

THE IMPACT OF THREE COLOR PRACTICE QUIZZES AND SELF PROGRESS  
MONITORING PORTFOLIOS ON ACHIEVEMENT AND ENGAGEMENT OF AT  
RISK BIOLOGY STUDENTS

by

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STATEMENT OF PERMISSION TO USE

In presenting this professional paper in partial fulfillment of the requirements for a master's degree at Montana State University, I agree that the MSSE Program shall make it available to borrowers under rules of the program.

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ABSTRACT

The addition of three-color practice quizzes aligned with learning objectives and student self-progress monitoring portfolios were examined for achievement and engagement of at-risk high school ninth/tenth grade biology students. Students assessed their own learning through practice quizzes taken alone, with peers, and with notes. They recorded their mastery of learning objectives, assignment completion, and quiz scores on a portfolio. The hope was that students would become more invested in their own education and subsequently more successful through the use of these formative assessments. The participants in this study were lower-achieving students, the majority of which received special education services, social/emotional services, or both. Many of these students were only mainstreamed for biology. Summative quiz scores, summative test scores, and quarter grades from this year's classes were compared with similar data from last year's classes to determine whether or not the intervention improved student achievement. Survey, interview, and teacher observation data were used to determine whether or not the intervention improved student engagement. Although the intervention positively impacted engagement, achievement did not improve significantly.

## INTRODUCTION AND BACKGROUND

I teach biology to an at-risk population of learners receiving special education services, social/emotional services, or both. They are mostly freshmen and sophomores and many are only mainstreamed for my class. The largest hurdle to achievement for the majority of them is lack of engagement in school, particularly because they lack motivation and confidence. My hope and purpose for this project was to encourage them to become more engaged in their own learning at this early stage in their high school career to help set them on the right path for future achievement.

My study was conducted at Glenbrook South High School in Glenview, Illinois, a suburb located northwest of Chicago. The student population is 2,677, with a racial/ethnic breakdown of 68.9% white, 1.3% black, 8.0% Hispanic, 18.8% Asian/Pacific Islander, 0.1% Native American, and 2.8% multi-racial/ethnic. Although the community is predominantly upper middle class, 20% of our students come from low-income families. The percentage of students with Individualized Education Plans (IEPs) is 11.6% and 3.4% of the student population have limited English proficiency. I would describe the school climate as friendly, caring, and student-focused. The culture is one of excellence and support. Students and staff are equally encouraged to strive for excellence and to take full advantage of the opportunities available to become involved in the school community.

The main focus of my action research project was to improve student achievement in my classes of under-achieving biology students through the implementation of formative assessments that would encourage them to become more engaged in their own learning. The interventions I used to accomplish that goal were three-color practice



quizzes aligned with learning objectives and self-progress monitoring portfolios. My hope was that as students monitored their own levels of engagement and progress towards learning goals, they would become more invested in their own education and subsequently more successful. My primary focus question was: How does the use of three-color practice quizzes and self-progress monitoring portfolios impact student achievement as measured by each of the following assessments: quizzes, tests, and quarter grades? An additional research sub-question was: How does the use of three-color practice quizzes and self-progress monitoring portfolios impact student engagement as measured by student participation and confidence?

### CONCEPTUAL FRAMEWORK

Keeping students engaged in the classroom is one of the teacher's most important roles and is particularly important for teachers of at-risk students. Results of a study conducted in Quebec surveying 13,330 high school students suggested that lack of engagement at the start of high school resulted in higher risk of dropping out later on in high school (Archambault, Janosz, Morizot, & Pagani, 2009). Delineating the components of student engagement presents a challenge as evidenced by the variety of interpretations in the literature. I found one interpretation particularly helpful when conceptualizing the meaning of student engagement for my own study. Harris (2008) identified six categories of student engagement: "Behaving, Enjoying, Being Motivated, Thinking, Seeing Purpose, and Owning" (p. 65). She further defined "Being Motivated" as "pupil motivation to participate and confidence in their ability to succeed" (p. 69). Having taught under-achieving students for over a decade, I have noticed that the majority of them lack both motivation and confidence. D. Shernoff, Csikszentmihalyi,

Schneider, and E. Shernoff (2003) looked at student engagement through flow theory perspective, specifically investigating the components of concentration, interest, and enjoyment. One of their findings suggested that students are best engaged when the difference between a task's challenge and the student's skill is moderate. I try to achieve that balance in my lower-level biology classes, but the challenge is achieving that balance in a classroom of students with variable skill levels.

Research suggests a link between student engagement and student achievement. Singh, Granville, and Dika (2002) analyzed data from the National Longitudinal Study 1988 and concluded that student achievement in mathematics and science correlates with their motivation, attitude, and engagement. Most of the students I teach have a history of receiving poor grades in science. From the onset of the course, they tell me they are “no good” at science. In my observation, their perception of their inability to comprehend science prevents them from engagement. Disengagement and underachievement are intertwined. Poor student engagement is a factor that contributes to underachievement; likewise, low achievement may cause students to become disengaged. One study looking at factors that predict academic engagement of high school students suggested that students who feel more competent tend to be more engaged and similarly, those who are afraid they will fail tend to be less engaged (Caraway, Tucker, Reinke, & Hall, 2003). Not only should we be helping students feel less fearful about failing, but we should also be helping them develop the proper mindset about failure. The research linking student engagement and achievement suggests that if we want students to succeed in school, we must turn our attention to helping students become invested in their own education. The

goal of engaging students in their education so that learning will take place is not only a worthy ambition, but a necessary one.

Educators realize that in order for learning to take place, students need to be engaged in their education. Numerous studies show the impact of student engagement and achievement in the classroom. Some studies looked at the difference between students' perception of their engagement in contrast to their teachers' perception. Appleton and Lawrenz (2011) studied the perceptions of student engagement of 159 teachers and 1,663 students over three years. One of their findings was that science and math teachers thought their students were more engaged in the classroom than the students felt they were engaged. The largest dichotomy between science teachers and their students was in understanding the topic. Students felt they understood the topic less than their science teachers thought the students understood. Others looked at the ways teachers can motivate students. Anderman, Andrzejewski and Allen (2011) studied teachers recognized by their students as providing a supportive environment that encouraged student motivation and learning. The researchers grouped the teacher characteristics identified by the students into three main themes: supporting understanding, managing the classroom, and building and maintaining rapport. They found that "student engagement resulted when teachers successfully managed these three tasks" (p. 984).

The methods for measuring student engagement depend on the components studied. Studies on motivation and attitude rely on surveys to gather data. Likert or Likert-type scales are often used (Anderman et al., 2011; Archambault et al., 2009; Caraway et al., 2003). Likert scales often use five or six values that range along a

continuum to help responders assess a particular subject. Possible choices on such a scale might be strongly agree, agree, neutral, disagree, or strongly disagree. Appleton and Lawrenz (2011) used an instrument called a classroom observation protocol (COP) to measure engagement. Caraway et al. (2003) gathered data using six different instruments: Demographic/Academic Data Sheet, Self-Efficacy Scale, Goal Orientation Scale, Test Anxiety Scale, General Fear of Failure Scale, Marlowe-Crowne Social Desirability Scale-Short Form, and the Engagement Subscale of the Rochester Assessment Package for Schools-Student Report. Interview methods are another way to assess student engagement. To determine teacher perception of student engagement, Harris (2008) used interviewing techniques to assess 20 secondary school teachers. More quantifiable data on student engagement might include attendance records, preparedness for class, homework completion, and time on task. Other methods used to evaluate engagement are journal-recorded observations and reflections. Student achievement can be quantitatively measured. Standardized test scores are used heavily across the nation to determine how well our students are learning. Within the day-to-day activities of the classroom, summative assessments are used to “grade” our students’ learning. When it comes to achievement, the measurements are easy, but linking that achievement to interventions is more complicated.

Knowing how important student engagement and student achievement are, educators have a responsibility to help students improve them. One suggestion Appleton and Lawrenz (2011) had in reaction to the finding that science teachers and their students did not view students’ understanding equally was for teachers to have students use self-assessment tools to help them see their progression. Brown and Hirschfeld (2008), after

surveying 3,469 students in New Zealand about their conceptions of assessment, found that students who view assessment as a means of holding themselves personally accountable for their own learning achieve more. A study looking at the impact of student self-assessment at the university level found that having students assess their own learning helped them reflect, examine their progress, and motivate them (Walser, 2009). As that study showed, in addition to monitoring their engagement and progress, students need time for reflection. The importance of student reflection was also considered by Nicol and Macfarlane-Dick (2006) to be one of seven principles they concluded were characteristic of good feedback. They stated, “one effective way to develop self-regulation in students is to provide them with opportunities to practice regulating aspects of their own learning and to reflect on that practice” (p. 207).

The responsibility for improving student engagement and learning must be shared by student and teacher alike. In addition to student self-assessment, teacher guidance is a critical component of students’ success. One strategy that may help teachers guide student learning is the use of formative assessments that measure students’ progress towards clear learning objectives. These objectives are the foundation for both the learning that takes place and the assessment of that learning. They are the benchmarks by which teachers measure students’ learning and students measure their own progress. Teachers that support student understanding let students know what assessments will cover (Anderman et al., 2011). Formative assessments are checkpoints along the way, allowing students to check their understanding in a non-threatening context. In their article, “Assessment and Classroom Learning,” Black and Wiliam (1998) interpreted formative assessment as “encompassing all those activities undertaken by teachers,

and/or by their students, which provide information to be used as feedback to modify the teaching and learning activities in which they are engaged.” Thus, a major component of formative assessment is feedback. Timely, productive feedback by the teacher helps students’ determine their progress. Fluckiger, Vigil, Pasco, and Danielson (2010) found that teaching and learning are enhanced when students are involved in the formative feedback process. The Fluckiger et al. study encouraged me to implement the three-color practice quiz method they presented. Students first took the quiz individually using black ink, then with a group using green ink, and finally with the use of their textbook and lecture notes using blue ink. According to the researchers, the threefold feedback involving product, process, and progress was responsible for a more positive learning atmosphere (95% of students felt better about their learning) and lower student anxiety (79% of students were less anxious) (Fluckiger et al.).

Studies on formative assessment have linked its use to student motivation and achievement. A study involving 3,242 Richmond, Virginia students and 161 teachers examining the use of formative assessment in secondary education found an overall positive link between formative assessment and student motivation (McMillin et al., 2010). A study done in the United Kingdom by Wiliam, Lee, Harrison, and Black (2004) that was partly funded by the National Science Foundation set out to determine if the use of formative assessments helps students perform better on standard assessments. Twenty-four teachers were trained, observed by researchers throughout implementation, and given time for reflection. Data showed that the use of formative assessments did increase scores on standardized tests. Interestingly, another study that looked at the effect of embedding formative assessments into a middle school science inquiry unit

found that it did not significantly impact student motivation, achievement, or conceptual change (Yin & Shavelson, 2008). The researchers did mention, though, that it may not have been the use of formative assessment, but its implementation, that determined its effectiveness. Even if formative assessments might not increase achievement, their use provides an opportunity for students to be more invested in their own learning (Truth-Nare & Buck, 2011).

There are many types of formative assessments. Angelo and Cross (1993) describe 50 Classroom Assessment Techniques (CATs) that provide different types of understanding checks. In their study on formative feedback in the university setting, Fluciger et al. (2010) used three-color practice quizzes, student-generated questions, and online collaborative assignment blogs as types of formative assessments. Formative assessments used in the Truth-Nare and Buck (2011) study in middle school science classrooms used probes to test for students' previous knowledge, writing prompts at the start and end of the period, and peer editing. The United Kingdom study (William et al., 2004) that looked at the impact of formative assessments on student achievement allowed the 24 teachers to choose their own assessments. The 102 activities used were grouped into five categories: questioning, feedback, sharing criteria with learners, self-assessment, and general.

Many methods may be used to gather data on self-assessments and formative assessments. Student self-assessment data may be collected in the form of student surveys (Appleton & Lawrenz, 2011; Brown & Hirschfeld, 2008; Walser, 2009), teacher surveys (Appleton & Lawrenz), and teacher reflections (Walser). Brown and Hirschfeld linked student conceptions of self-assessment with standardized reading test scores to

measure the link between student perception of assessment and achievement. Data on the effectiveness of formative assessment may also come from student and teacher surveys (Fluckiger et al., 2010; McMillan et al., 2010), student and teacher reflections (Truth-Nare & Buck, 2011; Wiliam et al., 2004), pre-tests and post-tests (Yin & Shavelson, 2008), summative assessment scores, and standardized test scores (Wiliam et al.; Yin & Shavelson). Teacher behavior is often collected by outside observers. For example, in the Wiliam et al. study, researchers observed teachers, recorded their behaviors, and reflected with them afterwards.

Engaging students in learning and helping them succeed academically are desired outcomes of education. Studies suggest that well-engaged students perform better and students who feel a sense of achievement tend to be more engaged. There are many ways to define student engagement and many methods used to measure it. Additionally, there are a variety of methods used to link student achievement with student engagement. Choosing methodologies to assess student engagement and learning is an important task, but the greater task becomes finding ways to improve them. I was encouraged to implement two classroom interventions in my Biology Team 163 classes of under-achieving students aimed at improving both student achievement and engagement: three-color practice quizzes that are aligned with clear learning objectives and student self-progress monitoring portfolios.

## METHODOLOGY

The main focus of my action research project was to improve student achievement in my classes of under-achieving biology students through the implementation of formative assessments that would encourage them to become more engaged in their own



learning. The interventions I used to accomplish that goal were three-color practice quizzes aligned with learning objectives and self-progress monitoring portfolios. My hope was that as students monitored their own levels of engagement and progress towards learning goals, they would become more invested in their own education and subsequently more successful. My research questions focused on how the use of three-color practice quizzes and self-progress monitoring portfolios would impact student achievement and engagement.

### Participants

My project was conducted in my two Biology Team 163 classes. The Biology Team 163 course is a foundation course aimed towards lower-achieving students. It is the first course of a two-year science sequence that provides students with two teachers in the classroom for extra support. I teach the first year, biology, and am assisted by another science teacher. She teaches the second year, physical science, and I assist her. Most of our students will stay with us for two consecutive years. The students are selected for the Team program based on their scores on the TerraNova test, a standardized test taken in middle school. The test consists of several sub scores: math, reading, language, and CSI (cognitive skills index, which is like an IQ score). Team students are typically the bottom 10th percentile locally. My first period class of 17 students has nine boys and eight girls. Ten of the students are ninth-graders and seven are tenth-graders. Seven students are white (41.2%), six are Hispanic (35.3%), two are black (11.7%), one is Asian/Pacific Islander (5.9%), and one is multi-racial (5.9%). There are nine students (52.9%) receiving special education services. Low-income students (those receiving free or reduced meals) comprise 41.2% of the class. The home

language is not English for eight (47.1%) of these students and for six of them (35.3%), English is not their primary language. My fourth period class of 18 students has ten boys and eight girls. Ten of the students are ninth-graders, seven are tenth-graders, and one is an eleventh-grader. Seven students are white (38.9%), eight are Hispanic (44.4%), one is black (5.6%), and two are Asian/Pacific Islander (11.1%). There are 13 students (72.2%) receiving special education services. Low-income students (those receiving free or reduced meals) comprise 72.2% of the class. The home language is not English for 12 (66.7%) of these students and for ten of them (52.6%), English is not their primary language. The research methodology for this project received an exemption by Montana State University's Institutional Review Board and compliance for working with human subjects was maintained.

### Intervention

The intervention portion of my project ran for nine weeks during the third quarter of the 2012-2013 school year, and spanned two complete units, Reproduction/Development and Classification/Diversity. I used achievement data collected from my 2011-2012 Biology Team classes (last school year), as my comparison. I compared pre-intervention unit quizzes, unit tests, and quarter grades scores from this year (first and second quarter) to unit quizzes, unit tests, and quarter grades scores from last year on the same material and I compared post-intervention unit quizzes, unit tests, and quarter grades scores from this year (third quarter) to unit quizzes, unit tests, and quarter grades scores from last year over the same material. The intervention tested whether or not the addition of three-color practice quizzes aligned with learning objectives and student self-progress monitoring portfolios would increase

student achievement and engagement. I was particularly interested in the student participation and confidence aspects of engagement. I created these new formative assessments for the intervention. They were not used at all during the 2011-2012 comparison year.

My students are typically anxious about taking quizzes and tests. Encouraged by the research of Fluckiger, et al. (2010), I decided to use the three-color practice quiz method with my students in an effort to improve their learning while lessening their anxiety. The three-color practice quizzes (see Appendix J) allowed students to take the quiz the first time (black pen) alone without any resources, a second time (green pen) with a group of their peers, and a third time (blue pen) with their notes and textbook. As students completed the quizzes initially on their own, I quickly gauged how well they did and put them in heterogeneous groups for the peer-aided portion such that each group would have at least one student who could help the others. I then gave students feedback on their answers. This was a formative assessment and therefore not graded. These quizzes were meant to give students a non-threatening way of checking their understanding of the unit objectives. Students could monitor their progress visually by looking at the amount of black, green, and blue ink. My hope was that as students took these quizzes throughout third quarter, they would gain confidence in their own abilities as they saw their need for peer and note resources lessen with each successive practice quiz. At the end of each unit, students were given a summative test. The summative assessments and learning objectives are summarized in Table 1.

Table 1  
*Intervention Summative Quizzes, Tests, and Aligned Learning Objectives*

Unit	Summative Assessment	Learning Objectives
Reproduction/ Development	Reproduction and Fertilization Quiz  Male and Female Quiz Puberty and STDs Quiz  Human Development Quiz  Unit Test – covers all	<ol style="list-style-type: none"> <li>1. Compare and contrast asexual and sexual reproduction and give examples of each.</li> <li>2. Understand the difference between external and internal fertilization and development.</li> <li>3. Know the structures of the human male and female reproductive systems.</li> <li>4. Describe the effects of puberty.</li> <li>5. Identify the causes, symptoms, and treatments of common STDs.</li> <li>6. Understand the terminology and stages of human fertilization and development.</li> </ol>
Classification/ Diversity	Classification and Using Keys Quiz  Create a Flow Chart and Key Quiz Kingdoms Quiz  Invertebrates and Vertebrates Quiz  Unit Test – covers all	<ol style="list-style-type: none"> <li>1. Understand the scientific naming and classification of organisms.</li> <li>2. Be able to identify organisms using dichotomous keys.</li> <li>3. Be able to create flow charts and dichotomous keys.</li> <li>4. Identify characteristics and organisms of the five and six kingdom classification systems.</li> <li>5. Identify the major characteristics of the Invertebrate classes.</li> <li>6. Identify the major characteristics of the Vertebrate classes.</li> </ol>

In an effort to encourage my students to be active participants in their own learning, and thus more engaged, I designed a self-progress monitoring portfolio to help them track their progress. The self-progress-monitoring portfolio (see Appendix F) gave each student a place to keep track of their feeling of mastery on the learning objectives, assignment completion and level of understanding, scores on three-color practice quizzes,

and scores on summative quizzes. I provided students with a portfolio made from card stock (similar to a manila folder) that had the learning objectives for the unit listed with spaces to check off their feeling of mastery of those objectives at various points during the unit (as seen in Appendix G), the unit's assignments listed with a place to keep track of their homework scores and level of understanding (see Appendix H), spaces to keep track of their three-color quiz scores and summative quiz scores, and a graph to chart their progress (see Appendix I). I made separate portfolios for the two third quarter intervention units.

I began each intervention unit by distributing the portfolios to the students. I spent a few minutes at the beginning of the first intervention unit, Reproduction/Development, showing students how they would be tracking their progress on the portfolios. Although I needed to reiterate the self-assessment instructions at the beginning of the second unit, I did not spend as much time as students were already familiar with the process. On the first day of each unit, we read over the objectives and students completed the first objective checkpoint showing how confident they already felt about each objective. After we covered an objective in class through lecture, activity, and/or lab, students completed the second objective checkpoint for that objective.

I gave the three-color practice quizzes at various points during the units. Students completed the third objective checkpoint after the corresponding practice quiz. I then gave a summative quiz that tested the same objectives as the practice quiz. Students recorded their quiz scores and graphed their quiz progress on the graph.

In addition to recording their mastery of learning objectives and quiz scores, students also recorded completed assignment scores on their portfolios, indicating their

level of understanding of each assignment by circling “high,” “medium,” or “low.”

When first starting the intervention, I had students fill out their own grades on assignments as I returned them. That took so much time, though, that I decided that for subsequent times, I would fill out their grades myself and just have them indicate their level of understanding. Too much instructional time would have been lost if I continued in the method I had originally devised. It was more accurate also, because many of the students did not write their grades down correctly because transferring information from one place to another is one of their challenges.

### Data Collection

I collected quantitative achievement data from last year’s classes and this year’s classes for first, second, and third quarters and qualitative engagement data during third quarter of this year. Quantitative data included summative quiz scores, summative test scores, and quarter grades. The summative quizzes and tests given this year were very nearly identical to those given last year. Most of the other assignments included in the quarter grades were nearly the same for both years, but they were not identical. Qualitative data included student surveys/interviews, three-color practice quizzes, student portfolios, and teacher observations.

In an effort to determine whether or not my intervention improved student achievement, I collected and compared quantitative data. I first compared student summative quiz scores, summative test scores, and quarter grades scores for first and second quarter of this year with similar data from the previous year’s two Biology Team 163 classes. I used this comparison to establish baseline data by which I could account for differences between this year’s students and last year’s students. I placed both of last

year's classes into one group (N=22) and both of this year's classes into another group (N=35) for statistical comparison. I was able to compare these data sets because I taught very nearly identical units during the same quarters and administered very nearly identical summative assessments both years. Then I compared third quarter quiz, test, and quarter grade scores from this year (intervention) with similar data from last year (during which I did not use three-color practice quizzes or self-progress monitoring charts) to assess the impact of my intervention. Any difference measured between the two years from first and second quarter was taken into account when comparing the two years for third quarter. I again placed both of last year's classes into one group (N=22) and both of this year's classes into another group (N=35) for statistical comparison. Additionally, I compared my Period 1 and Period 4 classes from this year separately for certain data analyses.

In an effort to determine whether or not my intervention improved student engagement, I collected and compared qualitative data. I collected baseline survey/interview data at the start of third quarter just prior to starting the intervention, survey data midway through the process, and survey/interview data once more at the end of the intervention. The surveys and interviews were designed to assess student engagement in biology by measuring student participation and confidence. The surveys were created in a Likert-type style and administered to all students (see Appendices A, C, and D). I interviewed all students from each class prior to the start of third quarter (see Appendix B). I was originally going to allow students to volunteer to be interviewed and then from the group of volunteers, choose them such that I would have a heterogeneous group in terms of gender, ethnicity, special education, and academic performance, but

because I had another teacher in the room with me, I decided to interview them all.

Interviews with all students except for two who were absent were administered again at the end of the intervention (see Appendix E).

Student artifacts were another source of data I collected. I kept copies of the three-color quizzes to view student progression throughout the intervention. I also collected student portfolios at the end of each unit for data on student feelings of mastery of the objectives, homework completion and level of understanding, student quiz score progression, and student participation from their perspective.

In addition, I used teacher observation data (see Appendix K) collected during the third quarter intervention units to assess student engagement from my perspective. Data collected from teacher observations included attendance, homework completion, time on task, ability to remain focused, level of participation, and student feedback during class. I looked at any changes I saw in engagement over the course of the intervention. The data sources I used are summarized in Table 2.



Table 2  
*Data Triangulation Matrix*

Focus Questions	Data Source 1	Data Source 2	Data Source 3
<i>Primary Question:</i> 1. How does the use of three-color practice quizzes and self-progress monitoring portfolios impact student achievement as measured by each of the following assessments: quizzes, tests, and quarter grades?	Summative quizzes and summative tests	Comparison of first and second quarter grades with third quarter grades	Comparison of summative assessment scores and quarter grades for this year's students with those of last year's students
<i>Secondary Question:</i> 2. How does the use of three-color practice quizzes and self-progress monitoring portfolios impact student engagement as measured by student participation and confidence?	Three-color quizzes and Student portfolios	Pre-, mid-, and post-intervention student surveys and pre- and post-intervention interviews	Teacher observations and journaling

## DATA AND ANALYSIS

In order to determine whether or not the implementation of three-color practice quizzes and self-progress monitoring portfolios improved student achievement and engagement, I collected and analyzed quantitative and qualitative data from a number of sources. Achievement data included summative quiz scores, summative test scores, and quarter grade scores from last year's students and this year's students. Engagement data included pre-, mid-, and post-intervention student surveys, pre- and post-intervention student interviews, teacher observations, and three-color practice quiz and student

portfolio artifacts from current students. The intervention was conducted in two classes with a total of 35 participants. Comparison achievement data was collected from a total of 22 former students. I analyzed data statistically using The R Foundation for Statistical Computing (<http://www.r-project.org>) and GraphPad (<http://www.graphpad.com>).

### Impact of Three-color Practice Quizzes and Self-progress Monitoring Portfolios on Student Achievement

In order to determine the impact of my intervention on student achievement, I first compared summative assessments and quarter grades scores of the non-intervention portion of the study for this year's students (2011-2012 school year,  $N = 22$ ) with those of last year's students (2012-2013 school year,  $N = 35$ ) to establish baseline data. I found that there was no statistically significant difference between the assessment and quarter grade scores between the two groups, which verified that I could use last year's students as a comparison group. Then I compared summative assessments and quarter grade scores of the third quarters for both comparison and intervention years to determine if the intervention had an effect on achievement. I found that there was not a statistically significant difference between the two groups, suggesting that achievement did not improve due to the intervention.

### Establishment of Baseline Data to Validate Comparison of Last Year with This Year

Quiz scores, test scores, and quarter grade scores for the first and second quarters of the comparison group (last year) and the intervention group (this year) were compared to determine the validity of comparing these two groups. All summative scores data and quarter grades data compared between the comparison and intervention groups showed no statistically significant difference.

Students in both the comparison group and the intervention group took ten very nearly identical quizzes during first and second quarters of their respective years. I found the average of each individual student's quiz scores and then combined the averages of all students in a group to determine that group's data. The comparison group's summative quiz scores ( $M = 81.77$ ,  $SD = 10.15$ ) and the intervention group's summative quiz scores ( $M = 80.12$ ,  $SD = 7.41$ ) showed no statistical significant difference between the two groups,  $t(55) = 0.71$ ,  $p = 0.4823$ . This data comparison is shown in Figure 1.

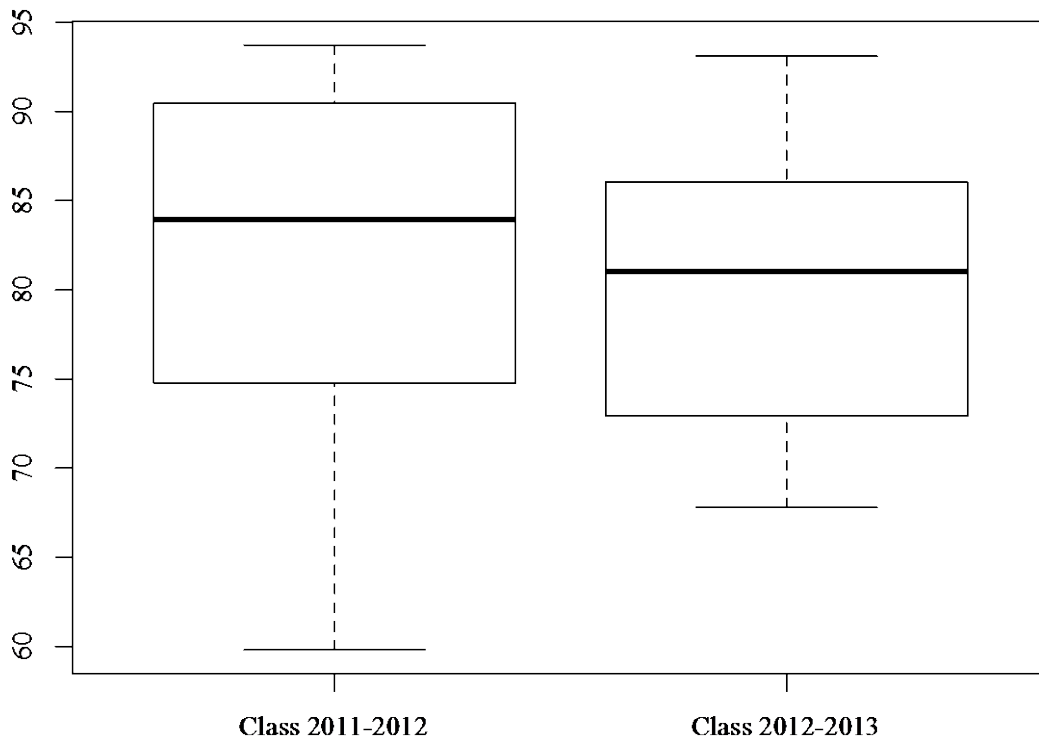


Figure 1. First and second quarter combined quiz scores comparison boxplot, ( $N = 57$ ).

Students in both the comparison group and the intervention group took three very nearly identical tests during first and second quarters of their respective years. I found the average of each individual student's test scores and then combined the averages of all students in a group to determine that group's data. The comparison group's summative

test scores ( $M = 78.87$ ,  $SD = 11.65$ ) and the intervention group's summative test scores ( $M = 77.08$ ,  $SD = 9.01$ ) showed no statistical significant difference between the two groups,  $t(55) = 0.65$ ,  $p = 0.5189$ . This data comparison is shown in Figure 2.

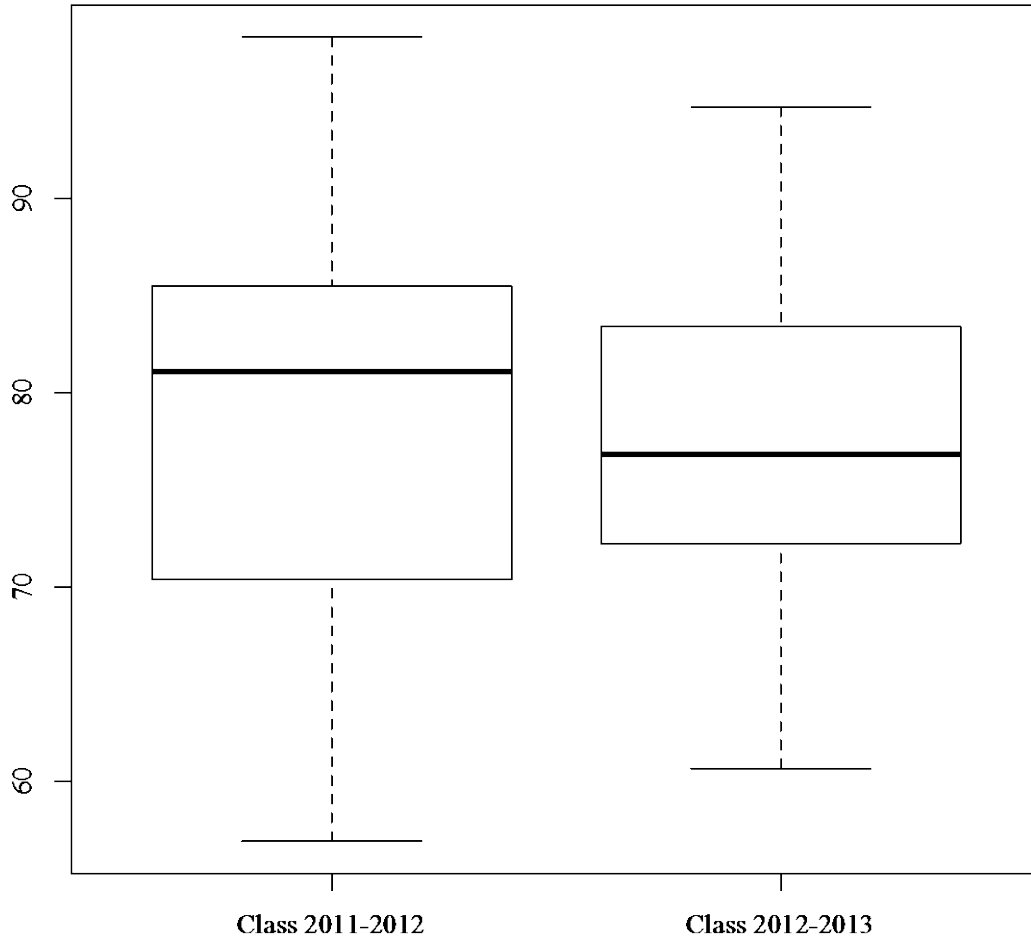
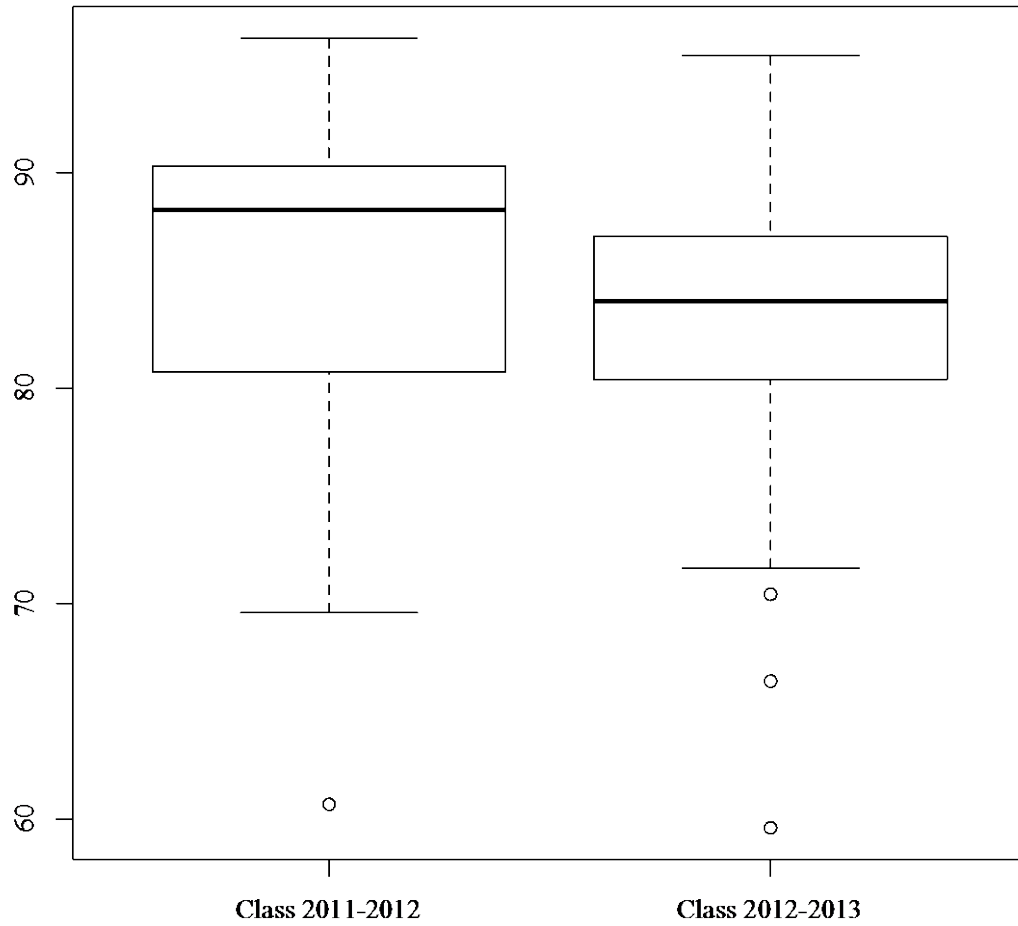


Figure 2. First and second quarter combined test scores comparison boxplot, ( $N = 57$ ).

I compared first quarter grades for students in the comparison group ( $M = 85.07$ ,  $SD = 8.42$ ) and the intervention group ( $M = 82.83$ ,  $SD = 8.01$ ) and found no statistical significant difference between the two groups,  $t(55) = 1.01$ ,  $p = 0.3173$ . I compared second quarter grades for students in the comparison group ( $M = 81.94$ ,  $SD = 7.70$ ) and the intervention group ( $M = 82.14$ ,  $SD = 8.35$ ) and found no statistical significant

difference between the two groups,  $t(55) = 0.09$ ,  $p = 0.9261$ . These data comparisons are represented in Figure 3 and Figure 4.



*Figure 3.* First quarter grades comparison boxplot, ( $N = 57$ ).

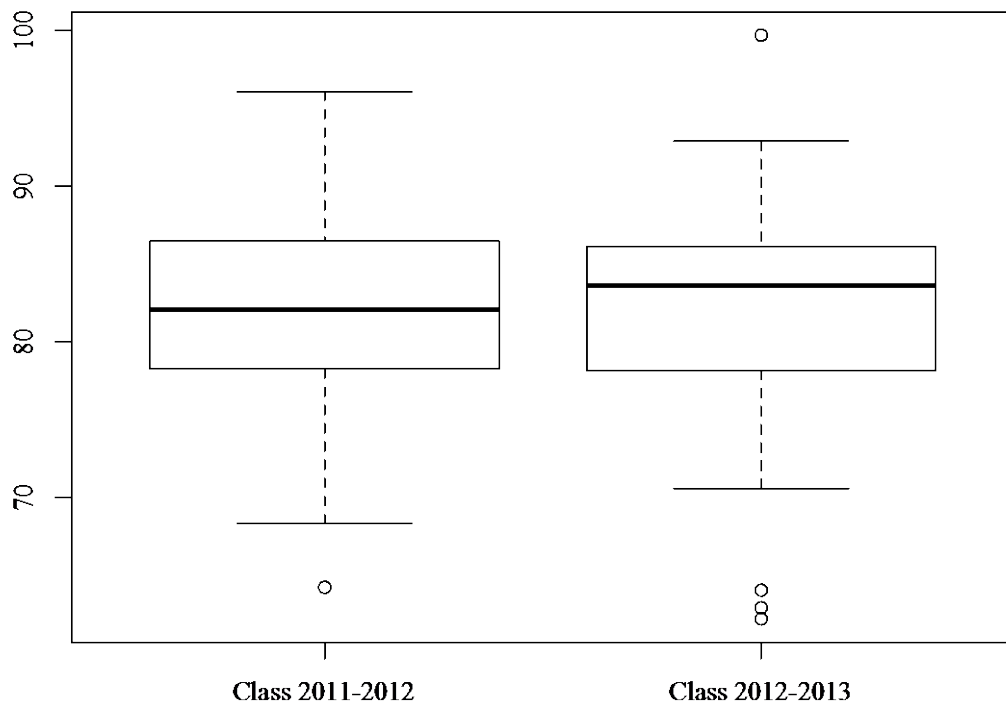


Figure 4. Second quarter grades comparison boxplot, ( $N = 57$ ).

Achievement data for first and second quarters shows no significant difference between last year's students and this year's students; therefore, data from last year's students is a reasonable baseline for comparison to this year's work. This is what I expected because each school year the students in the Biology Team 163 classes are selected for the course based on similar incoming scores and academic behaviors.

#### Impact of the Intervention on Student Achievement

The use of three-color practice quizzes and self-progress monitoring portfolios during third quarter of this year did not improve achievement when compared to last year's comparison group without the intervention. All third quarter summative scores data and quarter grades data compared between the comparison and intervention groups showed no statistically significant difference.

Students in both the comparison group and the intervention group took five very nearly identical quizzes during third quarter of their respective years. I found the average of each individual student's quiz scores and then combined the averages of all students in a group to determine that group's data. The comparison group's summative quiz scores ( $M = 85.64$ ,  $SD = 10.91$ ) and the intervention group's summative quiz scores ( $M = 85.57$ ,  $SD = 10.65$ ) showed no statistical significant difference between the two groups,  $t(55) = 0.03$ ,  $p = 0.9799$ . This data comparison is shown in Figure 5.

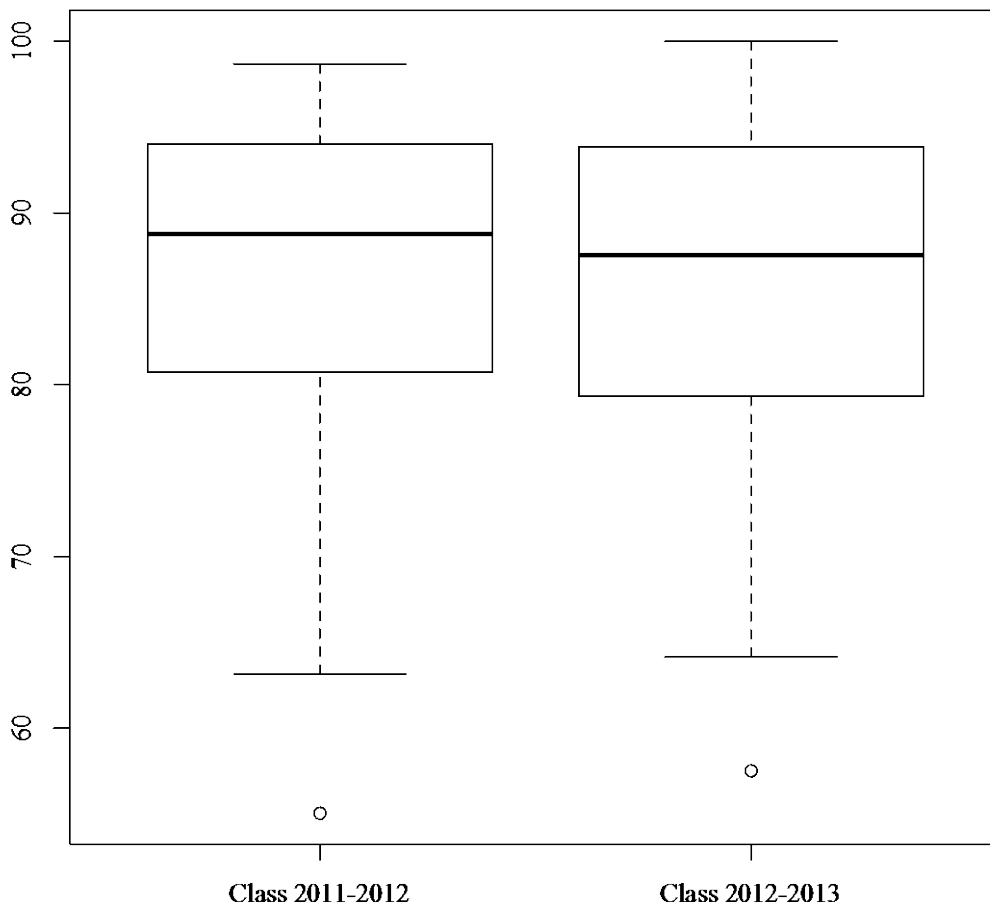


Figure 5. Third quarter combined quiz scores comparison boxplot, ( $N = 57$ ).

I then analyzed data on quiz score improvement from first and second quarters to third quarter for both groups, using paired  $t$ -tests to pair each individual student's first

and second quarter quiz score average with his/her third quarter quiz score average. I combined student first and second quarter quiz averages into one score because first and second quarters together provided my baseline data. I wanted to see if the three-color practice quizzes significantly increased students quiz score averages during the intervention quarter (third quarter) as compared with the earlier non-intervention part of the year (first and second quarters). The data did show improvement, but it did so for both last year's students and this year's students. This makes sense to me because I expect students to perform better on biology quizzes as the year progresses. In addition, the units during third quarter are generally easier for students to understand than the units during first and second quarters.

Improvement of the comparison group first and second quarter ( $M = 81.77$ ,  $SD = 10.16$ ) to third quarter ( $M = 85.64$ ,  $SD = 10.91$ ) was statistically significant,  $t(21) = 2.2647$ ,  $p = 0.0342$ , with third quarter quiz scores averaging higher than first and second quarter quiz scores. This data comparison is shown in Figure 6.



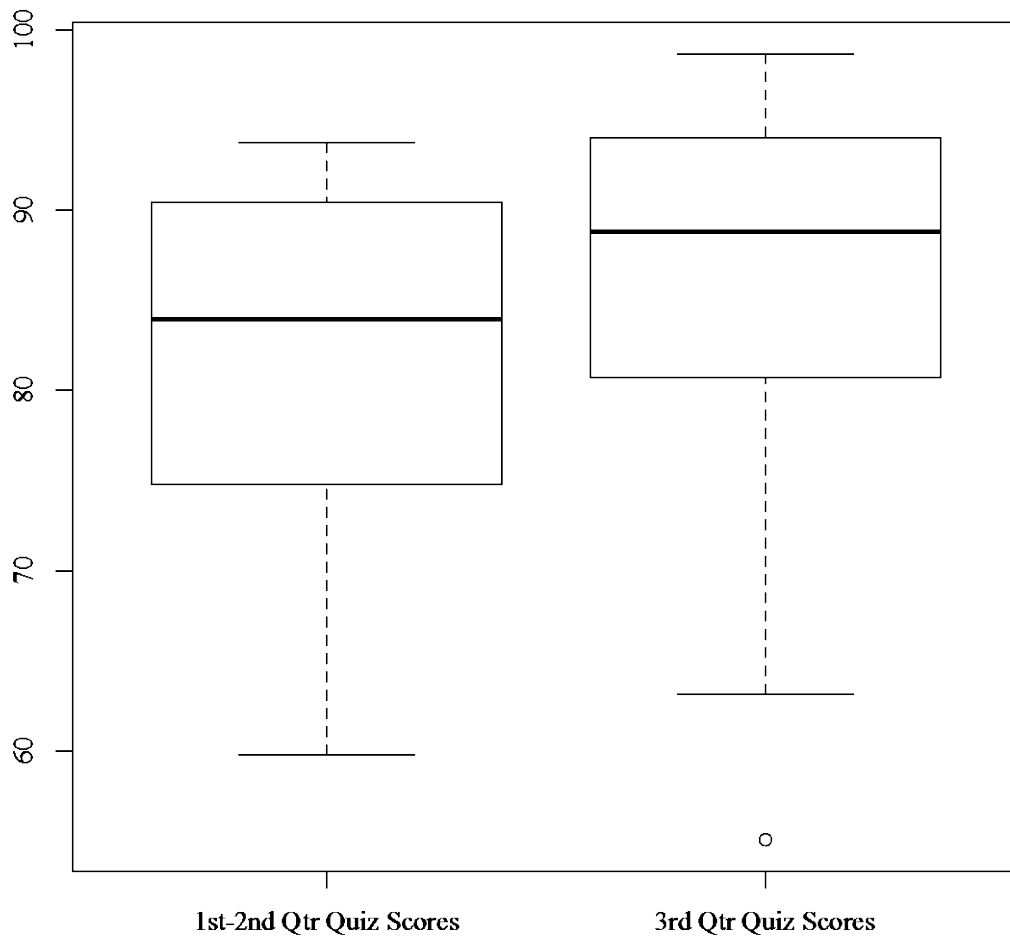


Figure 6. First/second quarters vs. third quarter 2011-2012 quiz scores boxplot, ( $N = 22$ ).

The intervention group improved significantly as well. Improvement of the intervention group first and second quarter ( $M = 80.12$ ,  $SD = 7.41$ ) to third quarter ( $M = 85.57$ ,  $SD = 10.65$ ) was statistically significant,  $t(34) = 4.2420$ ,  $p = 0.0002$ , with third quarter quiz scores averaging higher than first and second quarter quiz scores. This data comparison is shown in Figure 7.

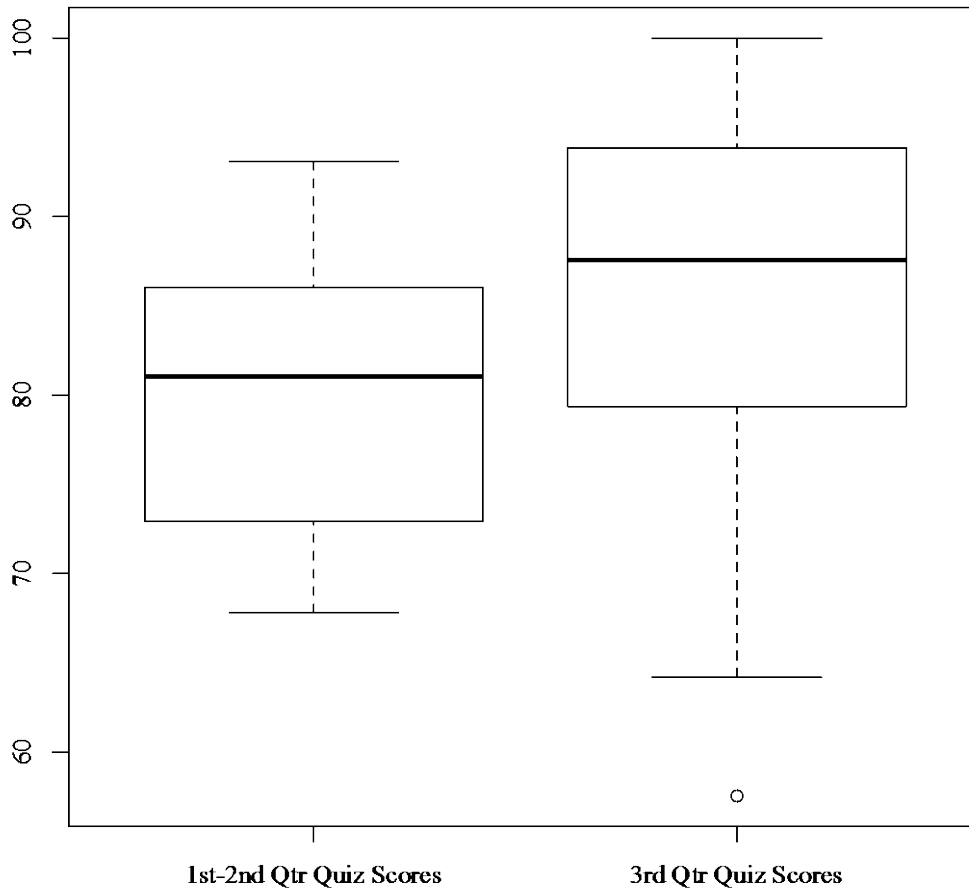
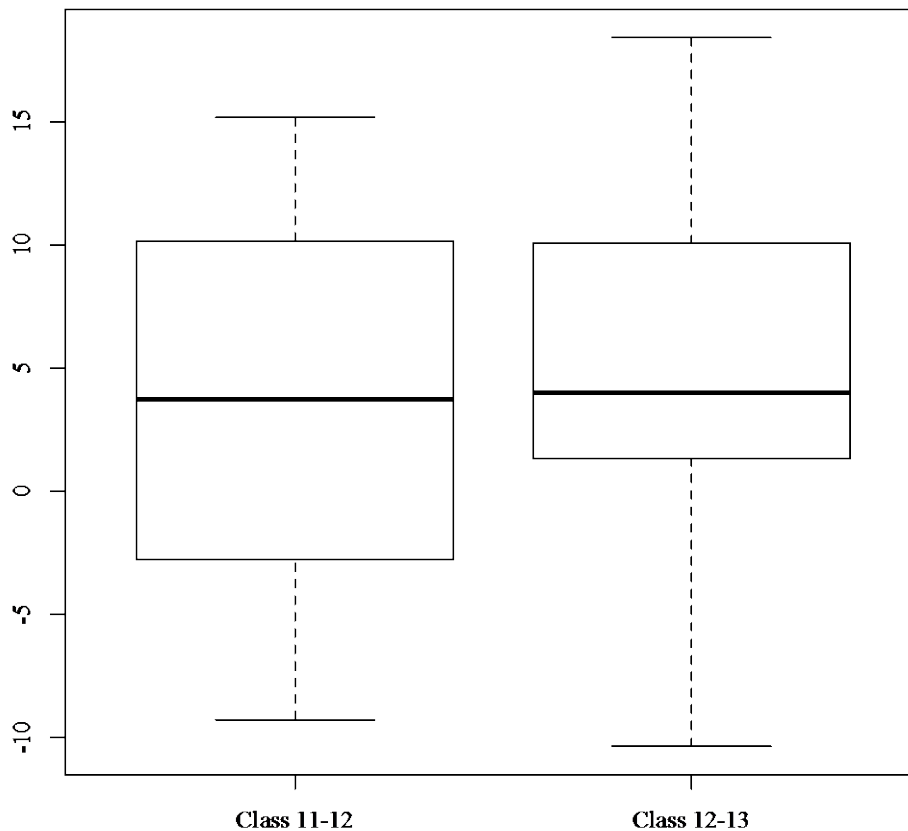


Figure 7. First/second quarters vs. third quarter 2012-2013 quiz scores boxplot, ( $N = 35$ ).

I also used  $t$ -tests on this year's two class periods separately for this data analysis because I wanted to know if both classes showed improvement with the three-color practice quizzes. I found that both classes improved. Improvement of the Period 1 intervention group first and second quarter ( $M = 83.80$ ,  $SD = 6.38$ ) to third quarter ( $M = 89.17$ ,  $SD = 8.38$ ) was statistically significant,  $t(16) = 3.5958$ ,  $p = 0.0024$ , with third quarter quiz scores averaging higher than first and second quarter quiz scores. Improvement of the Period 4 intervention group first and second quarter ( $M = 76.64$ ,  $SD = 6.73$ ) to third quarter ( $M = 81.26$ ,  $SD = 9.48$ ) was statistically significant,  $t(17) = 2.7282$ ,  $p = 0.0143$ , with third quarter quiz scores averaging higher than first and second quarter quiz scores. Knowing that both the comparison group and the intervention

group improved from first and second quarters to third quarter for quiz scores, I now wanted to find out if the intervention group improved more. To see if the quiz score improvement for the intervention group was significantly different from the quiz score improvement for the comparison group, I ran another  $t$ -test. The intervention group's change in quiz scores ( $M = 3.88$ ,  $SD = 8.03$ ) was not statistically different,  $t(55) = 0.7454$ ,  $p = 0.4592$ , from the comparison group's change in quiz scores ( $M = 5.45$ ,  $SD = 7.60$ ). This data comparison is shown in Figure 8.



*Figure 8.* Quiz scores change from first/second quarters to third quarter comparison boxplot, ( $N = 57$ ).

Students in both the comparison group and the intervention group took two very nearly identical tests during third quarter of their respective years. The comparison group's summative test scores ( $M = 81.39$ ,  $SD = 7.50$ ) and the intervention group's summative test scores ( $M = 77.41$ ,  $SD = 8.44$ ) showed no statistical significant difference between the two groups,  $t(55) = 1.80$ ,  $p = 0.0768$ . This data comparison is shown in

Figure 9.

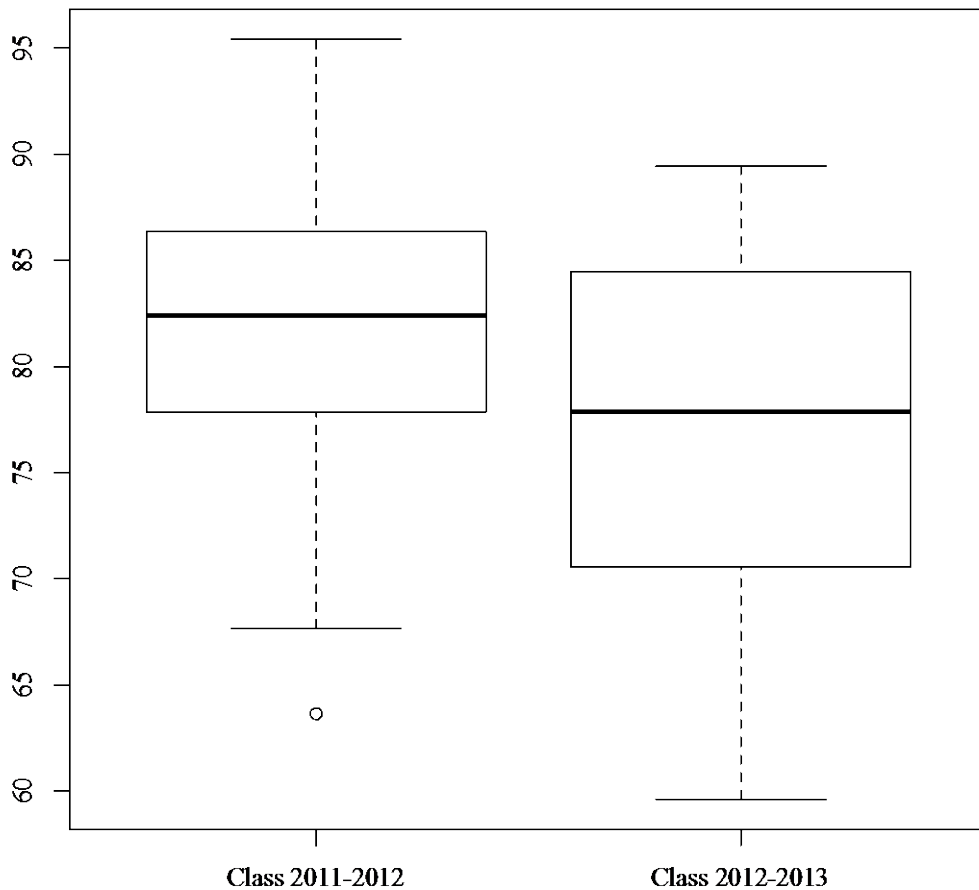


Figure 9. Third quarter test scores comparison boxplot, ( $N = 57$ ).

I compared third quarter grades for students in the comparison group ( $M = 84.38$ ,  $SD = 8.07$ ) and the intervention group ( $M = 84.57$ ,  $SD = 6.68$ ) and found no statistical significant difference between the two groups,  $t(55) = 0.09$ ,  $p = 0.9253$ . This data comparison is shown in Figure 10.

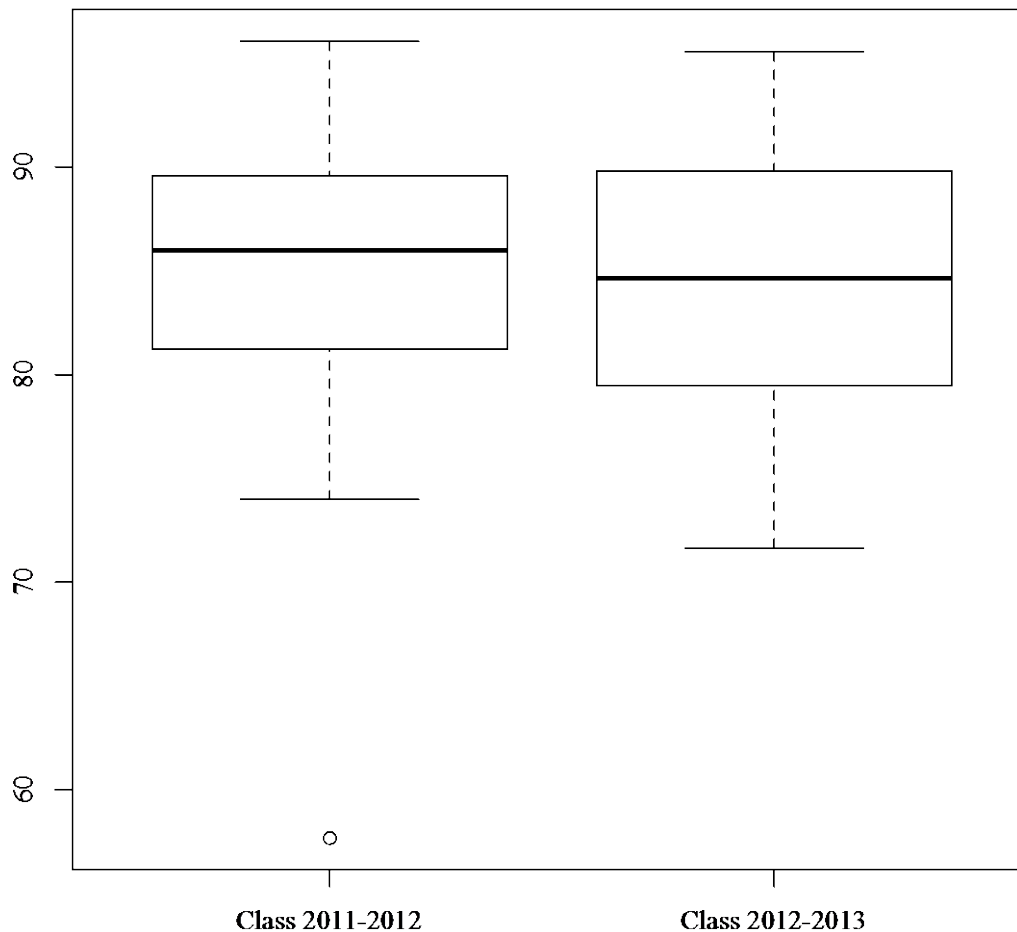


Figure 10. Third quarter grades comparison boxplot, ( $N = 57$ ).

Achievement data for third quarter showed no significant difference between last year's students (without the intervention) and this year's students (with the intervention). The three-color practice quizzes and self-progress monitoring portfolios did not improve the academic achievement of my students as judged by summative quizzes, summative tests, and quarter grades. The result might have been different if the intervention lasted the entire school year rather than for only one quarter. It takes time for students to learn how to self-monitor.

In order to determine the impact of my intervention on student engagement as measured by participation and confidence, I surveyed all intervention group students prior to the intervention, mid-way through the intervention, and after the intervention with Likert-type surveys. In addition, I interviewed all students prior to the intervention and all but the two who were absent after the intervention. There were five general questions on the pre-survey and these questions matched the first five questions on the post-survey. The ten mid-survey questions, which were specific to the three-color quizzes and self-progress monitoring portfolios, matched the last ten questions on the post-survey. I compared the student answers to the five general questions on the pre- and post-surveys and compared the ten specific questions on the mid- and post-surveys. Student artifacts, including the three-color practice quizzes and the self-progress monitoring portfolios were another source of qualitative data. I also looked at qualitative teacher observation data. Engagement data showed that the three-color practice quizzes and self-progress monitoring portfolios did have a positive impact on student engagement.

#### Comparison of Pre- and Post- Intervention General Student Survey Questions

The use of three-color practice quizzes and self-progress monitoring portfolios had a positive impact on student engagement as measured by student participation and confidence according to the results of the general student survey. Each statement on the survey was written such that positive feelings of participation and confidence would be answered as “Strongly Agree or Agree”. Student survey results of five general questions showed gains in all five areas from before the intervention to after the intervention as

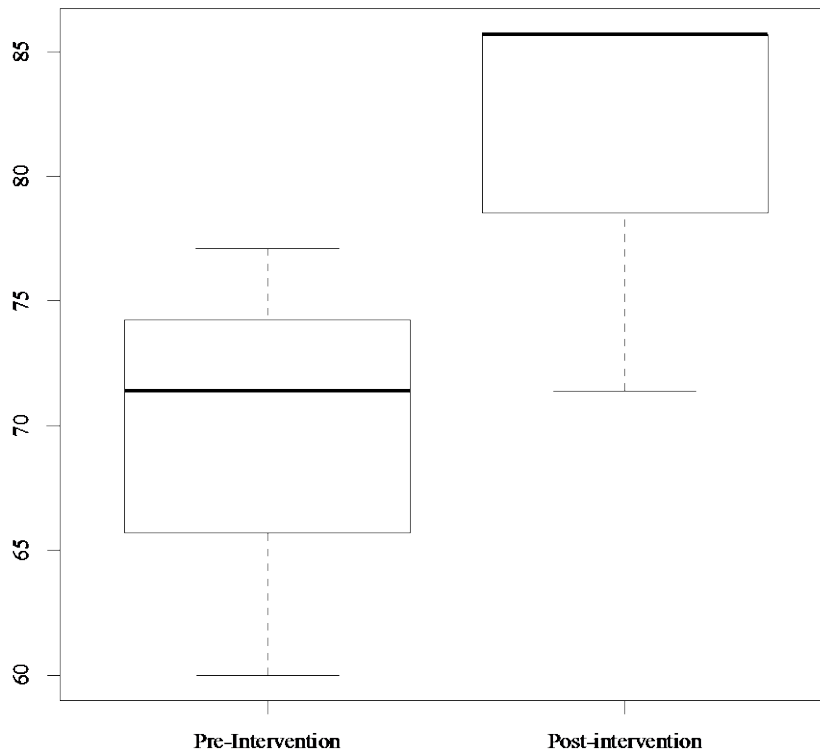
shown by Table 3. I considered questions 1, 3, and 5 as gauges of participation and questions 2 and 4 as gauges of confidence. Data for both class periods were combined.

Table 3  
*Student General Survey Responses (N=35)*

Survey Statement	Percentage of Responses Pre-intervention			Percentage of Responses Post-intervention		
	Strongly Agree/ Agree	Undecided	Disagree/ Strongly Disagree	Strongly Agree/ Agree	Undecided	Disagree/ Strongly Disagree
1. I participate often in biology.	60.0%	37.1%	2.9%	71.4%	22.9%	5.7%
2. I feel confident in my ability to do well in biology.	80.0%	14.3%	5.7%	88.6%	8.6%	2.9%
3. I am responsible about completing biology homework on time.	77.1%	11.4%	11.4%	85.7%	11.4%	2.9%
4. I understand the concepts on a biology quiz or test very well before I take it.	74.3%	22.9%	2.9%	77.1%	17.1%	5.7%
5. I know how I am doing in biology at all times.	71.4%	22.9%	5.7%	85.7%	11.4%	2.9%

Prior to the intervention, the majority of students already felt a high degree of participation and self-confidence in biology. At least 60% of the students chose “Strongly Agree/Agree” responses for all five questions. I partly attribute that to the way my class is set-up from the first day of school. My assisting teacher and I have worked together with this type of student for many years and have developed strategies to help

them feel comfortable in our class and raise their level of participation and confidence. My hope was that the addition of new strategies I had never tried before would further this aim. I was encouraged to find out that this was the case. After the intervention, at least 71.4% of the students chose “Strongly Agree/Agree” responses for all five questions. General survey question results are represented by Figures 11, 12, and 13.



*Figure 11.* General survey participation questions 1, 3, and 5 “Strongly Agree/Agree” responses comparison boxplot ( $N=35$ ).



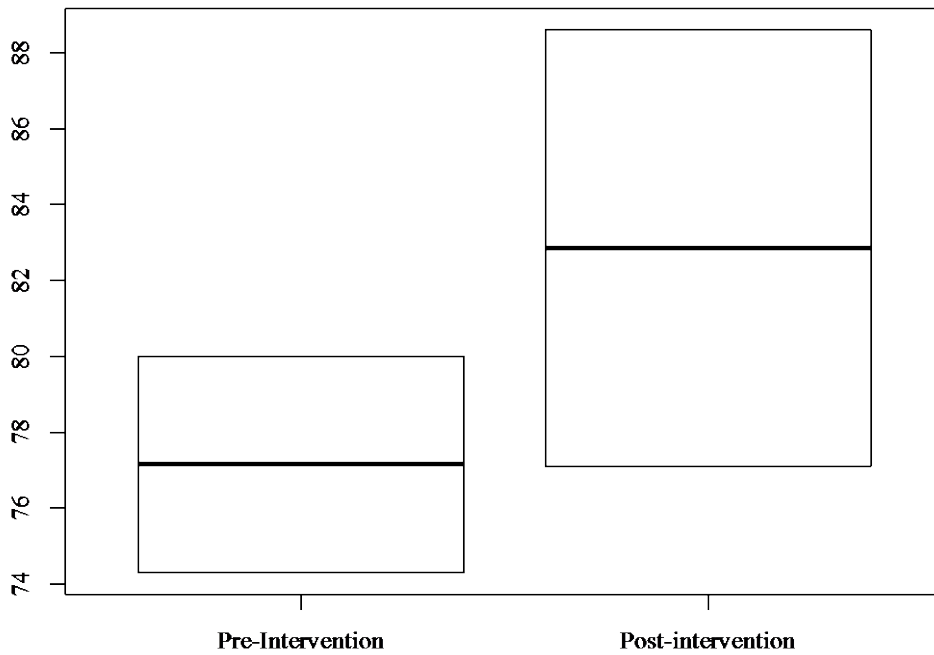


Figure 12. General survey confidence questions 2 and 4 “Strongly Agree/Agree” responses comparison boxplot ( $N=35$ ).

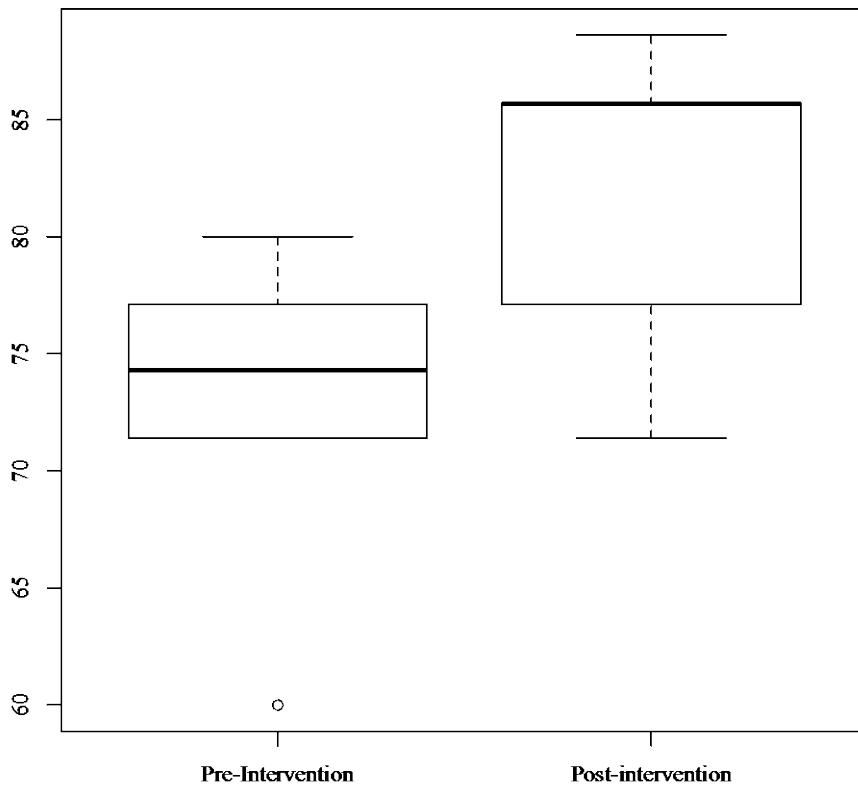


Figure 13. All five general survey questions “Strongly Agree/Agree” responses comparison boxplot ( $N=35$ ).

Besides circling their response to each survey statement, students had the option of adding written comments to any or all of the statements. On the pre-survey, eight students added comments for a total of 21 comments. On the post-survey, 17 students added comments for a total of 52 comments. A few post-survey responses especially made me feel as though the students were feeling good about biology. One student said, "The classes I'm interested in like biology I usually do better in." Another said, "When teachers help me I feel like I'm doing great." And still another commented, "I can get a good grade in biology. I just need to study and do homework."

Interviews allowed all students to comment verbally even if they did not comment on paper. When asked about participation during the interview, almost every student said that he/she participated more in biology class and felt more confident about his/her progress in biology after the intervention than he/she did before. One student said, "I never thought I would be a science person. Science is a weakness for me, but now that I know what I'm doing, I like science now." One comment that was echoed by many of the students was "I got better at understanding with the practice quizzes. They helped me understand the lesson more." Every student said he/she felt more responsible for his/her own learning except for one who said she did not feel different because she had always felt "we're responsible for our own learning." All students except two said that they felt more confident about taking biology quizzes and tests after the intervention and almost every one of them mentioned the main reason as "doing the three-color quizzes helped us see what we knew and didn't know." The two students who said they did not feel more confident said that they "always felt confident." Although most students indicated that they are aware of how they are doing in biology mainly by looking at printed grade sheets

or online grades, many students said that “the yellow portfolio helped” make them more aware of how they were doing.

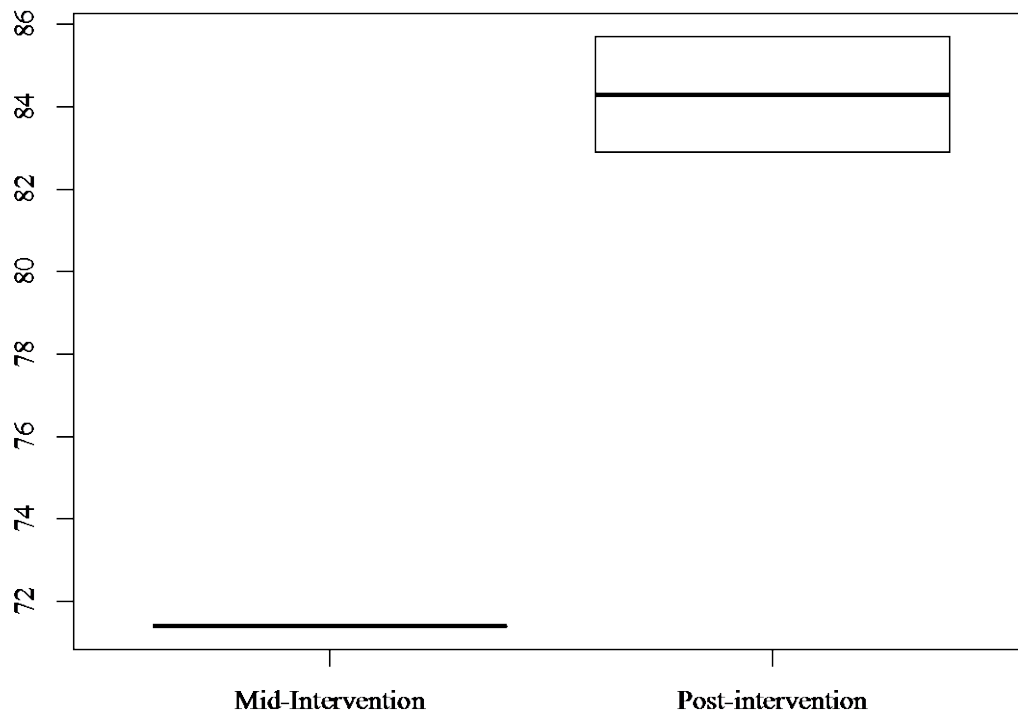
#### Comparison of Mid- and Post- Intervention Specific Student Survey Questions

The use of three-color practice quizzes and self-progress monitoring portfolios had a positive impact on student engagement as measured by student participation and confidence according to the results of the specific student survey given at the mid-point and end-point of the intervention. Student survey results of ten specific questions regarding the intervention given after the first unit of the intervention and again at the end of the second and final unit of the intervention showed that students overwhelmingly felt positive about the three-color practice quizzes and the portfolios. Each statement on the survey was written such that positive feelings of participation and confidence would be answered as “Strongly Agree or Agree”. All ten questions showed 57.1% or higher agreed or strongly agreed on the mid-point survey except for question 4 and 80% or more students agreed or strongly agreed by the post-intervention survey except for that same question (question 4). In addition, a comparison of student attitude in the middle of the intervention with their attitude at the end of the intervention showed gains in all areas. The areas of greatest growth are shown in Table 4. I considered questions 2 and 5 as gauges of participation and questions 4, 6, and 7 as gauges of confidence. Complete survey results are included in Appendix L.

Table 4  
*Student Specific Survey Responses (N=35)*

Survey Statement	Percentage of Responses Mid-intervention			Percentage of Responses Post-intervention		
	Strongly Agree/ Agree	Undecided	Disagree/ Strongly Disagree	Strongly Agree/ Agree	Undecided	Disagree/ Strongly Disagree
2. The three-color practice quizzes helped me better understand how to study for the “real” quizzes.	71.4%	25.7%	2.9%	82.9%	14.3%	2.9%
4. The three-color practice quizzes made me feel less anxious about taking the “real” quizzes.	31.4%	17.12%	22.9%	65.7%	22.9%	11.4%
5. Discussing the three-color practice quiz questions with other students helped me learn the material better.	71.4%	20.0%	8.6%	85.7%	11.4%	2.9%
6. The three-color practice quizzes helped me feel more prepared for this unit test than I did for earlier biology tests.	74.3%	25.7%	0.0%	91.4%	8.6%	0.0%
7. The yellow portfolio helped me think about how well I understood the unit objectives at various points during the unit.	57.1%	28.6%	14.3%	80.0%	11.4%	8.6%

Midway through the intervention, the lowest percentage of “Strongly Agree/Agree” responses on the 10-question specific survey was 31.4% for question 4 and the highest was 85.7% for both questions 8 and 9. After the intervention, the percentages of “Strongly Agree/Agree” responses went up, with the lowest being 65.7% for question 4 and the highest being 94.3% for question 9. The percentages went up between the mid- and post-surveys on every question except question 3, which stayed the same. This suggests that as the students became more familiar with the practice quizzes and portfolios, they felt even better about them. Figures 14, 15, and 16 represent specific survey results for the five questions shown previously in Table 4.



*Figure 14.* Specific survey participation questions 2 and 5 “Strongly Agree/Agree” responses comparison boxplot ( $N=35$ ).

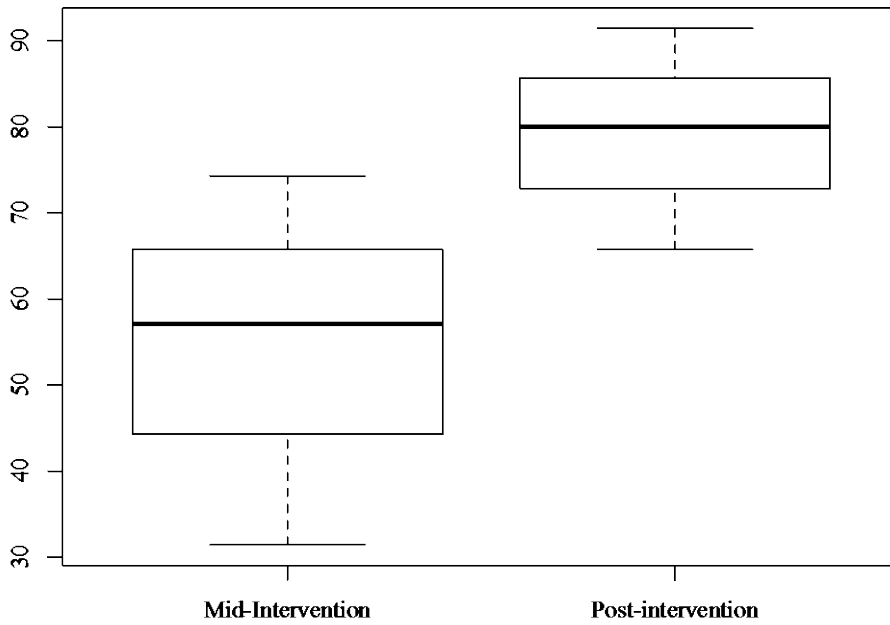


Figure 15. Specific survey confidence questions 4, 6, and 7 “Strongly Agree/Agree” responses comparison boxplot (N=35).

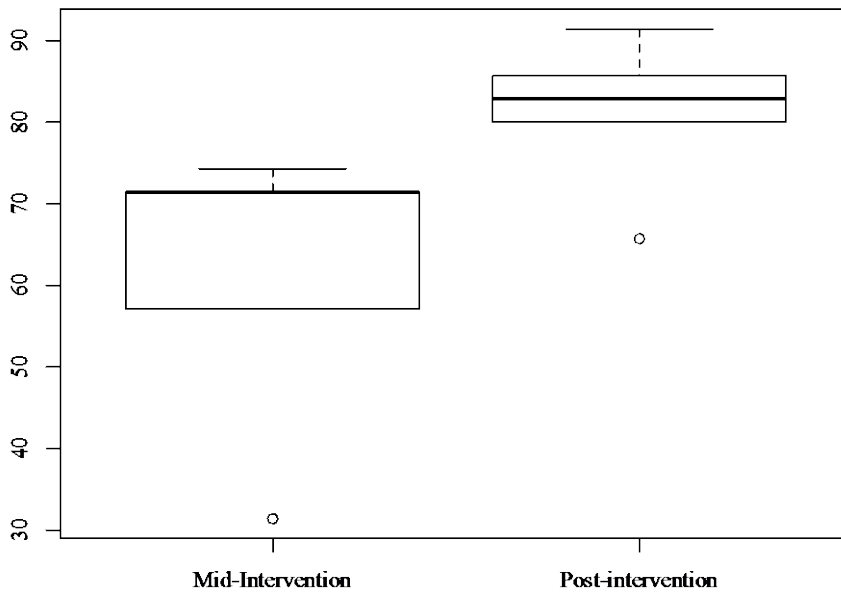


Figure 16. All five specific survey questions from Table 4 “Strongly Agree/Agree” responses comparison boxplot (N=35).

Besides circling their response to each survey statement, students had the option of adding written comments to any or all of the statements. On the mid-point survey, 32

students added comments for a total of 198 comments. The fact that they took the time and energy to add written comments, almost all of which were positive, was an indication that the intervention had a positive impact on student engagement. On the end-point survey, 12 students added comments for a total of 53 comments. This survey was given after the Classification/Diversity unit test and right before Spring Break, which could account for the fewer number of comments. Also, a number of students mentioned to me that they were the same questions as the mid-point survey, so they were less inclined to write the same comments again. Students were quite willing to discuss their post-intervention feelings during the interviews, though.

After the first intervention unit, Reproduction/Development, students already felt like they benefitted from the three-color practice quizzes and the self-progress monitoring portfolio. They thought the three-color practice quizzes helped them learn the material better. Reasons they gave were that “it gave me a chance to prepare and know what would be on the quiz,” “it helped me set some goals and try to aim higher,” and “I got better by doing it three times.” Comments about how the practice quizzes helped them understand how to study for the “real” quizzes included, “The three-color quizzes helped me understand how to study because by looking at my blue progress, it tells me what I need to study more.” and “It would help me correct myself before the real quiz.” The only question that less than the majority of students answered “Strongly Agree or Agree” to was question 4, but the reason for that became clear as I read their optional comments on the survey and interviewed them. Most of the students who circled “Disagree” or “Strongly Disagree” during both the mid-point and end-point surveys did so because they “never feel anxious for quizzes anyway.” Nearly all students thought that discussions

with their peers about their practice quiz answers helped them learn the material better. One student's reason was "because we go over it and I understand better like that." A few students said that it "depended on who I was grouped with because some talked and some didn't." Students felt like the three-color practice quizzes helped them feel more prepared for the unit test than they had felt for earlier biology tests. As one student stated, "I barely even studied. What we did in class made me fully understand this."

Students seemed to get more out of the three-color practice quizzes than they did out of the portfolio. Although every question on both the five-question survey and the ten-question survey showed a higher percentage of students agreeing vs. disagreeing, there was a greater percentage difference overall in questions pertaining to the quizzes than the portfolio. Question 7 (about understanding the unit objectives) had the highest difference of the portfolio questions, from a mid-point score of 57.1% or an end-point score of 80% Strongly Agree/Agree. I was encouraged to see this result because although I discuss objectives, I have never had students self-assess their understanding of the objectives at various points during the unit. As one student put it, "The yellow portfolio taught me about what I understood and didn't." Other benefits of the self-progress monitoring portfolios that students mentioned were that it was a "nice organized tool," it "showed me my improvements," it makes "you feel good about yourself and your progress," and it helped me be "more responsible knowing what I need to focus on and understand more and to study the subjects more."

During the post-intervention interviews, students made very positive remarks about both the three-color practice quizzes and the self-progress monitoring portfolios. When asked what they liked most about the three-color practice quizzes, three themes



kept coming up: they know what to expect on the “real” quizzes, they got to discuss their answers with others, and they got to see their improvement. Almost every student said there was nothing they liked least about them. When asked what they liked most about the portfolios, these themes emerged: they got to see their progression on their understanding of the unit objectives, they kept track of their assignments, and they could see their progress on their quiz scores. Again, almost every student said there was nothing they liked least about them. Although it is possible that the students respond favorably because they are being interviewed, the interview trends do seem to match the survey trends.

#### Student Artifacts and Teacher Observations

The use of three-color practice quizzes and self-progress monitoring portfolios had a positive impact on student engagement as measured by student participation and confidence as evidenced by student cooperation and completion of these interventions. I collected all student three-color practice quizzes and self-progress monitoring portfolios. Both types of artifacts were filled out completely by all students unless they were absent, which was an indication that there was a very high level of participation. They followed directions and cooperated. Many students needed help initially filling out the quizzes and the portfolio correctly, but they got better as the quarter progressed. I also modified both as time went on to make them more student-friendly. For example, I did not put separate lines in for the different colored pens on the first quiz and found out that it was confusing to the students and much harder for me to assess their progress. Subsequent quizzes, such as the sample in Appendix J, did have lines. I also modified the portfolio to include numbers for the assignments next to the check-off boxes (see Appendix H) so it was

easier for the students to find the ones for which they needed to indicate their level of understanding. The original portfolio had the check-off boxes but did not have numbers.

My assisting teacher collected observation data throughout the intervention quarter by recording her observations daily for both classes on teacher observation sheets (see Appendix K). Student attendance and homework completion was not significantly different during the intervention than it had been before. The students that always do their homework still did and most of the students who are careless about turning in homework on time still did not, although there were a few exceptions for individual students. The general climate of the classroom was positive for both Period 1 and Period 4 throughout the intervention, similar to how it has been all year. The level of participation for both classes was high. All students participated in the intervention and they all seemed to take it seriously. Period 1 did so without coaxing, but some students in Period 4 needed to be coaxed, but that was one of the differences between the two classes all year. Similarly, Period 1 students kept on task and remained focused better than Period 4 students. Student feedback throughout the process was positive. The only negative feedback was student frustration at the beginning when students were first learning how to take the practice quiz and fill out the portfolio.

#### INTERPRETATION AND CONCLUSION

Three-color practice quizzes aligned with learning objectives and self-progress monitoring portfolios positively impacted student engagement, but did not significantly impact achievement. Student achievement data showed no significant improvement in summative quiz scores, summative test scores, or quarter grade scores. Student engagement data, on the other hand, suggests that the intervention, especially the three-

color quiz approach, encourages students to participate more in class, lessens their anxiety, boosts their confidence, promotes meaningful discussions with peers, and helps students better understand how to study.

Although this short experience did not show improvement in achievement, I think it might have done so given more time. It is possible that had I started the year with these changes, by the second semester we might have seen an increase in achievement as well. Nine weeks is a short period of time to expect students to become familiar enough with self-monitoring to make it effective. It was also a short time for me to become adept at presenting and implementing it as effectively as I might have. It is quite possible that it was the implementation of the intervention rather than the intervention itself that rendered it ineffective in terms of achievement. Also, the intervention was tried on a relatively small number of students ( $N = 35$ ), making it more difficult to make a definitive judgment with such a small data set.

My hope when starting this intervention was that as students monitored their own levels of engagement and progress towards learning goals, they would become more invested in their own education and subsequently more successful. If summative scores alone define success, then my students were not successful. But I do not believe that we should measure student success by numbers alone. Although student grades did not improve with the intervention, students' perception of how they felt about their own progress in biology class did for the majority of students. There was improvement in response for fourteen of the fifteen total survey questions and no change in the other one. Changing students' perceptions about their ability to succeed in science, especially for an at-risk population, is no small feat.

The only downside to the intervention was the increased amount of time it took to proceed through the units. The practice quiz and portfolio additions added two full weeks to my curriculum for the two units. Normally I would have been into the next unit, Evolution, by the end of third quarter, but this year I was not able to start that unit until fourth quarter. I planned on continuing the intervention during fourth quarter, but time constraints made it too hard to do so without losing even more instructional time. I had already cut one entire unit from this year's curriculum and could not afford to lose another.

Next year I plan on using a modified version of this intervention in my Biology Team 163 classes. One change I would make is to start the year with both types of formative assessments in place. I would continue using the three-color quizzes as I did this year, but probably not for every quiz. I do not want the students to get tired of doing the same thing each time. I might vary them with other types of formative assessments throughout the unit. I plan on using the portfolios again as well, but modifying them so they are not as time-intensive. Because the students can see their assignment and quiz scores on grade sheets and online, I might take those sections out of the portfolio and replace them with a section of "Questions of the Day," quick formative assessments to start each class period. I have used these types of bell-ringers in the past and might look to use them again.

#### VALUE

This action research project provided me with the opportunity to think more critically about my teaching methods, add to my repertoire of strategies, grow professionally, and reflect upon my current and future practices. The entire process made

me look at everything that happens in the classroom with fresh eyes, from both my perspective and my students' perspectives. Even though I am the type of teacher that is constantly revising my curriculum and always looking for new approaches to teaching various concepts, this action research project pushed me even further in that regard. It forced me to critically reevaluate my current practices and take steps to improve them. Surveying and interviewing my students was a critical piece in assessing the effectiveness of my intervention. In addition, the surveys and interviews helped me look at science education from a student's perspective.

From a very pragmatic view, this project added new teaching and learning strategies to my repertoire. Although I had been using formative assessments already, I had never tried three-color practice quizzes or self-progress monitoring portfolios. I enjoyed creating them and using them in the classroom and was encouraged by the positive responses they elicited from my students, convincing me that these new strategies were worthwhile. The practice quizzes were more successful than review activities I had used in the past due to their scaffolded nature. The portfolio was a great way to help my students keep organized and stay aware of their progress.

I have grown professionally as a result of this process. It has reminded me, once again, that I must continually search out new instructional methods to further student achievement and engagement. It has also reminded me that flexibility is important by challenging me to modify my assessments and procedures as I saw what did and did not work with my students. It deepened my understanding of the different ways students learn as I became more aware of my students' challenges and perceptions about their learning. As I continue to reflect upon this project, I am confident that I will gain further

insights that will challenge me to pursue new instructional methods in a ceaseless effort to improve student achievement and engagement in my classroom.

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APPENDICES

APPENDIX A

STUDENT ENGAGEMENT SURVEY #1

### Student Survey (Pre-treatment)

*Please circle your response to the following statements and add comments if you wish.*

Participation is voluntary, and you can choose to not answer any question that you do not want to answer, and you can stop at any time. Your participation or non-participation will not affect your grade or class standing. All responses will be kept anonymous.

**ID #** \_\_\_\_\_ **Period** \_\_\_\_\_

(Your ID # will only be used to track responses from the pre- to the post-survey.)

**1. I participate often in biology.**

strongly agree    agree    undecided    disagree    strongly disagree

Comments: \_\_\_\_\_

\_\_\_\_\_

**2. I feel confident in my ability to do well in biology.**

strongly agree    agree    undecided    disagree    strongly disagree

Comments: \_\_\_\_\_

\_\_\_\_\_

**3. I am responsible about completing biology homework on time.**

strongly agree    agree    undecided    disagree    strongly disagree

Comments: \_\_\_\_\_

\_\_\_\_\_

**4. I understand the concepts on a biology quiz or test very well before I take it.**

strongly agree    agree    undecided    disagree    strongly disagree

Comments: \_\_\_\_\_

\_\_\_\_\_

**5. I know how I am doing in biology at all times.**

strongly agree    agree    undecided    disagree    strongly disagree

Comments: \_\_\_\_\_

\_\_\_\_\_

APPENDIX B

STUDENT ENGAGEMENT INTERVIEW #1

### Student Interview (Pre-treatment)

*(I interviewed students individually and recorded their responses by hand as I spoke with them. They were given the participation information below prior to their interview.)*

Participation is voluntary, and you can choose to not answer any question that you do not want to answer, and you can stop at any time. Your participation or non-participation will not affect your grade or class standing. All responses will be kept anonymous.

**ID #** \_\_\_\_\_ **Period** \_\_\_\_\_  
 (Your ID # will only be used to track responses from the pre- to the post-interview.)

1. How much do you participate in biology class currently?
2. What might encourage you to participate more than you do now?
3. How confident do you feel about your progress in biology so far?
4. What might help you feel more confident?
5. Do you feel responsible for your own learning? Explain.
6. Do you regularly do your biology homework? Do you complete it on time?
7. How prepared do you generally feel before taking biology quizzes and tests?
8. Are you nervous about taking biology quizzes and tests?
9. What could you do to help prepare yourself better for biology quizzes and tests?
10. Do you feel like you are always aware of how you are doing in biology or are you surprised when you receive a grade sheet?

APPENDIX C

STUDENT ENGAGEMENT SURVEY #2

**Student Survey (Mid-Point: After Reproduction/Development Unit)**

*Please circle your response to the following statements and add comments if you wish.*

Participation is voluntary, and you can choose to not answer any question that you do not want to answer, and you can stop at any time. Your participation or non-participation will not affect your grade or class standing. All responses will be kept anonymous.

**ID #** \_\_\_\_\_ **Period** \_\_\_\_\_  
(Your ID # will only be used to track responses from the pre- to the post-survey.)

**1. The three-color practice quizzes helped me learn the material.**

strongly agree    agree    undecided    disagree    strongly disagree

Comments: \_\_\_\_\_

\_\_\_\_\_

**2. The three-color practice quizzes helped me better understand how to study for the “real” quizzes.**

strongly agree    agree    undecided    disagree    strongly disagree

Comments: \_\_\_\_\_

\_\_\_\_\_

**3. The three-color practice quizzes made me feel more confident about taking the “real” quizzes.**

strongly agree    agree    undecided    disagree    strongly disagree

Comments: \_\_\_\_\_

\_\_\_\_\_

**4. The three-color practice quizzes made me feel less anxious about taking the “real” quizzes.**

strongly agree    agree    undecided    disagree    strongly disagree

Comments: \_\_\_\_\_

\_\_\_\_\_

**5. Discussing the three-color practice quiz questions with other students helped me learn the material better.**

strongly agree    agree    undecided    disagree    strongly disagree

Comments: \_\_\_\_\_

\_\_\_\_\_

- 6. The three-color practice quizzes helped me feel more prepared for this unit test than I did for earlier biology tests.**

strongly agree    agree    undecided    disagree    strongly disagree

Comments: \_\_\_\_\_

\_\_\_\_\_

- 7. The yellow portfolio helped me think about how well I understood the unit objectives at various points during the unit.**

strongly agree    agree    undecided    disagree    strongly disagree

Comments: \_\_\_\_\_

\_\_\_\_\_

- 8. The yellow portfolio helped me keep track of my assignment scores.**

strongly agree    agree    undecided    disagree    strongly disagree

Comments: \_\_\_\_\_

\_\_\_\_\_

- 9. The yellow portfolio Quiz Progress Graph helped me see my progress on quizzes.**

strongly agree    agree    undecided    disagree    strongly disagree

Comments: \_\_\_\_\_

\_\_\_\_\_

- 10. The yellow portfolio helped me feel more responsible for my own learning.**

strongly agree    agree    undecided    disagree    strongly disagree

Comments: \_\_\_\_\_

\_\_\_\_\_



APPENDIX D

STUDENT ENGAGEMENT SURVEY #3

**Student Survey (Post Treatment: After Classification Unit)**

*Please circle your response to the following statements and add comments if you wish.*

Participation is voluntary, and you can choose to not answer any question that you do not want to answer, and you can stop at any time. Your participation or non-participation will not affect your grade or class standing. All responses will be kept anonymous.

ID # \_\_\_\_\_ Period \_\_\_\_\_

(Your ID # will only be used to track responses from the pre- to the post-survey.)

**1. I participate often in biology.**

strongly agree    agree    undecided    disagree    strongly disagree

Comments: \_\_\_\_\_

\_\_\_\_\_

**2. I feel confident in my ability to do well in biology.**

strongly agree    agree    undecided    disagree    strongly disagree

Comments: \_\_\_\_\_

\_\_\_\_\_

**3. I am responsible about completing biology homework on time.**

strongly agree    agree    undecided    disagree    strongly disagree

Comments: \_\_\_\_\_

\_\_\_\_\_

**4. I understand the concepts on a biology quiz or test very well before I take it.**

strongly agree    agree    undecided    disagree    strongly disagree

Comments: \_\_\_\_\_

\_\_\_\_\_

**5. I know how I am doing in biology at all times.**

strongly agree    agree    undecided    disagree    strongly disagree

Comments: \_\_\_\_\_

\_\_\_\_\_

**6. The three-color practice quizzes helped me learn the material.**

strongly agree    agree    undecided    disagree    strongly disagree

Comments: \_\_\_\_\_  
\_\_\_\_\_

**7. The three-color practice quizzes helped me better understand how to study for the “real” quizzes.**

strongly agree    agree    undecided    disagree    strongly disagree

Comments: \_\_\_\_\_  
\_\_\_\_\_

**8. The three-color practice quizzes made me feel more confident about taking the “real” quizzes.**

strongly agree    agree    undecided    disagree    strongly disagree

Comments: \_\_\_\_\_  
\_\_\_\_\_

**9. The three-color practice quizzes made me feel less anxious about taking the “real” quizzes.**

strongly agree    agree    undecided    disagree    strongly disagree

Comments: \_\_\_\_\_  
\_\_\_\_\_

**10. Discussing the three-color practice quiz questions with other students helped me learn the material better.**

strongly agree    agree    undecided    disagree    strongly disagree

Comments: \_\_\_\_\_  
\_\_\_\_\_

**11. The three-color practice quizzes helped me feel more prepared for this unit test than I did for earlier biology tests.**

strongly agree    agree    undecided    disagree    strongly disagree

Comments: \_\_\_\_\_  
\_\_\_\_\_

**12. The yellow portfolio helped me think about how well I understood the unit objectives at various points during the unit.**

strongly agree    agree    undecided    disagree    strongly disagree

Comments: \_\_\_\_\_  
\_\_\_\_\_

**13. The yellow portfolio helped me keep track of my assignment scores.**

strongly agree    agree    undecided    disagree    strongly disagree

Comments: \_\_\_\_\_  
\_\_\_\_\_

**14. The yellow portfolio Quiz Progress Graph helped me see my progress on quizzes.**

strongly agree    agree    undecided    disagree    strongly disagree

Comments: \_\_\_\_\_  
\_\_\_\_\_

**15. The yellow portfolio helped me feel more responsible for my own learning.**

strongly agree    agree    undecided    disagree    strongly disagree

Comments: \_\_\_\_\_  
\_\_\_\_\_

APPENDIX E

STUDENT INTERVIEW #2

**Student Interview (Post-treatment)**

*(I interviewed students individually and recorded their responses by hand as I spoke with them. They were given the participation information below prior to their interview.)*

Participation is voluntary, and you can choose to not answer any question that you do not want to answer, and you can stop at any time. Your participation or non-participation will not affect your grade or class standing. All responses will be kept anonymous.

**ID #** \_\_\_\_\_ **Period** \_\_\_\_\_

(Your ID # will only be used to track responses from the pre- to the post-interview.)

1. Do you participate more now in biology class that you did before? Why or why not?
2. Do you feel more confident about your progress in biology now that you did before? Why or why not?
3. Do you feel more responsible for your own learning now than you did before? Why or why not?
4. Do you do your homework more regularly now and turn it in on time more than you did before? Why or why not?
5. Do you feel more confident about taking biology quizzes and tests than you did before? Why or why not?
6. Do you feel like you are more aware of how you are doing in biology now than you were before? Why or why not?
7. Did the three-color practice quizzes help you learn better and/or feel more confident? Explain.
8. What did you like most about the three-color practice quizzes? What did you like least about them? Explain.
9. Did the portfolio help you keep track of your progress in biology better and/or make you feel more responsible for your own learning? Explain.
10. What did you like most about the portfolios? What did you like least about them? Explain.

APPENDIX F

STUDENT PORTFOLIO SET-UP

## Student Portfolio Set-up

## Outside Panels

<p>The outside panels include the student's name, the class period, the title of the unit, and the unit objectives. Below each objective are spaces for students to indicate their degree of mastery at various points throughout the unit.</p>	

## Inside Panels

<p>The inside panels are where the student records his/her homework assignments, three-color quiz scores, final quiz scores, and charts his/her progress on a graph.</p>	



APPENDIX G

SAMPLE OBJECTIVE CHECKPOINT

## Sample Objective Checkpoint

Name \_\_\_\_\_ Period \_\_\_\_\_

## Unit: Classification and Diversity Learning Objectives Self-Assessment

**Objective #1: Understand the scientific naming and classification of organisms.**

Checkpoint #1 (before instruction):			Date _____
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Do not understand at all	Do not understand very well	Understand somewhat	Understand very well

Checkpoint #2 (after instruction/before practice quiz):			Date _____
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Do not understand at all	Do not understand very well	Understand somewhat	Understand very well

Checkpoint #3 (after practice quiz):			Date _____
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Do not understand at all	Do not understand very well	Understand somewhat	Understand very well

**Objective #2: Be able to identify organisms using dichotomous keys.**

Checkpoint #1 (before instruction):			Date _____
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Do not understand at all	Do not understand very well	Understand somewhat	Understand very well

Checkpoint #2 (after instruction/before practice quiz):			Date _____
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Do not understand at all	Do not understand very well	Understand somewhat	Understand very well

Checkpoint #3 (after practice quiz):			Date _____
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Do not understand at all	Do not understand very well	Understand somewhat	Understand very well

**Objective #3: Be able to create flow charts and dichotomous keys.**

Checkpoint #1 (before instruction):			Date _____
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Do not understand at all	Do not understand very well	Understand somewhat	Understand very well

Checkpoint #2 (after instruction/before practice quiz):			Date _____
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Do not understand at all	Do not understand very well	Understand somewhat	Understand very well

Checkpoint #3 (after practice quiz):			Date _____
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Do not understand at all	Do not understand very well	Understand somewhat	Understand very well

**Objective #4: Identify characteristics and organisms of the five and six kingdom classification systems.**

<b>Checkpoint #1 (before instruction):</b>			Date _____
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Do not understand at all	Do not understand very well	Understand somewhat	Understand very well

<b>Checkpoint #2 (after instruction/before practice quiz):</b>			Date _____
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Do not understand at all	Do not understand very well	Understand somewhat	Understand very well

<b>Checkpoint #3 (after practice quiz):</b>			Date _____
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Do not understand at all	Do not understand very well	Understand somewhat	Understand very well

**Objective #5: Identify the major characteristics and examples of the Invertebrate classes.**

<b>Checkpoint #1 (before instruction):</b>			Date _____
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Do not understand at all	Do not understand very well	Understand somewhat	Understand very well

<b>Checkpoint #2 (after instruction/before practice quiz):</b>			Date _____
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Do not understand at all	Do not understand very well	Understand somewhat	Understand very well

<b>Checkpoint #3 (after practice quiz):</b>			Date _____
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Do not understand at all	Do not understand very well	Understand somewhat	Understand very well

**Objective #6: Identify the major characteristics and examples of the Vertebrate classes.**

<b>Checkpoint #1 (before instruction):</b>			Date _____
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Do not understand at all	Do not understand very well	Understand somewhat	Understand very well

<b>Checkpoint #2 (after instruction/before practice quiz):</b>			Date _____
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Do not understand at all	Do not understand very well	Understand somewhat	Understand very well

<b>Checkpoint #3 (after practice quiz):</b>			Date _____
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Do not understand at all	Do not understand very well	Understand somewhat	Understand very well

APPENDIX H

SAMPLE ASSIGNMENT RECORD

### Classification and Diversity Assignment Checklist

Assignment:	Score:	My Level of Understanding:		
<input type="checkbox"/> 1. Classification Reading WS w/Text 47-50	___/___	High	Medium	Low
<input type="checkbox"/> 2. Classification Reading WS w/Text 51-55	___/___	High	Medium	Low
<input type="checkbox"/> 3. Classification Reading WS w/Text 56-60	___/___	High	Medium	Low
<input type="checkbox"/> 4. Lab: Shark Key	___/___	High	Medium	Low
<input type="checkbox"/> 5. Lab: Invertebrate Animal Phyla	___/___	High	Medium	Low
<input type="checkbox"/> 6. What a Strange Group WS	___/___	High	Medium	Low
<input type="checkbox"/> 7. Classification Reading WS w/Text 60-63	___/___	High	Medium	Low
<input type="checkbox"/> 8. Classifying Dinosaurs	___/___	High	Medium	Low
<input type="checkbox"/> 9. Earthworm Article and WS	___/___	High	Medium	Low
<input type="checkbox"/> 10. Lab: Living Earthworm	___/___	High	Medium	Low
<input type="checkbox"/> 11. Lab: Earthworm Dissection	___/___	High	Medium	Low
<input type="checkbox"/> 12. Lab: Squid Dissection	___/___	High	Medium	Low
<input type="checkbox"/> 13. Lab: Arthropods	___/___	High	Medium	Low
<input type="checkbox"/> 14. 8 Traits of Jointed-Leg Animals WS	___/___	High	Medium	Low
<input type="checkbox"/> 15. Vertebrates Study Guide w/Text 8.2	___/___	High	Medium	Low
<input type="checkbox"/> 16. Lab: Classify Vertebrates	___/___	High	Medium	Low
<input type="checkbox"/> 17. _____	___/___	High	Medium	Low
<input type="checkbox"/> 18. _____	___/___	High	Medium	Low
<input type="checkbox"/> 19. _____	___/___	High	Medium	Low
<input type="checkbox"/> 20. _____	___/___	High	Medium	Low
<input type="checkbox"/> 21. _____	___/___	High	Medium	Low
<input type="checkbox"/> 22. _____	___/___	High	Medium	Low
<input type="checkbox"/> 23. _____	___/___	High	Medium	Low
<input type="checkbox"/> 24. _____	___/___	High	Medium	Low
<input type="checkbox"/> 25. _____	___/___	High	Medium	Low
<input type="checkbox"/> 26. _____	___/___	High	Medium	Low
<input type="checkbox"/> 27. _____	___/___	High	Medium	Low
<input type="checkbox"/> 28. _____	___/___	High	Medium	Low

APPENDIX I

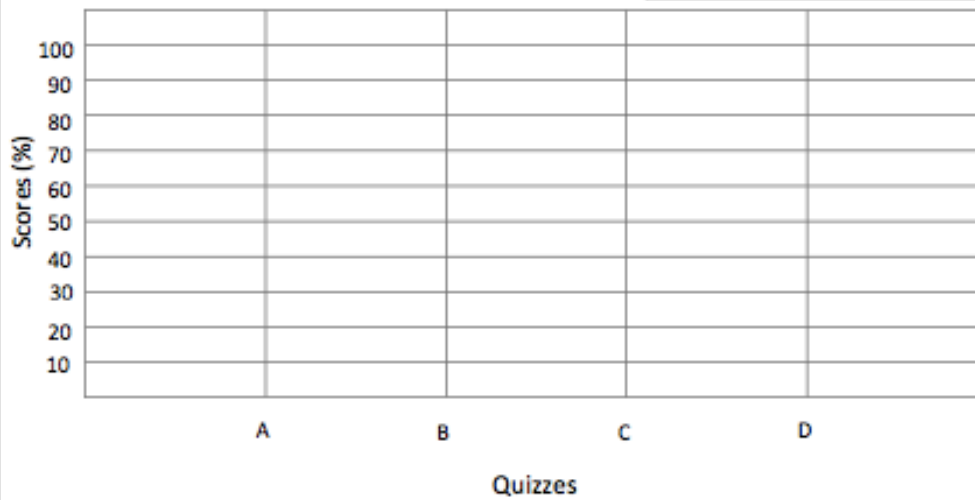
SAMPLE QUIZ PROGRESS SCORES AND GRAPH

Quiz Names	Three-Color Practice Quiz % Scores	Summative Quiz % Scores
A. Classification and Using Keys (Objectives #1 and #2)	black _____ % green _____ % blue _____ %	_____ %
B. Create Flow Chart and Key (Objective #3)	black _____ % green _____ % blue _____ %	_____ %
C. Kingdoms (Objective #4)	black _____ % green _____ % blue _____ %	_____ %
D. Invertebrates/Vertebrates (Objectives #5 and #6)	black _____ % green _____ % blue _____ %	_____ %

### Quiz Progress Graph

**KEY:**

- black pen scores
- green pen scores
- blue pen scores
- summative quiz scores



APPENDIX J

SAMPLE THREE-COLOR PRACTICE QUIZ



**Three-Color Practice Quiz:**  
**Part 1: Classification and Using Keys**

Name \_\_\_\_\_ Period \_\_\_\_\_

Quiz Name	Three-Color Practice Quiz % Scores	Summative Quiz % Score
A. Classification and Using Keys (Objectives #1 and #2)	black _____ % green _____ % blue _____ %	_____ %

**Instructions:**

- Using a **black** pen, answer the questions by yourself.
- Using a **green** pen, change or add to your answers after discussing with your group.
- Using a **blue** pen, change or add to your answers using your notes and/or textbook.

**Use the following terms to answer questions # 1 - 6.**

*Aristotle, binomial nomenclature, classification, Latin, Linnaeus, taxa*

1. What is the term that means "groups" such as Kingdom, Phylum, etc....?

BLACK \_\_\_\_\_ GREEN \_\_\_\_\_ BLUE \_\_\_\_\_

2. Which scientist grouped living things into two groups: plants and animals?

BLACK \_\_\_\_\_ GREEN \_\_\_\_\_ BLUE \_\_\_\_\_

3. What is the term that means "two-word naming"?

BLACK \_\_\_\_\_ GREEN \_\_\_\_\_ BLUE \_\_\_\_\_

4. Which scientist gave each organism a two-part name?

BLACK \_\_\_\_\_ GREEN \_\_\_\_\_ BLUE \_\_\_\_\_

5. What is the term that means grouping things based on similarities?"

BLACK \_\_\_\_\_ GREEN \_\_\_\_\_ BLUE \_\_\_\_\_

6. Scientific names are written in which language?

BLACK \_\_\_\_\_ GREEN \_\_\_\_\_ BLUE \_\_\_\_\_

7. Put the following taxa in order from most general to most specific by writing the first letter of each on the blank below: *Class, Kingdom, Species, Order, Phylum, Genus, Family*

BLACK \_\_\_\_\_ GREEN \_\_\_\_\_ BLUE \_\_\_\_\_

8. Which of these do scientists use to classify organisms? Choose all that apply by writing their letters on the blank below:

- A. embryological similarities
- B. structural similarities
- C. evolutionary relationships
- D. biochemical similarities

BLACK \_\_\_\_\_ GREEN \_\_\_\_\_ BLUE \_\_\_\_\_

Use the following chart to answer questions # 9 – 12.

	House Cat	Dog	Human	Grasshopper
<b>Kingdom</b>	Animalia	Animalia	Animalia	Animalia
<b>Phylum</b>	Chordata	Chordata	Chordata	Arthropoda
<b>Subphylum</b>	Vertebrata	Vertebrata	Vertebrata	
<b>Class</b>	Mammalia	Mammalia	Mammalia	Insecta
<b>Order</b>	Carnivora	Carnivora	Primates	Orthoptera
<b>Family</b>	Felidae	Canidae	Hominidae	Locustidae
<b>Genus</b>	<i>Felis</i>	<i>Canis</i>	<i>Homo</i>	<i>Schistocerca</i>
<b>Species</b>	<i>catus</i>	<i>familiaris</i>	<i>sapiens</i>	<i>americana</i>

9. Which taxon (Kingdom, Phylum, etc.....) do ALL the organisms have in common?

BLACK \_\_\_\_\_ GREEN \_\_\_\_\_ BLUE \_\_\_\_\_

10. Which organism(s) belongs to the Order Orthoptera?

BLACK \_\_\_\_\_ GREEN \_\_\_\_\_ BLUE \_\_\_\_\_

11. Which organism is most closely related to the dog?

BLACK \_\_\_\_\_ GREEN \_\_\_\_\_ BLUE \_\_\_\_\_

12. What is the scientific name of the house cat?

BLACK \_\_\_\_\_ GREEN \_\_\_\_\_ BLUE \_\_\_\_\_

Use the following key to classify the shapes indicated by questions #13 - 14.

### Shape Dichotomous Key

1. A. Contains one shape inside of another shape ..... Go to 2  
B. Only contains one shape ..... Go to 6
2. A. Outer shape has 3 or more sides ..... Go to 3  
B. Outer shape does not have any sides ..... Go to 5
3. A. Outer shape has 3 sides ..... Shape A  
B. Outer shape has 4 sides ..... Go to 4
4. A. Inner shape is round ..... Shape B  
B. Inner shape has 4 sides ..... Shape C
5. A. Inner shape is round ..... Shape D  
B. Inner shape has 4 sides ..... Shape E
6. A. Shape has 3 or more sides ..... Go to 7  
B. Shape does not have any sides ..... Shape F
7. A. Shape has 3 sides ..... Shape G  
B. Shape has 4 sides ..... Go to 8
8. A. All sides are the same length ..... Shape H  
B. All sides are not the same length ..... Shape I

13. Which shape is this? (Write the letter of the shape on the line below.)



BLACK \_\_\_\_\_ GREEN \_\_\_\_\_ BLUE \_\_\_\_\_

14. Which shape is this? (Write the letter of the shape on the line below.)



BLACK \_\_\_\_\_ GREEN \_\_\_\_\_ BLUE \_\_\_\_\_

**Three-Color Practice Quiz:**  
**Part 2: Create Flow Chart and Key**

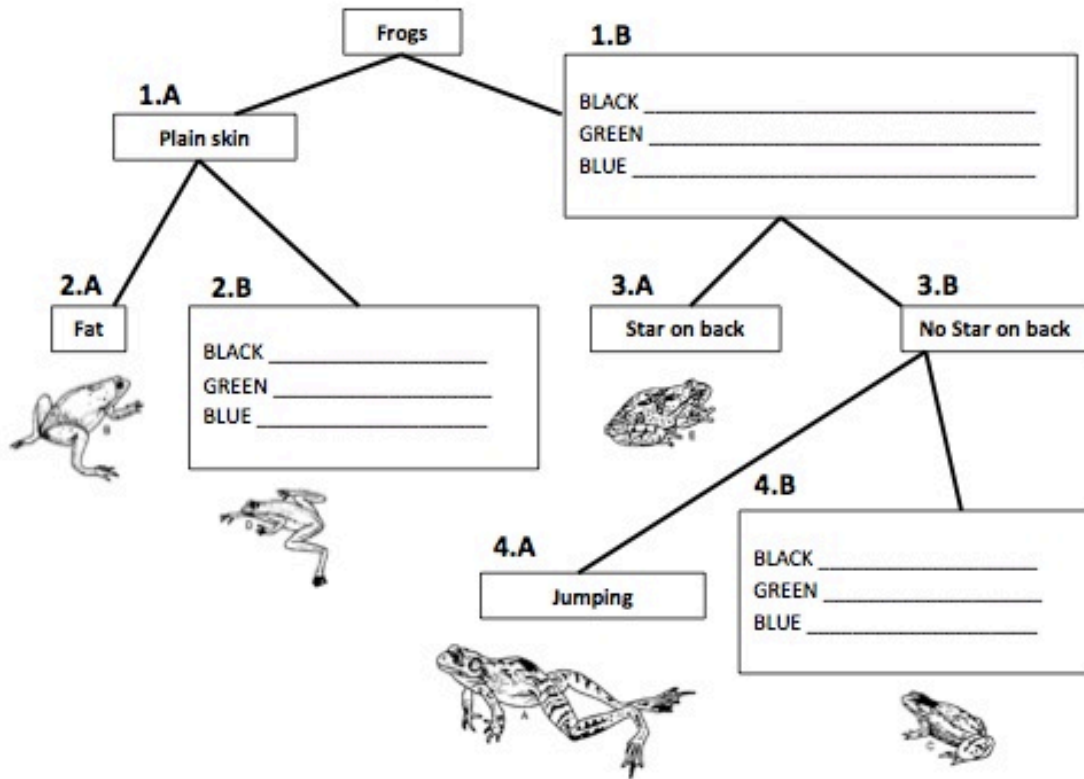
Name \_\_\_\_\_ Period \_\_\_\_\_

Quiz Name	Three-Color Practice Quiz % Scores	Summative Quiz % Score
B. Create Flow Chart and Key (Objective #3)	black _____ % green _____ % blue _____ %	_____ %

**Instructions:**

- Using a **black pen**, answer the questions by yourself.
- Using a **green pen**, change or add to your answers after discussing with your group.
- Using a **blue pen**, change or add to your answers using your notes and/or textbook.

Fill in the blanks on the following flow chart and key.



**Frog Dichotomous Key**

1. A. Plain skin.....Go to 2

B. BLACK \_\_\_\_\_  
GREEN \_\_\_\_\_  
BLUE \_\_\_\_\_

2. A. BLACK \_\_\_\_\_  
GREEN \_\_\_\_\_  
BLUE \_\_\_\_\_

B. BLACK \_\_\_\_\_  
GREEN \_\_\_\_\_  
BLUE \_\_\_\_\_

3. A. BLACK \_\_\_\_\_  
GREEN \_\_\_\_\_  
BLUE \_\_\_\_\_

B. BLACK \_\_\_\_\_  
GREEN \_\_\_\_\_  
BLUE \_\_\_\_\_

4. A. BLACK \_\_\_\_\_  
GREEN \_\_\_\_\_  
BLUE \_\_\_\_\_

B. BLACK \_\_\_\_\_  
GREEN \_\_\_\_\_  
BLUE \_\_\_\_\_

APPENDIX K

TEACHER OBSERVATION SHEET

**Teacher Observations**

Date \_\_\_\_\_ Period \_\_\_\_\_

Student attendance:

Homework completion:

General climate of the classroom:

Level of student participation:

Time on task:

Ability to focus:

Positive student feedback:

Negative student feedback:

APPENDIX L

STUDENT ENGAGEMENT SURVEY FULL RESULTS



## Full Results of Student Specific Survey Responses (Partial results shown in Table 4)

Survey Statement	Percentage of Responses Mid-intervention			Percentage of Responses Post-intervention		
	Strongly Agree/ Agree	Undecided	Disagree/ Strongly Disagree	Strongly Agree/ Agree	Undecided	Disagree/ Strongly Disagree
1. The three-color practice quizzes helped me learn the material.	80.0%	17.1%	2.9%	82.9%	17.1%	0.0%
2. The three-color practice quizzes helped me better understand how to study for the “real” quizzes.	71.4%	25.7%	2.9%	82.9%	14.3%	2.9%
3. The three-color practice quizzes made me feel more confident about taking the “real” quizzes.	80.0%	14.3%	5.7%	80.0%	14.3%	5.7%
4. The three-color practice quizzes made me feel less anxious about taking the “real” quizzes.	31.4%	17.12%	22.9%	65.7%	22.9%	11.4%
5. Discussing the three-color practice quiz questions with other students helped me learn the material better.	71.4%	20.0%	8.6%	85.7%	11.4%	2.9%
6. The three-color practice quizzes helped me feel more prepared for this unit test than I did for earlier biology tests.	74.3%	25.7%	0.0%	91.4%	8.6%	0.0%
7. The yellow portfolio helped me think about how well I understood the unit objectives at various points during the unit.	57.1%	28.6%	14.3%	80.0%	11.4%	8.6%

<b>8. The yellow portfolio helped me keep track of my assignment scores.</b>	<b>85.7%</b>	<b>14.3%</b>	<b>0.0%</b>	<b>88.6%</b>	<b>8.6%</b>	<b>2.9%</b>
<b>9. The yellow portfolio Quiz Progress Graph helped me see my progress on quizzes.</b>	<b>85.7%</b>	<b>8.6%</b>	<b>5.7%</b>	<b>94.3%</b>	<b>5.7%</b>	<b>0.0%</b>
<b>10. The yellow portfolio helped me feel more responsible for my own learning.</b>	<b>77.1%</b>	<b>22.9%</b>	<b>0.0%</b>	<b>82.9%</b>	<b>14.3%</b>	<b>2.9%</b>

!