be on the board so one would still have an idea of what was going on in class. The second advantage (given by the lowest score) was the fact that detailed notes would force the students to educate themselves more and hopefully make them strive for a better grade. This advantage thus promotes an increase in the amount of self-efficacy in the students.

The male student (highest score) described advantages of cooperative learning instruction by including his friends and peers in his responses. He enjoyed discussing and sharing information with his classmates and gained trust with them in the process. He also liked the idea of the students creating the rubric and categories for evaluating the presentations instead a rubric and categories created by the teacher.

The female student (lowest score) described personal advantages of cooperative learning instruction. First of all, cooperative learning enhanced her public speaking skills by allowing her to be more open minded in conversation as well as providing her with more creativity in her sentences while speaking. Secondly, she mentioned that cooperative learning provided the opportunity for students to present the subject matter in their own terminology and use their own examples to explain the concepts, allowing for the information to be at the "student level" so that all students could possibly understand and even enhance their learning. This same remark about students being on the "same level" of thinking with each other and teachers teaching on "a higher level" than what they could comprehend was given by the female in the control group (lowest score) when she explained the disadvantages of traditional teaching instruction.

All of these comments again confirmed Lord's studies[5] of positive reasons for using cooperative learning in biology teaching. The positive comments given by the students in the cooperative learning class supported the flexible cooperative technique of *Co-op Co-op*, as described by Kagan.[6] The use of teams increased student learning and sharing of resources and ideas, as described by the students in the treatment group. Learning and cooperating are the goals of *Co-op Co-op*, and the students explained that these did occur by the students all teaching on "the same level".

Disadvantages Of Classroom Instruction

One female (highest score) once again said there were no disadvantages unless students fall asleep in class and they don't get the notes. She did not suffer any type of personal loss with traditional instruction; it was her favorite type of learning. On the other hand, the other female (lowest score) made the comment that the students do not get to be educated from other class members. She said that some teachers in her classes do not bring the information down to the student's level and some teachers do. One personal loss she had about students educating each other was the fact that whether or not students would give each other the correct information. These students were used to traditional teaching instruction of rote memorization and therefore are comfortable with a low amount of learning goal persistence and challenge.

Both students in the treatment group answered this question with the same disadvantages in mind: whether or not the presentations contained accurate information and the fact that some students were not prepared and did not even understand the material that they were presenting. The one female student (lowest score) disliked the fact that the groups were chosen among the students. To correct any false information

given to her by the students presenting, she suggested that the instructor teach the subject matter first and then have the groups of students teach the information to the rest of the class. She would feel more comfortable getting a "double dose" of the same information, thus allowing for the use of a variety of teaching methods, some lecture on the teacher's part and some cooperative learning on the student's part. The responses of these students supported work by Collins, Langer & Beneventi, and Hill, as cited in Lord[5], that indicated cooperative learning is too time-consuming, too diffuse in responsibility, and too informal to bring about high level learning of complicated material that older students need to know. This explained why they needed a "double dose" of the same information.

Feelings About Cooperative Learning

Both females showed no real interest or positive feelings toward the idea of cooperative learning. Students knew each other pretty well within their grade level as to the attitude and amount of effort to do well and achieve in all their classes. Both females felt insecure and uncomfortable with the idea of certain students not giving correct information to them and therefore possibly confusing them even more. They knew they cannot possibly understand or comprehend the information and concepts if the students presenting do not even understand the information. If the students knew the information well, then there may be more of an interest in the minds of these two females to want to try cooperative learning in the classroom.

Self-Efficacy: Personal Ability To Achieve

Both students in the treatment group and one student in the control group (highest score) responded to learning biology with a high degree of self-efficacy. One female in

the control group (highest score) will put more effort into learning something she truly enjoys as well as put an increased amount of effort into something she least enjoys in order to keep her grades up. The male student in the treatment group (highest score) has a high ability to achieve because he has future plans to attend college and take additional science classes at college. The female student in the treatment group (lowest score) said her personal ability to achieve is totally self-driven and that there is no excuse for anyone getting bad grades if the students would just do the homework and reread the chapter. The remaining student in the control group (lowest score) has some self-efficacy, but knows that she could put more effort into her personal ability to achieve and succeed.

Overall, the students had a high amount of self-efficacy, the personal ability to achieve, which depends on the students' own efforts. They want to keep their grades above average; therefore, their amount of self-efficacy highly influences their motivation to keep their grades up. This supports the work of Bandura, as cited in Nichols.[22] The amount of self-efficacy students possess depended on the task at hand. For instance, the students had very low self-efficacy in Geometry class and Biology class third trimester due to the presentation of content and the degree of problem-solving. But when asked directly about their personal ability to achieve, they all responded with a high degree of self-efficacy based on the examples that they gave.

Motivational Aspects Of Learning Content

One student in each group enjoyed learning biology for intrinsic reasons of the subject matter itself. The female in the control group (highest score) enjoyed the dissections of the organisms and found life science information quite interesting. The female in the treatment group (lowest score) found most of the chapters interesting

(especially on the topics of genetics) and enjoyed the labs involving the use of microscopes.

The other two students, also one from each group, enjoyed learning biology for extrinsic reasons for the external rewards it brings. The female in the control group (lowest score) forced herself to learn the content as best she can because of the fact her classmates and friends get good grades and she wanted to keep up with them and keep her GPA high. She also mentioned that she really has very little interest in biology or any health-related field but her brother, now in college, told her to take these classes in high school. The male in the treatment group (highest score) was only motivated to learn biology because of the fact he may have to take it again in college and some of the subject matter may be useful to him in the "real world" after high school.

Least Enjoyment In Learning Biology

Each student with the highest score in each group had nothing negative to say. They enjoyed learning biology for their own reasons that were mentioned above. But, each student with the lowest score in each group, gave similar responses to what they least enjoyed about learning biology- the topics about plants and photosynthesis. One female in the treatment group (lowest score) added the fact that a teacher's personality and enthusiasm also contributes to the student's enjoyment in learning the subject matter as well. The students found the topics of plants and photosynthesis the least interesting and therefore developed a low motivation to learn the material. Many difficult concepts and biochemical pathways are found in these topics, so therefore the students may have developed a low learning goal orientation on these topics in biology. These findings were supported by Dweck's theory[23, 24] that students who adopted a goal for learning for

its own sake are more inclined to value a learning task. Personality and enthusiasm of the teacher on the topic or task at hand were important motivational factors for the students by providing more enjoyment, success, and motivation in the classroom.

Descriptive Information

Memorable Experience In Enjoying Life Science

Only one female (control group, highest score) had an interest in animals and life science as a little girl attending zoos and animal parks. The remaining three students did not really have any memorable experiences during their childhood. They all were introduced to life science topics at the junior high grade level and again their sophomore year. This lack of learning about life science during their younger years in school could explain why there is a combination of intrinsic and extrinsic motivation factors in enjoying biology and why they so heavily rely on detailed notes and explicit explanation of the notes to comprehend the material. The lack or very little of memorable experiences of life science may have had an effect on their lack of intrinsic motivation in biology. They did not have the majority of the fundamental principles of life science taught to them in their childhood years. The students' reliance on detailed notes may be an indication of low self-efficacy in their success to think and interpret the concepts of life science on their own. These findings also were supported by Dweck's theory[23, 24] that students who adopted a goal for learning for its own sake are more inclined to value a learning task. This would also contribute to a sense of fear for challenges assigned in the classroom and for the presence of new, more complicated content when they were not even exposed to the basic fundamentals of life science.

Teaching Methods Used In Memorable Experience

Two of the four students gave positive comments about the teaching methods used in their memorable experiences. One female (control group, highest score) liked how both teachers used hands-on activities with traditional learning. One male (treatment group, highest score) enjoyed how the teacher broke the information down "piece by piece" so the students could understand it. One female student (treatment group, lowest score) had negative feelings about her memorable experience in junior high at a private school. She said it was more of a teacher-based class because the teacher did everything for them, including providing the answers to their questions as well as giving open book tests. Students in his class were not even allowed to work with their peers except for dissecting. She thought this class was really stupid and did not learn from this junior high experience. No challenges for the students existed in this class. Since no effort was needed in this class, she felt no intrinsic valuing of the class. This supports the studies showing a positive relationship between self-efficacy and the students' views of the intrinsic task value.[8, 24, 26] The classroom environment of this junior high class provided no motivation or opportunity for the students to interact and learn amongst themselves. The students were therefore passive learners in a traditional classroom.

Challenging Topics

Personal Effort In Reviewing

The following categories provide responses that determine the goal orientation as well as the degree of self-efficacy of the students. In regards to personal effort in reviewing a challenging topic, all four students would challenge the topic by reviewing

the information again or even researching more about the topic to try to understand it first before asking their friends or the teacher. This demonstrates a high amount of self-efficacy as well as a high amount of learning goal characteristics in the students to persist under adversity and seek challenges on their own.

Challenging Lab Exercises Or Problems

When challenging lab exercises or problems arise, three out of the four students would ask their lab partners/peers first and then ask the teacher. These three students did not even mention the fact that they would try to work it out individually. This was quite opposite the responses mentioned above when reviewing a challenging topic. When challenging lab exercises or problems, these students now have low self-efficacy in their personal ability to solve the exercise or problem and also show performance goal characteristics by wanting to shy away from challenges. Only one student (treatment group, highest score) would try to make sense of the problem and break it down on his own to comprehend it before asking his friends and the teacher. Self-efficacy is therefore context dependent. It depends on the degree of difficulty on the task at hand. The students found reviewing a challenging topic easier to handle than attacking a challenging lab exercise or problem. It was much easier for them to reread a section in the text or research the topic than trying to manipulate a problem step-by-step where the answer cannot just be looked up. The students believed that the lab exercises or problems were beyond their capability, so therefore they avoided the activity by asking peers and friends to provide the answer for them. This supported the work by Bandura, as cited in Nichols.[22]

Aspects To Change The Way Biology Is Taught

Teaching Methods

If the students had the opportunity to change the way biology is taught, all four students responded with one key theme in mind - a biology class with a variety of teaching methods and hands-on activities. One student (control group, highest score) was comfortable with the traditional methods of group work, experiments, and detailed notes with an explanation of the notes. Another female (control group, lowest score) wanted to change the way her new biology teacher put notes on the board. She wanted more detailed notes from him and wanted him to spend more time on the chapters. She felt rushed in learning the information. She also felt student involvement was important and thought a variety of teaching methods would get the students more interested. But, in her opinion, a class of mostly cooperative learning would be a disadvantage because there would be less focus on the topics, too much "down time" of not being on the topic, and also concern of whether the students know the information or not. The response of this student supported work by Collins, Langer & Beneventi, and Hill, as cited in Lord[5], that indicated cooperative learning is too time-consuming, too diffuse in responsibility, and too informal to bring about high level learning of complicated material that older students need to know. One male student (treatment group, highest score) also wanted to change the way his new biology teacher puts notes on the board of just providing general, basic information without breaking the information down. Another female (treatment group, lowest score) also felt student involvement was important involving a combination of teaching methods. She believed the perfect combination was a mixture of the teacher teaching the material followed by the students re-teaching the same material. She

prefered the teachers choosing the groups to provide heterogeneous groups of students based on grades and abilities.

How Feelings And Attitudes Are Affected By Changes In Learning Biology

Two of the students, the highest scoring of each of the two groups, did not have a change in feelings and attitudes by the changes in learning biology. The female in the control group (highest score) was not overwhelmed nor stressed with traditional teaching instruction. This did not support the studies of traditional, competitive classrooms creating tension, self-doubt, and anxiety in students.[4, 5] She felt confident and assured that the information is always correct and accurate when the teacher is providing the information and not the students. With a variety of teaching methods, the female in the control group (lowest score) believed everyone will understand it better, increase their achievement, and thus earn better grades. The students develop a higher amount of self-efficacy in classrooms using a variety of teaching methods. The higher amount of self-efficacy, the greater the motivational rewards in the class and the greater the effort and persistence at a difficult task in class. These relationships found in a classroom involving a variety of teaching methods supported the work of Bandura[22, 26], Meece et al.,[8] and Miller et al.[24] The female in the treatment group (lowest score) believed the combination of traditional instruction followed by cooperative learning instruction will provide more "fun". A "fun" class seemed to be more important to her than comprehension of the material.

Additional Science Courses

All four students want to take additional science classes their junior and senior year of high school. One student (control group, highest score) wishes to take Vertebrate Zoology and hopes that it will be taught with traditional methods, experiments, and some group work. The other female in the control group (lowest score) wishes to take Biology II not for personal reasons, but only because her brother told her to take for future reference. She hopes Biology II will involve more review, detailed notes, and involve both lecture-based instruction as well as student-centered instruction. The male student (treatment group, highest score) wishes to take Chemistry and Biology II, only because he thinks it is important to prepare him for college. He also hopes for group activities and some cooperative learning, since all lecture classes to him are too difficult and not important. The female student (lowest score) wishes to take Genetics and Chemistry her junior and senior year. She enjoys genetics but her mother told her that chemistry was fun. She hopes both classes will mostly be traditional teaching but does want some student involvement. Although the dependency on traditional teaching and note-taking will always be present in the students, the students will develop a higher amount of self-efficacy in these additional classes using a variety of teaching methods. The higher amount of self-efficacy, the greater the motivational rewards in the class and the greater the effort and persistence at a difficult task in class. These relationships found in a classroom involving a variety of teaching methods supported the work of Bandura[22, 26], Meece et al.,[8] and Miller et al.[24]

Decision To Want These Classes Challenging

All four students want these additional classes to be a little challenging in both the topics covered and the problem-solving exercises, but not overwhelming to the point where it would be stressful and incomprehensible. This challenge would have them put more effort into the class and possibly better themselves as students. If the classes were too easy or "dumbed-down", they would not be of much interest to the students and therefore they would not try as hard to do well. Once students overcome the challenges that they encounter, they feel better about themselves and therefore will be more learning goal oriented, have a higher degree of intrinsic motivation, and have a higher degree of self-efficacy.

The Most Important Challenge With Respect To Learning Biology

All four students responded differently as to their most important challenge with respect to learning biology. Complex terminology was the most important challenge in learning biology for a female in the control group (highest score). She overcame this challenge by making sure the teacher explained the complex terminology and in doing so broke the information down in simpler steps. She felt that if she took all the information in at one time, she would get too overwhelmed and stress out. For the other female in the control group (lowest score), the most important challenge was the lack of time to study to get a good grade. She knew she was partly at fault because she was a procrastinator. She realized she needed to change her study habits to increase her studying time for science classes. The male student in the treatment group (highest score) considered the theories of life since the beginning of time to be the biggest challenge in learning biology. He felt he can overcome this challenge by continuing to do research and studying more

about the past. The female student in the treatment group (lowest score) considered the personality and teacher presentation of the material the biggest challenges in learning biology. To overcome these challenges she asked her friends to explain the information to her and her friends provided her with study sheets and they taught each other. This allowed her to get different viewpoints by asking friends for assistance.

All students felt they could overcome these challenges by increasing their self-efficacy. These students believed they have the capability to resolve their challenges; therefore, they will perform the activities required to overcome their challenges. These actions support the work of Bandura, as cited in Nichols.[22] Bandura stated that self-efficacy for a task and experiencing intrinsic rewards for the task have a positive relationship.[26] Since the students felt they could eventually overcome their challenges in learning biology, they increased their intrinsic liking of the subject matter to take additional science courses. The students were interested to acquire new skills and knowledge, to continue to persist when failures occur, and to accept challenges with persistence by wanting the additional science classes to include a variety of teaching methods as well as wanting the courses to be somewhat challenging.

The information provided by these students during the interviews indicated that, in actuality, the students were less goal oriented, less intrinsically motivated in valuing the subject matter, and displayed lower self-efficacy in their life science classes than the information they provided in the surveys of the quantitative part of this study. The amounts or degrees of these affective dimensions of learning science (goal orientation, motivation, and self-efficacy) the students had were independent of the type of learning instruction (traditional lecture versus cooperative learning).

This study suggests that cooperative group learning does not have a significant impact on the affective dimensions of learning goal orientation, motivation, and self-efficacy of learning biology. Analysis of both the quantitative data and the qualitative data showed differences in the data among the three variables of interest for both the traditional classroom instruction and the cooperative learning instruction.

Learning occurs as an active process requiring intentional effort. Motivation is relevant and essential to learning; therefore students need to be motivated to engage in learning activities. Slavin[10] claimed that one factor influencing success of cooperative group learning is the positive motivational impact of student support for learning. Although cooperative learning instruction did not raise motivational variable scores more than the traditional learning instruction, cooperative learning instruction was just as successful in this study as the traditional learning instruction. These sophomores were embedded with traditional methods throughout the school years with the teachers providing them with notes along with the explanation of notes. The students have negative attitudes about their peers presenting the correct information and seem very resistant to change. Cooperative learning instruction allows students to become interdependent on one another in small groups to accomplish specific learning objectives for the entire class. Students teaching each other did provide some comprehension on a "student level" rather than a higher "teacher level", but this did not lead to an increase in achievement and confidence in the material being presented. All four students both in the control group and the cooperative learning group showed similar degrees of high learning goals, which can result in greater persistence toward challenging tasks.

Self-efficacy has also been related to persistence toward difficult tasks, as stated by Bandura.[9] The greater the amount of self-efficacy, the greater the effort and determination should be, thus contributing to better grades. Studies[23] also indicate that learning goals and self-efficacy are very much related to the intrinsic valuing of the subject matter, but the relationship among these variables was not impacted by the cooperative learning instruction nor the traditional learning instruction.

Cooperative group instruction allowed students to verbally express and share their thoughts and ideas about the topics at hand, and also add to the variety of teaching methods to motivate the students and allow them to become active members in the learning process.

In agreement with Kagan[4], the high school experience of implementing *Co-op Co-op* was not uniformly positive as it was in the university studies. Different problems exist at the high school level versus the university level. There was a high amount of absenteeism in the classes as well as the fact that the students were turned off by the idea of students presenting possibly incorrect information to each other. The success of this type of instruction is largely determined by the creativity, commitment, and flexibility of the teacher.

IMPLICATIONS FOR PRACTICE

The findings of this study have important implications for the science classroom teacher and the methods of instructional techniques. Public education strives to provide an environment that is favorable to learning. The more intrinsic motivation students have for learning, the more likely they will be successful in the classroom. This can be

achieved in a classroom that provides a variety of teaching methods as well as an intrinsically motivated teacher who enjoys the subject matter that he/she is teaching.

There is no single instructional approach or cooperative learning approach that can be used to teach all students effectively and efficiently. Every teaching method has its purpose. A variety of lecture, group work, experiments/labs, and student projects and presentations make the students comfortable and motivated, as well as provide different techniques so all students, each with his/her own learning style, can learn effectively.

More teacher training time should be devoted to studying student interactions and structuring effective student-student interaction patterns so they will have a positive impact on student learning. This will hopefully enhance and build inter-relationships among the students, the teacher, and the entire school system.

This study investigated the use of one type of cooperative learning instruction, *Co-op Co-op*, on students in a high school biology class. No formal evaluation at the high school level has previously been conducted on this type of instruction. The results of this project did not support previous students of the positive effects cooperative learning has on motivational variables and student learning. Therefore, many new questions and further research of high school biology classes using *Co-op Co-op* should be evaluated and implemented.

CONCLUSIONS

1. No significant difference existed in learning goal orientation at each time period between the traditional learning group and the cooperative learning group.

2. No significant difference existed in the amount of intrinsic motivation toward the learning task at each time period between the traditional learning group and the cooperative learning group.

3. No significant difference existed in the degree of self-efficacy at each time period between the traditional learning group and the cooperative learning group.

SUGGESTIONS FOR FUTURE RESEARCH

Suggestions for future research include:

1) an analysis of the gender differences with regard to the impact of cooperative learning upon the affective dimensions of learning science. If there are at least one control group and one treatment group, is it possible to see a significant difference in scores between the genders of the variables of interest during different phases of the project? Pretest and posttest analyses would have to be conducted to determine differences and to make sure instruments used are consistent and reliable.

2) an analysis of the time frame it takes for the effects of cooperative learning instruction to change, whether it be positive effects or negative effects. This study could therefore be extended throughout the school year or through the next semester or trimester, if the same students are present. These effects or results could be stable throughout the years or the results could be due to the timing during the school year.

3) an analysis of the motivational variables of the teacher (i.e. learning goals, intrinsic/extrinsic motivation, and self-efficacy) during traditional learning instruction

versus cooperative learning instruction. These results could then be compared with the results of the students as well.

4) an analysis of the social interactions of the students during the cooperative learning instruction versus group work instruction in a traditional class. These social interactions could lead to positive peer relations such as trust and confidence in their peers, or they could lead to negative peer relations such as fighting, not being open-minded, and being selfish and not willing to work with others.

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Appendix A

List Of Biology Chapters (Topics) Covered During Project

List Of Biology Chapters (Topics) Covered During Project

Chapter Four: BIOCHEMISTRY

Chapter Five: STRUCTURE AND FUNCTION OF CELLS

Chapter Six: DIFFUSION AND ACTIVE TRANSPORT

Chapter Seven: PHOTOSYNTHESIS AND CELLULAR RESPIRATION

Chapter Eight: NUCLEIC ACIDS AND PROTEIN SYNTHESIS

Chapter Nine: CHROMOSOME STRUCTURE, MITOSIS, AND MEIOSIS

Chapter Ten: FUNDAMENTALS OF GENETICS

Chapter Eleven: STUDYING HUMAN GENETICS

Chapter Eighteen: CLASSIFICATION OF ORGANISMS

Appendix B

Survey On Learning Biology

SURVEY ON LEARNING BIOLOGY

Directions-Part 1: The following statements represent reasons that students might have for doing school work. Read each statement and indicate whether you agree that it is one of your reasons for doing the work in this class. Use the 5-point scale below and circle your response on the line following the item.

Strongly Disagree = 1 Disagree = 2 Undecided = 3 Agree = 4 Strongly Agree = 5

1. I do the work assigned in this class because I like to score higher than other students. 1 2 3 4 5

2. I do the work assigned in this class because I like to understand really complicated ideas. 1 2 3 4 5

3. I do the work assigned in this class because I want to look smart to my friends. 1 2 3 4 5

4. I do the work assigned in this class because I don't want to look foolish or stupid to my friends, family or teachers. 1 2 3 4 5

5. I do the work assigned in this class because I like to work hard to solve challenging problems. 1 2 3 4 5

6. I do the work assigned in this class because I can show people that I am smart. 1 2 3 4 5

7. I do the work assigned in this class because I like learning interesting things. 1 2 3 4 5

8. I do the work assigned in this class because I don't want others to think I'm not smart. 1 2 3 4 5

9. I do the work assigned in this class because I don't want to be embarrassed about not being able to do the work. 1 2 3 4 5

Strongly Disagree = 1 Disagree = 2 Undecided = 3 Agree = 4 Strongly Agree = 5

10. I do the work assigned in this class because I like to understand the material I study. 1 2 3 4 5

11. I do the work assigned in this class because I like to do better than other students. 1 2 3 4 5

12. I do the work assigned in this class because I don't want to be the only one who cannot do the work well. 1 2 3 4 5

Directions-Part 2: The following questions ask about how you view the material taught in this class and your beliefs about your ability in this area. Respond to the statements along the following 5-point scale. Circle your response on the line following the item.

Strongly Disagree = 1 Disagree = 2 Undecided = 3 Agree = 4 Strongly Agree = 5

13. I enjoy the challenge of learning biology. 1 2 3 4 5

14. I plan on taking science classes after this one. 1 2 3 4 5

15. I am confident about my ability to do biological (scientific) problem-solving in this class. 1 2 3 4 5

16. I find learning biology interesting. 1 2 3 4 5

17. I am certain I can understand the biological concepts presented in this class. 1 2 3 4 5

18. Being knowledgeable about biology will be of little value to me in the future. 1 2 3 4 5

19. I find working with biology enjoyable. 1 2 3 4 5

Strongly Disagree = 1 Disagree = 2 Undecided = 3 Agree = 4 Strongly Agree = 5

20. I think I am doing better than other students in this class.	1 2 3 4 5
21. I find working with other students in my biology class beneficial to my learning.	1 2 3 4 5
22. I am interested in learning more science in the future.	1 2 3 4 5
23. I am confident I have the ability to understand the ideas taught in this course.	1 2 3 4 5
24. Being able to use biology will help me in the future.	1 2 3 4 5
25. I am confident I can perform as well or better than others in this class.	1 2 3 4 5
26. Learning biology has little to do with my future work.	1 2 3 4 5
27. I will need to know biology for my future work.	1 2 3 4 5
28. I plan on taking more science classes in the future even if they are not required.	1 2 3 4 5
29. Relative to others in this class, I think I am good at biology.	1 2 3 4 5
30. I think working with biology is personally satisfying.	1 2 3 4 5
31. Compared with other students in this class my biology skills are weak.	1 2 3 4 5
32. I have a good understanding of the biological concepts I've been taught.	1 2 3 4 5

33. I am confident I can help others in the class achieve their best in biology. 1 2 3 4 5

Directions-Part 3: The following items are multiple choice. Select the one answer that best represents your view and circle the letter which corresponds to that answer.

34. What grade do you <u>want</u> to get in this course?
    a. A
    b. B
    c. C
    d. D

35. How certain are you that you will achieve that grade?
    a. 100% certain I'll get it.
    b. about a 75% chance of getting it.
    c. about a 25% chance of getting it.
    d. No chance of getting it.

36. What grade is the <u>lowest acceptable grade</u> you will take in this course?
    a. A
    b. B
    c. C
    d. D

37. How certain are you that you will achieve that grade?
    a. 100% certain I'll get it.
    b. about a 75% chance of getting it.
    c. about a 50/50 chance of getting it.
    d. about a 25% chance of getting it.
    e. No chance of getting it.

38. How would you rate your effort in this class compared to your typical amount of effort for school work?
    a. Extremely high (probably as much effort as I've ever put into a class).
    b. Fairly high (more effort than usual, but I have worked harder in other classes).
    c. About average.
    d. Fairly low (less effort than usual, but I have put less effort in other classes).
    e. Extremely low (probably the least amount of effort I've ever put into a class).

Appendix C

Survey On Learning Biology Scoring Key

SURVEY ON LEARNING BIOLOGY - SCORING
38 QUESTIONS IN 3 PARTS

Recall 5-point scale used in the survey:

Strongly Disagree = 1 Disagree = 2 Undecided = 3 Agree = 4 Strongly Agree = 5

Part 1: Subscale: Learning Goal Orientation - Questions 1-12

a. Learning goals: questions #2, #5, #7, #10

b. Performance goals: questions #1, #3, #4, #6, #8, #9, #11, #12

*All performance goal questions are recode items for scoring

Note: To recode items, reverse the scale. Change all "strongly disagrees" to "strongly agrees", all "disagrees" to "agrees". Items that are "undecided" remain unchanged. Next, add together the values of the reversed responses.

Example, an item originally marked 1 for "strongly disagree" would have been reversed to 5 for "strongly agree", and therefore would be scored for 5 points.

Score Range: 12-60

Score Analysis:

a. low score range: 12-28
The student is performance goal oriented. The student avoids challenging tasks and displays low persistence when difficulties arise.

b. middle score range: 29-45
The student has a mixture of both performance and learning goal orientations. The student is unsure about seeking challenges; it may depend on the degree of difficulty of the task. He/she has somewhat low persistence when difficulties arise.

c. high score range: 46-60
The student is learning goal oriented. The student seeks challenges and persists under adversity.

Part 2: Questions 13-33: These questions assess how students view the material taught in class and students' beliefs in their ability in biology.

Subscales:

a. Intrinsic Motivation: questions #13, #16, #19, #21 (later omitted in scoring), #30

b. Extrinsic Motivation: questions #18, #24, #26, #27
* recode items #18 and #26 for scoring

c. Self-Efficacy: questions #15, #17, #20 (later omitted in scoring), #23, #25, #29, #31, #32, #33
* recode item #31 for scoring

d. Student liking of science: questions #14, #22, #28

Scoring ranges for each subscale:

a. **Intrinsic motivation:** enjoyment in learning the subject matter for his/her own sake

score range (after #21 omitted): 4-20

Student score between 4-12: low intrinsic motivation for learning biology

Student score between 13-20: high intrinsic motivation for learning biology

b. **Extrinsic motivation:** subject matter valued primarily for its utility or the external rewards it brings

score range: 4-20

Student score between 4-12: low extrinsic motivation for learning biology

Student score between 13-20: high extrinsic motivation for learning biology

c. **Self-efficacy (locus of control):** degree of academic success which depends on students' own efforts; the students' self-perception of ability; this provides the students a chance to succeed; therefore, student's efforts lead to success.

score range (after #20 omitted): 8-40

Student score between 8 – 19: low self-perception of ability to succeed

Student score between 20 – 30: mid-range; student has some self-perception of ability to succeed, but it's a weak one.

Student score between 31-40: high self-perception of ability to succeed

d. Student liking of science – (This variable was not included in study)

score range: 3-15

Student score between 3-9: Student has little or no liking of science classes and is probably not willing to take anymore science classes than required.

Student score between 10-15: Student has a strong liking of science classes and is willing to take additional science classes than required.

Part 3: Multiple choice – Student's view of achievement (not included in study)

Possible subscales: Self-efficacy: questions #35, #37
Academic performance/motivation: questions #34, #36

*Hopefully students answer primarily A's and B's for these four questions!

Total final minimum score possible: 31
Total final maximum score possible: 155

Appendix D

Co-op Co-op Information To Students

THE TEN STEPS OF *CO-OP CO-OP*:

Co-op Co-op definition: structuring the classroom so that students are cooperating within teams in order to cooperate with the whole class in order to reach a class goal. The following ten steps are suggested to produce the cooperative within- and between-team structure *of Co-op Co-op*:

1. Student-centered Class Discussion
2. Selection of Student Teams
3. Team-Building and Skill Development
4. Team-Topic Selection
5. Mini-Topic Selection
6. Mini-Topic Preparation
7. Mini-Topic Presentations
8. Preparation of Team Presentations
9. Team Presentations
10. Evaluation: a. individual mini-topic presentations to the team (by teammates)
    b. team presentations to the whole class (by classmates)
    c. individual papers or projects on mini-topics (by teacher)

Appendix E

Within Group Evaluation Form for Treatment Group
And
Team Group Evaluation Form for Treatment Group

COOPERATIVE LEARNING WITHIN GROUP EVALUATION

GROUP TOPIC/TITLE:_____
GROUP MEMBERS:_____

EVALUATE THE FOLLOWING CATEGORIES USING
A SCALE FROM 1 (POOR) TO 5 (EXCELLENT):

1. PARTICIPATION: ____
2. RESEARCHED INDIVIDUAL TOPICS: ____
3. ORGANIZATION: ____
4. COOPERATION: ____
5. RESPECT WITHIN GROUP: ____

TOTAL SCORE OF ALL 5 CATEGORIES: _____ OUT OF 25 POSSIBLE POINTS

COOPERATIVE LEARNING GROUP EVALUATION

TITLE OF PRESENTATION:_____
GROUP MEMBERS:_____

EVALUATE THE FOLLOWING CATEGORIES USING
A SCALE FROM 1 (POOR) TO 5 (EXCELLENT):

1. CREATIVITY: ____
2. CONTENT (INFORMATION-RICH): ____
3. DID INFORMATION MAKE SENSE (EASILY UNDERSTOOD)?: ____
4. ORGANIZATION: ____
5. EYE CONTACT: ____
6. SPEECH: ____
7. ATTENTIVENESS: ____

TOTAL SCORE OF ALL 7 CATEGORIES: _____ OUT OF 35 POSSIBLE POINTS

Appendix F

SPSS Codebook

SPSS CODEBOOK

Variable	SPSS variable name	Coding Instructions
Identification #	id	Number assigned to each questionnaire
group	group	1 = treatment group, 2 = control group
sex	sex	1 = male, 2 = female
Learning goal orientation scale item #1	lgo1*	Enter number circled from 1(strongly disagree) to 5 (strongly agree) *recode score
Learning goal orientation scale item #2	lgo2	Enter number circled from 1(strongly disagree) to 5 (strongly agree)
Learning goal orientation scale item #3	lgo3*	Enter number circled from 1(strongly disagree) to 5 (strongly agree) *recode score
Learning goal orientation scale item #4	lgo4*	Enter number circled from 1(strongly disagree) to 5 (strongly agree) *recode score
Learning goal orientation scale item #5	lgo5	Enter number circled from 1(strongly disagree) to 5 (strongly agree)
Learning goal orientation scale item #6	lgo6*	Enter number circled from 1(strongly disagree) to 5 (strongly agree) *recode score
Learning goal orientation scale item #7	lgo7	Enter number circled from 1(strongly disagree) to 5 (strongly agree)
Learning goal orientation scale item #8	lgo8*	Enter number circled from 1(strongly disagree) to 5 (strongly agree) *recode score
Learning goal orientation scale item #9	lgo9*	Enter number circled from 1(strongly disagree) to 5 (strongly agree) *recode score
Learning goal orientation scale item #10	lgo10	Enter number circled from 1(strongly disagree) to 5 (strongly agree)

Variable	SPSS variable name	Coding Instructions
Learning goal orientation scale item #11	lgo11*	Enter number circled from 1(strongly disagree) to 5 (strongly agree) *recode score
Learning goal orientation scale item #12	lgo12*	Enter number circled from 1(strongly disagree) to 5 (strongly agree) *recode score
Intrinsic motivation scale item #13	inmo13	Enter number circled from 1(strongly disagree) to 5 (strongly agree)
Student liking of science scale item #14	stlik14	Enter number circled from 1(strongly disagree) to 5 (strongly agree)
Self-efficacy scale item #15	sleff15	Enter number circled from 1(strongly disagree) to 5 (strongly agree)
Intrinsic motivation scale item #16	inmo16	Enter number circled from 1(strongly disagree) to 5 (strongly agree)
Self-efficacy scale item #17	sleff17	Enter number circled from 1(strongly disagree) to 5 (strongly agree)
Extrinsic motivation scale item #18	exmo18*	Enter number circled from 1(strongly disagree) to 5 (strongly agree) *recode score
Intrinsic motivation scale item #19	inmo19	Enter number circled from 1(strongly disagree) to 5 (strongly agree)
Self-efficacy scale item #20	sleff20	Enter number circled from 1(strongly disagree) to 5 (strongly agree)
Intrinsic motivation scale item #21	inmo21	Enter number circled from 1(strongly disagree) to 5 (strongly agree)
Student liking of science scale item #22	stlik22	Enter number circled from 1(strongly disagree) to 5 (strongly agree)
Self-efficacy scale item #23	sleff23	Enter number circled from 1(strongly disagree) to 5 (strongly agree)

Variable	SPSS variable name	Coding Instructions
Extrinsic motivation scale item #24	exmo24	Enter number circled from 1(strongly disagree) to 5 (strongly agree)
Self-efficacy scale item #25	sleff25	Enter number circled from 1(strongly disagree) to 5 (strongly agree)
Extrinsic motivation scale item #26	exmo26*	Enter number circled from 1(strongly disagree) to 5 (strongly agree) *recode score
Extrinsic motivation scale item #27	exmo27	Enter number circled from 1(strongly disagree) to 5 (strongly agree)
Student liking of science scale item #28	stlik28	Enter number circled from 1(strongly disagree) to 5 (strongly agree)
Self-efficacy scale item #29	sleff29	Enter number circled from 1(strongly disagree) to 5 (strongly agree)
Intrinsic motivation scale item #30	inmo30	Enter number circled from 1(strongly disagree) to 5 (strongly agree)
Self-efficacy scale item #31	sleff31*	Enter number circled from 1(strongly disagree) to 5 (strongly agree) *recode score
Self-efficacy scale item #32	sleff32	Enter number circled from 1(strongly disagree) to 5 (strongly agree)
Self-efficacy scale item #33	sleff33	Enter number circled from 1(strongly disagree) to 5 (strongly agree)
View of achievement/academic performance/motivation scale item #34	acper34	Enter number circled from 1 =A; 2=B; 3=C; 4=D
Self-efficacy scale item #35	sleff35	Enter number circled from 1=a.100% certain I'll get it.; 2 = b. About a 75% chance of getting it.; 3 = c. About a 25% chance of getting it.; 4 = d. No chance of getting it.

Variable	SPSS variable name	Coding Instructions
View of achievement/academic performance/motivation scale item #36	acper36	Enter number circled from 1 =A; 2=B; 3=C; 4=D
Self-efficacy scale item #37	sleff37	Enter number circled from 1= a. 100% certain I'll get it.; 2 = b. About a 75% chance of getting it.; 3 = c. About a 50/50 chance of getting it.; 4 = d. About a 25% chance of getting it.; 5 = e. No chance of getting it.
Self-efficacy/effort scale item #38	sleff38	Enter number circled from 1 = a. Extremely high; 2 = b. Fairly high; 3 = c. Above average; 4 = d. Fairly low; 5 = e. Extremely low
Recode learning goal orientation scale item #1	rlgo1	Reverse scale so that 1(strongly agree) to 5 (strongly disagree)
Recode learning goal orientation scale item #3	rlgo3	Reverse scale so that 1(strongly agree) to 5 (strongly disagree)
Recode learning goal orientation scale item #4	rlgo4	Reverse scale so that 1(strongly agree) to 5 (strongly disagree)
Recode learning goal orientation scale item #6	rlgo6	Reverse scale so that 1(strongly agree) to 5 (strongly disagree)
Recode learning goal orientation scale item #8	rlgo8	Reverse scale so that 1(strongly agree) to 5 (strongly disagree)
Recode learning goal orientation scale item #9	rlgo9	Reverse scale so that 1(strongly agree) to 5 (strongly disagree)
Recode learning goal orientation scale item #11	rlgo11	Reverse scale so that 1(strongly agree) to 5 (strongly disagree)
Recode learning goal orientation scale item #12	rlgo12	Reverse scale so that 1(strongly agree) to 5 (strongly disagree)

Variable	SPSS variable name	Coding Instructions
Recode extrinsic motivation scale item #18	rexmo18	Reverse scale so that 1(strongly agree) to 5 (strongly disagree)
Recode extrinsic motivation scale item #26	rexmo26	Reverse scale so that 1(strongly agree) to 5 (strongly disagree)
Recode self-efficacy scale item #31	rslef31	Reverse scale so that 1(strongly agree) to 5 (strongly disagree)
Total learning goal orientation score	totlgo	lgo2 + lgo5 + lgo7 + lgo10
Total performance goal orientation score	totpergo	rlgo1 + rlgo3 + rlgo4 + rlgo6 + rlgo8 + rlgo9 + rlgo11 + rlgo12
Total intrinsic motivation score**	totinmo	inmo13 + inmo16 + inmo19 + inmm30
Total extrinsic motivation score	totexmo	rexmo18 + exmo24 + rexmo26 + exmo27
Total self-efficacy score***	totslef	sleff15 + sleff17 + sleff23 + sleff25 + sleff29 + rslef31 + sleff32 + sleff33
Total student liking of science score	tstlik	stlik14 + stlik22 + stlik28
Total score on survey	total	totlgo + totpergo + totinmo + totexmo + totslef + tstlik

**** Item #21 has been omitted from the total intrinsic motivation score**
***** Item #20 has been omitted from the total self-efficacy score**

Note: For all SPSS variable names except *id*, *sex*, and *group*, the letters *a*, *b*, and *c* have been added to the end of these variable names to represent 2 week, 6 week, and 12 week scores, respectively.

Appendix G

Interview Guide

INTERVIEW GUIDE

* Introduction
    1. Introduce myself and state purpose, context, and intended use of interview
    2. Assure confidentiality
    3. Ask for questions

* Descriptive information [to check] – Interview Questions

    1. What current classes are you taking?
    2. How are you doing in these classes?
    3. Which classes do you enjoy taking?
        a. Why do you like these classes?
        b. What types/kinds of teaching methods do the teachers use in these classes that you enjoy so much?
    4. Which classes do you not enjoy taking?
        a. Why do you dislike these classes?
        b. What types/kinds of teaching methods do the teachers use in these classes that you do not enjoy so much?
    5. What is your current GPA?
    6. Is this GPA self-driven or are you pressured to achieve a certain GPA by friends or family? Explain.

* Personal Experiences (specific in Biology)

I would like to shift gears now and spend some time talking about your personal experiences as a student in my Biology class from last trimester.

<u>For the treatment group only: cooperative learning approach</u>

7. What did you enjoy, if anything, about the cooperative learning projects and techniques in my biology class last trimester?
    a. Can you think of any specific examples?

8. What did you least enjoy, if anything, about the cooperative learning projects and techniques in my biology class last trimester?
    a. Can you think of any specific examples?

9. As a student, what do you feel are the advantages of cooperative learning in the classroom?
    a. What advantages, if any, did you gain by this type of learning?

10. As a student, what do you feel are the disadvantages of cooperative learning in the classroom?
    a. What disadvantages, if any, did you encounter by this type of learning?

For the control group only: traditional learning approach

7. What did you enjoy, if anything, about the traditional learning assignments in my biology class last trimester?
    a. Can you think of any specific examples?

8. What did you least enjoy, if anything, about the traditional learning assignments in my biology class last trimester?
    a. Can you think of any specific examples?

9. As a student, what do you feel are the advantages of traditional classroom instruction?
    a. What advantages, if any, did you gain by this type of learning?

10. As a student, what do you feel are the disadvantages of traditional classroom instruction?
    a. What disadvantages, if any, did you encounter by this type of learning?

The remaining questions are for both groups of students

11. How much of your academic success from biology do you feel comes from your own effort or ability? (How do you feel about your ability to achieve in biology?)

12. What factors, if any, motivate you to learn biology?

13. Do you enjoy learning biology?
    Why or why not?

14. Can you give me specific classroom experiences that led you to your response from the last question?
    a. What grade level was this experience? (When did this occur?)
    b. Who was your teacher?
    c. How did this teacher teach you? (What teaching methods did this teacher use to teach life science?)

15. Can you describe for me how you would handle a challenging topic in biology?

16. Can you describe for me how you would handle a lab exercise or problem that you found to be difficult or challenging?

17. If you could change the way biology is taught, what aspects would you change?
    a. Why did you choose these aspects?
    b. How would these changes affect your feelings and attitudes about learning biology?

18. As a sophomore, would you be interested in taking additional science courses?
    a. Which ones?
    b. Why did you choose these courses?
    c. How would you want them to be taught? Please describe.
    d. Would you want these courses to be challenging?
       Why or why not? Explain.

19. For you, what's the most important challenge with respect to learning biology?
    a. Could you please elaborate on your response?

20. How do you feel you can overcome this challenge? Please explain.

21. Is there anything else you would like to comment about or add to this interview?

* Summary/Member check
* Wrap-up and Thank you. Recontact?

Appendix H

Sample Interview

INTERVIEW WITH D.V.

CONTROL GROUP
HIGHEST SCORE ON SURVEY
DATE: 4/27/04

L: Good Evening, D.

V: Good Evening, Mrs. L.

L: As you know, the purpose of this interview is to get your attitudes, beliefs, and opinions about your biology class last trimester. I assure you that this interview is a confidential one between you and me, so only your responses will be used in my research. Are you OK with this?

V: Yes.

L: Good. Do you have any questions?

V: No.

L: What current classes are you taking?

V: Biology I, Modular Technology II, Geometry, and Connections, and Health.

L: How are you doing in these classes?

V: I got in an "A" in all of them, except for a "B" in Geometry.

L: Why do you have a "B" in Geometry?

V: Cause it's one of my harder subjects and it's a little more difficult to learn than the other classes.

L: Why, because it's mathematical based?

V: No. It's a little more less enjoyable. It's just not…

L: Because of the content or because of the way it's taught?

V: Um. A little bit of both.

L: Could you elaborate on that? (She laughs.)

V: I guess because my teacher is a little monotonic and I'm not…Math isn't one of my favorite subjects. I'd rather do Algebra than Geometry. But…

L: Which classes do you enjoy taking?

V: Biology and like Art classes that let me show my creativity, even though I'm not taking them this year.

L: And why do you like these classes?

V: Biology because you get to learn the different anatomies of things and a scientific health class and art because I like being creative in different things.

L: You don't feel like you're being creative in biology class?

V: Kind of. But it's kind of hard to put your creativeness into like dissecting an animal.

L: What types/kinds of teaching methods do the teachers use in these classes that you enjoy so much?

V: Mostly like traditional teaching. Like putting notes on the board and then showing us how to do the problems or how to learn the different things.

L: So, you are a visual learner. You like to have the information, the notes, in front of you to copy down in a notebook.

V: I like learning visually but I also like when like teachers explain it too because then they might describe it in a different way then it's on the board, a little more in detail or something

L: Or even in the textbook?

V: Yes. (She nods her head)

L: What about Art or any of the other classes this trimester that you enjoy? How are the teaching methods in those classes?

V: The rest of the ones this tri are mostly traditional teaching. But for like Art, you got to, he would tell you the assignment and then you'd put in your own terms and take it to a different, like use your creativity to interpret it the way you want to.

L: Which classes do you not enjoy taking?

V: Modular Technology… I enjoy his class but I don't like when we have to get working with partners and then your partner doesn't want to help you.

[interruption: knock on door]

L: Come in.

L: To continue...You do not like Modular Technology. Are there any other classes? I know you mentioned before you didn't care too much for Geometry.

V: Um, I really don't dislike any other classes because I like learning Geometry and I like math, it's just it's not what you call "fun" to learn. It's just something you are kind of required to learn.

L: Because of the way it is presented by the teacher?

V: Yeh.

L: What is your current GPA?

V: 3.9

L: Is this GPA self-driven or are you pressured to achieve a certain GPA by friends or family?

V: It's self-driven because I like seeing when I get "A"s and "B"s on my report card. Even though I always strive for straight "A"s, usually a "B" pops in somehow.

L: So you are not under any pressure by parents or by a certain college or university, or even any outside factors?

V: Not really. But I do know like when I want to go to a university or college. I want to get in to one of the schools that has a low student to teacher ratio and those ones you usually have to have the higher scores and the higher GPAs to get in, so, I know if I want to get what I want, I have to work for it. So, it's, what is it, self-achieved? Yeh.

L: I would like to shift gears now and spend some time talking about your personal experiences as a student in my Biology class from last trimester.

L: What did you enjoy, if anything, about the traditional learning assignments in my biology class last trimester?

V: Like the way you would give the notes on the board and explain the notes to us for one of the sections in the chapter and then make us do that section before we moved on to the next one and made sure everybody understood it. Unlike the teacher I have now that goes over all the notes at once and then says do the sections and goes from there...doesn't really elaborate on certain stuff.

L: Can you think of any specific examples, chapters, or topics?

V: Um. Like when we were learning the stuff with the monosaccharides and the disaccharides in Chapter four and trying to match up like what fatty acids was and what proteins were and trying to match up the groups and what different things were in each group and to learn the different aspects of the health of a human and animals and that kind of thing.

L: O.K. What did you least enjoy, if anything, about the traditional learning assignments in my biology class last trimester?

V: I enjoyed pretty much everything 'cause I like the way traditional learning is with putting the notes on the board and then the teacher explains them compared to saying just read the book and learn yourself 'cause I can understand through reading the notes on the board and then the teacher can give an example or something that will maybe make you understand it more.

L: As a student, what do you feel are the advantages of traditional classroom instruction?

V: Maybe, like some people I know, don't listen to what the teacher has to say because they dislike the teacher or something else. You can read the notes on the board and kind of have an idea what the teacher is saying, but maybe just not to the exact detail…you might miss some details, but you still have an idea of what's going on in class if you have the notes.

L: Your response would probably be related to the next question. What advantages, if any, did you gain by this type of learning?

V: Um. If you were listening to the teacher and you kind of didn't get all of the notes for the next day, the teacher would have some of them still on the board if you missed any from the day before, you could copy them down the next day at the beginning of class and it wouldn't be any disruption or a problem in class.

L: As a student, what do you feel are the disadvantages of traditional classroom instruction?

V: There really don't seem to be any unless you're one of those people that kind of falls asleep during class, but there's really no disadvantages to it if you pay attention in class.

L: What disadvantages, if any, did you encounter by this type of learning?

V: Actually, none, because I like this kind of learning. It's like my favorite type of learning.

L: So you would rather like and be in a room with traditional teaching with the teacher talking about the information and providing notes rather than students getting into groups teaching other students the information?

V: Like students teaching students? I wouldn't like that because knowing the students that are teaching, some of them you don't know if they're giving the exact, correct information and with the teacher teaching the subject, you know that he/she specialized in that subject and they know all the things about that subject unlike a student that could have possibly just wrote stuff down, not even knowing what was what.

L: O.K. How much of your academic success from biology do you feel comes from your own effort or ability? In other words, how do you feel about your ability to achieve in biology?

V: I feel pretty good because it's like when I enjoy learning something, I'll put more effort into it and it'll make me enjoy it more. But usually when I dislike learning something, you want to put less effort into it, but you still force yourself to put more into it so you can still keep your grades up and that kind of thing.

L: What factors, if any, motivate you to learn biology?

V: The dissections of different animals and learning things you probably wouldn't have learned otherwise in different classes if you would have took something else instead of biology, like you wouldn't learn how to dissect a frog usually in environmental science.

(She laughs.)

L: So you like learning about all the organisms around you as well as dissecting various organisms.

V: Yeh.

L: Do you enjoy learning biology? Why or why not?

V: Yes, because it's very interesting and there's many different aspects of it that you can learn and you can really never be bored kind of with it.

L: Can you give me specific classroom experiences that led you to your response from the last question?

[pause]

L: When did you first enjoy learning life science?

V: Um. I had an interest in animals since I was a little kid and now getting to learn about them more and more in depth and learning how they have certain behaviors makes you understand them more than you thought you did.

L: What grade level was your first experience in enjoying biology or any type of life science?

V: Um. Kind of between, a little bit of eighth grade, but more so tenth.

L: And who was your teacher?

V: Mr. R. and Mrs. L.

L: How did these teachers teach you? In other words, what teaching methods did these teachers use to teach life science?

V: Both teachers used hands-on stuff and traditional learning too. They kind of combined the two.

L: Can you describe for me how you would handle a challenging topic in biology?

V: Um. By first going over it by myself trying to understand it and then I would ask the teacher for help.

L: Would you ask other peers, friends?

V: Yeh, but I would try if I didn't understand it from them, though; I would still go to the teachers to get to try to get a better explanation.

L: Can you describe for me how you would handle a lab exercise or problem that you found to be difficult or challenging?

V: I would ask the members of my group first that were working with me on that assignment, and if they couldn't make me understand it then I'd go to the teacher who assigned us the lab and have he/she explain it.

L: If you could change the way biology is taught, what aspects would you change?

V: I really wouldn't change any. Just stick with the traditional methods.

L: Why did you choose that aspect?

V: Because it's easier for me to learn that way and even for people that don't like a class, you could learn stuff in that class through the traditional method by taking the notes and stuff and at least get through the class that way, instead of it being miserable.

L: Do you think that students would be just as motivated being in a traditional classroom where say, your note taking for one hour or two hours vs. more hands-on or a variety of teaching methods, where, let's say, there's some group work, teamwork, team teaching going on?

V: Um, when I say traditional method I kind of look at it with you have some group work in there and experiments, and different hands-on stuff, but you still have the half hour to an hour of notes and the teacher talking too and explaining things.

L: How would these changes affect your feelings and attitudes about learning biology?

V: Instead of it being overwhelming you could understand it better and not get stressed out with it.

L: So, traditional teaching would decrease your stress?

V: It's a little easier on the person than like kids teaching kids because then you don't know. With the teacher you're assured that it's the right information, unlike with kids teaching kids, you have to, you kind of stress out more 'cause you're trying to figure out if it is the right information.

L: As a sophomore, would you be interested in taking additional science courses?

V: Yeh.

L: Which ones?

V: Um. The only one I really been thinking of other than Biology II for next year it would be vertebrate zoology.

L: Why did you choose these courses?

V: Because I like learning about animals and stuff and learning about their anatomy and like how fins function on a shark and that kind of thing 'cause you wouldn't know that if you just like went to the zoo and seen a shark in the aquarium.

L: How would you want these classes to be taught? Please describe.

V: Um. With like the traditional method along with having experiments mixed in and not having to sit here for like two hours hearing a lecture with the notes on the board but still having hands-on and group work mixed in so you still have a variety of ways to learn but all in one kind of style of teaching.

L: Within the past few responses you mentioned group work, what types of group work would you like to do with fellow classmates?

V: Like if we had lab questions, to do the lab with one or two other people, and then be able to go over the questions with them and check the answers and that kind of thing.

L: Would you want this course to be challenging? Why or why not?

V: A little. Just to make it a little more interesting and that way it could be fun, too, the work up to a challenge, but not making it too hard that you're stressing out and overwhelmed with homework and different assignments that you have to get done.

L: For you, what's the most important challenge with respect to learning biology?

V: Um. *[long pause]* When you're, like when you see something really complex written on the board. When like when you walk into class and you seen a dihybrid cross on the board and you're like, what do I do with this and until the teacher explains it, you'll understand it more. Or like the different diagrams that were for the chapter seven photosynthesis chapter because some of them were complicated to understand even though we learned about photosynthesis and other processes in the past.

L: How do you feel you can overcome these challenges?

V: By like paying attention in class, taking one thing at a time, and learning it that way. Because if you try to take all the information in at one time, you gonna get overwhelmed and definitely stress out.

L: Is there anything else you would like to comment about or add to this interview?

V: Nothing really except Mrs. L. is one of the best biology *[she laughs]* teachers I've had because I know the one I have this tri doesn't teach things exactly the way I could learn them and interpret them.

L: Even though he also uses traditional teaching?

V: He does, but he does it in a slightly different way. He'll put the notes on the board and he'll talk about them, but they aren't as detailed or he'll put, he'll write them on the board as he is talking, and not have them already up there and they'll be kind of like, half notes 'cause instead of having the whole definition up there, he'll have the word with like an equal sign next to it and he'll say the definition but he won't say it more than once, and if you don't get in then, you're looking through your vocabulary or in the glossary in the back of the book trying to find it.

L: O.K. Thank you. Just to go back and summarize what you have said. You enjoy the traditional teaching that you've had. You could easily learn and pick up on the information on the board. You felt that you enjoy traditional teaching when there are notes on the board but the information is broken down into smaller parts and then you can

learn it section by section instead of all the notes at one time and all the assignments at one time. But you also enjoy a combination of lecture and notes with the labs and also with group work, going over lab questions and study guides and things like that. Um, your achievement is self-driven. You're GPA is self-driven. You're not pressured in any way by friends or family. You want to do the best you can. You're motivated to learn biology because you're fascinated with the dissections and the anatomy of various animals and organisms. And you're willing to take additional science classes that involve dissecting and an advanced level of learning about organisms. You're important challenge with respect to learning biology is taking information that's either real difficult or there's an abundance of information or large words on the board and you try to break the information down and learn it piece by piece and ask questions as the information goes in the chapter. Anything else?

V: No.

L: O.K. Thank you. *[She smiles.]*

Appendix I

Sample Interpretivist Qualitative Fieldnote

Interpretivist Qualitative Fieldnote
Interview #1

LOG

*Date: 4/27/04 Site: Room 123 – Girard High School
*Type of data collection activity: interview
*Respondents or people observed: D.V. – sophomore female in control group of Biology I – highest score on survey: 141/155
*Data Collector: Mrs. Christine Lucarielli- researcher and her former biology teacher
*Purpose of data collection activity: To get her attitudes, beliefs, and opinions about her biology class last trimester (traditional learning instruction)
* Type of Data Report – verbatim transcript from tape recording

DATA – refer to verbatim transcript for actual data and observations

SUMMARY/HIGHLIGHTS

She seems to have a strong interest in the life sciences from her childhood to the present. She is used to traditional teaching and is comfortable with it. She seems to be very resistant to change or any other type of teaching methods that aren't similar to the traditional teaching techniques. Very detailed notes and the explanation of the notes in sections is very pertinent to her learning success. She feels that academic success comes from an individual's own efforts and abilities in the class. She defined traditional method by including a variety of activities such as group work, experiments, hand-on stuff, and some notes with explanation.
She feels very secure having the teacher provide her with the correct information rather than students presenting information that may not be correct. She has a 3.9 GPA and it is mainly self-driven. Her responses towards challenging topics and additional science classes show a high amount of learning goal orientation, self-efficacy and intrinsic motivation.

METHODOLOGICAL COMMENTS

This classroom is a great place to conduct interviews, especially after school. Hardly any interruptions took place. I feel my data is of good quality and the recording of the data went well using the microcassette recorder. She was very sociable and provided specific examples and detailed responses. Possible additional questions to ask for the remainder of the interviews may focus on the importance of notes/information being presented in the class as well as teacher personality since she mentioned one teacher who was "a little monotonic." I may even ask for more specific examples and pay attention to how the other students define the teaching methods that they enjoy and do not enjoy.

ANALYTIC COMMENTS

It's interesting that she has no desire to want to learn via cooperative learning instruction from her peers. Her responses were consistent with her highest score on the survey, scoring high on the learning goal orientation, intrinsic motivation to learn, and self-efficacy. After interviewing her, it seems that she was always taught traditionally throughout school, and she does very much seem comfortable and set in her ways of detailed note taking, studying habits, and lab/group work with partners. Therefore, any type of change or cooperative learning technique will more than likely have a slightly negative effect to her achievement and understanding of the subject matter. As a teacher who taught the treatment group last trimester via cooperative learning instruction, I wonder if the two treatment group students will have similar views as she did on traditional learning and how cooperative learning instruction affected their motivation to learn biology.

Appendix J

Human Subjects Approval

YSU

Youngstown State University / One University Plaza / Youngstown, Ohio 44555-0001
Dean of Graduate Studies
330-941-3091
FAX 330-941-1580
E-Mail: graduateschool@cc.ysu.edu

December 1, 2003

Dr. Stacey Lowry Bretz, Principal Investigator
Ms. Christine Lucarielli, Co-Investigator
Department of Biological Sciences
UNIVERSITY

RE: HSRC PROTOCOL NUMBER: 31-2004
TITLE: What Impact Does Cooperative Learning in High School Biology Have on the Affective Dimensions of Learning Science?

Dear Dr. Bretz and Ms. Lucarielli:

The Human Subjects Research Committee of Youngstown State University has reviewed your response to their concerns regarding the above mentioned protocol and determined that your protocol now fully meets YSU Human Subjects Research guidelines. Therefore, I am pleased to inform you that your project has been fully approved.

Any changes in your research activity should be promptly reported to the Human Subjects Research Committee and may not be initiated without HSRC approval except where necessary to eliminate hazard to human subjects. Any unanticipated problems involving risks to subjects should also be promptly reported to the Human Subjects Research Committee.

We wish you well in your study.

Sincerely,

Peter J. Kasvinsky
Dean, School of Graduate Studies and Research
Research Compliance Officer

PJK:cc

c: Dr. Robert Leipheimer, Chair
Department of Biological Sciences

Protocol # _____
(To be completed by Human Subjects Secretary)

INVESTIGATOR STATEMENT OF ASSURANCES

A. **I/we hereby state that I/we will follow and conform to all applicable laws, regulations and policies affecting human subjects in research established by Youngstown State University and/or other cognizant oversight authorities, including but not limited to those cited in the handbook, *Human Subjects Research: Regulations and Procedures.***

B. **I/we hereby recognize the right of legally-authorized access by members or representatives of the Youngstown State University Human Subjects Committee to any pertinent records associated with the above study, and further agree to provide the Committee, upon request, with documentation of any and all procedures undertaken as part of this study.**

C. **I/we hereby agree to notify the Committee in advance of any changes in project scope that would materially affect the conduct of the study, or any aspect of the study, relative to human subjects activity or involvement.**

D. **I/we affirm that the project as described above is a true, accurate, and complete representation of the study to be conducted under Youngstown State University auspices and with Youngstown State University approval.**

E. **I/we affirm that all individuals associated with the conceptualization, organization and conduct of the study described above possess the requisite qualifications to undertake it.** (All student investigators must attach a copy of their *curriculum vitae* and/or a letter from their approved academic advisor attesting to the students' qualifications to conduct faculty-supervised research).

F. **(For studies conducted off-campus) I/we affirm that all appropriate authorizations, clearances and approvals have been obtained to allow the above activity to occur at the above designated site(s), and that documentation to this effect is, or is being, provided to the Human Subjects Committee in support of this protocol.**

Avery Lavery Bretz	10/1/03	Christina A. Lucariello	9-30-03
Investigator/Advisor Signature	**Date**	**Co-Investigator/Student Signature**	**Date**
Co-Investigator Signature	**Date**	**Co-Investigator Signature**	**Date**

This form supercedes any previous Human Subjects protocol forms, which may not be used for Human Subjects Committee review.

Girard City School District

Dr. Marty D. Santillo
Superintendent
marty.santillo@neomin.org

31 N. Ward Avenue • Girard, Ohio 44420
Phone: (330) 545-2596
Fax: (330) 545-2597
www.girard.k12.oh.us

September 29, 2003

The Human Subjects Committee
Youngstown State University
One University Plaza
Youngstown, Ohio 44555-0001

Gentlemen,

Please be advised that at the September 24, 2003 Girard Board of Education meeting Mrs. Christine Lucarielli's request to conduct a classroom research project was approved. It is our understanding that this was a requirement in pursuit of obtaining a Master's Degree in Science.

Sincerely,

Dr. Marty D. Santillo
Superintendent of Schools

Appendix K

Letter To Parents

Girard High School
31 N.Ward Ave.
Girard, OH 44420
(330) 545-5431 ext.153

December, 2003

Dear Parent/Guardian:

I am currently pursuing a Masters of Science in Chemistry and Chemistry Education (Biology Education) with Youngstown State University. As part of my requirements for this degree, I must complete legitimate and testable classroom research. I have chosen to complete this research over one year with my Biology I classes at Girard. Since your son/daughter is a student in my class, I wanted to take some time to give you some preliminary information about my research topic.

Research suggests that student learning exists in three types: competitively, individualistically, and cooperatively. The two dominant interaction patterns among students are having students competing with one another for grades or working independently to reach a set criteria. The vast majority of research comparing student-student interaction patterns states that students learn more effectively when they work cooperatively.

In a traditional, competitive classroom presentation of the curriculum is very lecture oriented followed by individual student assignments and laboratories to confirm the concepts being presented. Students are forced to do their own work with no interaction with other students. This can create more tension, self-doubt, and anxiety in students. Learning involves progress toward predetermined teacher-defined goals in which knowledge is transferred from teacher to students. Students, therefore, are passive learners and have impersonal relationships among the teacher and other students. Learning theorists who support cooperative learning propose a possible solution to this problem, adding cooperative teaching methods to the curriculum to provide a full range of social situations to all students.

Cooperative learning exists in many forms and involves a set of instructional strategies which include cooperative student interaction over the subject matter as an integral part of learning. Learning is a process that flows out the interests of the students.

The results of hundreds of studies make it clear that cooperative learning has a number of very positive outcomes such as academic gains for all students, improved race-relations among students, and improved social and affective development among all students. This cooperative learning strategy precedes most of the lecture and replaces individual student worksheets. Laboratory experiences follow the presentations to verify key concepts. When compared to students receiving traditional instruction, the students should display higher levels of biology achievement, report being more learning goal oriented, display greater intrinsic valuing of biology, and display greater positive self-efficacy beliefs regarding their abilities in biology. The goal of my research is to test these hypotheses. I will be testing them by using a questionnaire at the beginning and end of the second trimester followed by interviews third trimester. Data will be collected

from each participating student on a completely voluntary basis with no coercion taking place.

The control and the experimental groups of students in my research study will be taught using the same Biology I curriculum that was adopted by the Girard Area School District and approved by the Girard Area School Board in 2000. No changes will be made to the existing biology curriculum, the topics covered, or the order in which the topics are covered. The main difference between the control and experimental groups will be the mode of instruction for comparison purposes. The experimental group will be doing the *Co-op Co-op* cooperative learning approach prior to instruction and laboratory exercises; whereas, the control group will have the instruction first, followed by individual worksheets and verification laboratory exercises. Both methods of instruction are considered to be pedagogically sound and documented in recent biology education literature.

Attached is a Human Subjects Informed Consent Form. Please take time to discuss this letter with your son/daughter, and then complete the form to be submitted to me by December 12, 2003. Please be aware that this project has been approved by the Girard Area School Board and Dr. Santillo, Superintendent. Feel free to contact me with any questions you may have. Thank you very much for supporting exciting classroom research that may influence how science is taught in the future!

Sincerely,

Mrs. Christine Lucarielli
Biology Teacher

Appendix L

Consent Form

Human Subjects Informed Consent Form
Girard High School

Dear Parent/Guardian:

I am conducting classroom research to determine if the type of instruction in biology
classes will influence affective dimensions of learning science. In this study, your child will be answering a questionnaire and possibly be interviewed during the second and third trimester of the 2003/2004 school year, respectively.

Your child will be asked to allow me to use the information from his/her responses in the analysis of group data. There are no risks to your child, and all information/data collected will be handled in a strictly confidential manner, so that no one will be able to identify your child when the results are reported. There will be no penalty assigned to any student's grade if he/she chooses not to participate. Your child's participation in this study is totally voluntary, and your child has the right to withdraw from the study at any time without negative consequences. In addition, no data will be collected for the non-participating students.

Please feel free to contact either of the addresses below if you have any questions:

Dr. Stacey Lowery Bretz
Programs
Associate Chemistry Professor
Chemistry Department
Youngstown State University
(330) 941-7112

Office of Grants and Sponsored

Youngstown State University
357 Tod Hall
(330) 941-2377

I understand the study described above and have been given a copy of the descriptions as outlined above. I agree to allow my son/daughter's data to be included with his/her assent.

_____
Signature of Parent/Guardian Date

I understand how my data will be used in this study and am willing to take part in the study.

_____
Signature of Child/Ward Date

Appendix M

Group Means and Standard Deviations Over Time for Each Variable

Tables VI to X

Table VI

Means And Standard Deviations For Learning Goal Orientation
By Class And Time

	2wk Pretest		6wk Posttest		12 wk Post-posttest	
	M	SD	M	SD	M	SD
Control	16.18	2.90	15.69	2.96	15.82	3.03
Treatment	15.30	3.25	15.10	2.47	15.47	1.95

Table VII

Means And Standard Deviations For Performance Goal Orientation
By Class And Time

	2wk Pretest		6wk Posttest		12 wk Post-posttest	
	M	SD	M	SD	M	SD
Control	19.82	6.77	21.62	7.24	21.65	7.37
Treatment	23.30	7.09	22.20	7.35	22.05	8.02

Table VIII

Means And Standard Deviations For Intrinsic Motivation
By Class And Time

	2wk Pretest		6wk Posttest		12 wk Post-posttest	
	M	SD	M	SD	M	SD
Control	14.41	3.16	14.69	2.94	15.41	3.20
Treatment	15.60	2.74	14.95	2.65	15.47	2.70

Table IX

Means And Standard Deviations For Extrinsic Motivation
By Class And Time

	2wk Pretest		6wk Posttest		12 wk Post-posttest	
	M	SD	M	SD	M	SD
Control	13.47	3.62	12.88	4.35	13.65	4.60
Treatment	13.45	2.95	12.75	3.16	12.74	3.89

Table X

Means And Standard Deviations For Self-Efficacy
By Class And Time

	2wk Pretest		6wk Posttest		12 wk Post-posttest	
	M	SD	M	SD	M	SD
Control	30.41	5.04	30.19	4.79	30.76	5.07
Treatment	29.95	3.24	28.50	4.96	29.84	1.98

Appendix N

Correlational Matrix for the 2nd week pretest, 6th week posttest, and 12th week post-posttest

Tables III to V

Table III

Correlational Matrix for 2nd week Pretest

	LGO	PGO	INTMO	EXTMO	SELEFF
LGO	------				
PGO	-0.37*	----------			
INTMO	0.58**	-0.15	----------		
EXTMO	0.40*	0.04	0.65**	----------	
SELEFF	0.24	-0.10	0.35*	0.23	----------

N = 37 2-tailed significance *0.05 **0.01

Table IV

Correlational Matrix for 6th week Posttest

	LGO	PGO	INTMO	EXTMO	SELEFF
LGO	------				
PGO	-0.17	----------			
INTMO	0.53**	0.18	----------		
EXTMO	0.51**	0.34*	0.64**	----------	
SELEFF	0.31*	-0.09	0.34*	0.13	----------

N = 44 2-tailed significance *0.05 **0.01

Table V

Correlational Matrix for 12th week Post-posttest

	LGO	PGO	INTMO	EXTMO	SELEFF
LGO	------				
PGO	-0.18	----------			
INTMO	0.65**	0.19	----------		
EXTMO	0.57**	0.42**	0.70**	----------	
SELEFF	0.60**	-0.06	0.52**	0.30	----------

N = 43 2-tailed significance *0.05 **0.01

Appendix O

Independent-Samples t-tests For Each Variable of Interest

Tables XI to XV

Table XI

Independent-Samples t-test for Total Learning Goal Orientation Scale-2nd week

	Levene's Test for Equality of Variances		t-test for Equality of Means			
	F	Sig.	t	df	Sig.(2-tailed)	Mean Difference
Equal Variances assumed	0.218	0.643	-0.859	35	0.396	-0.88
Equal Variances not assumed			-0.867	34.898	0.392	-0.88

Treatment group, N=20; Control Group, N=17

Table XII

Independent-Samples t-test for Total Performance Goal Orientation Scale-2nd week

	Levene's Test for Equality of Variances		t-test for Equality of Means			
	F	Sig.	t	df	Sig.(2-tailed)	Mean Difference
Equal Variances assumed	0.141	0.710	1.517	35	0.138	3.48
Equal Variances not assumed			1.523	34.503	0.137	3.48

Treatment group, N=20; Control Group, N=17

Table XIII

Independent-Samples t-test for Total Intrinsic Motivation Scale-2nd week

	Levene's Test for Equality of Variances		t-test for Equality of Means			
	F	Sig.	t	df	Sig.(2-tailed)	Mean Difference
Equal Variances assumed	0.753	0.391	1.224	35	0.229	1.19
Equal Variances not assumed			1.210	31.975	0.235	1.19

Treatment group, N=20; Control Group, N=17

Table XIV

Independent-Samples t-test for Total Extrinsic Motivation Scale-2nd week

	Levene's Test for Equality of Variances		t-test for Equality of Means			
	F	Sig.	t	df	Sig.(2-tailed)	Mean Difference
Equal Variances assumed	0.155	0.696	-0.019	35	0.985	-0.02
Equal Variances not assumed			-0.019	30.829	0.985	-0.02

Treatment group, N=20; Control Group, N=17

Table XV

Independent-Samples t-test for Total Self-Efficacy Scale- 2nd week

	Levene's Test for Equality of Variances		t-test for Equality of Means			
	F	Sig.	t	df	Sig.(2-tailed)	Mean Difference
Equal Variances assumed	3.647	0.064	-0.337	35	0.738	-0.46
Equal Variances not assumed			-0.325	26.450	0.748	-0.46

Treatment group, N=20; Control Group, N=17

Appendix P

Mixed Within-Between Groups ANOVA For Each Variable Of Interest

Tables XVI to XX

Table XVI

Mixed Within-Between Groups ANOVA For Learning Goal Orientation

Multivariate Tests

Effect	Value	F	Hypothesis df	Error df	p-value	Partial Eta Squared
TIME-Wilks' Lambda	0.906	1.653	2.000	32.000	0.207	0.094
TIME*GROUP-Wilks' Lambda	0.987	0.209	2.000	32.000	0.812	0.013

Tests of Between-Subjects Effects

Source	Type III Sum of Squares	df	Mean Square	F	p-value	Partial Eta Squared
Intercept	25450.000	1	25450.000	1410.587	0.000	0.977
GROUP	18.000	1	18.000	0.998	0.325	0.029
Error	595.390	33	18.042			

Table XVII

Mixed Within-Between Groups ANOVA For Performance Goal Orientation

Multivariate Tests

Effect	Value	F	Hypothesis df	Error df	p-value	Partial Eta Squared
TIME-Wilks' Lambda	0.988	0.192	2.000	32.000	0.826	0.012
TIME*GROUP-Wilks' Lambda	0.910	1.587	2.000	32.000	0.220	0.090

Tests of Between-Subjects Effects

Source	Type III Sum of Squares	df	Mean Square	F	p-value	Partial Eta Squared
Intercept	50067.686	1	50067.686	347.972	0.000	0.913
GROUP	76.143	1	76.143	0.529	0.472	0.016
Error	4748.181	33	143.884			

Table XVIII

Mixed Within-Between Groups ANOVA For Intrinsic Motivation

Multivariate Tests

Effect	Value	F	Hypothesis df	Error df	p-value	Partial Eta Squared
TIME-Wilks' Lambda	0.830	3.272	2.000	32.000	0.051	0.170
TIME*GROUP-Wilks' Lambda	0.933	1.154	2.000	32.000	0.328	0.067

Tests of Between-Subjects Effects

Source	Type III Sum of Squares	df	Mean Square	F	p-value	Partial Eta Squared
Intercept	23887.148	1	23887.148	1143.132	0.000	0.972
GROUP	2.653	1	2.653	0.127	0.724	0.004
Error	689.576	33	20.896			

Table XIX

Mixed Within-Between Groups ANOVA For Extrinsic Motivation

Multivariate Tests

Effect	Value	F	Hypothesis df	Error df	p-value	Partial Eta Squared
TIME-Wilks' Lambda	0.879	2.212	2.000	32.000	0.126	0.121
TIME*GROUP-Wilks' Lambda	0.949	0.864	2.000	32.000	0.431	0.051

Tests of Between-Subjects Effects

Source	Type III Sum of Squares	df	Mean Square	F	p-value	Partial Eta Squared
Intercept	18150.529	1	18150.529	470.061	0.000	0.934
GROUP	3.329	1	3.329	0.086	0.771	0.003
Error	1274.232	33	38.613			

Table XX

Mixed Within-Between Groups ANOVA For Self-Efficacy

Multivariate Tests

Effect	Value	F	Hypothesis df	Error df	p-value	Partial Eta Squared
TIME-Wilks' Lambda	0.881	2.151	2.000	32.000	0.133	0.119
TIME*GROUP-Wilks' Lambda	0.973	0.438	2.000	32.000	0.649	0.027

Tests of Between-Subjects Effects

Source	Type III Sum of Squares	df	Mean Square	F	p-value	Partial Eta Squared
Intercept	93970.358	1	93970.358	2334.798	0.000	0.986
GROUP	42.739	1	42.739	1.062	0.310	0.031
Error	1328.175	33	40.248			

Appendix Q

Final Category System

FINAL CATEGORY SYSTEM WITH CODES

All Students – Control and Treatment Groups

Category #1: Current Classes
- Code #1: List Of Classes
- Code #2: Grades Earned In These Classes
- Code #3: Enjoyable Classes and Why
- Code #4: Not Enjoyable Classes and Why

Category #2: Types/Kinds of Teaching Methods
- Code #1: Enjoyable Classes
- Code #2: Not enjoyable Classes

Category #3: Grade Point Average (GPA)
- Code #1: Current GPA
- Code #2: Influence of GPA

Control Group Only

Category #4: Traditional Learning Assignments
- Code #1: Assignments That Students Enjoyed
- Code #2: Assignments That Students Least Enjoyed

Category #5: Advantages of Traditional Classroom Instruction
- Code #1: Presentation of Content
- Code #2: Personal Gains

Category #6: Disadvantages of Traditional Classroom Instruction
- Code #1: Presentation of Content
- Code #2: Personal Losses
- Code #3: Feelings of Cooperative Learning

Treatment Group Only

Category #4: Cooperative Learning Assignments
- Code #1: Assignments That Students Enjoyed
- Code #2: Assignments That Students Least Enjoyed

Category #5: Advantages of Cooperative Learning Instruction
- Code #1: Presentation of Content
- Code #2: Personal Gains

Category #6: Disadvantages of Cooperative Learning instruction
- Code #1: Presentation of Content
- Code #2: Personal Losses

All Students – Control and Treatment Groups

Category #7: Biology I Class
- Code #1: Self-Efficacy – Personal Ability To Achieve
- Code #2: Motivational Aspects of Learning Content
- Code #3: Enjoyment In Learning Biology

Category #8: Descriptive Information
- Code #1: Memorable Experience In Enjoying Life Science
- Code #2: Teaching Method Used In Memorable Experience

Category #9: Challenging Topics
- Code #1: Personal Effort In Reviewing
- Code #2: Challenging Lab Exercises or Problems

Category #10: Aspects To Change The Way Biology Is Taught
- Code #1: Teaching Methods

Category #11: How Feelings and Attitudes Are Affected By Changes In Learning Biology

Category #12: Additional Science Courses
- Code #1: List Of Additional Science Courses and Why
- Code #2: Ways Students Want Additional Classes To Be Taught
- Code #3: Decision To What These Classes Challenging

Category #13: The Most Important Challenge With Respect To Learning Biology
- Code #1: Complex Terms
- Code #2: Time Constraints
- Code #3: Understanding Past Concepts
- Code #4: Teaching Style

Category #14: Overcoming These Challenges