EFFECTS OF TRACKING STUDENT GROWTH AND SUCCESS CELEBRATIONS
ON HIGH SCHOOL ENGLISH LEARNERS IN SCIENCE

by

Hannah Smith

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## TABLE OF CONTENTS

1. INTRODUCTION AND BACKGROUND .......................................................... 1

2. CONCEPTUAL FRAMEWORK ....................................................................... 5

3. METHODOLOGY ......................................................................................... 9

4. DATA AND ANALYSIS .............................................................................. 17

5. INTERPRETATION AND CONCLUSION ...................................................... 27

6. VALUE .................................................................................................. 31

REFERENCES CITED ................................................................................... 36

APPENDICES .............................................................................................. 39

   APPENDIX A Institutional Review Board Exemption Form ......................... 40
   APPENDIX B Likert Survey ......................................................................... 42
   APPENDIX C Interview Questions .............................................................. 47
   APPENDIX D Student Progress Tracking Sheet ............................................. 49
   APPENDIX E Histograms for Growth .......................................................... 51
   APPENDIX F Histograms for Likert Survey .................................................. 55
LIST OF TABLES

1. Summary and Timeline for Treatment and Comparison Topics ........................................14
2. Data Triangulation Matrix .................................................................................................16
3. Statistical Analysis of Average Gains...........................................................................19
4. Statistical Analysis of Likert Survey .............................................................................23
LIST OF FIGURES

1. Average Gains from Pre-test to Post-test Analyzed Using Three Methods......................18

2. Overall Average Likert Survey Scores for EL and Non EL Students
   During Each Collection Period.................................................................22
ABSTRACT

This classroom research project focused on English Learner (EL) students and implemented two strategies to assess how the strategies would impact EL students’ engagement and academic growth. The first strategy had students set goals for end-of-unit test scores at the beginning of a unit, and tracked their progress over the course of a unit. The second strategy implemented the Scientists of the Lab Award. This award was given during labs based on the lab group that best demonstrated the use of specific scientific behaviors. Quantitative results suggest that despite showing growth from pre-test to post-test scores, the growth during the units in which the treatment was applied was not significantly different than the growth during the units in which the treatment was not applied (control units). Qualitatively, EL students in general did like the two strategies implemented during the treatment and felt that it helped them as learners.
INTRODUCTION AND BACKGROUND

Project Background

According to the Office of English Language Acquisition, in 2015 Washington State ranked second, following Texas, for the highest number of English Learners (ELs) enrolled in preschool programs (Barnett, W.S., Carolan, M.E., Squires, J.H., Clarke Brown, K., & Horowitz, M., 2015). Burlington-Edison School District (where I teach) reflects this, with 31.4% of its students classified as ELs. With a relatively high number of EL students, one of the goals at Burlington-Edison High School (B-EHS) is to eliminate the achievement gap between EL students and non EL students over a period of 10 years. As a result, I spent my first year at B-EHS immersing myself in dialogue and professional learning communities (PLCs) that provided strategies and background on this population of students. This information was immediately useful because my classes were reflective of the district with about one third of the students classified as ELs. I tried various strategies from the Sheltered Instructional Observational Protocol (SIOP) book group along with strategies presented to staff from the EL coordinator during professional development days. Over the course of the year, I found some strategies to work more effectively than others, but I consistently ran into a lack of engagement in EL students.

This lack of EL student engagement took many different forms including non-completion of classwork, low participation in class discussions, and a hands-off approach during lab work. The most consistent indicator of disengagement was statements made by multiple EL students claiming they were “not good at science.” This insight into
students’ self-perception sparked my classroom research project. How could I get students to see themselves as more scientifically capable? If science self-esteem improved, would this manifest into improved engagement in class?

With my classroom research project in mind, I went about soliciting support for my project from my principal and his administrative team. They were more than happy to support my project. I also gathered the support of the EL department who thought it would be a great project to pursue. My science department was also invested in my project because the classes I teach are mostly freshman and sophomore students who feed directly into their upper level classes. With the support of these professionals, I felt prepared to begin researching.

The support from my colleagues and administration was strong because EL students, on average, perform lower on tests than non EL students at our school. In the 2015-2016 school year, only 12.5% of EL students at B-EHS passed the Biology End of Course (EOC) exam, which is a state-mandated science test that students must pass in order to graduate. In contrast, 76.4% of non-limited English speakers at B-EHS passed this same test according to the Washington State Report Card (Office of Superintendent of Public Instruction, 2016). My school is invested in changing this statistic.

In my classroom, I administer tests prior to beginning a unit (pre-test) to assess my students’ background knowledge and experience with the concepts. A final assessment (post-test) on that unit is given at the culmination of the unit. A general observation of EL students’ post-test scores was found to be overall relatively low (around 50-60% on average), and because these scores are F’s and D’s, this translates to
failure to them and that sense of failure negatively impacts their self-esteem which could hinder their learning. I hypothesized that if I could get students to see that even though, for example, they scored a 57% on their final assessment they still improved by 30% because they scored 27% on their pre-test. This tracking of their growth and seeing that there was progress would change their self-perception that they are not good at science.

The self-perception of scientific failure also appeared when EL students were conducting labs. EL students often let their non EL partners take the lead; if two EL students were partners, both struggled to take the lead, resulting in little progress. I hypothesized that students would be more engaged in the lab if they were focusing on a specific skill used by scientists that was accessible to all students, such as communicating with clarity and precision. To encourage engagement, lab groups who displayed the targeted skill the best would be awarded the Scientists of the Lab. They would receive a small gift bag along with having their photo displayed in the hallway alongside other famous scientists.

I hypothesized that having EL students track their progress throughout a unit would improve their self-perception of their abilities in science. I also looked for a connection between an increase in self-esteem in science and with increased engagement. In addition, I hypothesized that celebrating student success through the Scientists of the Lab awards would provide students the opportunity to see themselves as future leaders and learners in science.
Focus Questions

The primary focus question of my classroom research project was “What impact does creating an environment where students’ successes are celebrated, through regular assessment growth celebrations and Scientists of the Lab awards, have on the engagement of English Learners?” This question was broken down into four sub questions that were investigated to support my primary question. They are listed below with the rationale for each sub question:

1. ELs’ summative assessment scores (quizzes and tests), on average, are lower than their peers. Do ELs’ test scores improve through regular tracking of their own progress toward a specific goal they set themselves based on a pre-test?

2. ELs tend to be unsure of themselves in lab settings and are less involved in the labs. How does the implementation of the Scientists of the Lab Award program influence EL students’ level of engagement in science?

3. I want to look at the classroom culture as a whole for ELs when both interventions are implemented. What impact do the Scientists of the Lab Award and progress tracking have on the students’ attitude towards science?

4. I want to be able to celebrate more student success in my classroom. What impact does implementing the Scientists of the Lab Award and student progress tracking have on me as a teacher?
CONCEPTUAL FRAMEWORK

Introduction

According to the United States Census Bureau as of July 1st, 2015, the Hispanic population in the United States was 56.6 million people, making it the largest ethnic or racial minority in the US. At B-EHS, 95% of the EL students are Hispanic. “If Hispanic EL students do not perform better academically, the status of the United States as a world power is threatened” (Elizondo, 2014, p.7). It is imperative that teachers investigate ways to help their Hispanic EL students perform better. In a study that analyzed four high schools that represented different school population sizes, 1A, 3A, 4A, 5A in South Texas, four students were selected from each one to address why these Hispanic EL students achieved high academic science performance while others did not. Elizondo’s key findings were that “students are motivated to perform academically when they think about their future and how they can achieve a good life” (2014, p. 132). He identified two key components in the Hispanic language that were consistently brought up in his interviews, “empeño” meaning a deep-rooted or burning desire to succeed or accomplish a goal, and “ecandole ganas” which means the action taken to achieve a goal. These concepts relate to my research hypothesis in that tracking improvement can increase science self-esteem because students can set goals based on pre-test scores and work toward those goals.

Goal setting

At the University of Minnesota, a learning attitudes survey was administered to two introductory geoscience courses where the population of underrepresented students
(EL students) was 49. The intent of the survey was to determine general attitudes and beliefs around science. This study found that the development of a goal along with specific strategies to collaborate around was found to have “greater gains in positive attitudes towards learning science, which can potentially increase retention and persistence…” (Fayon, A.K., Goff, E., & Durancyzk, I. M., 2010, p.16). Participating in self-guided reflection can help students become invested in their own success in class. Reflection often leads to a desire to set goals and to work to achieve them. Research performed by Travers, Morisano, and Locke (2015) found that when students set growth goals and made progress towards them (e.g., better academic performance) there was an increase in self-esteem (positive self-evaluation) and self-efficacy (task-specific confidence). “Success encouraged many students to set higher growth goals for the future and energized those who were less motivated academically” (Travers et al., 2015, p. 238). This idea of students being more motivated by setting growth goals was supported by an Australian study that looked at setting personal best goals. It was found that setting personal best learning goals was associated with motivational growth in students’ lives (Martin, Durksen, Williamson, Kiss, & Ginns, 2014). This research in the field of growth goals supports my classroom research questions and suggests that successful outcomes are associated with setting goals and reflecting upon them.

Engagement

The second direction of my AR project stemmed from a research paper that looked at the importance of displaying immediacy behaviors towards students. Immediacy behaviors are verbal and non-verbal communication behaviors that
demonstrate the approachability of teachers to their students (Allen et. al, 2006). These behaviors enhance the closeness that students perceive with their teachers based on the use of certain cues, questions, and responses (Mehrabian, 1981). Often, science teachers feel they have few opportunities to develop lasting relationships with each of their students due to the large teaching demands and their lack of availability (Kocher, 2013). Kocher emphasized, however, that by displaying immediacy behaviors, one can increase the level of perceived closeness, and in turn, affect student motivation and learning.

Based on this research, emphasis on individual student success and focusing on positive interactions with students can increase student engagement with both the teacher and subject.

Research compiled by Rodríguez and Osgera from three high poverty urban communities in the Northeast, Southeast, and Southwest (2015) also found similar results, but specific to Latina/o students.

Relationships are a vital dimension to institutional culture, particularly among Latina/o students who find themselves in struggling schools with inadequate opportunities to learn. Institutions need to learn from those practices and policies that produce relational success and start from that point forward (p.134).

Students want to build meaningful relationships with educators, and educators have to create space within their classroom for this to occur. An example of this would be when students are asked about quality teachers and learning environments, they often state that they want the opportunity to be heard, to teach others and listen to others (Hooks, 1994; Rodríguez & Brown, 2009). If educators create the opportunities for students to engage both with teachers and each other, student engagement learning should increase.
Celebrating Student Success

Building meaningful relationships with students can happen through many different avenues within the classroom. “Many students, and Latina/o students specifically, often went through a typical school day without any meaningful interactions with school adults” (Rodriguez and Osguera, 2015, p.139). Because of this, it is of even greater importance that educators take the time to recognize student success within the confines of the classroom. In a study where 132 first-year students were selected based on specific characteristics such as being Hispanic, open-ended interview’s found that “First generation and underrepresented students are especially responsive to institutional agents’ expressions of interest and confidence in their potential” (Rendon 1994, p. 40). Teachers celebrating student success can create a relationship that helps the students grow and remain or become motivated.

Based on the research, EL engagement should be positively impacted by creating moments in the classroom where immediacy behaviors can be expressed such as celebrating student success. This can be supported by goal setting and helping students recognize their own growth and personal success. Human nature is designed to build connections, and this is especially important when students might feel separated from their environment due to a language barrier. Through intentional strategies that focus on each student feeling success, students can build relationships with their teachers that are positive and student-centered. At B-EHS, where the majority of the teaching staff is non-Hispanic, it can be challenging for students to be able to see themselves in their teachers, and making these connections that much more imperative to create.
METHODOLOGY

Study Overview

I implemented the treatment in Physical Earth Science. This course did not have a specific curriculum. It was developed over the years by the four previous teachers who taught it. I used the same curriculum and sequence I used last year, with slight modifications due to natural teaching adaptations. I added the various components of my classroom research project over the course of the two treatment units. The timeline of my classroom research project fell within the constraints of a semester. I could not extend beyond a semester because students might switch teachers at the end of the first semester. The semester was approximately 18 weeks long; however, because finals take up two weeks at the end of the semester, and in order to allow flexibility in the schedule, I allotted nine weeks for my classroom research project. I broke these nine weeks into two parts: comparison and treatment. The first three weeks were the comparison period. One unit of subject matter was completed within these three weeks. During the next six weeks, two subject units were covered. During this time period, I implemented my classroom research project. Students were accustomed to the flow of class by then, and hopefully able to transition when new strategies were implemented.

Study Participants

I taught two Physical Earth Science classes and applied the treatment to all students in both my classes. There are a total of 45 Physical Earth Science students in these two classes, 27 students in one class and 19 in another. There are 30 boys and 16 girls. Fifty-six percent (25 students) of the Physical Earth Science students are freshman,
33% (15 students) are sophomores, 9% (11 students) are juniors, and 2% (1 student) are seniors. The class is considered an entry level class where students are exposed to a wide variety of science topics, in order to give them the scientific skills needed in all other science classes at the high school. The cumulative average GPA of students in this class is 1.9. Twenty-six percent of the class population receives special education services and have Individualized Educational Plans. As a result, there were three instructional aids for the two classes to support these students. Twenty-eight percent of the students are considered EL’s. All but one of the EL students were classified under state and federal code as Hispanic/Latino with their primary language being Spanish. The one student who was not Hispanic was Pacific Islander and his primary language was Marshallese. EL students are classified into levels based on their English proficiency. Fifty-three percent of the EL students were classified as Level 1 or 2 (out of 4) which is considered to be “developing English fluency.”

All students experienced the treatment, and I collected data from all students. This way, I could compare results from non EL students to results from EL students. Random sampling was not done in this study because my population of EL students was small so all students in that category were sampled. However, for the individual interviews, I only interviewed my level 1 and 2 EL students, those students that have not yet developed complex English fluency. I interviewed these students because they are the primary focus of my research and I wanted to learn their opinions and self-perceptions. All of my level 1 and 2 EL students were interviewed because my sample size was small.
The research methodology received an exemption from Montana State University’s Institutional Review Board, and compliance for working with human subjects was maintained (Appendix A).

Comparison

The comparison period took place during the first three weeks of November. The comparison period covered a Chemistry unit. To start this unit, students began by recording their responses to a Likert survey on engagement (Appendix B). Each response, from strongly disagree to strongly agree, was quantified by a numerical response (1-7). Students completed the survey during the last 20 minutes of class. I explained the purpose of the survey to the students and clarified that was optional. All students opted to take it. Students used their student ID numbers for anonymity. This survey served as baseline data for student engagement level. Following the survey, students were given a Chemistry pre-test. I emphasized that students were not expected to know the content, but instead were to show me what they knew so that we could see what to focus on for the unit. The pre-test was intentionally not reflected on the following day by the students. I did not have the students reflect on this pre-test the following day. The unit consisted of guided notes, practice problems, a lab, and a project. At the end of the unit, students were given a post-test to determine how much they improved from the beginning of the unit. This post-test was the same as the pre-test given to them at the beginning of the unit.
Treatment

The treatment period immediately followed the comparison period. We covered two units in the six week treatment period. These units were nuclear chemistry and astronomy. Students began by taking a pre-test. The pre-test was the same test as the post-test that they took at the end of each unit. The test included vocabulary, multiple choice, short answer, and an application question. The following day, students received their scored tests back with a graphing instrument to tape into the back of their Interactive Notebook (see Appendix D for an EL student example). On this day, students plotted their score on a grid and then wrote a numerical goal that they would like to reach by the end of the unit. Students transferred this goal onto a word bubble with their student ID number on it. Their student ID number kept their goals anonymous when publicly displayed on a classroom bulletin board. The unit began the following day. The way that the content was presented did not change from the normal implementation of the curriculum during the comparison period. However, as students completed assignments they were provided class time to reflect on their progress towards their goal. On the day prior to the test, in order to continue to build students’ self-confidence, we had a reflection day to look at the growth that each student has made over the course of the unit thus far. This day included students reflecting back on their progress monitoring sheet to see what their original pre-test score was and what they had set their goal for the post-test. We spent time looking at our notes to emphasize the amount of content covered. Lastly we reflected on progress reports and highlighted assignments that students did well on and continue the emphasis on positive growth in the unit content.
Students concluded the unit by taking a post-test, which was exactly the same as the pre-test. The following day, students’ post-tests were returned. Students graphed the progress they made and calculated the percentage of growth they made over the course of the unit. Students added this growth number to their final goal displayed in the classroom. Next, they reflected on possible reasons for either reaching their goal or not and what they would try to do differently next time. This reflection of individual growth was the first part of the treatment aimed at improving their self-perception and engagement in science.

The second part of the treatment was the Scientists of the Lab award. The Scientists of the Lab Award was an award given to the group of students who did the best at modeling a specific scientific skill throughout the entirety of a lab. This scientific skill was chosen from the 16 Dispositions of Deeper Learning, which is a focus at my school. For example, the specific scientific skill that may be chosen to focus on could be Communicating with Clarity and Precision or Questioning and Problem Posing. As a class, we decided what I would see when their group was modeling this skill. They brainstormed a list on the whiteboard and it remained there for all students to be able to reference throughout the lab. As students conducted the pre-lab, collected data, and then analyzed and wrote a conclusion, I visited with groups, checked on their progress and wrote comments about the targeted skill. At the end of the lab, the award was presented with an explanation as to why that group exemplified that skill. Students were presented with a gift certificate to our school’s espresso stand for a drink of their choice. Along with this, their photo went up in the hallway as the Scientists of the Lab. I piloted this
program in 2016 and had great success with an increase in the attention to detail throughout the entirety of the lab from students. It was a great addition to my lab dynamics because it seemed to improve students’ focus on working with their peers and being on-task. This is why I chose to include it in my project because I wanted to quantify the effect I observed in my pilot session of this program.

Table 1
Summary and Timeline for Treatment and Comparison Topics

<table>
<thead>
<tr>
<th>Unit</th>
<th>Methods</th>
<th>Timeline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comparison Unit:</td>
<td>Likert Survey administered</td>
<td>November 1st-18th</td>
</tr>
<tr>
<td>Chemical Reactions</td>
<td>Pre-test &amp; post-test</td>
<td>3 weeks</td>
</tr>
<tr>
<td></td>
<td>Teacher Journaling</td>
<td></td>
</tr>
<tr>
<td>Treatment Unit 1:</td>
<td>Likert survey administered</td>
<td>November 21st-December 9th</td>
</tr>
<tr>
<td>Nuclear Chemistry Treatment</td>
<td>Pre-test &amp; post-test</td>
<td>3 weeks</td>
</tr>
<tr>
<td></td>
<td>Students track progress</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Scientist of the Lab Award</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Teacher Journaling</td>
<td></td>
</tr>
<tr>
<td>Treatment Unit 2:</td>
<td>Likert survey administered</td>
<td>December 12th-January 13th</td>
</tr>
<tr>
<td>Astronomy Treatment</td>
<td>Pre-test &amp; post-test</td>
<td>3 weeks</td>
</tr>
<tr>
<td></td>
<td>Students track progress</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Scientist of the Lab Award</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Interview Individual Students</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Teacher Journaling</td>
<td></td>
</tr>
</tbody>
</table>

Data Collection

Student assessment was one measure being implemented to determine the effectiveness of the treatment. Assessing students’ prior knowledge and then reflecting on their growth could be important in regards to how students perceive their abilities in science. One method of relaying this information to students is through the use of pre-tests and post-tests. Greene, Costa, Robertson and Deekenas (2010) found that these instruments allow students to measure their declarative knowledge of the content that is stored in their memory and needs to be shown through pre-test and post-test scores.
These differences in scores should provide students evidence in the growth of knowledge they have experienced over the course of the unit. By administering the pre-test and post-test during the non-treatment unit and the treatment unit, progress could be assessed.

Another tool for quantitative and qualitative data collection was a Likert Survey on engagement (Appendix B). JohnMarshall Reeve created a 21 question survey that looked at students’ engagement, specifically agentic engagement. Agentic engagement is defined by Reeve and Tseng (2011) as “students’ constructive contribution into the flow of the instruction they receive” (p.258). The Likert survey also looked at behavioral, cognitive, and emotional engagement as well. The survey was validated through three different studies that addressed different components of the survey such as types of questions, criteria introduced, and conclusions that could be drawn. It allowed for students to quantify their engagement level on a scale of 1 to 7. Some questions were coupled with short answer responses as follow up questions to allow for reflection. Students took this survey at the beginning of the comparison unit, at the start of the treatment unit, and then for a final time at the end of the treatment unit. The data were used to gauge whether engagement levels increased through the implementation of the treatment.

Qualitative data were also collected through individual student interviews with level 1 and 2 EL students (Appendix C). In a study by Tracey Ann Todd (2013), data was collected through interviews with EL students and teachers and analyzed for common themes about learning experiences in different environments. Todd indicated that a key to the interviews was making sure that they relied on “open-ended questions to
allow the participants to share their experiences and points-of-view” (2013). Similar interview questions to Todd’s were used to gather opinions about engagement levels pre-treatment and post-treatment. EL students were interviewed individually at the end of the treatment unit. Interviews were voice recorded. This data provided insight into student perceptions of themselves in science and their engagement level over the course of the treatment.

Finally, the teacher journal provided a qualitative record of my perception of how students responded to the treatment when evaluated against to the comparison unit. It also provided insight on teacher engagement throughout this classroom research project.

Table 2 shows the different methods of data collection used for each research question.

Table 2  
*Data Triangulation Matrix*

<table>
<thead>
<tr>
<th>Research Questions</th>
<th>Pre &amp; Post-Test</th>
<th>Student Survey (Likert Survey)</th>
<th>Individual Student Interviews</th>
<th>Teacher Journal</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Main Focus Question:</strong> What impact does creating an environment where students’ successes are celebrated through regular pre-test &amp; post-test growth celebrations and Scientist of the Lab awards have on the engagement of English Learners?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Does regular tracking of their own progress towards a specific goal increase growth in test scores for EL students?</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>How does the implementation of the Scientists of the Lab Award influence EL students’ level of engagement in science?</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>What impact does implementation of both test score tracking and Scientists of the Lab have on the students’ engagement towards science?</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>What is the impact of the study on the teacher?</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>
DATA & ANALYSIS

Once I collected all of my quantitative data from my students, I used BasicR software to statistically analyze the data. The big-picture question for each data set was the same: did the data show any difference in outcomes from the treatment phase as compared to the comparison phase?

Pre- and Post-Test Data

I looked at pre-test and post-test scores from the comparison unit and treatment units in three different ways. The first way was to compare the scores for each student from pre-test to post-test and calculate the difference showing growth of each student using the following equation.

\[
\text{Difference} = (post - test) - (pre - test)
\]

Histograms showing the difference (growth) for each category can be seen in Appendix E. The second way was to calculate the percent gain by using the following equation.

\[
Percent \ Gain = \frac{(post - test) - (pre - test)}{pre - test} \times 100
\]

This showed the amount of student growth based off initial pre-test. The third way to compare pre-test to post-test scores was finding the normalized gain. I used the following equation to calculate these gains.

\[
Normalized \ Gain = \frac{(Post - test) - (pre - test)}{100 - (pre - test)} \times 100
\]

The normalized gain is different from the percent gain in that it is normalized by the amount of growth possible instead of the initial score. Hake first introduced this method in 1998 in a paper regarding introductory physics courses (Hake 1998). Often, using the
normalized gain “allowed for a consistent analysis over diverse student populations with widely varying initial knowledge states” (Hake 1998, p. 66). The results from looking at growth in these three ways is shown in Figure 1.

<table>
<thead>
<tr>
<th></th>
<th>EL</th>
<th>NonEL</th>
<th>EL</th>
<th>NonEL</th>
<th>EL</th>
<th>NonEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category</td>
<td>Comparison</td>
<td>Treatment 1</td>
<td>Treatment 1</td>
<td>Treatment 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average Growth Difference (post-pre)</td>
<td><img src="insert_chart_image" alt="Chart" /></td>
<td><img src="insert_chart_image" alt="Chart" /></td>
<td><img src="insert_chart_image" alt="Chart" /></td>
<td><img src="insert_chart_image" alt="Chart" /></td>
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<tr>
<td>Percent Gain</td>
<td><img src="insert_chart_image" alt="Chart" /></td>
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<td><img src="insert_chart_image" alt="Chart" /></td>
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<tr>
<td>Normalized Gain</td>
<td><img src="insert_chart_image" alt="Chart" /></td>
<td><img src="insert_chart_image" alt="Chart" /></td>
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*Figure 1: Average gains from pre-test to post-test analyzed using three methods, (EL N=10, non EL N=31).*

Figure 1 shows that students did have growth on average from pre-test to post-test in all groups and categories. In order to compare the growth in each of the categories, I populated Table 3 to show comparison of each of the categories and to show whether observed differences in average gains was statistically significant or not.
In Table 3, the same students are compared as in Figure 1. I used either a Welch Two-Sample t-test or Wilcoxon Rank Sum test to statistically calculate if the difference in average gains was significant. I used a Welch Two-Sample t-test if the assumptions were met. The assumptions to be met are that the data is normally distributed and the data sets have equal variance (MinitLab, 2015). In looking at the variance of the data, I assumed that variances were close enough to being equal if they were within roughly 50% of each other. If these assumptions were not met, I then used a Wilcoxon Rank Sum test to compare. This test requires no assumption about the distribution of the data, other than that the distributions are similar. It only requires that the data is paired data, which is the case for my data (Wild, 1997). The significance level (alpha level) I used was .05 to determine if the difference was statistically significant.
Table 3 demonstrates that growth during the treatment phases was not greater than growth during the comparison phase for either EL or non EL students. Growth, when looked at in any of the three methods, was no different during either treatment phase than during the comparison phase for EL students. This answered the research sub-question of whether EL students improved their growth in test scores more after setting a goal and tracking their progress toward that goal. Figure 1 shows that there was, on average, more growth during the treatment phases than during the comparison phases, but the improvement was not statistically significant. This could be due to the difference in the difficulty of the units which is addressed in the Interpretation and Conclusions section.

For non EL students, there was less growth during the treatment phases than during the comparison phase, and this decrease in growth was statistically significant when comparing treatment 2 to comparison (difference and normalized gain). I did not observe any indications that the treatment techniques had a negative impact on non EL students, so I thought about whether there might have been other factors that could explain the difference. Perhaps the non EL students started off the treatment 2 unit knowing more about the subject; therefore they would have less room to grow. However the pre-test non EL scores were about the same during treatment 2 as they were for the other units, so this probably does not explain it. Perhaps the timing of the unit, at the end of the semester, had an effect on the motivation of the non EL students. If they were relatively satisfied with their grade at that point, they may have had less motivation to achieve at the end of the semester.
Four out of the twelve EL students showed more growth during the treatment periods than the comparison providing an indication that even though there was not statistically significantly more growth for the EL population as a whole during the treatment phase than the comparison phase, the treatment did appear to benefit a handful of students. These students showed more growth during both treatment periods than during the comparison. Analysis of these students is found in the Interpretation and Conclusion section.

Likert Survey Data

Likert Survey data average responses per student are summarized by histograms in Appendix F. Histograms are provided for both EL and non EL groups. The histograms show that both groups’ responses were not normally distributed and positively skewed which influenced how I analyzed the Likert survey responses.

Figure 2 graphically shows the overall average scores of each group for each time the Likert survey was administered. The score is a mean of all 21 responses on the Likert survey for engagement.
Figure 2 appears to indicate that there was little change in overall average score over the data collection period. In order to determine if the change was statistically significant, a Wilcoxon Rank Sum test was used because the data was not normally distributed as described above. A significance value of .05 was used to determine if the change in average responses was statistically significant. Table 4 shows the findings.
Table 4
Statistical Analysis of Likert Survey (EL N=10, non EL N=37)

<table>
<thead>
<tr>
<th>Study Groups</th>
<th>Comparison of Data Sets</th>
<th>Higher Average</th>
<th>p-value</th>
<th>Difference Statistically Significant?</th>
</tr>
</thead>
<tbody>
<tr>
<td>EL</td>
<td>Initial to Comparison</td>
<td>Initial</td>
<td>0.5</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Comparison to Treatment</td>
<td>Comparison</td>
<td>0.0001</td>
<td>Yes</td>
</tr>
<tr>
<td>Non EL</td>
<td>Initial to Comparison</td>
<td>Initial</td>
<td>0.02</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Comparison to Treatment</td>
<td>Treatment</td>
<td>0.02</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Table 4 summarizes the quantitative answers to the research sub-question “What impact does implementation of both test score tracking and Scientists of the Lab have on the students’ engagement towards science?” When comparing EL responses from the initial survey to the comparison survey, the decrease in the average responses was not significant as seen in Table 4. This means EL students’ engagement did not change over the comparison period. There was a statistically significant difference from the comparison to the treatment with a decrease in average responses indicating lower engagement after the treatment period than after the comparison. The question becomes whether or not the decrease in engagement responses after the treatment was due to the treatment techniques, to other variables, or some combination of the two? This will be further discussed below.
When comparing non EL responses from the initial survey to the comparison survey, the average decrease in responses was significant. This means that non EL students’ engagement did change over the comparison period indicating a lower engagement after the comparison unit. Non EL students’ responses increased from comparison to treatment and the change was found to be statistically significant. Perhaps the increase in engagement is related to the treatment techniques implemented. It is also possible that other factors influenced the change such as the subject matter (overall, students were observed to be somewhat more interested in astronomy than some other subjects including the comparison subject).

**EL Student Interviews**

Even though, quantitatively, the data found that the impact the treatment had on EL students was a decrease in engagement, the qualitative data indicated the opposite. The Scientists of the Lab Award and students tracking their own progress toward a goal were identified qualitatively as being something that 78% (7 out of 9) of EL students mentioned finding value in doing (during the interviews). One student said “I like doing labs and the Scientists of the Lab Award because it doesn’t focus on me being “good” at science. Instead I get to show me being good at a skill.” This was repeated in various forms throughout the interviews of the Level 1 and 2 EL students. Students who were recognized for this award were students who were less outspoken in class, often only sharing if called upon, and were also interested in technical skills programs post high school. For example, one student was going through a dental technical assistant program
as part of her high school experience, and expressed that this award allowed her the opportunity to show her knowledge base through skills rather than specific content.

When asked “How do you know you are getting better at science”, 78% of EL students mentioned tracking their progress. One student said “I can see that I am getting better by looking at where I started and where I ended.” This same sentiment was expressed by another student: “I can see how much I learned from the pre-test to the post-test when we compare the scores.” This observation, as a teacher, was noted in my reflection when we did this as a class: “I could see their attitude change about their score as we analyzed the amount of growth they had over the course of the unit rather than focusing on the actual score.”

**Teacher Journal**

This entire study was based on seeing low engagement in EL students in science. This was reflected in my observations of my teacher journal during the comparison period. Various entries during the comparison period consisted of observations about EL students not being engaged in their classroom environment. This was exemplified during the lab in the comparison period, when I had to work with one group of EL students who were not progressing on the lab because neither of them wanted to take a lead role.

During the treatment period, I observed a noticeable shift in many of the EL students during various aspects of the treatment especially during times when we were tracking progress or during a lab. During both treatments, when we would track student progress as a class, there was a noticeable difference in EL body language as they realized that they had made growth from the pre-test to the post-test. I heard comments
such as “Wow, I am surprised that my bar (on their graph) went up that much”. Tracking the amount of growth they made shifted the focus from the grade they received to the amount of knowledge they gained. Students who were normally pretty disengaged were actually curious to see how much they improved. Even a few of my EL students who did not make significant growth from pre-test to post-test were able to reflect and identify why they did not improve that much. A few reasons they gave included that their notes were not up to date due to absences or didn’t review/study the night before. One student in particular was never provided a translator because the district does not have one for the language he speaks and he did not speak any English. So despite attempted translated documents from myself, his scores never improved greater than a guessing score.

During the lab portion of the treatment, I saw more students focusing on the discussed skill we were focusing on rather than if they were doing the lab right or wrong. During the comparison period, students were focused on not doing the lab wrong but that negative focus took away from the learning experience. By shifting the focus through the Scientist of the Lab Award to skill based celebrations of success, students were able to focus on tangible skills that they felt they could do. This replaced their focus on “not doing the lab wrong”. I observed students communicating with each other and being intentional in their interactions with one another and in the lab itself.

By implementing this treatment I was able to focus on celebrating student success with my students rather than when I am by myself grading. Reflecting on student growth and celebrating use of scientific skill sets, allowed me the time within the classroom structure to build classroom culture that focused on student success. Ultimately as a
teacher this is what it boils down to for me; making sure that each student knows that they are valued and can have success.

INTERPRETATION & CONCLUSIONS

The goal of this research project was to see if there was an impact on EL engagement by having students monitor their progress and celebrate their success. Despite observing a quantitative decrease in engagement from this treatment (from the survey responses), there were qualitative indicators of improvement in engagement from comparison to treatment. The quantitative decrease in engagement is likely attributable to other variables. As has been mentioned, the subject matter was different and could have influenced engagement. Another factor that may have influenced engagement is that a student teacher began her student teaching in my classroom during treatment 2. This was not the ideal time, however it was out of my control. As discussed in the Conceptual Framework introduction to this paper, relationships between students and teachers can influence student engagement. Since the student teacher was starting fresh with the students at this time, this could have been challenging for the students. Anecdotally, one student specifically mentioned to me that he was having a hard time adjusting to the change of having a new teacher. I think this is not atypical, especially for EL students.

When students set goals and tracked their own progress throughout the course of a unit, there was no statistically significant increase in their growth over a subject unit. They did grow from pre-test to post-test but not more than during the comparison period. One variable that could have impacted the results was the subject matter. The average
post-test score for the comparison was 67%, the treatment 1 post-test was 55%, and the treatment 2 post-test was 71%. Treatment 1’s content was nuclear chemistry which students’ may have never experience prior to that unit in the science background unlike the other two units. The comparison unit covered chemistry which all students have experienced or been introduced to if they have gone through the Washington state education system in middle school. Along with this, treatment 2 covered astronomy which is another content are that students have some background knowledge to build from. Treatment 1’s content of nuclear chemistry definitely requires a higher background knowledge that present challenges for students. This demonstrated the range of variability in student performance that could be due to many factors.

An interesting finding was that the EL students who scored below the standard deviation of the EL group in the comparison and treatment were not consistent. Some of these students were impacted by outside factors that affected their learning. For example, one student is classified as a migrant student, and during the comparison unit (in which she scored below the standard deviation), many migrant families were in transition between seasons. Her family did not end up moving, but she was absent 33% of that unit. One of the male students who scored below the standard deviation during the first treatment ended up failing 70% of his classes. When asked about the reason for this in an individual interview, his response was “I like the teachers, but I don’t really like the content. I don’t really need school because I am going to work at my mom’s taco truck.” When questioned further he explained that he didn’t really know what he wanted to do and only at school because of the legal requirement to attend. This sentiment was shared
by another student who scored below the standard deviation; however, he was repeating the class because he failed it the previous semester. Despite having gone through the content once before, he was still failing the class. In an individual interview, a similar sentiment was expressed confusion over what he wanted to do and a dislike of science content. He made sure to clarify that he liked what we did in class, but didn’t really need school, so he wasn’t really trying. These outliers definitely impacted the results of this project, but they were not removed from the data set because these attitudes are commonly encountered by teachers who continue to try to improve.

All of the EL students who scored above the standard deviation of the EL group were females. There was one female who scored above the standard deviation on the final unit who was likely motivated because the consequences of her failure were more significant. She was retaking the class because she failed first semester last year and, prior to taking this unit test, was still failing. She worked hard and did well on the test so that she could pass. It was interesting to see that she waited until the last moment possible though to actually care about passing the class despite retaking it.

During the qualitative interviews, EL students referenced the Scientists of the Lab award and tracking their progress on both the Likert survey and individual student interviews. Most students explained that they liked to track their progress and see how much they grew over the course of a unit. Based on this feedback, I would be curious to see how a year-long progress monitoring program would impact students. One interesting finding when looking at some EL student growth goals (Appendix D) was that some students set higher goals during the second treatment unit than the first treatment
unit. Research on goal setting found that “Success encouraged many students to set higher growth goals for the future and energized those who were less motivated academically” (Travers et al., 2015, p. 238). This was found to be true for some EL students when they set goals in both treatment periods. Students increased their own personal growth goal during the second treatment period because they felt that they knew they could do better after tracking their progress in the first treatment unit. Along with this, just like researchers Rodriquez and Osguera (2015) found, EL students find greater connection to content when there is a relational aspect to their environment. By taking the time to celebrate all students’ learning in class through both tracking their progress and Scientists of the Lab Awards, I was able to celebrate individual student success and have all students feel part of the classroom community.

To address my second action research question, I did observe a shift in the learning environment of the classroom and engagement in students. Many students were focused on the specific skill that was the focus of the Scientist of the Lab and their increased focus lead to a more engaged, less distracted lab environment. This lab environment was conducive for learning and appears to me as a teacher as being beneficial whether or not the quantitative data shows a change.

In response to my third action research question on analyzing the combination of strategies from the treatment, I found that tracking student growth and the Scientist of the Lab award did not quantitatively improve EL engagement as measured by the Likert Survey. In fact, the data showed a decrease in engagement after the treatment. As discussed previously, it is possible that the new student teacher that began instructing
during the second treatment unit impacted the results. She was responsible for the Scientists of the Lab Award in one class and tracking final progress. She watched me go through the process of emphasizing the Scientists of the Lab Award in one class and then replicated it in the other class. However due to differences in delivery style, it may have had an impact on the results. Another consideration is that the Likert survey is a general survey of engagement and was not specific to strategies used in the treatment. This was intentional because I wanted to quantify engagement as a whole, not specific to strategies. This relied on student reflection as a whole without the input of the teacher to remind them of the various activities designed to promote engagement. Along with these concepts, there were some students who marked all 7’s or all 1’s (maximum and minimum responses on the survey) to complete it quickly despite the fact that they received an explanation of the purpose of the survey and understanding that it was optional for them to fill out.

VALUE

Making all my students feel successful and that they can “do” science has been a primary focus for me in my teaching career. This classroom research project made me want to continue to build classroom systems that celebrate student success such as the Scientists of the Lab Award or student growth celebrations from data based on feedback from my EL students which specifically addresses my fourth action research question. This study has shown me that there is a pressing need to continue to build student relationships and create classroom communities that actively include EL students. This is supported by observations from my teacher journal and through individual student
comments in the interviews. Comments such as “I was surprised by how much I actually grew from post-test to pre-test” and “I felt like I talked more about the lab during the lab with my lab partner when we did the Scientist of the Lab award” provide qualitative indicators that the practice of focusing on student success should be continued.

At B-EHS, there are very few teachers the EL students see as a reflection of themselves. Out of the 64 classroom teachers, only one is Hispanic. This does not reflect the student population with 33.4% of students being Hispanic (Office of Superintendent of Public Instruction, 2016). This emphasizes the importance of all teachers building intentional relationships with EL students, especially when this cultural relatability piece is not present in their everyday experiences in their education system. By using different strategies within the classroom, such as tracking student growth progress and celebrating all success, relationships can be built between teachers and EL students through an understanding that we as their teachers want them to be successful. Through targeted recognition of success, immediacy behaviors are conveyed from the teacher to the student which is proven to increase EL engagement as found by Kocher (2013). I plan to continue to use these two strategies from my treatment to continue to build a classroom that celebrates all students’ successes. I came to this conclusion based on my observations in my teacher journal and captured during individual student interviews. Upon reflection of my teacher journal, I noticed a shift in my observations as a teacher focusing on students to celebrate rather than things to change each lesson or behavior issues. This was an important observation for myself because I want all students to feel valued within my classroom community and often it is easy to get bogged down in the
fine details of the day. Students reflected this sentiment in their individual student interviews by commenting how they liked being recognized and enjoyed the time focusing on how they were doing in the class. These qualitative observations tell me that impacted their sense of worth in the class which is one of the things I was aiming for in the development of the treatment which is why I plan to continue to use it.

One improvement that I think would have made the project more impactful and can improve my teaching practice is to build in more consistent time for student reflection on themselves as learners. The MSSE program has deeply strengthened my use of formative assessment. I have found that I utilizing daily quick checks on student understanding has strengthened my teaching. I would also like students to be able to know what strategies work for them in school, especially since I teach primarily freshman and sophomores who need effective strategies for their future in high school. Specifically pertaining to my project, I think if we had reflected as a class or individually prior to the survey, students would have had the opportunity to think about strategies or aspects of the class that increased their engagement and responded with how that impacted them. This may have changed some of their responses on the survey and ultimately the outcome of the data collected. Taking this reflection and applying it to my class, I think incorporating more consistent reflection of strategies throughout a unit would help students begin to analyze themselves and make greater gains toward their goals. This improvement to my teaching practice could help EL students identify what works for them as a learners.
The classroom research process has definitely strengthened my skills as a teacher because it required me to dive in to the research about EL students and their specific learning needs. Often my professional development time is focused on specific strategies that can be used with EL students. However, strategies can only be effective if a strong student-teacher relationship is present. The research in this project emphasized the importance of relationship building with EL students. In order for students to be successful in their science content, a strong relationship is required. Often, as science teachers, we feel pressure to get through a lot of content. However it is important to take the time to build those relationships and strengthen our classroom communities to insure that students can build connections and deep understanding of the content. Through the relationships that I have built with my EL students at B-EHS, I have learned so much about other cultures. Students want to share their heritage. Despite not finding quantitative data to support my classroom research project, I found that the time building those relationships at the beginning of the year has paid off and that student’s feel invested in our science community. With the Hispanic population on the rise in the United States, it is so important for these students to feel part of not only the science community, but also our school as a whole so that they can leave with the best educational experience and become the leaders of tomorrow.

The MSSE program allowed me an opportunity to collaborate with colleagues near and far providing me insight into educational views in different parts of the country and world. I have a great network of teacher-leaders that I could collaborate at any moment and get a whole new perspective which I very much appreciate. Along with this,
I have deeply strengthened my use of formative assessment and on a daily basis, through the various strategies used, I have a much more clear idea of what my students know in my classroom. Moreover, through the completion of the classroom research project, I have developed an understanding for the importance of data analysis frequently in the classroom. It was fascinating to be able to analyze results and determine if a specific treatment was effective. Incorporating a simpler, more daily/unit version of this will be important going forward. I want to continue to be a data driven teacher to really assess the effectiveness of what is happening within my classroom. The MSSE program has provided me many resources to develop my own system which I intend to do. The knowledge I have gained over the last two years has been invaluable to me as an educator and I would recommend it to other teachers.
REFERENCES CITED


Kocher, B. (2013). *English Language Learners in Mainstream Science Classrooms: Understanding how English Language Learners’ perceptions of Teachers’ Use of Immediacy and Instructional Conversation Behaviors Impacts Students’ Language Acquisition and Achievement* (Doctoral Dissertation). Retrieved from ProQuest. UMI 3586145


APPENDIX A

INSTITUTIONAL REVIEW BOARD EXEMPTION FORM
MEMORANDUM

TO: Hannah Smith and Walt Woolbaugh
FROM: Mark Quinn
DATE: November 16, 2016
SUBJECT: “Increasing English Learners Engagement in Science through Celebration of Student Success” [HS111616-EX]

The above research, described in your submission of November 14, 2016, is exempt from the requirement of review by the Institutional Review Board in accordance with the Code of Federal regulations, Part 46, section 101. The specific paragraph which applies to your research is:

_X_ (b) (1) Research conducted in established or commonly accepted educational settings, involving normal educational practices such as (i) research on regular and special education instructional strategies, or (ii) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.

_X_ (b) (2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless: (i) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) any disclosure of the human subjects’ responses outside the research could reasonably place the subjects at risk of criminal or civil liability, or be damaging to the subjects’ financial standing, employability, or reputation.

_X_ (b) (3) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior that is not exempt under paragraph (b)(2) of this section, if: (i) the human subjects are elected or appointed public officials or candidates for public office; or (ii) federal statute(s) without exception that the confidentiality of the personally identifiable information will be maintained throughout the research and thereafter.

_X_ (b) (4) Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available, or if the information is recorded by the investigator in such a manner that the subjects cannot be identified, directly or through identifiers linked to the subjects.

_X_ (b) (5) Research and demonstration projects, which are conducted by or subject to the approval of department or agency heads, and which are designed to study, evaluate, or otherwise examine: (i) public benefit or service programs; (ii) procedures for obtaining benefits or services under those programs; (iii) possible changes in or alternatives to those programs or procedures; or (iv) possible changes in methods or levels of payment for benefits or services under those programs.

_X_ (b) (6) Taste and food quality evaluation and consumer acceptance studies, (i) if wholesome foods without additives are consumed, or (ii) if a food is consumed that contains a food ingredient at or below the level and for a use found to be safe, as identified by the FDA, or approved by the EPA, or the Food Safety and Inspection Service of the USDA.

Although review by the Institutional Review Board is not required for the above research, the Committee will be glad to review it. If you wish a review and committee approval, please submit 3 copies of the usual application form and it will be processed by expedited review.
APPENDIX B
LIKERT SURVEY ON ENGAGEMENT
**Student ID Number:** ____________________________  **Date:** ____________________________

Note: Participation in this research is voluntary. Participation or non-participation will not affect your grades or eligibility to participate in any other class activities.

### Behavioral Engagement items

#### When I am in class, I listen very carefully.

<table>
<thead>
<tr>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Slightly disagree</th>
<th>Neither agree or disagree</th>
<th>Slightly agree</th>
<th>agree</th>
<th>Strongly agree</th>
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<td>6</td>
<td>7</td>
</tr>
</tbody>
</table>

#### I pay attention in this class.

<table>
<thead>
<tr>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Slightly disagree</th>
<th>Neither agree or disagree</th>
<th>Slightly agree</th>
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<th>Strongly agree</th>
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</tr>
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</table>

What helps you pay attention? __________________________________________________________

_______________________________________________________________________________

#### I try hard to do well in this class.

<table>
<thead>
<tr>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Slightly disagree</th>
<th>Neither agree or disagree</th>
<th>Slightly agree</th>
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<th>Strongly agree</th>
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</tbody>
</table>

Can you give me an example? __________________________________________________________

_______________________________________________________________________________

#### In this class, I work as hard as I can.

<table>
<thead>
<tr>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Slightly disagree</th>
<th>Neither agree or disagree</th>
<th>Slightly agree</th>
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<th>Strongly agree</th>
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<td>7</td>
</tr>
</tbody>
</table>
When I’m in this class, I participate in class discussions.

<table>
<thead>
<tr>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Slightly disagree</th>
<th>Neither agree or disagree</th>
<th>Slightly agree</th>
<th>agree</th>
<th>Strongly agree</th>
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</tbody>
</table>

Are discussions important? Why or why not?

---

**Agentic Engagement (candidate items)**

I let my teacher know what I need and want.

<table>
<thead>
<tr>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Slightly disagree</th>
<th>Neither agree or disagree</th>
<th>Slightly agree</th>
<th>agree</th>
<th>Strongly agree</th>
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<td>7</td>
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</tbody>
</table>

I let my teacher know what I am interested in.

<table>
<thead>
<tr>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Slightly disagree</th>
<th>Neither agree or disagree</th>
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<td>7</td>
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</table>

During this class, I express my preferences and opinions

<table>
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<tr>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Slightly disagree</th>
<th>Neither agree or disagree</th>
<th>Slightly agree</th>
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</table>

During class, I ask questions to help me learn.

<table>
<thead>
<tr>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Slightly disagree</th>
<th>Neither agree or disagree</th>
<th>Slightly agree</th>
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<th>Strongly agree</th>
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</table>

When I need something in this class, I’ll ask the teacher for it.

<table>
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<tr>
<th>Strongly disagree</th>
<th>Disagree</th>
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<th>agree</th>
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I adjust whatever we are learning so I can learn as much as possible.

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<tr>
<th>Strongly disagree</th>
<th>Disagree</th>
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<td>Can you give me an example of this?</td>
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I try to make whatever we are learning as interesting as possible.  

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Cognitive Engagement items  

When I study for this class, I try to connect what I am learning with my own experiences.  

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Can you give me an example of this?  

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<tr>
<td>I try to make all the different ideas fit together and make sense when I study for this class.</td>
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When doing work for this class, I try to relate what I’m learning to what I already know.  

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Why did you answer the way you did in the above question?  

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<tr>
<td>I make up my own examples to help me understand the important concept I study for this class.</td>
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**Emotional Engagement items**

When we work on something in class, I feel interested

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This class is fun.

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I enjoy learning new things in this class.

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When I’m in this class, I feel good.

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Why did you answer the way you did in the above question?


When we work on something in this class, I get involved.

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APPENDIX C

INDIVIDUAL STUDENT INTERVIEWS
Student Interview Questions

Student ID Number:______________________________ Date: ......................

Note: Participation in this research is voluntary. Participation or non-participation will not affect your grades or eligibility to participate in any other class activities.

1. Tell me about a time you were successful in science class? Why do you think you were successful? Do you get good grades in science? Why or Why not?

2. Tell me something (maybe a strategy learned) that made you feel prepared to face difficult scientific questions or situation?

3. What do you see as your biggest limitations in studying science? Why do you think it is a limitation?

4. How would you know you are getting better at scientific thinking or science in general?
APPENDIX D

EXAMPLE OF EL STUDENT TRACKING SHEET
Figure D1: Example of EL student goal setting sheet.
APPENDIX E

HISTOGRAMS OF GROWTH DATA
Figure E1: Histogram showing growth results (difference) in EL students’ scores (post-test minus pre-test) for the comparison period ($N=10$).

Figure E2: Histogram showing growth results (difference) in non EL students’ scores (post-test minus pre-test) for the comparison period ($N=36$).
Figure E3: Histogram showing growth results (difference) in EL students’ scores (post-test minus pre-test) for treatment 1 period (N=9).

Figure E4: Histogram showing growth results (difference) in non EL students’ scores (post-test minus pre-test) for treatment 1 period (N=32).
**Figure E5:** Histogram showing growth results (difference) in EL students’ scores (post-test minus pre-test) for treatment 2 period ($N=9$).

**Figure E6:** Histogram showing growth results (difference) in non EL students’ scores (post-test minus pre-test) for treatment 2 period ($N=37$).
APPENDIX F

HISTOGRAMS OF LIKERT SURVEY
Figure F1: Frequency of EL student responses on the Likert Survey for engagement at the start of the comparison period (N=10).

Figure F2: Frequency of non EL student responses on the Likert Survey for engagement at the start of the comparison period (N=36).
Figure F3: Frequency of EL student responses on the Likert Survey for engagement at the start of the end of the comparison period ($N=9$).

Figure F4: Frequency of non EL student responses on the Likert Survey for engagement at the end of the comparison period ($N=32$).
Figure F5: Frequency of EL student responses on the Likert Survey for engagement at the end of treatment period (N=9).

Figure F6: Frequency of non EL student responses on the Likert Survey for engagement at the end of the treatment period (N=37).