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The Effect of Teacher vs. Student-Set Performance Goals on Academic Achievement in a Middle School Science Classroom

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THE EFFECT OF TEACHER VS. STUDENT-SET PERFORMANCE GOALS ON ACADEMIC ACHIEVEMENT IN A MIDDLE SCHOOL SCIENCE CLASSROOM

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ABSTRACT

Self-regulation and self-efficacy are both necessary for students to be independent learners. During middle school, students begin to yearn for academic autonomy, but lack the ability to regulate themselves and are unreasonable about their abilities. Goals have been proven to promote the development of these two skills. The purpose of this investigation was to determine which type of performance goal most efficiently promotes the development of self-regulation. The effects of performance goal source were analyzed to determine if teacher-assigned or student assigned performance goals produce greater growth in content knowledge for seventh grade life science students. The effects of goal source on goal attainment, test-anxiety, and goal orientation were also measured.

Goal source did have a significant effect on normalized learning gains (nLGs). Students with teacher-set goals consistently had higher nLGs compared to students with self-assigned goals, these differences being significant for two units. It was also found that teacher-assigned performance goals produce greater nLGs amongst white students and female students. For all four units, a positive correlation between unit goals and nLGs could be found for students with teacher-set goals, indicating that assigning students higher assigned goals produces greater gains. This relationship could not be established for students with self-assigned goals.

The mean goal set by the teacher was significantly lower than the mean student-set goal for three units. In the final unit, the mean goal for both groups were not statistically different, indicating that students were beginning to grasp the concept of what is a realistic goal. Both groups experienced an increase in goal attainment over the course of study, however the rate of attainment was greater for students with teacher-set goals.

Test anxiety did not significantly increase over the course of the study. An inverse relationship between test anxiety and nLGs was initially established for students with self-set goals, but not for students with teacher-assigned goals. By the end of the experiment, no relationship between anxiety and normalized learning gains could be established for either group. Additionally, it was found that anxiety was not related to goal attainment. These results demonstrate a shift in the control anxiety had over achievement through the use of goals.

While there was no significant change in performance-goal orientation for either group over the course of the experiment, both groups experienced a significant drop in mastery-goal orientation by the end of the experiment, suggesting students were more interested in letter grades than truly mastering content. The findings

of this study suggest that performance goals are more efficient with seventh grade science students if they are assigned. Furthermore, the use of performance goals within the classroom shows promise as a tool to develop students' self-efficacy and self-regulation.

INTRODUCTION

Need for Self-Regulation

Middle school is the ultimate transitional period for students. It is a time when young scholars are trying to define themselves as individuals. Academic independence is something for which students battle their parents. It has been my experience that some parents who reluctantly take the back seat in monitoring their children's grades are surprised at their students' inabilities to realistically monitor their own grades. Mothers and fathers become alarmed when their A/B students begin earning C's and D's. Many parents, concerned with a sudden reduction in performance, resume their role of grade-monitor and the students are stripped of the academic autonomy they briefly possessed. While this renewed oversight offers a temporary solution to the problem, it prevents students from developing the self-regulation and metacognitive skills necessary for success in high school, college, and career.

What parents are failing to recognize is that their children have a healthy appetite for the freedom to manage their own academic performance but lack the necessary skills to do so. According to "How People Learn" (Bransford et al., 2000), the development of metacognition, or the ability to reflect on one's own performance, is an important component of learning. In order to be proficient in metacognition, a student must be able to self-regulate. Proper self-regulation requires that a student must be able to "plan ahead, monitor success, and correct errors when appropriate" (Bransford et al., 2000). Students cannot be expected to possess these skills without first being taught how to develop them. I argue that rather than removing this responsibility at the first sign of failure, we should help students cultivate self-monitoring skills through setting manageable performance goals and tracking progression towards these goals.

The Environment

Iberville Math, Science and Arts Academy West (MSA), the location of this study, is a selective magnet program. In order to ensure acceptance and retention in the program, students must maintain a cumulative grade point average of at least 2.75. It is critical that students in such a program be aware of their academic performance. While a student's performance in a class is considered a measure of current success, it can also be used to gauge potential for success in future courses covering related content (Harackiewicz et al., 2000). By cultivating an early awareness of performance through self-monitoring, we may be able to ensure continued academic achievements for students.

The ability to self-monitor would have to be developed through scaffolding, in which students would be moved progressively into a position of awareness, and comfort with the responsibility of monitoring their growth and performance. The development of metacognition in these middle school students may lead to the cultivation of intrinsic motivation to perform well and the skills necessary to meet not only the academic requirements of the school but also those of their future academic endeavors.

Goals and Feedback in Education

According to one study, the most successful and productive science classrooms are those in which students are assigned instructional objectives, are kept aware of these expectations, and are given feedback on their progress towards these objectives (Wise and Okey, 1983). In order for a student to achieve a goal, they not only need to know what is necessary to fulfill the goal but also how they are progressing towards this goal. Therefore success depends on setting objectives, and utilizing feedback to monitor progress.

A goal can be simply defined as a desired result. Goals function as discriminative stimuli. They establish and reinforce expectations, deterring possessors from straying towards less desirable outcomes (Isley, 2007). Goals can then be used to monitor and adjust current performance. According to Latham and Locke's goal-setting theory, goals are most effective when a person is committed to the goals. Goal commitment relies on an intrinsic motivation and the level of importance to the possessor. An adequate learning goal can motivate students, producing greater success on challenging tasks (Grant and Dweck, 2003).

For the purposes of this study, we will focus on achievement goals in the classroom. Achievement goals can be split into two categories: mastery and performance. A person who is mastery goal-oriented is more concerned with developing new skills and acquiring new knowledge (e.g. I want to learn why leaves are green). In contrast, a performance-oriented individual is concerned with showing proof of ability, usually in a normative setting (e.g. I want to make a grade higher than the class average) (Ames and Archer, 1988). While mastery goals have been shown to foster greater interests in a course, performance goals are shown to promote greater academic achievement. Harackiewicz et al. (2007) contend that performance goals lead to greater academic achievement because they mirror the criteria with which students are graded. Studies have also shown that specific, challenging goals lead to higher performance than vague, undemanding goals. This may be because more challenging goals require the pursuer to work more in order to satisfy such a goal than a lower goal may demand (Locke & Latham, 2006).

While a goal establishes a desired outcome, it requires relevant feedback that a person can use to track their progress (Locke and Latham, 2006). Hattie and Timperley (2007) define feedback as “information provided by an agent regarding aspects of one’s performance and understanding”. A study of 500 meta-analyses produced by Hattie in 1999 showed that the average effect size, or correlation, between feedback and academic performance is 0.40. Other studies have produced effect sizes easily doubling the amount seen in the Hattie study (Lysakowski and Walberg, 1982; Walberg, 1982). In addition to these data, eight meta-analyses on the effects of goals and feedback produced an average effect size of 0.46, suggesting that feedback is more effective when framed within a learning context (Hattie and Timperley, 2007). Based upon these data, it is safe to assume that feedback can be a powerful tool if used effectively.

How then do we discriminate between constructive and destructive feedback? Feedback is more powerful for students if it provides information on correct rather than incorrect responses and shows what improvements have been made (Klugger and DeNisi, 1996). Negative feedback may cause a student to lower their commitment to the established goal, leading to lower levels of achievement. This tends to happen whenever the goal tied to the feedback is either unrealistic, overly demanding, or too simplistic. However, in some situations, negative feedback may cause people to increase their effort in place of lowering their expectations. For this to occur the goal the person is striving for needs to be clear and commitment to this goal must be high (Klugger and DeNisi, 1996). In other words, the person must want to succeed and believe it is possible. As long as buy-in is established with a student, feedback can be used to aid in attainment of academic goals set.

What is less clear is how we can maximize a seventh grade student’s commitment to an achievement goal? What is the best way to facilitate the development of metacognitive skills such as self-regulation? This process can begin by setting performance goals and providing feedback to students. The literature supports that combining these two strategies can produce significant academic gains. However there is little research on the effectiveness of students-set goals versus teacher-set goals. Furthermore, there is the issue of middle school students lacking the self-regulation and metacognition skills seen in high school and college-level students, making student-set goals potentially even less likely to be effective. Is it better then to begin the development of these skills by setting goals for the students or allowing them to set their own?

According to Locke and Latham (2006), goal choice is swayed by several aspects. These include self-efficacy, or belief in one's own ability, past performance, and various social influences. Based on these factors, students who are allowed to set their own performance goals may over-extend themselves due to an inflated ego or sell themselves short. In either case, the result could be lower academic achievement, decreased self-efficacy, and reduced commitment to future goals. However, Igel, Clemons, and Apthorp (2010) argue that students should be allowed to help set learning objectives, citing that both can increase student motivation and learning. This may be because goal commitment is heavily influenced by the degree of importance to the person (Isley, 2007). By establishing his or her own goal, the student is providing personal significance to the objective. Conversely, students in the 7th grade with little experience in self-monitoring may not set realistic goals, leading to failure. A teacher can prevent this by providing specific, appropriately challenging goals for students based upon observation of abilities. By having teacher-set academic performance goals, students' commitment to the pursuit and attainment of the goal can be nurtured and built, resulting in future self-regulation (Hattie and Timperley, 2007). The challenge then becomes how to increase student commitment to a goal that is not self-imposed and may therefore seem arbitrary. A suggested solution is to make the goal public to an important audience (Isley, 2007), such as other classmates, the teacher, or students' family. An expectation of performance may force students to commit to a goal established by their teacher.

Review of Achievement Goals and Feedback Studies

Ames and Archer (1988) of the University of Illinois at Urbana-Champaign conducted a study to determine the effects that achievement goals could have on students' learning strategies and motivational processes. The study was conducted using 167 academically advanced students in grades 8-11. Students were randomly pulled from core courses and asked questions about the class. These questions were used to measure goal orientation, learning strategies, task challenge, attitude towards class, and perceived ability. Students' scores on the goal orientation scale were correlated with the other measured factors using a z-order correlation. This type of measure is typically used to measure the correlation between two variables. Students' perceptions of mastery goal orientation were shown to have a positive correlation with their use of learning strategies, attitude towards class, and preference for challenging tasks. These students typically attributed success in a course to effort, strategy, and their teacher. The data also show that these same students weakly attributed failures to lack of effort and strategy. In contrast, students' perceptions of performance goal orientation resulted in lower level of self-competence and a negative attitude towards class. Student's attributed success of performance goals to the same factors as those seen with mastery goals, effort and strategy. However, students' causes of failure for performance goals differed. Lack of ability, strategy used to prepare, and task difficulty were attributed to failure on perceived performance goals. These results illustrate that a student's experience in a classroom can vary drastically depending on their goal orientation.

Extensive research on achievement goals has also been performed at the college level Harackiewicz et al. (1997) have conducted several studies on the consequences of achievement goals in introductory psychology courses. This research team investigated the correlation between personality predictors of achievement goals and the effects seen when students adopted the achievement goals. Based upon student survey responses, mastery goals were most likely to be adopted by students, followed closely by performance goals. Mastery goals were shown to have a correlation with work mastery and interest in the subject. Though mastery goals were more likely to be adopted, there were strong correlations between performance goals and competitiveness and final grade, suggesting that these students are extrinsically motivated by grades. Mastery goals actually correlated with a lower amount of competitiveness and, surprisingly, an inverse relationship with final grade (Harackiewicz et al., 1997). These data suggest that performance goals may be better suited for a competitive, college preparatory environment such as MSA.

Another study produced by the same authors sought to examine the short-term and long-term consequences of students' achievement goals (Harackiewicz et al., 2000). Once again, mastery goals were shown to positively correlate with interest in a subject, but not with grades. Mastery goals were shown to have positive correlations with interest and enjoyment of the course. Performance goals always had a positive correlation with grade expectations, be it mid-semester, final class grade, semester GPA, or subsequent semesters. Based upon these data, the authors suggest that students who adopt both performance and mastery goal orientations will benefit more than those who adopt only one or neither.

Though both performance and mastery goals are shown to have positive effects on student performance, the need for feedback is crucial for students, especially for those who are just beginning to develop self-regulation skills. A meta-analysis conducted by Igel et al. (2010) confirms that combining objectives with feedback can increase motivation and academic achievement in students. The effect size of objectives was measures for four studies. All studies had positive effect sizes, with an overall effect size of 0.31. Five studies were then analyzed to determine a composite effect size of feedback (Igel et al., 2010). Overall, the effect size of feedback was 0.76. One study analyzed by the authors, conducted by Shirbagi (2007), found that written feedback produced larger, statistically significant effects when compared to oral feedback. This suggests that there is much power in having students "see" their progression towards a goal. Though the authors did not use any studies that examined the effects of combining feedback with objectives, the authors do cite a report produced by Marzano et al. (2001). In this study, utilizing a combination of the two techniques produced an effect size of 0.61, which is much higher than the 0.31 effect size seen when only objectives are implemented.

Rationale for this Study

This study differs from previous studies in that it was conducted in a middle school science classroom rather than a high school, collegiate, or work-force setting. It is novel in that it seeks to reveal if 7th grade life science students are mature enough to set manageable goals for themselves and intrinsically motivated enough to put in the work to meet these goals. Throughout the course of this experiment, four main hypotheses were investigated:

<u>Effects of Goal Source</u>

While the studies discussed above support the use of goal-setting and feedback, research testing the effect of the goal-source on student performance is minimal. For this reason, one purpose of this study was to determine if the source of a performance goal affects the amount of growth a student experiences. It was hypothesized that teacher-set performance goals would produce more growth and greater goal attainment than student-set goals. Due to students' lack of experience with self-regulation, teacher-set goals may seem more reasonable to students and therefore provide more motivation for students to strive for goal attainment. Because the skill of setting and work towards objectives is beneficial for future endeavors in all facets of life, it was worthwhile to explore the possibility of developing these skills early in a students' academic career.

Effects of Test Anxiety on Growth and Goal Attainment

This study involves very impressionable middle school students. The students are at a point in their mental development where self-perception of academic ability plays a major role in performance. If a student has a negative view on their abilities or suffers from performance anxiety, they will most likely produce weaker results than an equally talented peer with a more positive outlook. For these reasons, the effects of test anxiety on student achievement were also be analyzed. It was hypothesized that there would be a negative correlation between reported test-anxiety and student growth and goal-attainment. Should this hypothesis be supported by the projects' data, it would provide more insight into the importance of improving students' academic self-confidence when preparing students for exams, especially high-stakes testing that is mandatory for all middle-school and high school students in the state of Louisiana.

Effects of Performance Goals on Test Anxiety

One way to defeat the monster of self-doubt teenagers face in the classroom may be exposure to a goal. Many teenagers, especially those in middle school, view grades as a situation in which there are only two outcomes: 100% success or 100% failure. Providing goals to students allows for more manageable outcomes and creates situations in which students can experience success without feeling the need to make a 100% A. By giving students a realistic, manageable, individualized goal based upon their abilities, students may be able to alleviate some of their test anxiety. This study hoped to determine if scaffolding goals for students lead to a reduction of test anxiety. It was hypothesized that the presence and use of performance goals would lower test-anxiety. It was further postulated that students who were given goals by a teacher would experience a greater reduction in test-anxiety than students who set their own goals. The data generated through the investigation of this hypothesis was used to determine if the use of performance goals is a valid method to manage students' test-anxiety.

Maintenance of Goal-orientation

As stated earlier in the literature review, mastery goals are more likely to be adopted by students than performance goals. However, both goal-types play a role in student success and a successful student would need to possess tendencies towards both goal-types. Additionally, students' natural goal orientation is something that is developed throughout the course of their academic careers. The final purpose of this study was to investigate if providing mastery goals to students would cause a shift in natural goal-orientation. The hypothesis for this investigation was that there would be no major change in students' natural goal-orientation between the beginning and end of the experiment. It was expected that students would learn how to be better managers of their grades while still remaining true to their beliefs.

MATERIALS AND METHODS

Experiment Procedures

Prior to beginning this study, IRB approval was obtained to conduct this experiment (Appendix A). Permission for participation was obtained and documented for both parents and students via a parental permission form (Appendix B) and a child assent form (Appendix C).

This study was designed to test the effect of the source of performance goals on student performance in 7th grade Life Science classes. The students in the research group attended the Iberville Math, Science, and Arts Academy (MSA) in Plaquemine, LA. MSA has a 6th-12th-grade enrollment of 665 students. The school's 7th grade student population was made up of 45.45% African American, 52.83% Caucasian, 0% Asian, and 0.94% Hispanic. Of these students, 66.35% were on free and reduced lunch. The sample population of students used in this study was made up of 55 students, 65.45% of which were on free and reduced lunch. The demographics of this sample group was 43.63% African American, 54.54% Caucasian, 0% Asian, and 1.82% Hispanic, which is similar to the whole grade-level population. Three different sections of Life Science participated in this study. The fifth and seventh period classes, which were used at the control group, consisted of twenty and sixteen students, respectively. The sixth period class consisted of nineteen students and was used as the experimental group. Four units were used in this study. These units included Unit 1 (Scientific Method and Using Mathematics in Science), Unit 2 (The Cell), Unit 3 (Genetics and Bioengineering), and Unit 4 (Body Systems and Life Cycles) (Appendixes D, E, F, and G). These units were chosen in order to track students' progression throughout the school year.

During the first week of school, all students in the study were given two surveys. The first survey, consisting of 13 questions, was used to measure students' natural goal orientation (see Appendix H). For each item, students were asked to rank the truthfulness of the statement on a scale of 1 *untrue* to 5 *true*. The second survey was a 35-item survey that measured Test Anxiety (see Appendix I). This survey was developed by modifying the Test Anxiety Inventory available on the University of New England's website (http://www.une.edu/sites/default/files/TestAnxietyInventory.pdf). Students were asked to identify statements that described themselves. Scores on these surveys were used determine if the students in the control and experimental groups were statistically similar in their natural goal orientation and test anxiety

Prior to beginning Unit 1, students in both groups were given a pre-test to determine students' prior knowledge of scientific method and calculations. The unit exam consisted of 20 multiple-choice questions, six true-false questions, two short answer questions, and one graph interpretation task. The scores were analyzed to determine that that the sample populations were statistically equivalent based on a p-value greater than 0.05. Students in the control group were given their pre-test scores and post-test performance goal on a unit progress chart. The initial goals assigned were scaled scores based upon the previous year's iLEAP science scores. The iLEAP is a standardized assessment used to measure how well students are performing in science and social studies in relation to other students in the state. The students' unit 1 goals were generated using the following formula where x stands for a student's iLEAP score: $y=0.2903x+10.57$. Students in the experimental group were given their pre-test score on a unit progress chart and asked to assign themselves a post-test performance goal based upon their pre-test performance. Throughout the unit, students were given quizzes on material and were required to record the percent score, letter grade, and topics assessed for each quiz on the same unit progress chart (Appendix J). At the end of the unit, students were given a post-test identical to the pre-test. This procedure was repeated for units 2, 3, and 4; students' in the control group were assigned new unit goals based upon the previous unit's post-test score. Students who were further than 5% from attaining their goal had their goal lowered by 5%. Students who surpassed their goal by more than 5% have their goal increased by 5%. Students who were within a 5% range of their goal were assigned the same goal.

Mid-experiment, students in both groups were given an attitude survey to determine students' perceptions and feelings towards the use of goals in the classroom. The survey included nine scale-scored questions and a free-response section where students were asked to describe how having goals and tracking progress towards those goals impacted their experience in the classroom (see Appendix K).

After completing unit 4, students were given the goal orientation and test anxiety surveys again.

Data Analysis Procedures

For each unit, Microsoft Excel 2011 was used to calculate both the pre-tests and post-tests average scores and standard errors were calculated to look for baseline statistical similarities and differences between the control and experimental groups. Because learning gains provide an alternate method of measuring student achievement, analyses of normalized learning gains were also conducted. Using the equation below, the normalized learning gains for each student was calculated for all four units. Students with negative learning gains were automatically assigned a learning gain of 0.

$$nLGs = \frac{\text{posttest-pretest}}{\text{100-pretest}} * 100$$

Linear regressions showing the relationship between unit goals and normalized learning gains were done for all four units (Figures 12-15). The r^2 values, linear equations, and p-values were calculated via Prism 6 to observe how strong the correlation between goals and learning gains for each unit. In addition to linear regressions, the average normalized learning gains and standard errors were calculated. In order to more closely analyze the data for differences, the data was further divided based upon race and gender. There was only one Hispanic student who socialized with mainly white students; for these reasons, she was classified as “white” for data analysis purposes. Average normalized learning gains and standard errors were then calculated for each of these individual sub-groups.

In addition to student growth, changes in goal levels and the attainment of goals themselves was of interest to the experimenter. One-way ANOVAs were used to determine if the goals of each group were changing over the course of the experiment and if students were progressing towards greater goal attainment (Figure 16 and Figure 17). In order to better understand the frequency of goal attainment over the course of the experiment, the difference between students’ post-test scores and post-test goals were calculated for each unit. These differences were then averaged and standard errors were calculated. For all four units, students were classified into one of four categories: Further than 5% from goal, Missed goal by 5% or less, Exceeded goal by 5% or less, Exceeded goal by 5% or more. The percentage of students in each category for both the control and experimental were calculated and recorded.

Prism 6 was used to do a paired t-test that compared the pre- and post-experiment test anxiety surveys was conducted for each group (Figure 20). The purpose of this analysis was to determine if test-anxiety was reduced through the use of goals, be them teacher-generated or student-generated.

In order to understand the effect of test-anxiety on performance, two sets of linear regressions were then generated. The first set aimed to show the correlation between test-anxiety and normalized learning gains (Figure

21 and Figure 22). The set second showed the relationship between test-anxiety and goal attainment. In both scenarios, the slopes of the line, the r^2 value, and p-value were calculated (Figure 23 and Figure 24).

The final purpose of the data analysis was to determine if goal orientation would be unaffected by the use of performance goals. The mean initial and final mastery-goal and performance goal scores for each group were calculated along with their standard errors. Paired t-tests were used to detect any changes in goal orientation over time (Figure 25 and Figure 26).

Unless otherwise stated above, Welch's t-tests were used to analyze the significance of the results obtained throughout this investigation.

RESULTS AND DISCUSSION

Analysis of Pre-and Post-test Scores

Pre-tests and post-tests were used to monitor student's growth throughout the unit under the control (teacher-set goals) and experimental (student-set goals) treatments. It was important to determine if there were any initial differences between the two groups because the experimenter wanted to ensure that one group did not have a starting advantage over the other. Any significant initial differences between the two groups would have impacted the chosen data analysis. Differences in post-test scores were used to give the experimenter an initial indication of any differences between the control group of teacher-set goals and the experimental group of student-set goals. No significant differences in pre-test scores were found between the groups (Unit 1: TSG=43.2±1.9%; SSG=41.4±3.0%; p=0.61, Unit 2: TSG=27.5±2.0%; SSG=28.3±1.9%; p=0.78, Unit 3: TSG=25.1±2.1%; SSG=25.4±1.9%; p=0.67, Unit 4: TSG=32.9±1.5%; SSG=30.7±3.40%; p=0.49, TSG n=36, SSG n=19, Welch's t-test) (Figure 1). This confirms that students in the control group and experimental group began each unit with comparable amounts of content knowledge.

The same analysis was done for the post-test scores (Figure 2). It was found that students' in the control and experimental groups were not statistically different for any of the units (Unit 1: TSG=68.8±2.0%; SSG= 66.5±2.6%; p=0.49, Unit 2: TSG=65.3±2.3%; SSG=65.8±3.0%; p=0.89, Unit 3: TSG=66.3±2.4%; SSG=70.7±2.5%; p=0.22, Unit 4: TSG=70.8±2.5%; SSG=66.3±3.7; p=0.33, TSG n=36, SSG n=19, Welch's t-test). This shows that students ended each unit with similar amount of knowledge.

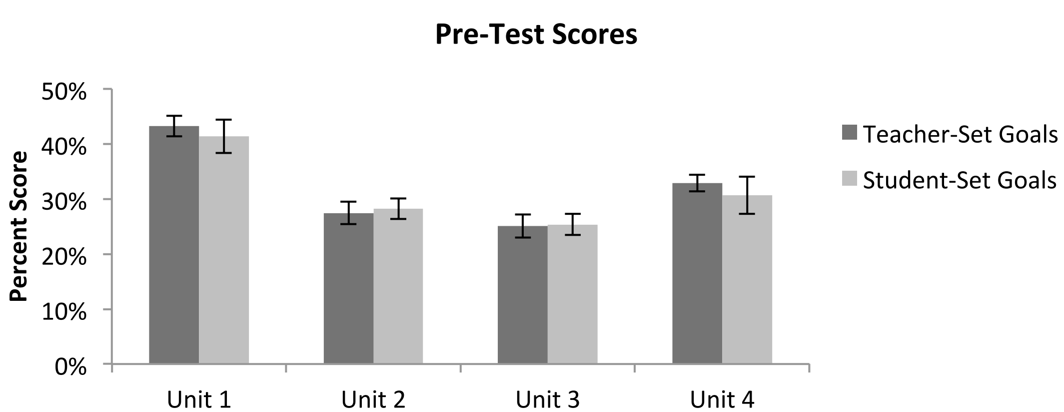

Figure 1. Summary of pre-test scores for students with teacher-set goals (N=36) and students with student-set goals (N=19). Means and standard errors are shown.

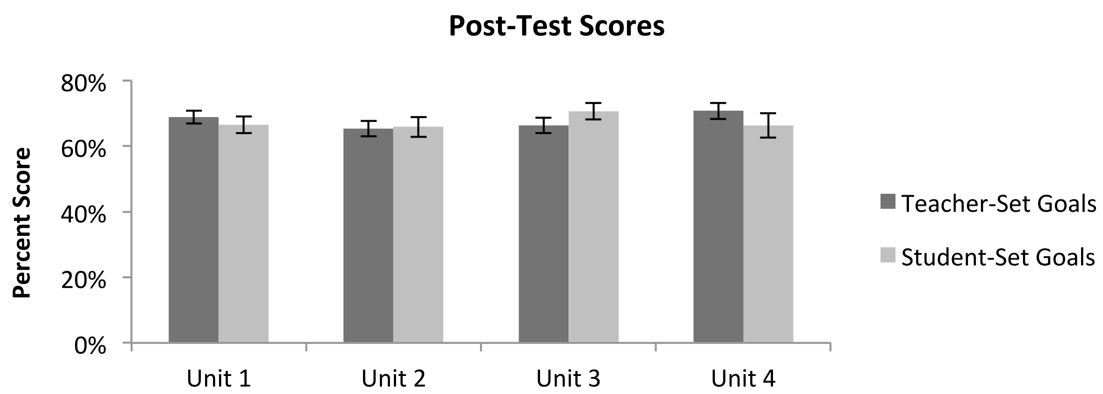

Figure 2. Summary of post-test scores for students with teacher-set goals (N=36) and students with student-set goals (N=19). Means and standard errors are shown.

Analysis of Normalized Learning Gains

Normalized learning gains (nLGs) were calculated for each unit (Figure 3). The average nLGs for the control group were compared against those of the experimental group. In every unit, the average learning gain for students with teacher-set goals were higher than those of students who set their own goals. These differences in nLGs were not significant for Units 1 and 4, but were significant for units 2 and 3. (Unit 1: TSG=44.3±3.3%; SSG=40.7±5.0%; p=0.55, Unit 2: TSG=52.5±2.9%; SSG=37.7±3.4%; p=0.002, Unit 3: TSG=55.1±3.1%; SSG=45.4±3.3%; p=0.04, Unit 4: TSG=55.7±3.9%; SSG=49.5±5.6%; p=0.38, TSG n=36, SSG n=19, Welch's t-test)

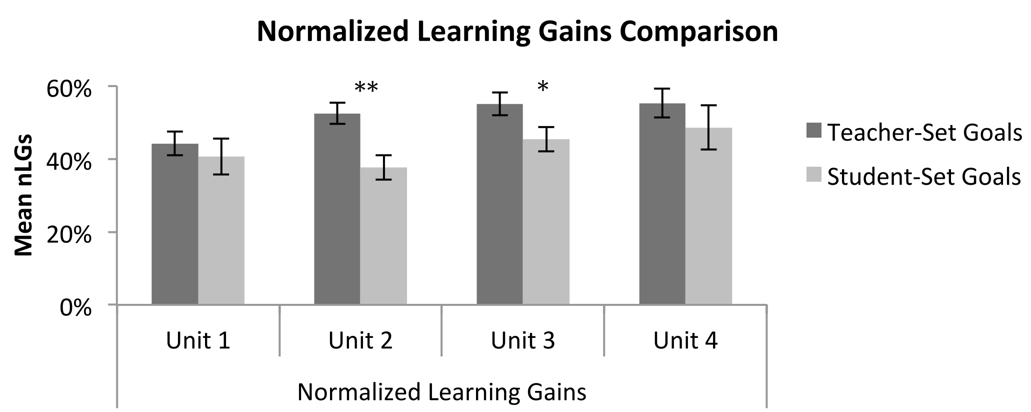

Figure 3. Normalized learning gains for students with teacher-set goals (N=36) and students with student-set goals (N=19). Means and standard errors are shown. Asterisks signify statistical differences between nLGs of the control and experimental groups for that unit. *p<0.05, **p< 0.01

Effect of Gender on Normalized Learning Gains

Middle school is typically when self-belief is formed for students and gender differences begin to emerge (Pajares and Britner, 2001). One study conducted with middle school students discovered that female students tend to moderately outscore males on standardized tests in life science (Lee and Burkam, 1996). The nLGs were analyzed by gender to detect the presence of two trends: 1) gender differences in nLGs and 2) effects gender on goal-source response.

To determine if gender plays a role in the effect of performance goal source on nLGs, the males and females of the control and the experimental groups were compared to each other (Figure 4). It was observed that females in the control group typically achieve higher nLGs than males. These differences were significant for Unit 3 but not for Unit 1, Unit 2, and Unit 4 (Unit 1: female=50.0±2.8%; male=41.6±2.8%; p=0.43, Unit 2: female=57.4±2.5%; male=47.6±2.8%; p=0.10, Unit 3: female=61.9±2.3%; male=48.2±3.4%; p=0.03, Unit 4: female=61.8±3.9%; male=48.8±3.9%; p=0.12, female n=18, male n=18, Welch's t-test). This analysis was repeated for students in the experimental group, who were allowed to set their own goals (Figure 5). The data indicated that males, on average, have higher nLGs than females when allowed to set their own goals. However, these differences were not found to be significant for any of the units (Unit 1: female=35.7±5.2%; male=51.4±3.9%; p=0.11, Unit 2: female=36.6±3.1%; male=40.1±4.3%; p=0.69, Unit 3: female=46.1±3.5%; male=43.9±3.1%; p=0.75, Unit 4: female=47.6±6.4%; male=50.9±5.9%; p=0.81, female n=13, male n=6, Welch's t-test). Overall, these results suggest that, the goal source does not significantly benefit one gender more than another. However, there are some indications that females may benefit more from teacher-set goals than males.

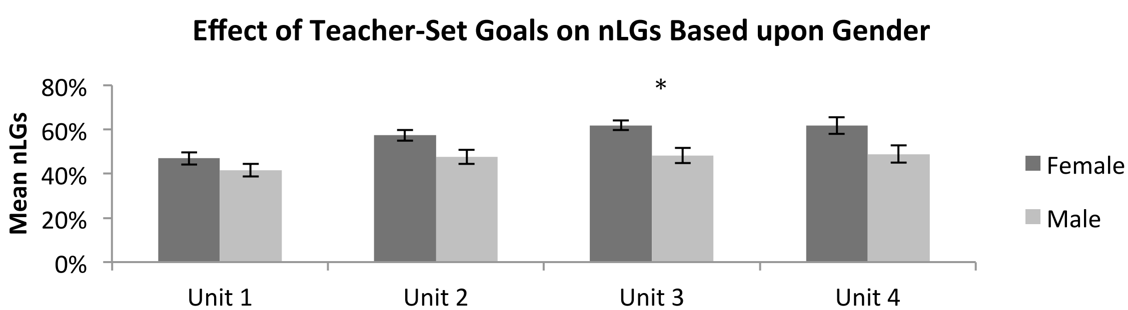

Figure 4**:** Normalized learning gains for male (N= 18) and female students (N=18) with teacher-set goals. Means and standard errors are shown. Asterisk signifies statistical differences between nLGs for males and females. *p<0.05

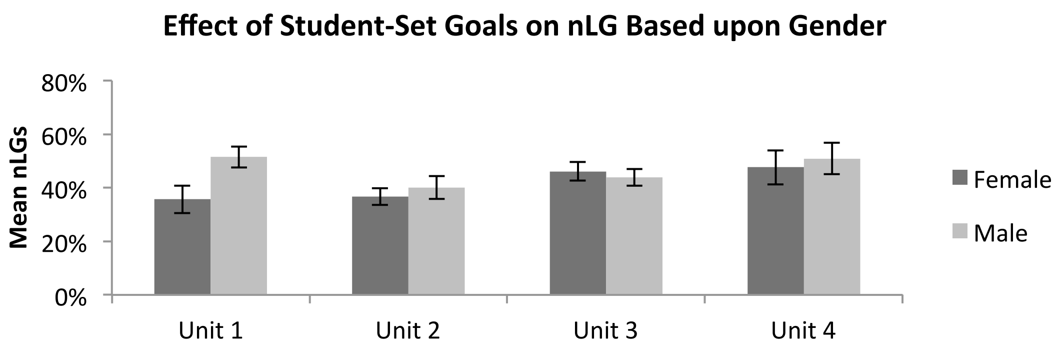

Figure 5: Normalized learning gains for male (N=6) and female students (N=13) with student-set goals. Means and standard errors are shown.

When examining the effect of goal source on females' nLGs, the data showed that females with teacher-set goals (n=18) experienced greater gains than females with student-set goals (n=13) (Figure 6). No significant differences in the average normalized learning gain were found for Units 1 and 4, but the nLGs for females with teacher-set goals were statistically higher than those of females with student-set goals for Units 2 and 3 (Unit 1: TSG=47.0±2.8%; SSG=35.7±5.2%; p=0.15, Unit 2: TSG=57.3±2.5%; SSG=36.6±3.1%; p=0.0004, Unit 3: TSG=61.9±2.3%; SSG=46.1±3.5%; p=0.007, Unit 4: TSG=61.8±3.9%; SSG=47.6±6.4%; p=0.16, TSG n=18, SSG n=13, Welch's t-test). Based on these results, it can be concluded that females experience greater nLGs when goals are assigned to them.

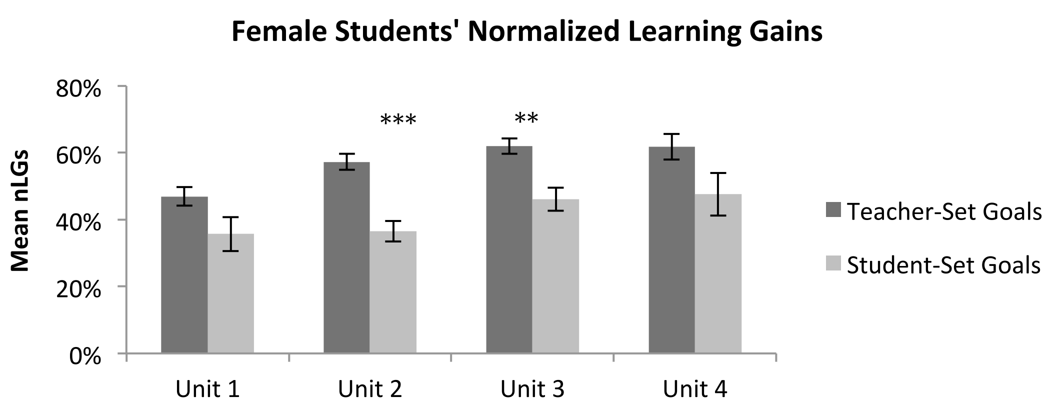

Figure 6. Normalized learning gains for female students with teacher-set goals (N=18) and students with student-set goals (N=13). Means and standard errors are shown. Asterisks signify statistical differences between female students' nLGs for those with teacher-set goals and those with self-set goals. *p<0.05, ***p<0.001

The same process was repeated for males with teacher-set goals (n=18) and those with student-set goals (n=6). There was no initial trend observed between nLGs and goal source for males (Figure 7). Further analysis showed no statistical difference in nLGs for males (Unit 1: TSG=41.6±3.7%; SSG=51.4±3.9%; p=0.28, Unit 2: TSG=47.6±3.2%; SSG=40.1±4.3%; p=0.42, Unit 3: TSG=48.2±3.4%; SSG=43.9±3.1%; p=0.57, Unit 4: TSG=48.9±3.9%; SSG=50.9±5.9%; p=0.91, TSG n=18, SSG n=6, Welch's t-test). These results indicate that the nLGs of males are unaffected by the source of a performance goal.

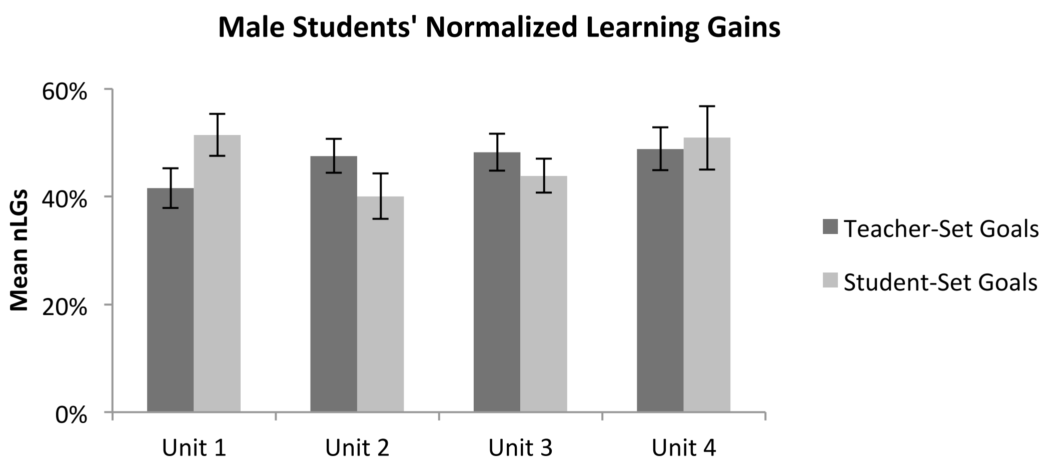

Figure 7. Normalized learning gains for male students with teacher-set goals (N=18) and students with student-set goals (N=6). Means and standard errors are shown.

Effect of Race on Normalized Learning Gains

In a science self-efficacy study, Pajares and Britner found that black students had substantially lower science GPAs than white students, but reported "similar levels of science self-concept… confidence that they could engage in self-regulatory practices…and valued science equally" (Pajares and Britner, 2001). Research suggests that at the middle-school level, differences in mathematics achievement are more closely related to ethnicity than gender (Catsambis, 1994). It was of interest to see if these trends would be observed amongst the students in this study. The nLGs were analyzed by race in order to determine two things: 1) how the implementation of a self-regulatory practice affects the nLGs of black students and 2) if the source of a goal affects the nLGs of one race more than another.

To determine if race plays a role in the effect of performance goal source on nLGs, white students and black students of the control group and the experimental groups were compared to each other (Figure 8). It was observed that white students with assigned performance goals have a higher mean nLGs than black students. It was determined that these differences were not significant (Unit 1: white=47.4±4.5%; black=39.3±4.8%; p=0.23, Unit 2:

white=55.6±3.8%; black=47.6±4.7%; p=0.19, Unit 3: white=58.0±3.9%; black=50.5±5.4%; p=0.26, Unit 4: white=61.1±3.9%; black=46.3±8.2%; p=0.12, white n=22, black n=14, Welch's t-test). This procedure was repeated for students in the experimental group (Figure 9). White students had higher mean nLGs for units two, three and four. However, these differences seen in nLGs for black and white students with student-set goals were found to be insignificant (Unit 1: white=40.6±5.9%; black=40.7±8.1%; p=0.996, Unit 2: white=40.0±4.5%; black=35.6±5.2%; p=0.53, Unit 3: white=48.1±5.1%; black=43.0±44%; p=0.53, Unit 4: white=55.5±7.7%; black=44.2±8.1%; p=0.47, white n=9, black n=10, Welch's t-test). Overall, these results suggest that race does not impact the effect of performance goal source on nLGs. While the data somewhat support the concept that white students experience higher academic achievements than black students, these differences were not found to be statistically significant.

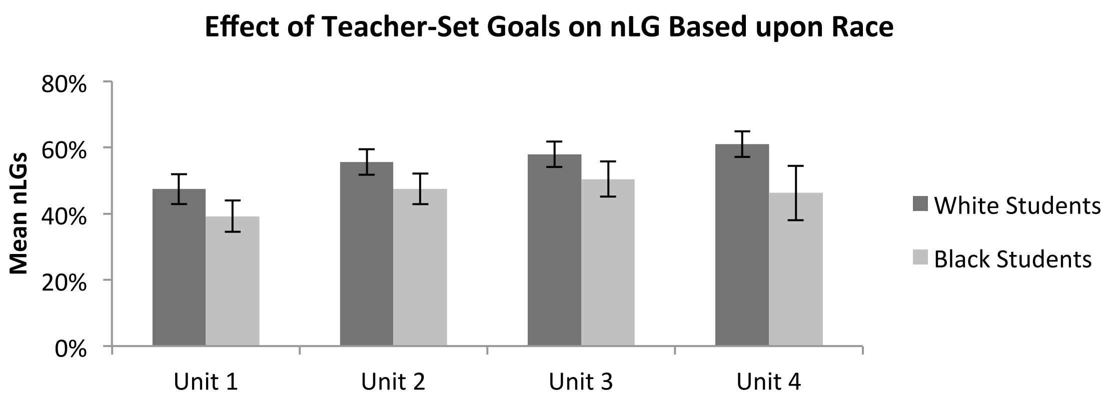

Figure 8. Normalized learning gains for white (N=22) and black students (N=14) with teacher-set goals. Means and standard errors are shown.

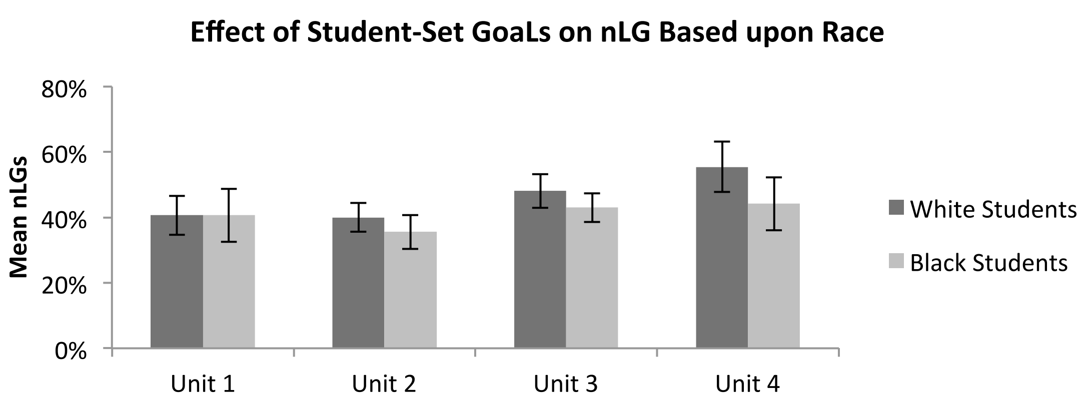

Figure 9. Normalized learning gains for white (N=9) and black students (N=10) with student-set goals. Means and standard errors are shown.

When comparing white students, the data initially showed that white students with teacher-set goals (n= 22) experienced greater learning gains than white students with student-set goals (n=10) (Figure 10). No significant differences in the average nLGs between white students in the control and experimental group were found for Units 1, 3, and 4, but the nLGs for white students with teacher-set goals were statistical higher than those of student-set goals for Unit 2 (Unit 1: TSG=47.4±45%; SSG=40.6±5.9%; p=0.34, Unit 2: TSG=55.6±3.8%; SSG=40.0±4.5%; p=0.02, Unit 3: TSG=58.0±3.9%; SSG=48.1±5.1%; p=0.14, Unit 4: TSG=61.1±3.9%; SSG=55.5±7.7%; p=0.49, TSG n=22, SSG n=10, Welch's t-test). These data indicates that teacher-set goals may result in slightly higher nLGs for white students.

The same process was repeated with data for black students with teacher-set goals (n=14) and those with student- set goals (n=10). Black students with teacher-set goals had higher mean nLGs for Unit 2, 3, and 4 (Figure 11). These differences in nLGs for black students were not statistically significant (Unit 1: TSG=39.3±4.48%; SSG=40.7±8.1%; p=0.88, Unit: TSG=47.6±4.7%; SSG=35.6±5.2%; p=0.10, Unit 3: TSG=50.5±5.4%; SSG=43.0±4.4%; p=0.30, Unit 4: TSG=46.3±8.2%; SSG=44.2±8.1%; p=0.80, TSG n=14, SSG n=10, Welch's t-test). These data suggests that teacher-set goals may result in greater nLGs for black students, but more research is needed to confirm this trend.

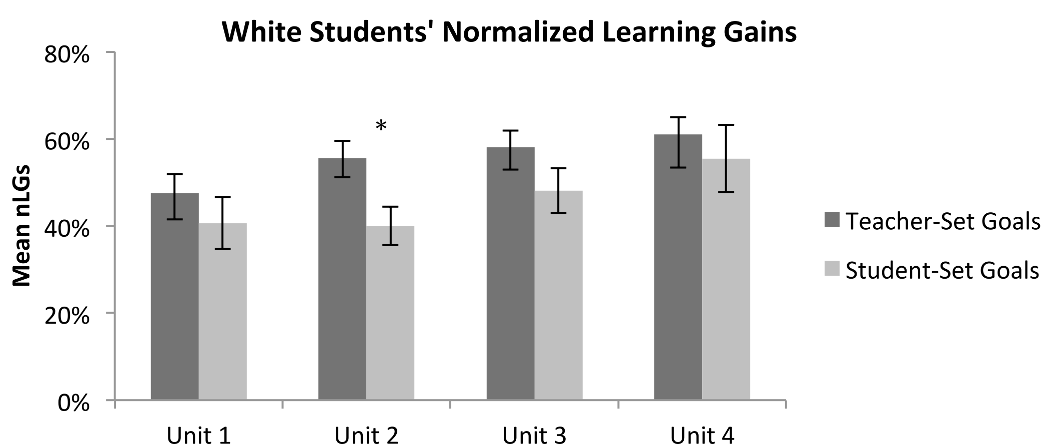

Figure 10. Normalized learning gains for white students with teacher-set goals (N=22) and students with student-set goals (N=10). Means and standard errors are shown. Asterisk signifies statistical differences between white students' nLGs with different goal sources *p<0.05

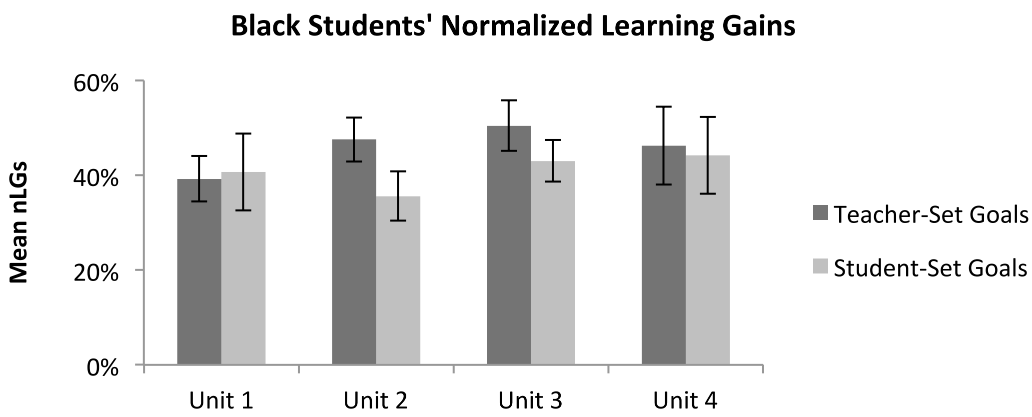

Figure 11. Normalized learning gains for black students with teacher-set goals (N=14) and students with student-set goals (N=10). Means and standard errors are shown

Correlation between Goal Level and Normalized Learning Gains

Multiple studies have shown that more difficult goals result in greater academic achievement (Locke, 1996, Grant and Dweck, 2003, Locke and Latham, 2006). Research has also shown that goal commitment, and therefore goal attainment, can be influenced by assigned goals (Locke and Latham, 1990).

To determine whether there were relationships between student nLGs and goal level and goal source, linear regression analyses were conducted for each unit. In Unit 1, students with teacher-set goals showed a stronger correlation between goal level and nLGsn than those with student-set goals (Figure 12). The slope of the trend-line for the teacher-set goals group (m=1.3126, R^2=0.17955) was steeper than that of the students with student-set goals (m=0.1352, R^2 =0.00112). Further analysis showed that the slope of the trend-line for teacher-set goals was significantly different from zero (TSG n=36; p=0.01) while the slope of the trend-line for student-set goals did not significantly differ from zero (SSG n=19; p=0.89). These results demonstrate that difficult, teacher- set goals do result in higher academic achievement. This supports research that has shown students who are assigned higher, more difficult goals are more likely to experience greater learning gains than students who are assigned lower goals. No relationship between goal level and nLGs was observed for students with self-assigned goals.

The linear regression for goal and nLGs for Unit 2 showed an even stronger relationship than Unit 1 (Figure 13). The slope for teacher-set goals trend-line was steeper (m=1.6708, R^2=0.37578) than the trend-line for student-set goals (m=-0.0102, R^2=$2x10^{-5}$). The trend-line for Unit 2 goals and nLGs for students with teacher-set goals was shown to be significantly non-zero (TSG n=36; p=<0.001) while the trend-line for students with student-set goals was not (SSG n=19; p=0.99). The relationship between goals and gains for teacher-assigned goals grew stronger in Unit 2 while the relationship for student-assigned goals became weaker.

The linear regression for Unit 3 followed the same trend seen in the first two units (Figure 14). The slope of the best-fit line for teacher-set goals was once again steeper (m=1.5578, R^2=0.38835) than that of student-set goals (m=0.1871, R^2=0.00868). The slope for teacher set goals was shown to be significantly different than zero (TSG n=36; p=<0.001) and the slope for student-set goals was not (SSG n=19; p=0.71). Once again, higher goals produced higher gains when assigned by the teacher.

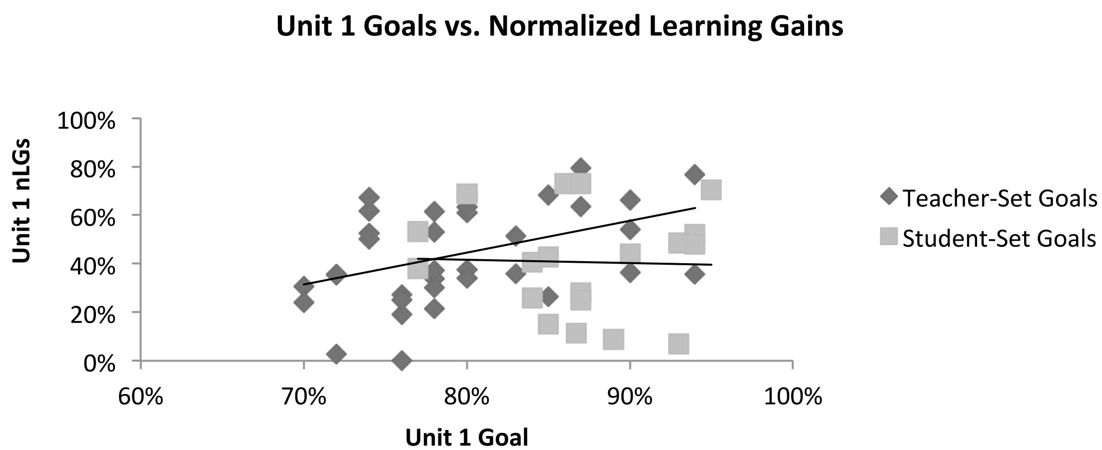

Figure 12. Unit 1 goals and normalized learning gains linear regression for students with teacher-set goals (N=36) and students with student-set goals (N=19).

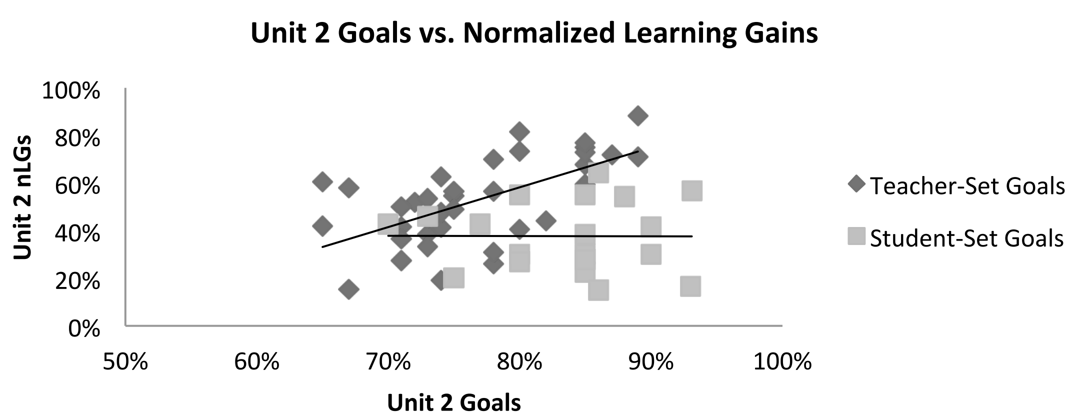

Figure 13: Unit 2 goals and normalized learning gains linear regressions for students with teacher-set goals (N=36) and students with student-set goals (N=19).

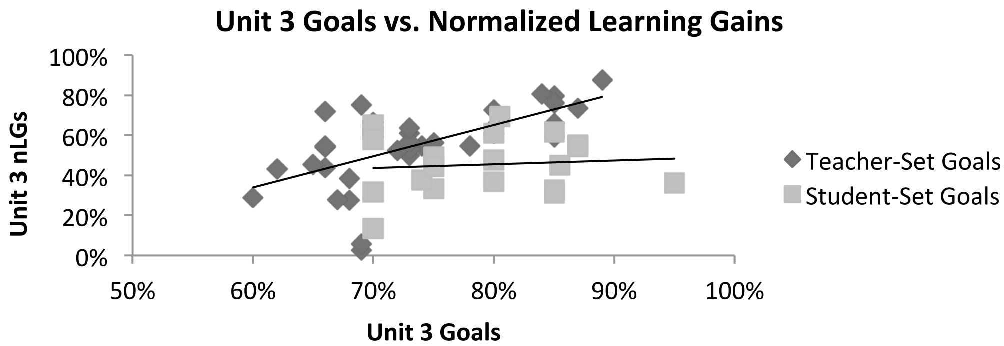

Figure 14**:** Unit 3 goals and normalized learning gains linear regression for students with teacher-set goals (N=36) and students with student-set goals (N=19).

Unit 4 also showed a stronger relationship between goals and gains for teacher-assigned goals. The best-fit line slope for teacher-set goal was steepest (m=1.872, R^2=0.46958) in Unit 4 and was shown to be significantly different from zero (TSG n=36; p <0.001). The best-fit line slope for student-set goals was also steepest (m=0.8776, R^2=0.09457) in Unit 4, but the slope was shown to not significantly differ from zero (SSG n=19; p=0.12). Teacher-set goals consistently produced a significantly stronger relationship between goal level and nLGs than student-set goals.

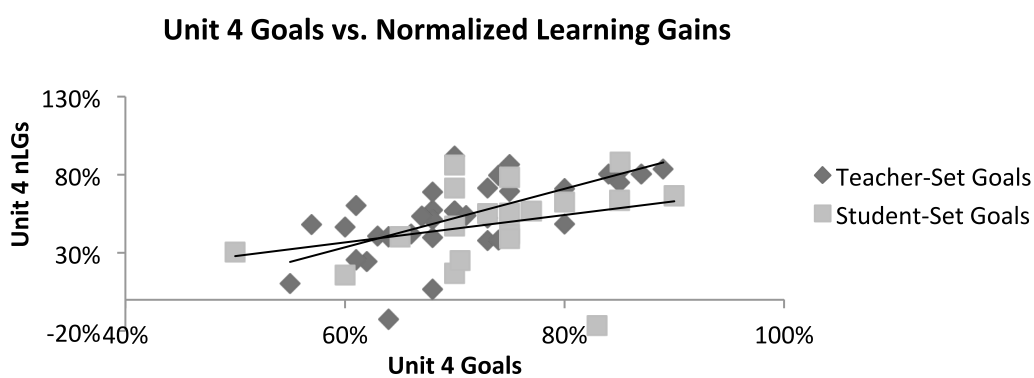

Figure 15**:** Unit 4 goals and normalized learning gains linear regression for students with teacher-set goals (N=36) and students with student-set goals (N=19).

Changes in Goals Over Time

Because most students are over-confident about their academic abilities (Pajares and Britner, 2001) and have unrealistic levels of self-efficacy, it was expected that student-set goals would be higher than teacher-set goals. It was also expected that student-set goals would become more realistic and more closely aligned with teacher-set goals based upon Bandura's (1986) concept of reciprocal determinism: people's interpretation of previous goal attainment is used to inform changes in future performances. Because the main goal of this study was to promote the development of self-efficacy in both groups, it was of use to study how goal levels changed over the course of the study.

To determine if goals were changing between units and the rate at which they were changing, the average unit goals for both the control and experimental group were compared to each other. The teacher-assigned goals were shown to be significantly different from student-set goals for Units 1, 2, and 3, but not for Unit 4 (Unit 1: TSG=79.8±1.1%; SSG=87.0±1.2%; p=<0.0001, Unit 2: TSG=76.6±1.1%; SSG=83.5±1.5%; p=0.0006, Unit 3: TSG=73.6±1.2%; SSG=79.4±1.7%; p=0.0076), Unit 4: TSG=71.6±1.5%; 73.6±2.1%; p=0.45, TSG n=36, SSG=19, Welch's t-test). The average goal difference between student' Unit 1 and Unit 4 goal was -8.167±0.8614% for students with teacher-set goals and -13.43±2.540% for students with student-set goals, however this difference in goal level decrease was shown to not be significantly different between the two groups (p=0.063, Welch's t-test).

The average teacher-set goal for each unit was shown to be statistically different from each other, showing that the goals being set for each unit were unique (n=36; p-value=<0.0001; one-way ANOVA). Whenever the same analysis was applied to the average student-set goal for each unit, the same trend was seen (n=19; p-value=<0.0001, one-way ANOVA). These data shows that teacher-set goals were initially lower than student-set goals at the beginning of the experiment, but both student-set and teacher-set goals changed significantly over the course of the experiment (Figure 16).

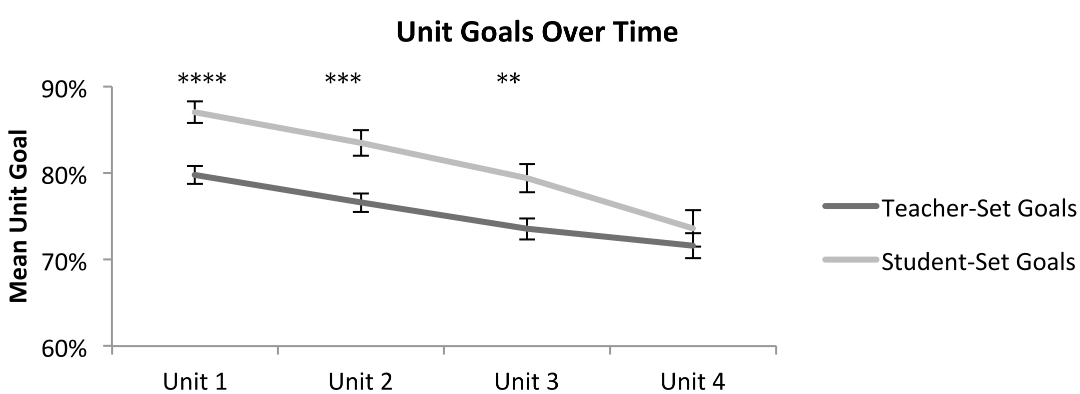

Figure 16. Unit goals over time for students with teacher-set goals (N=36) and students with student-set goals (N=19). Mean unit goals and standard errors are indicated. Asterisks signify statistical differences between the mean goal set by the groups. *p<0.05, ***p<0.001, ****p<0.0001

Goal Attainment Over Time

As self-efficacy increases, it would be expected that goal attainment would also increase. As previously stated, students interpretation of past performances is used to modify future performance (Bandura, 1986). It was expected that over time, more and more students would attain their goals as their development of self-efficacy and self-belief progressed. It was also expected that students with self-set goals would have lower rates of goal attainment due to a lack of direction in setting manageable goals. When students are in familiar situations, they will use task-specific self-efficacy that is closely tied to the task at hand (e.g. setting unit exam goals based on previous goal attainment). If the student is in an unfamiliar situation, as was most of the experimental group, he/she is forced to generalize their ability to complete this new task based upon previous achievements on tasks they perceive to be similar to the current one at hand (Pajares, 1996). Because the concept of goal-setting was new to the students, the probability of them having past experiences similar to the task they were asked to perform was low, leading to unrealistic estimations of performance abilities. However, as the students progressed through the units, they developed a better understanding of the task, and therefore were expected to develop a better sense of their abilities. If true, this would lead to greater goal attainment in the later units for students with student-set goals.

In order to determine the rate of goal attainment, each student had their post-exam score subtracted from the goal score set for that unit. A positive score indicates achievement of the goal and a negative score indicates a failure to achieve the goal. For each unit, the difference between each student's goal score and post-test score was calculated. The average distance between these two were then compared between students that were assigned goals and students that set their own goals (Figure 17). Both groups averaged a negative goal attainment for all four units, meaning students typically did not achieve their unit goal.

For all four units, students with self-set goals were further from achieving their goals than students with teacher-set goals. It was found that students with student-set goals were significantly further from achieving their goal than those with teacher-set goals for Unit 1. The differences in goal attainment were not found to significant for Unit 2, Unit 3, and Unit 4. (Unit 1: TSG=-11.0±1.5%; SSG=-20.6±29%; p=0.0065, Unit 2: TSG=-11.3±1.7%; SSG=-17.6±3.4%; p=0.11, Unit 3: TSG=-7.2±1.7%; SSG=-8.8±2.8%; p=0.65, Unit 4: TSG=-0.8±1.7%; SSG=-7.3±3.0%; p=0.07, TSG n=36, SSG n=19, Welch's t-test).

Each group's progression towards goal attainment was also analyzed to determine if goals were unique from unit to unit. It was found that student's goal attainment changed significantly between each unit for students with teacher-set goals and for students with self-set goals (experimental: n=36; p=<0.0001, control: n=19; p=0.0003, ANOVA).

For each unit, students were classified into one of four categories based upon their goal attainment: further than 5% from goal, less than 5% from goal, exceeded goal by less than 5%, exceeded goal by more than 5%. For each unit, the percentage of students that fell into each category was calculated (Table 1).

The largest category of students for Unit 1 was students who failed to achieve their unit goal by greater than 5%; the smallest category was students who exceed their unit goal by more than 5%. By Unit 4, there were equal amounts of students that fell into the categories of "further than 5% from goal," "met or exceeded goal by less than 5%, and "exceeded goal by more than 5%" for students with teacher-set goals, each category containing 27.80% of students. The largest category of students with student-set goals for Unit 4 remained "further than 5% of goal," with 57.90% of students falling into this category. These results suggest that most students with self-set goals were still unable to set manageable goals by the end of Unit 4. However, the fact that 21.2% of students were close to attaining their goals and 21.2% of students were able to exceed their goals demonstrates that an increase in self-efficacy for many students.

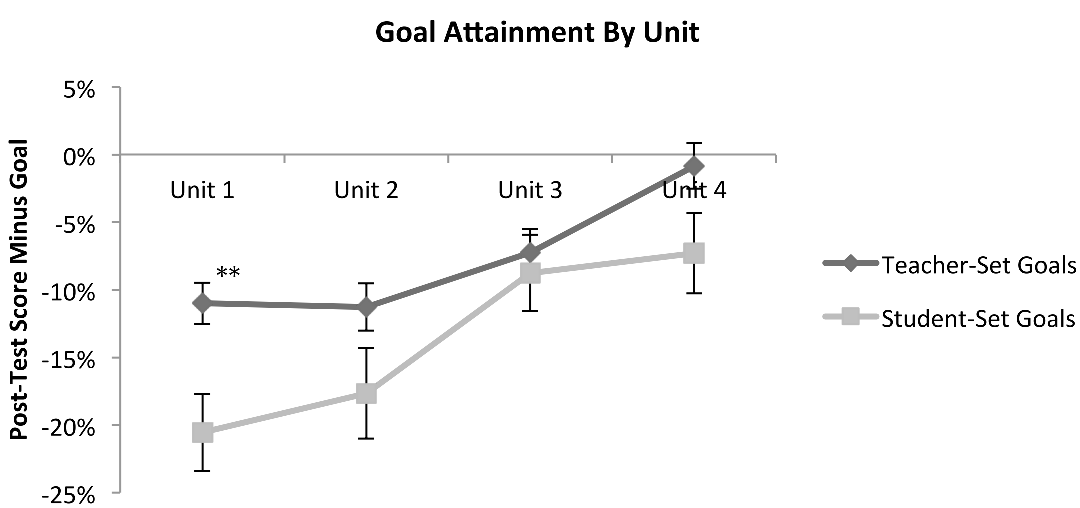

Figure 17. Goal attainment by unit for students with teacher-set goals (N=36) and students with student-set goals (N=19). Mean distance from goal and standard errors are indicated. **p<0.01

Table 1. Percentage of students in goal categories by unit. Percentages for students with teacher-set goals (N=36) and student-set goals (N=19) are shown.

Unit	Further than 5% from goal		Less than 5% from goal		Met or exceeded goal by less than 5%		Exceeded goal by more than 5%	
	Teacher-Set Goals	Student-Set Goals	Teacher-Set Goals	Student-Set Goals	Teacher-Set Goals	Student-Set Goals	Teacher-Set Goals	Student-Set Goals
1	69.4%	84.2%	16.7%	10.5%	11.1%	5.3%	2.8%	0%
2	63.9%	73.7%	15.8%	15.8%	13.9%	10.5%	2.8%	0%
3	44.4%	63.2%	27.8%	10.5%	19.4%	15.8%	8.3%	10.5%
4	27.8%	57.9%	16.7%	21.2%	27.8%	0%	27.8%	21.1%

Between Units 1 and 4, there was a greater decrease in the number of students that were further than 5% from the goal amongst students with teacher-set goals (Figure 18). The slope of the trend-line showing the percent change in students who are further than 5% from the unit goal was steeper for students with teacher-set goals (m=-0.4054) than students with self-set goals (m=-0.2105). Conversely, there was a greater increase in the number of students who exceeded their goal by more than 5% between Units 1 and 4 for students with teacher-set goals (Figure 19). The slope of the trend-line showing the percent change in students who exceeded their goals by more than 5% was steeper for students with teacher-set goals (m=0.2433) than students with self-set goals (m=0.1579). These results indicate that teacher-set goals lead to greater rates of goal attainment.

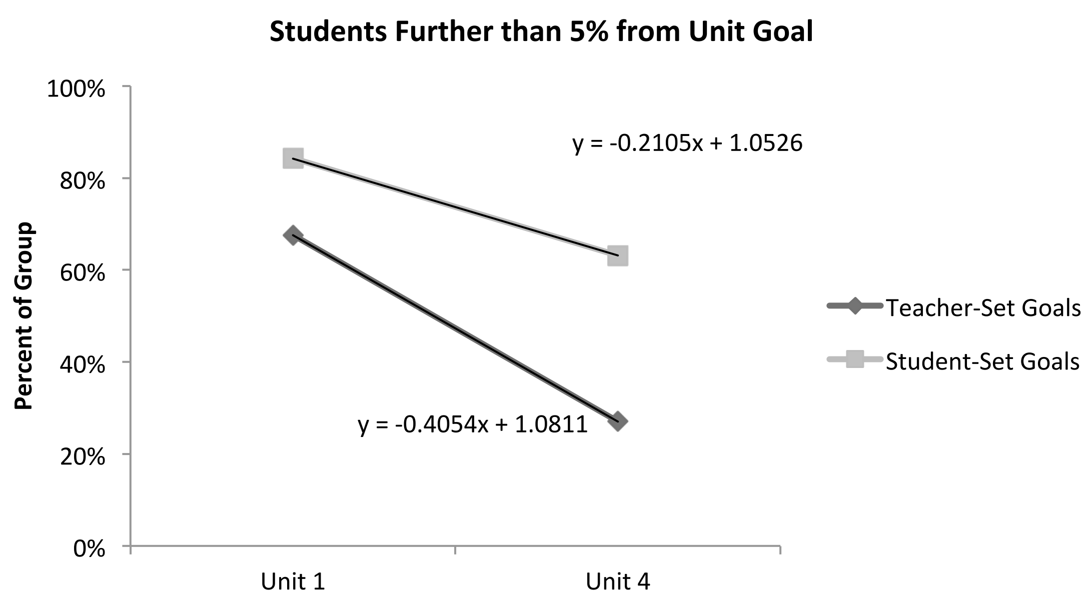

Figure 18: Students further than 5% from unit goal between Units 1 and 4 for students with teacher-set goals (N=36) and students with student-set goals (N=19). Equation of line is shown.

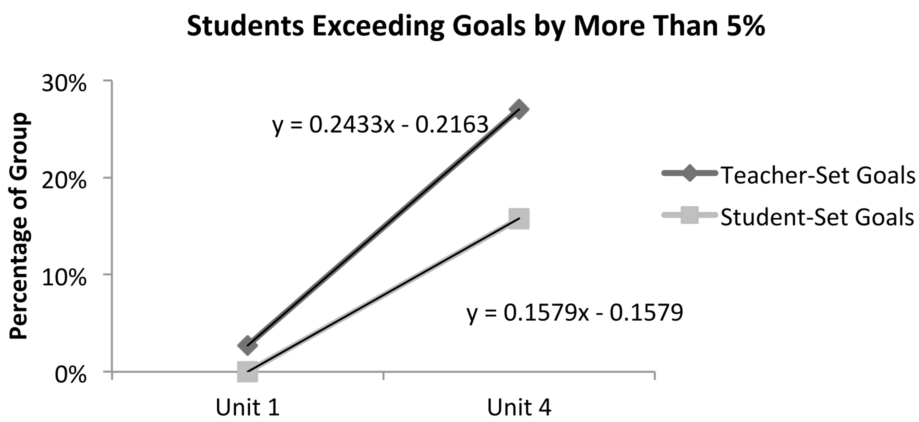

Figure 19**:** Students exceeding unit goal by more than 5% between Units 1 and 4 for students with teacher-set goals (N=36) and students with student-set goals (N=19). Equation of line is shown.

Effects of Goal Source on Test Anxiety

It was predicted that test anxiety would be reduced through the use of goals. It was of use to explore the effects of goal source on test anxiety because test-anxiety has been shown to have a negative correlation on exam performance and overall grades while self-efficacy and self-regulation have both been shown to have positive correlations with the same factors for seventh grade science students (Pintrich and Groot, 1990). Because the major goal of this experiment was to foster the development of self-efficacy through the self-regulation strategy of performance goals, it was useful to examine students' test anxiety levels at the beginning and end of the experiment.

Student test anxiety was measured via a 35-question survey administered prior to beginning Unit 1 and at the conclusion of Unit 4. These survey data were analyzed by calculating the mean anxiety rating and standard error for pre-experiment anxiety and post-experiment anxiety. The control group had a pre-experiment test anxiety rating of 14.74±1.10 and the average post-experiment score was 16.00±1.14. The experimental group had a pre-experiment test anxiety rating of 17.0±0.92 and the average post-experiment score was 19.89±1.23 (Figure 20). These initial levels of test-anxiety were found to be statistically similar (TSG n=36; SSG n=19; p=0.18, Welch's t-test). The same treatment was applied to the post-experiment test-anxiety scores. It was found that the post-experiment test anxiety of students with student-set goals was significantly higher (TSG n=36; SSG n=19; p=0.038, Welch's t-test) than those with teacher-set goals. While both groups did show a slight increased in text-anxiety over time, the pre- and post-experiment anxiety levels did not change significantly for the control group and the experimental group (control: Δ=+1.3; n=36; p=0.11, experimental: Δ=+2.9; n=19;p=0.05, paired t-test). This shows that although the students with student-set goal ended with higher anxiety, overall, test anxiety does not change significantly with the presence of a goal.

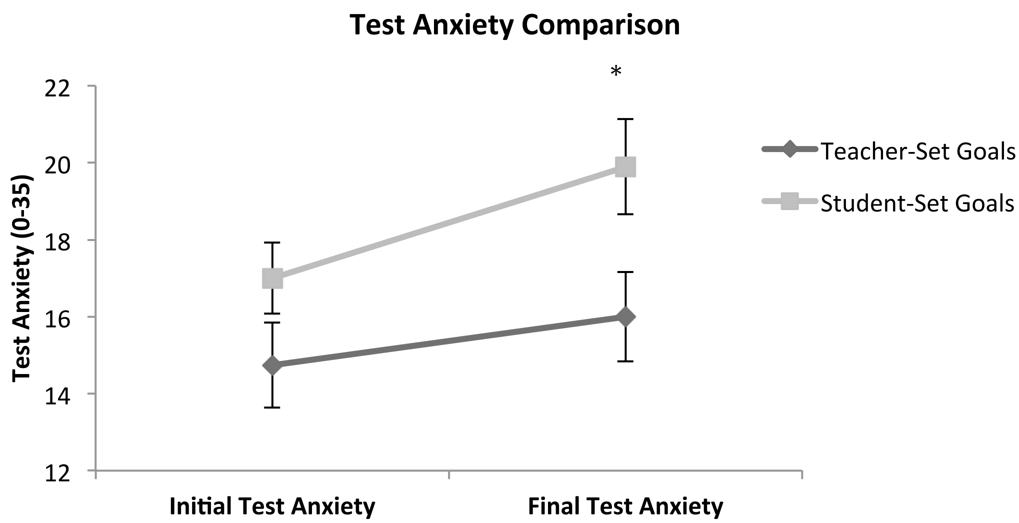

Figure 20: Changes in test anxiety over time for students with teacher-set goals (N=36) and students with student-set goals (N=19). Mean test anxiety ratings and standard errors are indicated. Asterisk indicates significant difference in groups' final test anxiety. *p<0.05

Effect of Test Anxiety on Growth and Goal Attainment

Students with high test anxiety demonstrate lower academic performance than peers with less anxiety (Zeidner, 1998). Furthermore, performance goals have shown to have a positive correlation with fear of failure and overall test anxiety (Elliot and Church, 1997). For these reasons, it was expected that as students' test anxiety increased, lower nLGs and less goal attainment would be achieved

In order to determine the effect of test anxiety on student growth, two linear regressions were generated. The first compared students' initial test anxiety to their unit 1 nLGs (Figure 21). The slope of the teacher-set goals best-fit line (m=-0.0008, R^2=0.00067) was shown to not be significantly different from zero (n=36; p=0.88). The slope of the student-set goals best-fit line (m=-0.029, R^2=0.28908) was shown to be significantly different from zero (n=19; p=0.02). There was no correlation between initial test anxiety and nLGs for students with teacher-set goals, but a weak correlation was found for students in the experimental group. The second linear regression compared students' final test anxiety to their unit 4 nLGs (Figure 22). The best-fit line slope (m=-0.0072, R^2=0.04751) for teacher-set goals was not significantly different from zero (n=36; p=0.20) while the best-fit line slope for student-set goals (m=-0.0212, R^2=0.21619) was different from zero (n=19; p=0.05). These results indicate that there is an inverse relationship between test anxiety and nLGs for students who are allowed to set their own goals, but not for students who are assigned goals.

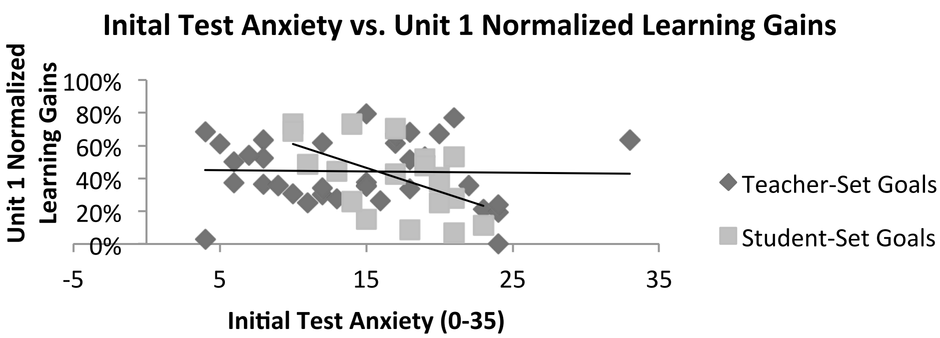

Figure 21: Initial test anxiety and Unit 1 normalized learning gains linear regression for students with teacher-set goals (N=36) and students with student-set goals (N=19).

To observe any correlations between test anxiety and goal attainment, a linear regression comparing students' initial test anxiety and goal attainment for unit 1 was generated (Figure 23). The best-fit line slope for students in the control group (m=-0.0023, R^2=0.02692) was not significantly different from zero (n=36; p=0.34). The best-fit line slope for students in the experimental group (m=-0.0117, R^2=0.14396) was also not significantly different from zero (n=19; p=0.11)

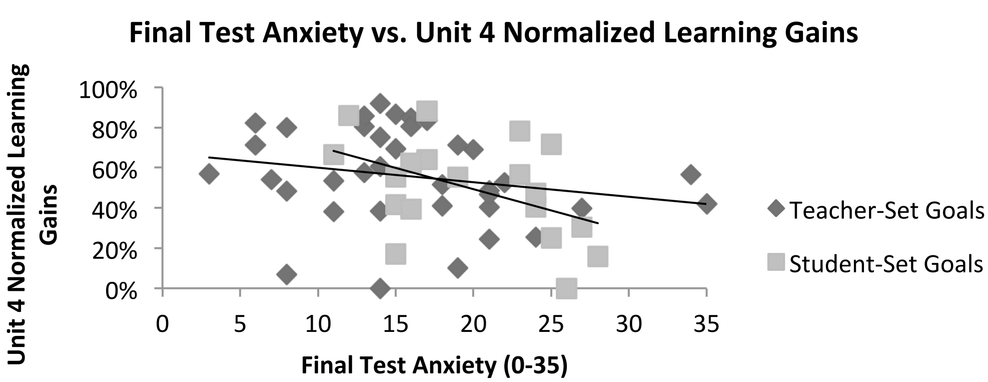

Figure 22: Final test anxiety and Unit 4 normalized learning gains linear regression for students with teacher-set goals (N=36) and students with student-set goals (N=19).

This process was repeated with students' final test anxiety and their unit 4 goal attainment to determine if the use of performance goals led to a relationship between test anxiety and goal attainment (Figure 24). The best-fit line slope for students in the control group (m=-0.0033, R^2=05051) was not different from zero (n=36; p=0.19) and the best-fit line slope for students in the experimental group (m=0.0005, R^2=0.00036) was not significantly different from zero (n=19; p=0.94).

These results indicate that there was no significant correlation between test anxiety and goal attainment neither at the beginning nor at the end of the experiment.

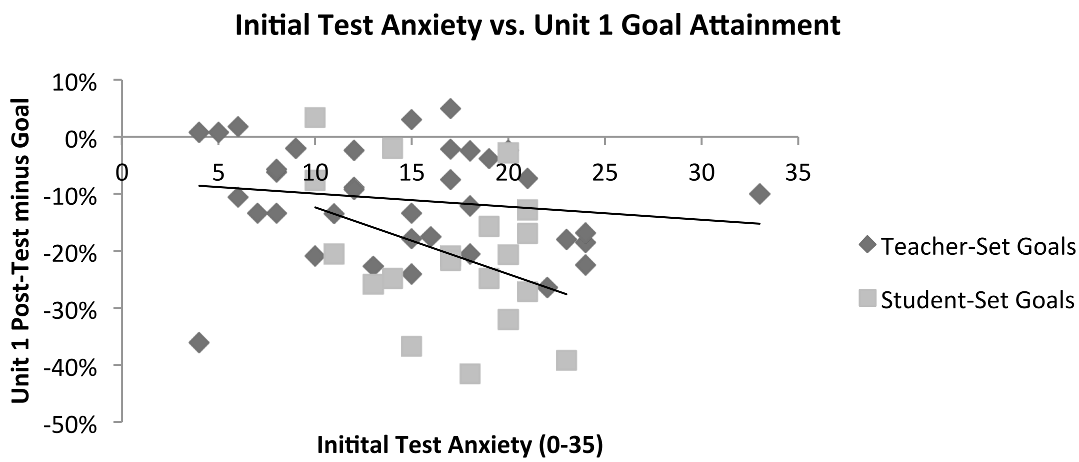

Figure 23**:** Initial test anxiety and unit 1 goal attainment linear regression for students with teacher-set goals (N=36) and students with student-set goals (N=19).

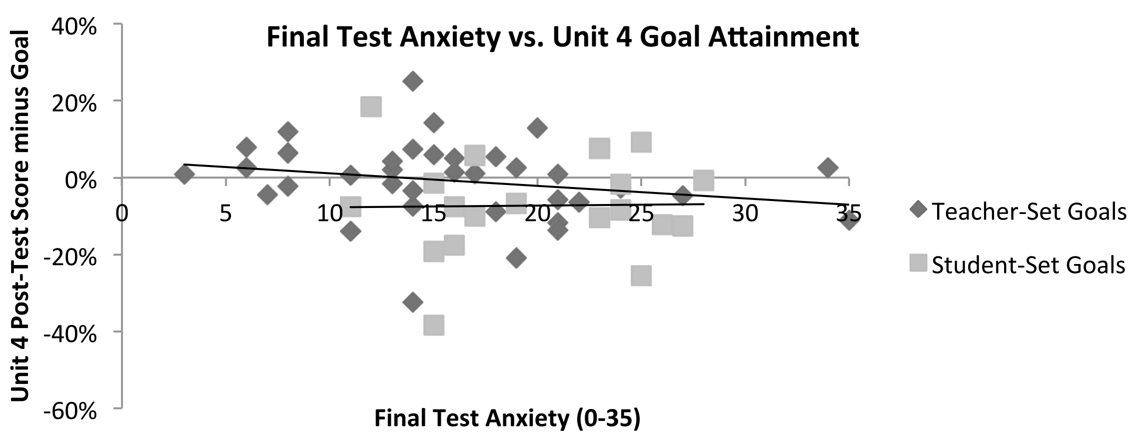

Figure 24. Final test anxiety and Unit 4 goal attainment linear regression for students with teacher-set goals (N=36) and students with student-set goals (N=19).

Effect of Goal Source on Goal Orientation

Research has shown that students who maintain both mastery-goal and performance-goal orientations benefit more than those who maintain only one type of orientation (Harackiewicz et al., 2000). Both types of goals have been positively associated with high standards (Eum and Rice, 2011), which is something that is expected of students at MSA. However, goal orientation is an intrinsic attribute that is developed with time and depends on several factors outside of the classroom. Therefore, it was expected that students would maintain their natural orientations.

Students' level of performance and mastery goal orientation was evaluated based upon students' answers to a goal-orientation survey (see Appendix I). The mean performance goal and mastery goal orientations were calculated along with the standard error of these means for both groups (Table 2).

Table 2**.** Initial and final goal orientation scores for both performance and mastery goals. Mean percent score and standard error are shown.

	Performance Goal Orientation		Mastery Goal Orientation	
	Initial	Final	Initial	Final
Teacher-Set Goals (N=36)	82.50 ± 2.04%	78.13 ± 2.46%	84.56 ± 1.46%	77.38 ± 2.17%
Student-Set Goals (N=19)	82.81 ± 2.69%	80.35 ± 2.55%	86.47 ± 1.76%	75.94 ± 3.28%

The initial performance goal orientations and the final performance goal orientations of both groups were compared. The initial levels of performance goal orientation, as well as the final levels of performance goal orientation, for both groups were not significantly different (initial levels: TSG=82.5±2.0%; SSG=82.8±2.7%; $p=0.93$, final levels: TSG=78.1±2.5%; SSG=80.4±2.6%; $p=0.54$, TSG $n=36$, SSG $n=19$, Welch's t-test). Whether each group's performance goal orientation significantly changed over the course was also analyzed (Figure 25). It was found that there were no significant changes in performance goal orientation for students with teacher-set goals and for students with student-set goals (control: $\Delta=-4.4$ %; $n=36$; $p=0.10$, experimental: $\Delta=-2.5\%$; $n=19$; $p=0.34$, paired t-test). These results indicate that students maintained their natural levels of performance goal orientation over the course of the experiment.

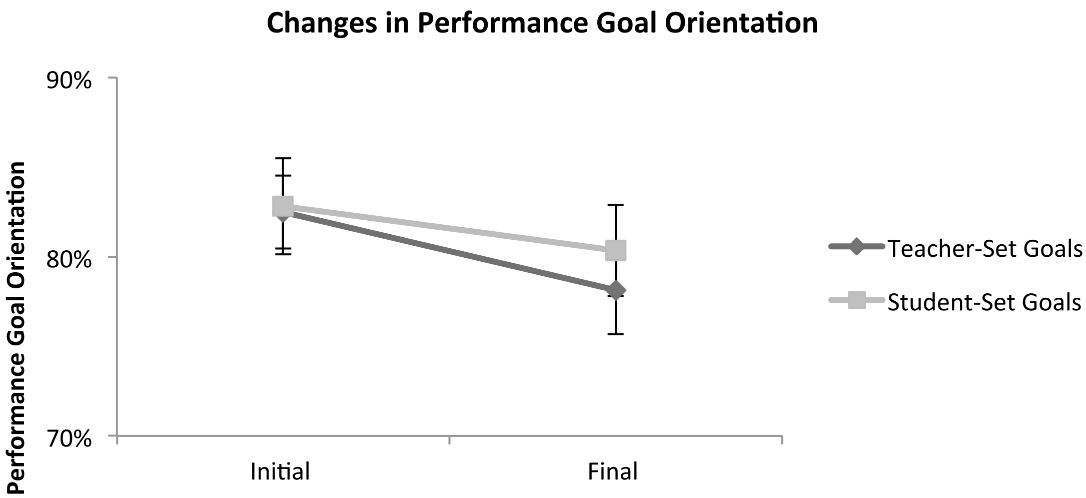

Figure 25. Changes in performance goal orientation for students with teacher-set goals (N=36) and students with student-set goals (N=19). Mean scores and standard errors are indicated.

The same procedure was followed when analyzing changes in students' mastery goal orientation (Figure 26). The initial levels and final levels of mastery goal orientation for both groups were found to not be statistically different (initial levels: TSG=84.6±1.5%; SSG=86.5±1.8%; p=0.41, final levels: TSG=77.4±2.2%; SSG=75.9±3.3%; p=0.72, TSG n=36, SSG n=19, Welch's t-test). The level of mastery goal orientation dropped significantly over the course of the experiment for both groups (control: Δ=-7.2%; n=36; p=0.003, experimental: Δ=-10.5%; n=19; p=0.004, paired t-test). This indicates that both groups experienced similar amounts of change in mastery goal orientation over the course of the experiment.

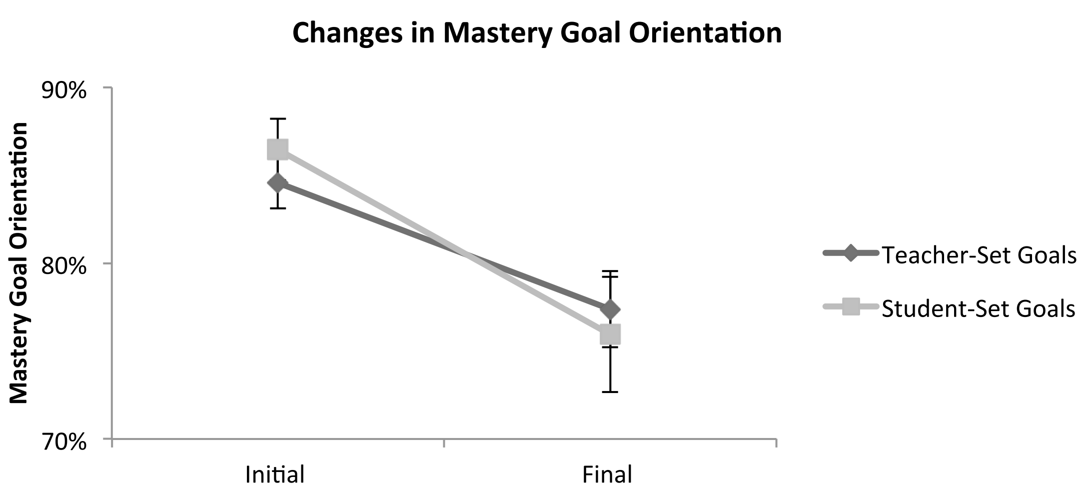

Figure 26. Changes in mastery goal orientation for students with teacher-set goals (N=36) and students with student-set goals (N=19). Mean scores and standard errors are indicated.

Students' Perceptions of Goals

Both groups of students were given a mid-year survey (Table 3). For each statement, students could rank their level of agreement on a scale of 1 -5 (see Appendix K). For each question, a Welch's t-test was analyzed for significant differences in opinions between students with teacher-set goals and those with student-set goals. No statistical differences were found between the groups, indicating similar opinions for each question. Overall, students valued not only having goals but also taking pre-tests. The most popular statement was "I like having goals to work towards," with an average agreement of 4.16±0.127 for students with teacher-set goals and 4.26±0.168 for students with self-set goals. Students also seemed to recognize that goals make them more aware of their grades and motivate them to work harder in class. The least popular statement on the survey was "I prefer to have my teacher set my goals," with an average agreement of 3.11±0.231 for students with teacher-set goals and 3.05±0.28 for students with self-set goals. However, a score of 3 would indicate indifference about the statement, not a negative response. These results indicate that students enjoy having goals and that goals promote grade awareness. Furthermore, because there were not average scores below 3 for either group, it seems that the overall response towards the use of goals was positive amongst the students involved in this study.

Table 3: Mid-year attitude survey responses. Survey scores ranged from 0 (strongly disagree) to 5 (strongly agree). Means and standard deviations are shown.

Statement	Teacher-Set Goals		Student-Set Goals	
	M	SD	M	SD
I like having a goal to work towards	4.16	0.76	4.26	0.73
Having a goal motivates me to work harder in class	4.14	0.89	4.11	0.88
Having a goal has lead to me studying more for quizzes & exams	3.85	1.02	3.58	0.90
Having a goal has made me more aware of my grades in class	4.08	1.12	4.11	0.88
I prefer to set my own goals	3.46	1.22	3.84	1.26
I prefer to have a teacher set my goals	3.11	1.39	3.05	1.22
Taking a pre-test is useful	4.03	1.32	3.89	1.10
I wish other teachers gave me pre & post tests	3.35	1.34	3.05	0.97
I wish other teachers gave me goals to work towards	3.49	1.15	3.32	1.06

CONCLUSIONS

Effects of Goal Source: Overview

The findings of this study support the use of performance goals in the classroom, with more favorable results being found for teacher-set goals than for student-set goals. All students began each unit with similar amounts of content knowledge and produced similar post-test scores. However, students with teacher-set goals consistently experienced higher nLGs, these results being significant for Unit 2 and Unit 3. Because Unit 1 was on scientific method, which is taught every year, it is understandable that the students had similar nLGs. Conversely, the Unit 4 post-test was given during the same week as Common Core mandated questions. The students may have been over-tested and therefore less driven to perform on the exam. Nevertheless, these results indicated that teacher-set goals promote greater nLGs.

The nLGs were further analyzed by gender and race. When assigned a performance goal by the teacher, female students earned higher nLGs than male students, this difference being significant for Unit 3. Females with teacher-assigned goals also generated higher nLGs than those with self-assigned goals for each unit, these results being significant for Unit 2 and Unit 3. There were no notable differences in nLGs between black and white students. However, white students with teacher-set goals experience greater nLGs than those with student-set goals. Because the experimental and control groups were small, further dividing the groups by race and gender created even smaller sample sizes. Stronger, more reliable results could potentially be obtained if this experiment were to be repeated with a larger sample size of students.

In a study conducted at Michigan State University, it was found that goal commitment is stronger if the goal is made public (Hollenbeck et al., 1989). The students' goals in this experiment were not private. Both the experimenter and the student were aware of the performance expectation at the beginning of each unit, however just the mere fact that an authority figure was assigning the goal may have led to increased achievement for students with teacher-set goals. A workplace study conducted by Locke and Latham demonstrated that goals set by authority figures play a major role in motivating subjects' performance. A person who is assigned a goal may feel that their superior considers them capable of attaining the goal. Subsequently, the person will alter their behavior to achieve the goal in order to prove to their superior that they are, in fact, capable of the work (Locke and Latham, 1990). These studies correspond with the success seen not only amongst students with teacher-set goals, but also the success seen among white students and female students. Because the experimenter was both white and female, there may have been an added pressure among these subgroups to prove their competency. It may be of interest to others to investigate if students with teachers who have the same gender/ethnicity as them experience greater academic achievement than their peers.

When analyzing the data for a correlation between unit goals and nLGs, the control group consistently demonstrated a positive correlation between goal level and learning gains for all four units. No correlation between these two factors could be established for the experimental group. It is postulated that students who set their own goals assigned themselves difficult goals that were created out of context. This resulted in goals that were insignificant to their creators. According to Locke and Latham (1996), high goal commitment is associated with goals that are considered important. Because the goals created by the students were perceived as unimportant, the goal commitment for these students was low. In having low goal commitment, these students also had less motivation to perform than their peers in the control group. This would explain the lack of correlation between goals and nLGS seen in the experimental group.

While the mean unit goal for both groups significantly decreased over the course of the experiment, the unit goals set by students were significantly higher than those set by the teacher for the first three units. Furthermore, the rate of goal attainment seen in the experimental group lagged in comparison to that of the control group at the beginning of the experiment. By Unit 4, both group's mean unit goal and goal attainment were statistically similar. These trends indicate that by the end of the experiment, students in the experimental group were setting more realistic goals. By adjusting the goals, both groups experienced an increase in the number of students achieving their goals and a decrease in students who failed to meet their goals.

Most seventh grade students lack the ability to self-regulate their own learning. Students at this age lack both the ability to conceptualize what a challenging, realistic goal is, and the self-regulation to achieve those goals (Zimmerman, 1989). However, experimental studies have shown that student who are taught how to set their own goals have greater self-efficacy, higher academic attainments, and are most interested in their areas of study (Zimmerman et al., 1992). Pajares (1996) suggests that the development of self-efficacy, which impacts academic achievement, can be influenced by acquiring cognitive skills, modeling by teachers, feedback on performance, and the presence of goals. All of these factors were present for the control group and only modeling was absent for the experimental group. The lack of modeling had a notable effect in the experimental group while its presence in the control group lead to greater academic success for those students. The results of this experiment correspond with the findings of Pajares (1996) and Zimmerman et al. (1989): the students who were *taught* what reasonable goals are through teacher-set goals did demonstrate better self-regulation and self-efficacy.

Effect of Test Anxiety on Growth and Goal Attainment

It was initially expected that high test anxiety would be inversely related to student growth. A statistically significant, negative correlation between test-anxiety and nLGs was initially established for students with self-assigned goals. This inverse relationship parallels what has been observed in other studies. Zatz and Chassin (1985) found that as anxiety increases, test performance drops. It has also been shown that as the importance of an evaluation increases, the performance of students with high test anxiety decreases significantly (Hancock, 2001). Because this anxiety correlates with the Unit 1 exam, the students' first major exam in the class, it is understandable that anxiety would be higher in students with no direction on reasonable goals. A very weak correlation between anxiety and nLGs could be established for experimental group at the end of the experiment, but not for students with teacher-set goals throughout the whole experiment. The lack of correlation between test anxiety and normalized learning gains seen with the control group is difficult to explain. It is hypothesized that perhaps students gained confidence from the fact that their goals were set purposefully by the teacher. Because goals were set based upon the teacher's perceive ability of the students, children with teacher-set goals may have had greater confidence in their own capabilities, felt more in control of their situation, and therefore were less affected by test anxiety.

Effects of Performance Goals on Test Anxiety

It was hypothesized that the presence of performance goals would lead to a reduction in test anxiety, this decrease being stronger amongst students with teacher-set goals. These data do not support this hypothesis. Both groups began the experiment with statistically similar test-anxiety survey scores and showed an increase in test-anxiety. These increases mirror trends seen in previous research. Performance goals have been associated with increased amounts of test anxiety (Elliott and Church, 1997). In the case of this experiment, the overall increases in test anxiety were found to not be statistically significant for each group. However, students with self-set goals were shown to have significantly higher final test anxiety than student with teacher-set-set goals. Having important academic goals has been associated with increased levels of anxiety (Eum and Rice, 2011). Students with self-set goals may have higher post-experiment test anxiety because repeated failure to attain self-set goals. Because anxiety did not show a significant change through the use of performance goals, no correlation between performance goal use and test anxiety can be claimed.

Maintenance of Goal-orientation

It was hypothesized that there would be no major change in students' natural goal-orientation between the beginning and end of the experiment. When comparing students' goal orientation survey responses from the beginning and end of the experiment, there were no significant changes to performance goal orientation for students in both groups, but there were significant decreases in the level of mastery goal orientation reported by the students in both groups. This decrease in mastery goal orientation may be due to student's academic environment. The normative culture of the school places a great emphasis on grades and not necessarily on content mastery. As observed by Harackiewicz et al. (1997), mastery goals correlated with lower amounts of competitiveness and lower final grades. Students strongly associated their letter grades with their level of understanding, and so "mastering" a topic is not as much of a concern as performing on exams. Seventh grade is when students at MSA begin to be considered for advanced placement classes, so it would make sense that their orientation towards mastery goals would decrease as their attention begins to become primarily focused on GPA and outperforming their peers.

Moving Forward

It has been demonstrated that setting performance goals for middle school students does lead to greater academic achievement and goal attainment than allowing them to set their own goals. These results support the idea that goals can be useful in students' development of self-monitoring as long as the goals set are reasonably difficult and students are motivated to achieve them.

Though this experiment did illuminate some interesting trends between performance goal source and student achievement, the results do come with some limitations and restrictions. The main limitation was sample size of the groups. Compared with other experiments performed at the collegiate level, this study's sample size was small. It would be beneficial to repeat this experiment in a setting with more participating 7^{th} grade students. A second limitation was time. This study only covered four units of material. Stronger results may be attained in a study that investigates the effects of performance goal source over a longer period of time.

As indicated by the mid-year attitude survey responses, students enjoy having goals because the goals are motivating and make students more aware of their grades. However, they show apprehension when it comes to using goals in other courses. It would be of great interest to repeat a similar experiment in other 7th grade courses. Perhaps teacher-set performance goals could lead to greater learning gains in other courses such as Math or American History.

Ending the experiment with statistically similar goals for both groups leads the experimenter to speculate about the power of self- assigned goals' long-term use. It may be of use to conduct a multi-year study in which teacher-assigned and student-assigned goals are given to students during all three years of middle school. It is postulated that initial differences similar to those reported in this study would be seen, but eventually student-set goals and teacher-set goals not only would be similar, but also achievement of those goals would be parallel.

There is a valid argument for the implementation of goals in the middle- school classroom. Goals are known to play crucial role in student motivation and academic performance (Martin et al., 2014), therefore it is beneficial to scaffold the use of goals for younger students in order to develop their self-efficacy and their ability to self-regulate their learning in order to achieve future goals. It has been shown that students with a well-developed sense of self-efficacy are more persistent in the face of adversity, exert a greater amount of effort in their studies, and have a greater level of interest in the topics they are studying (Zimmerman et al., 1992). For these reasons, the researcher encourages others to use this research to pursue an even deeper level of understanding of the effects of goals on students' development as independent learners.

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APPENDIX A: IRB APPROVAL

ACTION ON EXEMPTION APPROVAL REQUEST

LSU
Institutional Review Board
Dr. Dennis Landin, Chair
130 David Boyd Hall
Baton Rouge, LA 70803
P: 225.578.8692
F: 225.578.5983
irb@lsu.edu | lsu.edu/irb

TO: Tyne Courville
Natural Science

FROM: Dennis Landin
Chair, Institutional Review Board

DATE: June 17, 2014
RE: **IRB#** E8825

TITLE: Effects of Teacher vs. Student-set Performance Goals on Academic Achievement in a Middle School Science Classroom

New Protocol/Modification/Continuation: New Protocol

Review Date: 6/17/2014

Approved ___X___ **Disapproved**__________

Approval Date: 6/17/2014 **Approval Expiration Date:** 6/16/2017

Exemption Category/Paragraph: 1

Signed Consent Waived?: No

Re-review frequency: (three years unless otherwise stated)

LSU Proposal Number (if applicable): ____

Protocol Matches Scope of Work in Grant proposal: (if applicable) _________

By: Dennis Landin, Chairman ____DLandin____________

PRINCIPAL INVESTIGATOR: PLEASE READ THE FOLLOWING –
Continuing approval is CONDITIONAL on:

1. Adherence to the approved protocol, familiarity with, and adherence to the ethical standards of the Belmont Report, and LSU's Assurance of Compliance with DHHS regulations for the protection of human subjects*
2. Prior approval of a change in protocol, including revision of the consent documents or an increase in the number of subjects over that approved.
3. Obtaining renewed approval (or submittal of a termination report), prior to the approval expiration date, upon request by the IRB office (irrespective of when the project actually begins); notification of project termination.
4. Retention of documentation of informed consent and study records for at least 3 years after the study ends.
5. Continuing attention to the physical and psychological well-being and informed consent of the individual participants, including notification of new information that might affect consent.
6. A prompt report to the IRB of any adverse event affecting a participant potentially arising from the study.
7. Notification of the IRB of a serious compliance failure.
8. SPECIAL NOTE:

**All investigators and support staff have access to copies of the Belmont Report, LSU's Assurance with DHHS, DHHS (45 CFR 46) and FDA regulations governing use of human subjects, and other relevant documents in print in this office or on our World Wide Web site at http://www.lsu.edu/irb*

APPENDIX B: PARENTAL PERMISSION FORM

Parental Permission Form

Project Title: Effects of Teacher vs. Student-Set Performance Goals on Academic Achievement in a Middle School Science Classroom

Performance Site: Iberville Math, Science, and Arts Academy-West

Investigators: The following investigator is available for questions,

Tyne Courville
(225) 687- 6845
tynecourville@ipsb.net

Purpose of Study: The purpose of this project is to determine if the source of a performance goal affects student achievement.

Description of Study: Students' scores on unit pre-tests will be used to set performance goals for the unit post-tests. These goals will be set by either the student or by the teacher. Students' pre-test and post-test scores will be used to determine learning gains and goal attainment. The scores will be used to decide if students who set their own performance goals achieve those goals more often than students who have performance goals set by their teacher.

Benefits: All students will become more self-aware of how to set and achieve academic goals.

Risks: This research is not expected to cause any harm or discomfort.

Right to Refuse: Participation is voluntary, and a child will become part of the study only if both child and parent agree to the child's participation. At any time, either the subject may withdraw from the study or the subject's parent may withdraw the subject from the study without penalty or loss of any benefit to which they might otherwise be entitled.

Privacy: The school records of participants in this study may be reviewed by investigators. Results of the study may be published, but no names or identifying information will be included for publication. Subject identity will remain confidential unless disclosure is required by law.

Signature: I will allow my child to participate in the study described above and acknowledge the investigator's obligation to provide me with a signed copy of this consent form.

Parent's Signature________________________________ Date: ____________

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APPENDIX C: CHILD ASSENT FORM

Child Assent Form

I,____, agree to be in a study to help find out if setting my own grade goals helps me to learn more than my teacher setting my grade goals. I will have to know what my grades are and try my best at all times. I have to follow all classroom rules. I can decide to stop being in the study at any time without getting in trouble.

Child's signature:____________________________

Age:__________ Date:___________

Witness*______________________

Date: _______________________

*N.B. Witness must be present for the assent process, not just the signature by the minor.

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Unit 1: Scientific Thinking & Using Mathematics in Science

Multiple Choice

Write the letter of the correct answer on the line at the left.

______ **1.** Making decisions and drawing conclusions based on available evidence involves using which kind of thinking?

a. subjective
b. deductive
c. curious
d. objective

______ **2.** Why would a scientist reject a scientific theory?

a. New evidence contradicts it.
b. It covers too broad a topic.
c. Some people disagree with it.
d. It applies everywhere in the known universe.

______ **3.** Interpreting observations based on reasoning from what you already know is called

a. classifying.
b. predicting.
c. inferring.
d. observing.

______ **4.** When you make a possible explanation for a set of observations you are formulating a

a. theory.
b. law.
c. prediction.
d. hypothesis.

______ **5.** In a scientific experiment, facts, figures, and other evidence gathered through observations are called

a. data.
b. manipulated variables.
c. responding variables.
d. laws.

______ **6.** A scientific hypothesis must be

a. correct.
b. able to be manipulated.
c. able to be controlled.
d. able to be tested.

______ **7.** Trying to explain why tides occur on Earth is an example of

a. making a prediction.
b. carrying out an experiment.
c. applying scientific inquiry.
d. making a classification.

______ **8.** When observations deal with amounts or numbers they are called

a. manipulated observations.
b. responding observations.
c. qualitative observations.
d. quantitative observations.

______ **9.** One useful tool that may help a scientist interpret data by revealing unexpected patterns is a

a. variable.
b. graph.
c. theory.
d. law.

______ **10.** A well-tested explanation for a wide range of observations or experimental results is called a

a. scientific law.
b. scientific inquiry.
c. scientific hypothesis.
d. scientific theory.

_______ **11.** The metric system of measurement is based on the number

a. 1. **c.** 12.
b. 10. **d.** 100.

_______ **12.** The basic unit of length in the metric system is the

a. foot. **c.** mile.
b. meter. **d.** kilometer.

_______ **13.** If scientists cannot obtain exact numbers, they should rely on a(n)

a. calculation. **c.** guess.
b. estimate. **d.** assumption.

_______ **14.** To determine how close to the true value an experimental value is, you would use

a. a precision calculation. **c.** significant figures.
b. a median. **d.** a percent error calculation.

_______ **15.** The horizontal axis of a graph runs

a. left to right. **c.** vertically.
b. up and down. **d.** diagonally.

_______ **16.** A line graph in which the data points do not fall along a straight line is called

a. linear graph. **c.** circle graph.
b. nonlinear graph. **d.** bar graph.

_______ **17.** What are some reasonable safety precautions for field investigations?

a. None; there are no hazards in the field.
b. Always wear goggles and aprons.
c. Be prepared and use common sense.
d. Always go into the field alone.

_______ **18.** When preparing for a laboratory investigation, if any of the directions are unclear you should

a. ask a classmate to explain.
b. ask your teacher to explain.
c. go ahead and begin the lab.
d. skip the part of the lab that is not clear.

_______ **19.** A group of parts that work together is called a

a. technology. **c.** process.
b. system. **d.** feedback.

_______ **20.** The middle number in a set of data is the

a. mean. **c.** mode.
b. median. **d.** significant figure.

True or False

If the statement is true, write true. *If it is false, change the underlined word or words to make the statement true.*

____________ **21.** In a scientific experiment, the one variable that is purposely changed to test a hypothesis is called the <u>independent</u> variable.

____________ **22.** A scientific <u>hypothesis</u> describes an observed pattern in nature without attempting to explain it.

____________ **23.** Thinking and questioning is the start of the <u>scientific inquiry</u> process.

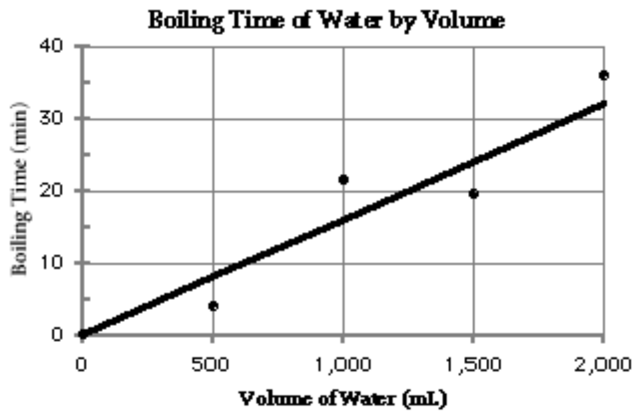
____________ **24.** When scientific work conflicts with the beliefs of society and its leaders, a controversy can arise.

____________ **25.** To measure the mass of a small insect, scientists would use the gram

____________ **26.** A scientist would most likely use the Kelvin scale to measure daily temperature.

Using Science Skills

Use the figure below to answer the following questions in the spaces provided.



27. According to the graph, what is the experimental boiling time for a 500-mL volume of water?

____

____

____

28. What is the point where the *x*-axis and *y*-axis cross called?

____

____

____

29. Use the graph to predict the boiling time of water that has a volume greater than 2,000 milliliters.

____

____

____

Essay

Write an answer for each of the following questions on a separate sheet of paper.

30. What are some ways scientists communicate their findings?

31. Why can't you use a ruler to measure the volume of an irregular object such as a rock? How could you measure the volume of the rock?

Unit 2: Chemistry of Life & Introduction to Cells

Multiple Choice

Write the letter of the correct answer on the line at the left.

_______ **1.** Sugar molecules can combine with one another to form large molecules called

a. proteins.
b. starches.
c. enzymes.
d. lipids.

_______ **2.** All organic compounds contain the element

a. water.
b. oxygen.
c. carbon.
d. nitrogen.

_______ **3.** How does photosynthesis benefit heterotrophs?

a. It adds carbon dioxide to the air.
b. It creates food that they can eat.
c. It eliminates harmful sugars.
d. It creates clean water.

_______ **4.** What are the products of photosynthesis?

a. carbon dioxide and water
b. oxygen and water
c. carbon dioxide and sugars
d. oxygen and sugars

_______ **5.** Under which of the following conditions is lactic acid fermentation most likely to occur?

a. a very fast run
b. a long walk
c. sleeping
d. playing video games

_______ **6.** What captures energy from sunlight during photosynthesis?

a. solar cells
b. stomata
c. chlorophyll
d. carbohydrates

_______ **7.** What happens during cellular respiration?

a. Oxygen is released into the air.
b. Glucose is broken down, releasing energy.
c. Carbohydrates are released into the bloodstream.
d. Water and carbon dioxide are converted into energy.

_______ **8.** Proteins that speed up chemical reactions in living things are called

a. starches.
b. enzymes.
c. lipids.
d. nucleic acids.

_______ **9.** The invention of the microscope made it possible for people to discover

a. plants.
b. skin.
c. animals.
d. cells.

_______ **10.** Which of the following statements is part of the cell theory?

a. Only plants are composed of cells.
b. All cells are produced from other cells.
c. Cells can be produced from nonliving matter.
d. Cells are one of several basic units of structure and function in living things.

_______ **11.** What is the function of a cell membrane?

a. to support the cell
b. to perform different functions in each cell
c. to control which substances enter and leave the cell
d. to form a hard outer covering for the cell

_______ **12.** Which organelles store food and other materials needed by the cell?

a. mitochondria
b. chloroplasts
c. ribosomes
d. vacuoles

_______ **13.** Cells in many-celled organisms

a. all look the same.
b. all have the same structure.
c. are often quite different from each other.
d. are the same size in every part of the organism.

_______ **14.** Mitosis is the stage of the cell cycle during which

a. the cell's nucleus divides into two new nuclei.
b. the cell's DNA is replicated.
c. the cell divides into two new cells.
d. the cell's cytoplasm divides.

_______ **15.** What is the total magnification of a microscope with two lenses when one lens has a magnification of 15, and the other lens has a magnification of 30?

a. 15
b. 30
c. 45
d. 450

_______ **16.** Which organelle is the control center of a cell?

a. mitochondrion
b. ribosome
c. nucleus
d. chloroplast

_______ **17.** During _______, a cell diviveds to form two cells that have sets of chromosomes that are complere and identical to each other and to the partent cell.

a. meiosis
b. mitosis
c. mutation
d. fertilization

_______ **18.** Suppose a new medication slows the cell cycle. How would this medication likely affect cancerous cells?

a. It might slow the rate of mutations nucleus
b. It might slow blood flow to the tumor
c. It might slow the division of cancerous cells.
d. It might slow the effectiveness of chemotherapy.

_______ **19.** A mass of cancer cells is called a

a. tumor.
b. chromosome.
c. mutation.
d. phenotype.

_______ **20.** Which of the following is an example of an element found in organisms?

a. cell
b. hydrogen
c. starch
d. water

True or False

If the statement is true, write true. *If it is false, change the underlined word or words to make the statement true.*

____________ **21.** In passive transport, materials move from an area of higher concentration to an area of lower concentration through a cell membrane.

____________ **22.** A heterotroph is an organism that cannot make its own food.

____________ **23.** Photosynthesis and respiration form a cycle that keeps the levels of water and carbon dioxide fairly constant in the atmosphere.

____________ **24.** A cell makes a copy of its DNA during the stage of the cell cycle called mitosis.

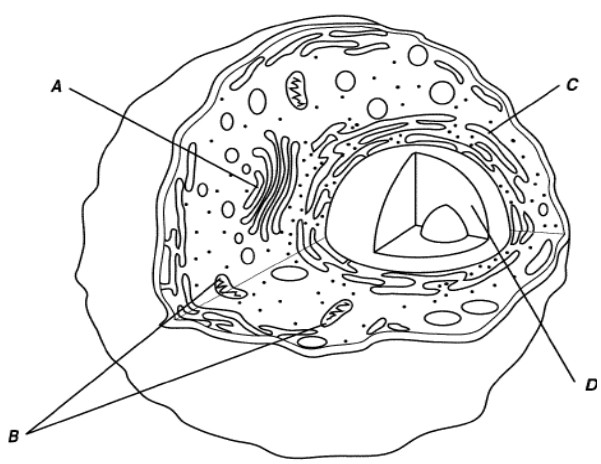
____________ **25.** Cell repair helps replace damaged cells when a bone is broken.

____________ **26.** Mitosis produces four identical daughter cells.

Using Science Skills

Use the figure below to answer the following questions in the spaces provided.

Cell Structures



27. Structure A is a Golgi apparatus. Describe its function.

____

____

____

28. Identify the structures labeled B and describe their function.

____

____

____

29. Name two structures that are not found in the cell shown here but that are found in plant cells.

____

____

____

Essay

Write an answer for each of the following questions in the space provided.

30. Compare and contrast diffusion and osmosis.

31. Animals do not make their own food from energy in sunlight. Explain why they still depend on the sun for energy.

Unit 3 Exam Genetics: The Science of Heredity

Multiple Choice

Write the letter of the correct answer on the line at the left.

______ **1.** What did Gregor Mendel do to study different characteristics in his genetics experiments?

a. He studied only asexual plants.
b. He studied only tall and short pea plants.
c. He cross-pollinated plants.
d. He cross-pollinated both plants and animals.

______ **2.** Which term refers to physical characteristics that are studied in genetics?

a. traits
b. offspring
c. generations
d. hybrids

______ **3.** What does the notation *TT* mean to geneticists?

a. two dominant alleles
b. heterozygous alleles
c. at least one dominant allele
d. one dominant and one recessive allele

______ **4.** What is the probability of producing a tall pea plant from a genetic cross between two hybrid tall pea plants?

a. one in four
b. two in four
c. three in four
d. four in four

______ **5.** What is a mutation?

a. any change that is harmful to an organism
b. any change in a gene or chromosome
c. any change that is helpful to an organism
d. any change in the phenotype of a cell

______ **6.** Cancer is a disease in which cells

a. grow and divide uncontrollably.
b. die before they can mature.
c. stop producing DNA.
d. die during mitosis.

______ **7.** An organism's physical appearance is its

a. genotype.
b. phenotype.
c. dominance.
d. allele.

______ **8.** Which of the following traits is influenced by both inheritance and environmental factors?

a. the ability to sing well
b. the ability to cough
c. natural hair color
d. dyed hair color

______ **9.** A heterozygous organism has

a. three different alleles for a trait.
b. two identical alleles for a trait.
c. only one allele for a trait.

d. two different alleles for a trait.

_______ **10.** Which term or phrase describes what occurs when more than one gene controls the expression of a trait?

a. incomplete dominance
b. multiple alleles
c. polygenic inheritance
d. codominance

_______ **11.** Which of these traits is controlled by a gene with multiple alleles?

a. straight hairline
b. smile dimples
c. widow's peak
d. blood type

_______ **12.** Which combination of sex chromosomes results in a male human being?

a. XX
b. YY
c. XY
d. either XX or YY

_______ **13.** How does a geneticist use pedigrees?

a. to create genetic crosses
b. to replicate identical strings of DNA
c. to prove that sex-linked traits are caused by codominant alleles
d. to trace the inheritance of traits in humans

_______ **14.** Genetic disorders are caused by

a. pedigrees.
b. DNA mutations or changes in chromosomes.
c. dominant alleles only.
d. recessive alleles only.

_______ **15.** Cloning results in two organisms that are

a. both adult mammals.
b. produced from cuttings.
c. genetically similar.
d. genetically identical.

_______ **16.** Which of these is an example of the benefits of genetic engineering?

a. cross-breeding to create disease-resistant crops
b. creating human insulin to treat people with diabetes
c. analyzing karyotypes and pedigree charts
d. growing a new plant from a cutting

_______ **17.** What was the purpose of the Human Genome Project?

a. to identify the DNA sequence of every gene in the human genome
b. to clone every gene on a single chromosome in human DNA
c. to cure genetic diseases
d. to inbreed the best genes on every chromosome in human DNA

_______ **18.** What is a genome?

a. all the cells produced during meiosis
b. all the plasmids produced from inserting DNA into a cell
c. all the DNA in one cell of an organism
d. all the karyotypes in a cell

_______ **19.** Sex-linked genes are genes on

a. the X chromosome only.
b. the Y chromosome only.
c. the X and Y chromosomes.

d. all 23 pairs of chromosomes.

______ **20.** A carrier is a person who has

a. one recessive and one dominant allele for a trait.
b. two recessive alleles for a trait.
c. two dominant alleles for a trait.
d. more than two alleles for a trait.

True or False

If the statement is true, write true. *If it is false, change the underlined word or words to make the statement true.*

____________ **16.** The ability to speak a certain language is an <u>inherited</u> trait.

____________ **17.** When Mendel crossed purebred short plants with purebred tall plants, all of the offspring were <u>short</u>.

____________ **18.** A mutation in a <u>sex</u> cell can be passed to offspring.

____________ **16.** Even if a gene has multiple alleles, a person cannot have more than <u>three</u> of those alleles.

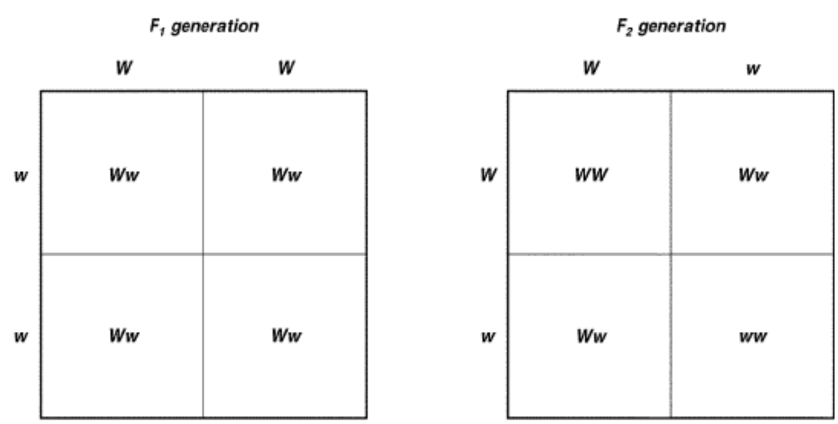
____________ **17.** Sex-linked traits that are controlled by recessive alleles are <u>more</u> likely to show up in males.

____________ **20.** Except for identical twins, all people have <u>the same</u> DNA.

Using Science Skills

Use the figure below to answer the following questions in the spaces provided.

Punnett Squares



W = white flowers   w = purple flowers

21. Which trait—white flowers or purple flowers—is controlled by a dominant allele? Which is controlled by a recessive allele? How do you know?

____

____

22. In the F_1 generation, what is the genotype of the offspring? What is their phenotype?

23. In which generation are the parents purebred? In which generation are they hybrids?

Essay

Write an answer for each of the following questions in the space provided.

24. In pea plants, green pod color is controlled by a dominant allele. Yellow is controlled by a recessive allele. Explain why a plant with yellow pods can never be a hybrid.

29. Is it possible for a son to inherit an allele on an X chromosome from his father? Explain why or why not.

Unit 4 Exam: Plant and Animal Life Cycles & Structures

Multiple Choice

Write the letter of the correct answer on the line at the left.

______ **1.** Which type of human body tissue can contract, or shorten?

a. nerve tissue
b. muscle tissue
c. connective tissue
d. epithelial tissue

______ **2.** The body part where two bones come together is a

a. bone.
b. joint.
c. muscle.
d. ligament.

______ **3.** Nutrients move into the bloodstream from the digestive system by a process called

a. elimination.
b. absorption.
c. filtration.
d. ingestion.

______ **4.** After you breathe air into your lungs, oxygen from the air goes into your

a. heart.
b. muscles.
c. bones.
d. bloodstream.

______ **5.** The endocrine system produces chemicals that

a. begin to function after puberty.
b. require a system of nerves to control many body activities.
c. travel to selected locations through tiny tubes.
d. control both daily activities and long-term changes through hormones.

______ **6.** The process by which an organism's internal environment is kept stable in spite of changes in the external environment is called

a. healing.
b. digestion.
c. homeostasis.
d. respiration.

______ **7.** Which of the following is a physical change that usually takes place during childhood?

a. Friends become more important as individuals begin to think about others.
b. Individuals become more coordinated as they practice skills.
c. Individuals learn to crawl, then begin to walk.
d. Individuals begin to play with toys.

______ **8.** What structure directs the activities of a cell?

a. nucleus
b. cytoplasm
c. cartilage
d. cell membrane

______ **9.** The Food Pyramid indicates how many servings from each food group should be eaten

a. at each meal.
b. each day.
c. each week.
d. each month.

______ **10.** The heart is an organ because it

a. maintains homeostasis.

b. is made up of different kinds of tissues.
c. contains blood.
d. contains muscle.

_______ **11.** The stages of a plant's life cycle are

a. sporophyte and spore.
b. sporophyte and gametophyte.
c. spore and gametophyte.
d. egg and gametophyte.

_______ **12.** Where does a placental mammal develop before its body systems can function independently?

a. inside its mother's body
b. in a pouch on its mother's body
c. in a nest near its mother
d. inside an egg that is protected by the mother

_______ **13.** What produces egg and sperm cells during the life cycle of a plant?

a. gamete
b. gametophyte
c. sporophyte
d. zygote

_______ **14.** Germination begins when a seed

a. is dispersed.
b. grows leaves.
c. uses its stored food.
d. absorbs water.

_______ **15.** An offspring that is the result of asexual reproduction

a. has two parents.
b. developed from a zygote.
c. inherited genes from two parents.
d. is genetically identical to its parent.

_______ **16.** Why must ferns live in moist environments?

a. to transport spores to new locations
b. to transport water to all cells
c. so that egg and sperm cells can join
d. so that fiddleheads develop for food

_______ **17.** As it changes from tadpole to adult, a frog's body undergoes a series of dramatic changes. Hind legs develop and the tail disappears. This process is called

a. reproduction.
b. fertilization.
c. photosynthesis.
d. metamorphosis.

_______ **18.** Budding is a form of

a. sexual reproduction.
b. gestation.
c. asexual reproduction.
d. complete metamorphosis.

_______ **19.** After they are born, most mammals

a. can care for themselves.
b. are helpless for a long time.
c. begin to fly within two weeks.
d. reproduce asexually.

_______ **20.** Which is one advantage of sexual reproduction?

a. More offspring are produced.
b. More offspring survive to maturity.
c. The offspring have more genetic variation.

d. The offspring and the parents are identical.

True or False

If the statement is true, write true. *If it is false, change the underlined word or words to make the statement true.*

_____________ **21.** Tissues perform more complex jobs than organs.

_____________ **22.** The respiratory system removes oxygen and water from the body.

_____________ **23.** The body reacts to a stimulus with a response.

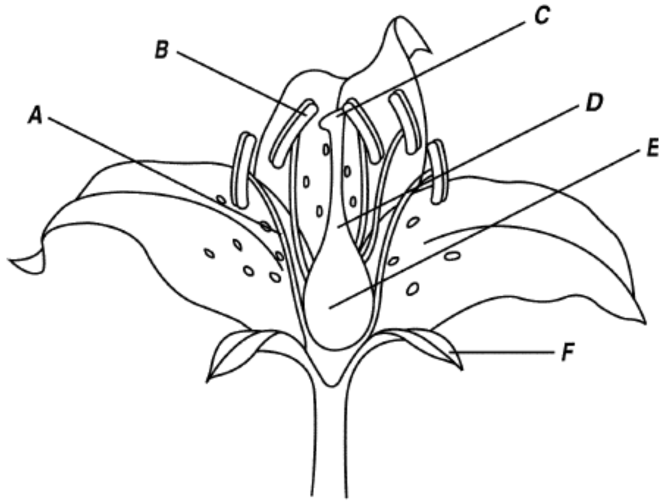
_____________ **24.** The main function of leaves is to carry out the food-making process of germination.

_____________ **25.** Cnidarians reproduce sexually while in the polyp stage.

_____________ **26.** Most gymnosperms have reproductive structures called cones.

Using Science Skills

Use the figure below to answer the following questions in the spaces provided.



27. Identify the structures labeled A and B in the diagram. Are these male or female reproductive structures?

____

____

____

28. Identify the structures labeled C, D, and E in the diagram. Are these male or female reproductive structures?

____

____

____

29. Identify the structure labeled F in the diagram, and describe its function.

____

Essay

Write an answer for each of the following questions in the space provided.

30. List and describe the four levels of organization of the human body.

31. Describe two functions of plant stems.

APPENDIX H: STUDENT GOAL ORIENTATION SURVEY

Name______________________

Mastery Goals					
	Untrue	Somewhat Untrue	Neutral	Somewhat True	True
One of my goals in this class is to learn as much as I can about life science.	1	2	3	4	5
Understanding life science is important to me.	1	2	3	4	5
I want to learn as much as possible.	1	2	3	4	5
I like it best when something I learn makes me want to find out more.	1	2	3	4	5
I want to feel involved in the process of learning.	1	2	3	4	5
I do not want to feel involved in the process of learning.	1	2	3	4	5
I think what I will learn in life science will be useful for me to know.	1	2	3	4	5
The best way to succeed in this class is to learn a lot.	1	2	3	4	5
Performance Goals					
One of my goals in this class is to get a good grade.	1	2	3	4	5
It is important for me to do better than other students.	1	2	3	4	5
It is important for me to do well compared to others in this class.	1	2	3	4	5
It is important for me to get a good grade in this class.	1	2	3	4	5
I want others to think I am smart.	1	2	3	4	5
I do not want others to think I am smart.	1	2	3	4	5
The best way to succeed in this class is to get a good grade.	1	2	3	4	5

APPENDIX I: TEST ANXIETY SURVEY

Directions: Read each item below to see if it reflects your experience in test taking. If it does, place a check mark in the box next to the number of the statement. Check as many as seem fitting. Be honest

			18. Worrying about how well I will do interferes with my preparation and performance on tests.
	1. People (family, friends, etc.) are counting on me to do well.		
	2. Even though I don't always think about it, I am worried about how other will view me if I do poorly.		19. I never seem to be fully prepared to take tests
	3. If I score low, I am not going to tell anyone exactly what my score was.		20. I often feel the need to cram before a test.
	4. If my score is low, my parents will be very disappointed.		
	5. Some people I know will think it's funny if I score low, and this bothers me.		21. One of my problems is not knowing exactly when I am prepared for a test.
			22. Having to face an important test disturbs my sleep.
	6. Getting a good score on one test does not seem in increase my confidence on other tests.		23. I cannot relax physically before a test.
	7. Before or during an important exam, I find myself thinking about how much smarter some of the other students are.		24. My stomach becomes upset before important tests.
	8. Tests do not really show how much a person knows.		25. I often find my fingers tapping or my legs jiggling while taking a test.
	9. If I do not do well on a test, it will mean I am not as smart as I thought I was.		
	10. I do not feel confident before a test.		26. I cannot stand to have people walking around, watching me while I take a test.
			27. Room noises (from lights, air conditioners, other students) bother me.
	11. My test performance controls my future success.		28. After taking a test, I often feel I could have done better than I actually did.
	12. I wish there were some way to succeed without taking tests.		29. I think I could do much better on tests if I could take them alone and/or not feel pressured by a time limit.
	13. People who do well on tests generally end up more successful in life.		30. During tests, I sometimes get so nervous that I forget facts I really know.
	14. Knowing that my future depends on doing well on tests upsets me.		
	15. Tests make me wonder if I will every reach my goals.		31. Tests should not be made the "bid deal," tense situations they are

			32. If exams could be done away with, I think I would actually learn more from my courses.
	16. One of my problems is not knowing exactly when I am prepared for a test.		33. I have a hollow, uneasy feeling before taking a test
	17. I am afraid of courses in which the teacher likes to give pop quizzes.		34. I start feeling very anxious or uneasy just before getting test results.
			35. I would rather write a paper than take a test for a grade.

APPENDIX J: STUDENT GOAL AND PROGRESS MONITORING FORM

Unit _____ Progress Chart
Keeping Track of My Learning

Name: ______________________________
My score on the unit ____ pre-test was _______________.
My goal on the unit ____ post-test is _________________.

Assessment	Percent Score	Letter Grade	Topics of the Assessment	Time Spent Studying for Assessment

APPENDIX K: MID-YEAR ATTITIUDE SURVEY

Name: ____

Circle your class period: 5th 6th 7th

	Strongly Agree	**Somewhat Agree**	**Doesn't matter**	**Somewhat disagree**	**Strongly disagree**
I like having a goal to work towards	5	4	3	2	1
Having a goal motivates me to work harder in class	5	4	3	2	1
Having a goal has lead to me studying more for quizzes & exams	5	4	3	2	1
Having a goal has made me more aware of my grades in class	5	4	3	2	1
I prefer to set my own goals	5	4	3	2	1
I prefer to have a teacher set my goals	5	4	3	2	1
Taking a pre-test is useful	5	4	3	2	1
I wish other teachers gave me pre & post tests	5	4	3	2	1
I wish other teachers gave me goals to work towards	5	4	3	2	1

Has having goals and tracking your grades in science class helped you? Explain how having a unit goal and/or tracking your scores has helped or hurt you. Remember to be honest ☺

VITA

Tyne Courville was born in Lafayette, Louisiana, in May 1990. She attended elementary, middle and high school in Cecilia, Louisiana. She then transferred to and graduated from the Louisiana School Math, Science, and the Arts in May 2008. She then entered Louisiana State University Agricultural and Mechanical College in August of 2008 and earned her Bachelors of Science in Biology in May 2012. She entered Graduate School at LSU in June 2013 and is a candidate for a Masters of Natural Sciences. She has been a science teacher in Iberville Parish for 3 years. She currently teaches middle school and high school science at the Iberville Math, Science, and Arts Academy in Plaquemine, Louisiana.