THE EFFECTS OF CLICKER USE ON STUDENT ENGAGEMENT AND PERFORMANCE IN THE ELEMENTARY SCIENCE CLASSROOM

by

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TABLE OF CONTENTS

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

2. CONCEPTUAL FRAMEWORK .........................................................................................3

3. METHODOLOGY .............................................................................................................8

4. DATA AND ANALYSIS ....................................................................................................13

5. INTERPRETATION AND CONCLUSION .........................................................................21

6. VALUE ..........................................................................................................................23

REFERENCES CITED ..........................................................................................................26

APPENDICES .....................................................................................................................29

APPENDIX A Clicker Questionnaire......................................................................................30
APPENDIX B Health Summary Worksheet............................................................................32
APPENDIX C Nervous System Quiz.....................................................................................34
APPENDIX D Possessive Nouns Quiz..................................................................................36
APPENDIX E Equivalent Fractions Worksheet .....................................................................39
APPENDIX F Topic 10 Test Questions 9, 10, and 11...........................................................42
APPENDIX G Equivalent Fractions Quiz ............................................................................44
APPENDIX H Practice 11-2 Homework................................................................................48
APPENDIX I Topic 11 Test Questions ..................................................................................50
APPENDIX J Adding Fractions Quiz....................................................................................54
APPENDIX K Chapter 4 Lesson 1 Assessment......................................................................58
APPENDIX L Seasons and Earth’s Tilt and Rotation Quiz.....................................................60
APPENDIX M Teacher Observation Log .............................................................................63
APPENDIX N Clicker Interview Questions............................................................................65
LIST OF TABLES

Data Triangulation Matrix

13
LIST OF FIGURES

1. Pre Clicker Questionnaire Responses ..............................................................14
2. Post Clicker Questionnaire Responses.............................................................15
3. Pre and Post Scores to the Health Summary Worksheet and the Nervous System Clicker Quiz along with Student Engagement ...........................................16
4. Normalized Gain for Possessive Nouns ..................................................................17
5. Student Engagement on Possessive Nouns Pre and Post Tests .........................18
6. Pre and Post Scores on Finding Equivalent Fractions Assignments along with Student Engagement .................................................................19
7. Pre and Post Scores on Adding Fractions with Unlike Denominators along with Student Engagement .................................................................20
8. Pre and Post Scores on Seasons Earth’s Tilt and Rotation Lessons along with Student Engagement .................................................................21
Student inattentiveness has long been an issue in classrooms. As students continue to have access to video games and other high tech gadgets, which provide immediate gratifications, teaching by direct instruction doesn’t always hold an individual’s attention. The purpose of this study was to see if using Smart Board presentations and clickers increased student engagement and performance. Students were introduced to clickers last year, so they were familiar with how to use them at the beginning of the study. Students’ surveys, class work, homework, assessments, teacher observation, clicker quizzes and interviews were all used to evaluate the effectiveness of their use in the classroom. The findings did not show a statistically increase on every quiz, however, there was a noticeable increase in the area of math. Overall student opinions were highly supportive of clicker use in the classroom and many stated they were fun to use.
INTRODUCTION AND BACKGROUND

Lajes Elementary High School at Lajes Air Force Base Azores, Portugal is a small kindergarten through 11th grade school. Our student population was made up of Air Force personnel’s children or Department of Defense civilian’s children. The year began with 22 middle and high school students and 54 elementary students (Lajes Faculty Meeting, August 21, 2014). The student population was approximately 54% Caucasian, 29% multiracial, 9% Asian, 6% Hispanic and 2% African American. All students came from a middle class background and had housing and insurance provided by the Air Force or the Department of Defense.

Our school was constantly in transition, whether it was from the uncertainty about the school’s future or from students’ families receiving their permanent change of station (PCS) orders. The school was finally told in October 2014 that the 2014 – 2015 school year would be its last year. This left the very small population of 86 students enrolled for the final school year. By winter break about 35 students and their families had moved on to their new bases. After spring break 13 more students left, which dropped the population down to about 38 students (Lajes Faculty Daily Bulletin, February 16, 2015). In addition to the normal rotation of families due to PCSing, there was the additional burden of the Air Force downsizing by 25,000 members. Many airmen and their families were affected by the downsizing and PCSed sooner than expected and several others retired which had them leaving earlier than their original orders specified.
With the small student population many grade levels were combined. Three of the four elementary classes were multiage classrooms; my fourth grade class was the only traditional one grade level class in kindergarten through sixth grade. Most of the classes ended the year with extremely low numbers while my class remained the largest in the entire school.

At the beginning of the last school year, I quickly realized many of my 15 students had issues staying on task and paying attention. Last year about 40% of my class struggled with attention issues and the families of four of those six children were aware of their struggles. Even with our small population our school offered special education testing and limited services for students who qualified. However, I have heard many times airmen do not want their children identified with any learning disabilities because it can affect their future career paths and base assignments. Families with children who have been identified and receive services may be limited on their choices where they can transfer. Not all bases offer the same special education services. Yet, if families withhold information regarding health or educational needs the airmen involved can be demoted and family members sent back to the states (V. Morgan, personal communication, November 21, 2014). Therefore it is not unusual for parents to avoid special education testing for students even though it may be something as simple as attention disorders.

During one of our monthly staff meeting, I was made aware that the school had several sets of classroom clickers available. Classroom clickers are simple hand held devices for the students to use in order to enter their responses during interactive lessons.
After working with clickers at my previous school I was very interested in using them again to increase student engagement. So I immediately requested a classroom set in order to address the constant challenge of attention in my classroom. Then during a professional development meeting my co-worker shared a resource, which offered professionally created Smart Board presentations with clicker quizzes to supplement our curriculum. Once I investigated this wonderful resource, onboardacademics.com, I realized that this would offer a great resource to encourage students to stay on task.

After introducing the Smart Board presentation and clickers into my classroom for the first time I saw an immediate increase in student participation. Not only did students pay attention during the presentation, but the majority were also able to successfully pass the clicker quizzes with a 70% or higher. This sparked the idea for my focus question Does the use of clickers in the classroom increase student engagement and performance?

CONCEPTUAL FRAMEWORK

Maintaining student interest and participation in the classroom has always been a challenge, whether in a large or small classroom. One tool introduced into the classroom to help overcome this hurdle is the use of clickers. These devices have many different names, but they all primarily do the same job. A clicker, as it is most commonly called, is a technological product that uses the combination of hardware and software which is designed to support communication and interactivity within classrooms (Beatty, 2004). There are two types of clickers, infrared and radio frequency. Students select a choice on their clicker and the responses are sent to the teacher’s computer where the teacher can
view and display the students’ responses. Bruff (2007) referred to clickers as classroom or audience response systems and defined them as instructional technologies that allow the teacher to quickly collect and analyze students’ responses. Another study found that the quick and accurate collection of data from students’ responses provided a valuable method for evaluating students’ performance (Kulatunga & Rameezdeen, 2013). The use of clickers is very beneficial for the teacher because it provides immediate feedback regarding the students’ understanding and allows the teacher to gauge the overall comprehension of the concepts involved in the tested material (Blasco-Arcas, Buil, Hernández-Ortega & Sese, 2013). This immediate feedback on student learning helps educators respond immediately to their students’ needs (Bruff, 2007). Students are also reassured instantly that their response has been recorded, and they receive feedback regarding their input (Lantz, 2010).

The technology used in classroom response systems was first developed to meet the needs of the military. The concept of clickers began in the 1950s and was used during training exercises where the anonymous recorded responses were analyzed to access the understanding of trainees (Sternberger, 2012). Clickers continued to be used in science courses throughout the 1960s and 1970s (Judson & Sawada, 2002). Large college lecture halls used clickers for approximately ten years and now that the technology is more affordable they are making their way into elementary and secondary classrooms. Hu (2008) noted that clickers provide an advantage over other classroom technology because they are tools to assess students’ learning. Introducing clickers into classrooms with a variety of other technological resources like Smart Boards, teaches students the 21st
Educators discovered numerous uses for clickers in the classroom. Zhu (2007) concluded the most common uses for clickers include assessing students’ prior knowledge or misconceptions before starting new material. After new material has been introduced clicker technology can be used to quickly assess student knowledge of the new material. Using this anonymous technology, teachers can facilitate classroom discussion on difficult or challenging material. Offering students the immediate feedback on their inputted answers helps them more easily remember the correct answers (Lantz, 2010). In addition, administering quizzes and tests with ease allows for immediate collection of data and provides feedback on teaching practices. Levesque (2011) found that using clickers allows students to engage in problem solving by simply allowing them to attempt to solve the problems. This technology can also be used to record attendance and classroom participation.

Researchers determined that clickers used in large lecture classes helped student performance, but they also saw the benefits in smaller classes as well (Caldwell, 2007). While clickers are quick and easy to introduce into the classroom some planning needs to go into implementing their use. The initial investment needed by educators to incorporate technology into their classrooms may be time consuming. Teachers need to learn the software and generate the materials to use with the clickers, but once the material is created or purchased, clickers are valuable tools within the classroom. With the increased use of clickers, instructors are becoming more comfortable writing their own questions to
assess student learning and understanding. Companies also produce questions or tests on extensive topics that allow clickers to be even more practical for daily use. The *Clicker Resource Guide (2009)* determined using clickers sends the message to students that the instructor’s primary focus is on student learning.

Teachers have been using interactive, teaching strategies to enhance learning since the time of Socrates (Caldwell, 2007). As class size increases, students are becoming unwilling to speak up for fear of making mistakes or embarrassing themselves in front of their peers. The use of clickers increases student participation by allowing all of them to respond to questions rather than a small fraction of the class. The research revealed that, “clickers promote active participation, engagement, and discussion among all students, even those who might not participate in typical class-wide discussions” (Bruff, 2007, p. 7). Student responses can be displayed in graphs, spreadsheets or eye-catching graphics that allow further discussion or intervention strategies to increase understanding (Miller, 2014; Hu, 2014).

Blasco-Arcas et al. (2013) found promoting interactivity for students in a traditional classroom using clickers is crucial and leads to better and more effective learning. In addition to actively participating in the classroom, engagement is a key factor for success. Engaged students are more likely to be successful academically. Manzo’s (2009) study found that using clickers in well-planned lessons increased test scores.

Lantz (2010) discussed the generation effect that explains how participation and engagement can increase student performance, “Active participation in the classroom may be beneficial due to the generation effect. The generation effect occurs when a
student generates the correct answer rather than simply being given the answer. The effect is an increase in future recall” (p. 558).

Researchers discovered several studies that concluded using clickers in the classroom increased student participation and engagement, and this led to increased performance. These studies determined the anonymity provided by the use of clickers increased overall student involvement. In addition interactive teaching methods encourage students to behave and feel more engaged (Kulatunga & Rameezdeen, 2013). “Active engagement during lectures has been perceived by Biggs and Tang (2007) as a method that encourages deep learning” (Kulatunga & Rameezdeen, 2013, p.12). Research suggests that using clickers does increase engagement and participation that leads to increased student performance. As student participation in the classroom increases so does short and long-term assessment scores (Wood, 2004).

The students’ perspective on the use of clickers in the classroom is very important. Zhu’s (2007) research on student attitudes supported previous findings that students enjoy using clickers because they make class fun and interesting and this enjoyment aligns with the increased participation and engagement. Many studies support the idea that students in general have positive feedback about the use of clickers in lectures. In Sternberger’s (2012) study she reviewed several researchers’ findings which all concluded that students’ overall responses to clicker use were positive and greatly agreed that they increase student engagement. “Not only do most students enjoy using this system simply because it is fun, but anonymity draws in those students who are afraid to contribute” (Adams & Howard, 2009, p. 55).
Kulatunga and Rameezdeen (2013) discovered through focus group discussions that students believed they were more engaged during class sessions where clickers were used. Students also pointed out that the use of clickers to answer questions during PowerPoint presentations forced them to be actively engaged during class. The Clicker Resource Guide (2009) stated that students overwhelmingly agreed that when clickers are used effectively in the classroom it helps their learning. Levesque’s (2011) study found that student engagement in critical thinking and problem solving during class with the use of clickers correlated to increased performance. Findings determined that attempting to answer the problem increased success on exams. An overwhelmingly popular response found in many of the studies was that students appreciate the anonymity of clickers. Bruff (2007) also noted that students enjoyed “the opportunity to test their understanding against their peers” (p.7)

METHODOLOGY

To investigate the effectiveness of clickers increasing engagement and performance in the fourth grade classroom, clickers were evaluated over a four-month period in the winter and spring of 2015. 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. Participation in this research was voluntary and did not affect a student’s grade or standing in any way. The study assessed nine fourth grade students’ progress on regular class work, homework and assessments compared to their progress using presentations and clicker assessments. The assessments involved students answering questions using clickers after participating in a
short presentation on the Smart Board. The questions consisted primarily of two types: true/false and multiple choice. Students watched and answered questions throughout the presentation and were allowed to take notes. Students were allowed a few minutes to answer each question individually and without any discussion with their neighbors.

The study consisted of several subjects and skills, many of which students were struggling with after analyzing and working with these students in third grade. Treatments were used to help support singular and plural possessive nouns and fractions. These were areas of difficulty in English Language Arts and math. Health and science lessons on the systems of the body and Earth’s tilt and rotation on the effects of the seasons were also lessons that received treatments as part of this study.

Several different types of data were collected and analyzed during this study to achieve triangulation. The study began with students answering the Pre Clicker Questionnaire to get a general understanding about their feelings regarding using clickers in the classroom (Appendix A). The data collected from the Clicker Questionnaire was analyzed by looking for trends in student responses between their feelings about using clickers and their performance while using clickers. Each pre and post assessment was handled differently to check the validity of the treatment. The first treatment to be administered was the health concepts on the nervous system and the brain. The lesson was taught using the book and classroom discussion. After the lesson’s reading and discussion were finished, students completed their Health Summary Worksheet on Lesson 2 to check their understanding of the material (Appendix B). Students then participated in the treatment using the Smart Board and clickers. Once the presentation
was completed students took the Nervous System Quiz (Appendix C). Their overall percentages from the Nervous System Quiz were then compared to their percentages on Lesson 2 of the Health Summary Worksheet. The students’ score from the health topic quiz was entered into an Excel document that produced a bar graph displaying both scores from the treatment and non-treatment assessments.

The English Language Arts section on possessive nouns was the next treatment unit. Possessive nouns was an area that students struggled with in third grade and their scores from the end-of-year test were reviewed prior to beginning the treatment. Students were given the Possessive Nouns Quiz as a pretest prior to receiving the treatment but after encountering the weekly grammar lessons with class work and homework assignments (Appendix D). Students scored poorly on their grammar assignments during this week and this supplied further evidence of their struggle with possessive nouns. The data from the Possessive Nouns Pre-Test and Possessive Nouns Post-Test was collected and checked for normalized gains. These results were displayed in a histogram.

Fractions were another area students struggled with during third grade. Finding equivalent fractions and adding fractions with unlike denominators were challenging concepts for many students. The lessons on these two concepts were taught separately over several weeks and after each lesson was presented and examples were explained, independent practice was assigned. Once students finished their work on finding equivalent fractions, I graded their work individually and reviewed errors made by the class. The concept was reviewed again the following week prior to taking their topic test on fractions. Students were given a homework worksheet on finding all equivalents
fractions to a given fraction (Appendix E). This assignment was collected and graded for comparison to the clicker quiz results. After a final review of the fraction topics, students were given their topic test. Topic test questions were analyzed to find those that were related to finding equivalent fractions (Appendix F). The results from the three questions were totaled and averaged with the equivalent fraction worksheet. The following week students participated with the interactive Smart Board presentation on equivalent fractions and then the quiz was administered (Appendix G). The results from the treatment and non-treatment lessons were displayed in a bar graph comparing students’ scores.

The next week when the non-treatment lesson on adding fractions with unlike denominators was taught, data was collected on students’ class work and Practice 11-2 homework (Appendix H). The topic test was administered and analyzed to determine that seven questions involved adding fractions with unlike denominators (Appendix I). The following week students watched the Smart Board lesson and then answered the Adding Fractions Quiz (Appendix J). The data from all of these lessons was recorded and used to create a bar graph.

The lesson on the seasons and Earth’s tilt was the final treatment unit. The class read and discussed the chapter readings and review questions. Students were assigned the lesson assessment provided by the textbook as a homework assignment (Appendix K). The following day the Smart Board presentation on Seasons and Earth’s Tilt and Rotation and quiz were administered (Appendix L). After both assessments were completed
students then participated in lab activities to further expand their understanding of Earth’s tilt and the effect on the seasons.

The data collected from the treatment and non-treatment lesson were compared using a bar graph to show the difference between the treatment and non-treatment lesson. The Teacher Observation Log was used throughout the lessons to record student engagement and performance on the clicker assessments (Appendix M). This data was organized in the bar graphs with 25% representing low engagement, 50% representing medium engagement and 75% representing high engagement. The graphs were used to see if a connection was observed between engagement and performance on each treatment.

Student interviews were conducted with seven students using the Clicker Interview Questions to gain understanding on their perspectives about using clickers in the classroom (Appendix M). The interview data was assessed for themes and used to support evidence from the performance assessment analysis. The post Clicker Questionnaire was administered again at the end of the treatments to see if there was any change in the overall feeling about using clickers (Appendix A).

The triangulation matrix in Table 1 identifies the focus question for my study and the data collected to support my findings.
Table 1
*Data Triangulation Matrix*

<table>
<thead>
<tr>
<th>Research Questions</th>
<th>Data Source</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Understanding of Clickers</td>
<td>Interview Questions</td>
<td>Clicker Questionnaires</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Performance - Mastery of Concepts</td>
<td>Smart Board Assessments</td>
<td>Lesson Assessments</td>
<td>4th Grade post assessment results</td>
<td></td>
</tr>
<tr>
<td>3. Increased engagement</td>
<td>Teacher Observation Log</td>
<td>Smart Board Assessments</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**DATA ANALYSIS**

The results of the pre Clicker Questionnaire were analyzed and the highest percentage of *strongly agree* responses was noted to the question that asked if clickers are easy and fun to use. Eighty-eight percent of the students responded *strongly agreed* that clickers are fun and easy to use in the classroom ($N=9$). One student shared, “It’s like playing a video game.” Another student said, “They are easier to maneuver than pencils.”

Students had differing opinions on using clickers instead of laptop in the classroom. Sixty-seven percent of the students who answered this question *strongly disagreed* with it as opposed to only 33% who *strongly agreed* with the statement.

Three other questions all had 63% of students responding that they *strongly agreed* with the statement. Eighty-nine percent of students answered they *strongly agreed* or *agreed* when asked if using clickers in the classroom increases student engagement and participation. One student who was asked if they wanted to continue to use clickers
in the classroom shared, “Yes, I like clickers very much and they are a good source of education, like the quiz show we use in math and social studies” (Figure 1).

The results of the post Clicker Questionnaire were analyzed and compared to the pre Clicker Questionnaire to look for changes in the students’ opinions (Figure 2). There was an increase of 11% in the strongly agreed responses to the statement about using clickers on a daily basis will help them focus on the subject matter. One student commented, “I would use them with all kinds of subjects because it is better than writing everything down and it is entertaining.”

An increase of 45% was noted between the strongly agree responses on the pre questionnaire compared to the responses on the post questionnaire to the question about using the Smart Board lessons and clickers making difficult material easier to understand.

Figure 1. Pre-Clicker questionnaire responses, (N=9).
In the interviews one student shared their thoughts on the material that clickers should be used with, “Social Studies because it is the hardest subject. It is where we are mostly failing and could have more practice in.”

When students were asked if they would like to take all their tests using clickers 78% of the students strongly agreed or agreed with this statement in the pre questionnaire compared to only 56% responding that they strongly agreed or agreed with the statement on the post questionnaire. When asked about taking tests on the clicker one boy said, “Yes, because clickers are easy to answer questions with the Smart Board.”

A few students shared a common thought about using the clickers for taking tests. One explained, “Someone can look at the clicker and get the answer.” Another students said, “I didn’t like that some people took a long time to answer.”

![Figure 2. Post clicker questionnaire responses, (N=9).](image-url)
The data collected for the health treatment and non-treatment was recorded and analyzed. Sixty-seven percent of the class scored higher on the Health Summary Worksheet than the Nervous System Quiz. One student’s score dropped by 60% and another student’s score by 53%. There were also three students who scored higher on their post treatment assessment. One student raised his score by 27%, which was the largest increase, and another student had a 17% increase (Figure 3).

\[ \text{Figure 3. Pre and post scores to the health summary worksheet and the nervous system clicker quiz along with student engagement, (N=9).} \]

Student engagement was observed while students participated in the nervous system presentation and quiz and noted on the Teacher Observation Log. Sixty-seven percent of the students who improved on the post treatment were highly engaged during the Smart Board lesson and quiz. Only 11% of the students showed a low level of engagement and their score was only slightly lower on the post treatment results.
The normalized gain was calculated for each student to determine their increased understanding on the use of singular and plural possessive nouns (Figure 4). A change in normalized gain of 0.31 to 0.70 is considered a moderate to medium gain. Normalized gains above 0.7 are viewed as high gains and a change below 0.3 indicate low gains.

One student scored a 100% on both the pre and post-test and his normalized gain of zero is included in the data. Twenty-two percent of the students showed a low gain in their understanding of possessive nouns, while 33% of the students showed a moderate or medium gain in their knowledge. Thirty-three percent of the students dropped to a negative normalized gain after taking the post-test.

![Normalized Gains for Possessive Nouns Pre-test and Post-test, (N=9).](image)

*Figure 4. Normalized gains for possessive nouns pre-test and post-test, (N=9).*

The only correlation between student engagement and an increase in normalized gains for the post-test on possessive nouns was that 67% of the highest increases were highly engaged students (Figure 5). Yet that is contradicted by the results that 50% of the students who were highly engaged scored the highest negative normalized gains of -0.58.
Figure 5. Student engagement level on possessive nouns treatment lesson, (N=9).

The results of the equivalent fractions lessons and student engagement were analyzed and found that 88% of the students scored higher on their clicker quiz than their averaged two non-treatment assignments (Figure 6). Eleven percent of the students scored the same on both their non-treatment and treatment assignments. Eighty-eight percent of the students taking the quiz scored a 100% on it, and the remaining 11% passed the quiz with a score of 75%.
Figure 6. Pre and post scores on finding equivalents assignments along with student engagement, \((N=8)\).

Student engagement was monitored during the clicker quiz on equivalent fractions and it showed a connection between the 88% of students scoring 100% on their clicker quiz and the high level of engagement that was observed during the lesson. The student who had no difference between his pre and post scores had a medium level of engagement during the lesson.

The data collected on adding fractions with unlike denominators showed that 89% of the students improved their scores on the post-test (Figure 7). The average increase on the clicker quiz was 15.5%. The 11% of students who had a score that dropped had a decrease of 17%. Seventy-eight percent of the students passed the clicker quiz with a score of 70% or higher.
Figure 7. Pre and post scores on adding fractions with unlike denominators along with student engagement, (N=9).

Only 11% of the students observed during the adding fractions lesson had a decrease in their post score. Eighty-nine percent of the students had an increase in their post score. Fifty-six percent of the students displayed a high level of engagement during the lesson and 100% of those students increased their post score.

The final data collection was on the science lesson about Earth’s tilt and rotation (Figure 8). Eighty-nine percent of the students taking the clicker quiz dropped their scores from the pretest to the post-test. Eleven percent of the students maintained their scores of 90% on both assessments. Eighty-nine percent of the student passed the pretest assessment with 70% or higher compared to only 56% of the students passing the post-test quiz. The average pretest score was 87% compared to the average post-test score of 71%.
The student engagement data for this lesson varied greatly with 22% of the students showing low engagement during the lesson. Thirty-three percent of the students were observed displaying medium engagement. Only 44% of the student had a high level of engagement.

**INTERPRETATION AND CONCLUSION**

This study has shown me the importance of evaluating my teaching practices in order to improve student learning. The post questionnaire revealed that students *strongly agreed* using the clickers made difficult material easier to understand. However, student agreement to taking all their tests using the clickers dropped after all the treatments were concluded. This data showed that students definitely want to use clickers yet not always to take their assessments as they had originally stated. This may have changed due to students taking more tests and seeing their results were not always successful.
This change in attitude may have also been affected by the health and science results, which required a lot of recall of facts. Students overall did not do as well on the Smart Board quiz as they did in the lesson assessment. One big difference between the non-treatment lessons and the treatment quizzes was the fact that students had their books and notes to refer to during their assessment rather than having to do it from memory.

The greatest student success on all the treatments came from the math lessons. I believe the reason for this success was due to the fact that each treatment was specific to one concept. The student engagement was also the highest during the math lessons, which contributed to their success.

Even though some lessons varied in student engagement, overall the level of engagement was much higher than traditional lessons for several of the students who struggle with attention issues. Many of the students in my class are very high readers and in turn often do not pay much attention to things they think they know. This research helped me see that using clickers did increase engagement during the lesson, which is where about 30% of my students struggle to stay focused. I also saw a correlation between student engagement and performance. In most cases when a student is paying attention to the lesson they did well on the quiz. There were a few cases such as the student who scored a 100% on the non-treatment health lesson and then scored a 40% on the treatment quiz that puzzled me. In that case I am not sure what happened, it appeared she was paying attention during the lesson.

Some of the concerns I had about my research came when I saw the results of the health and science quizzes. One difference between the health assessments was that the
Health Summary Worksheet had eleven questions compared to only five questions on the quiz. Another factor I noticed was that the material on the Nervous System Quiz was a little more challenging and without a book or notes students may not have remembered the information or they may have felt rushed to answer and just quickly picked something. The science assessment varied quite a bit and that is why the student quiz results were a lot lower than the chapter assessment. The chapter assessment supplied by the book was very easy compared to the clicker quiz. In the future I would change the material on one of the assessments to more closely reflect the other. The clicker quiz had the same number of questions as the chapter assessment however, many of them referred to two solstices and the two equinoxes. Where as the chapter assessment varied more in the material it was asking about.

VALUE

This study really helped me understand that there is a connection between student success and my effectiveness as a teacher. If students are missing the boat, perhaps I haven’t done what I should have as a teacher. Over the last three years I have been able to change how I can teach due to smaller class sizes. Some of the changes I made were to analyze my students’ assessment results weekly after they completed their language arts testing and used those results to gear weekly center activities. I also differentiated their center groups weekly to make sure I was covering the areas the individual students needed reteaching or practice with based on assessment data. When I was working with a larger group the students would stay in the same group for an entire trimester in most cases rather than changes on a weekly basis. In math we spent a day a week reviewing the
more challenging concepts with games and other hands-on activities to improve their understanding. I would pick the different activities based on my students’ scores from the weekly class work and homework assignments.

In addition to class sizes I am also working with a higher percentage of proficient or advanced readers. This opportunity has allowed me to see an additional resource I can use in the classroom to keep student engaged. Students seem to really like using clickers and answered on average that they would like to use them at least twice per week.

This idea raised additional questions for me. Would using clickers on a more daily basis increase retention of harder materials? How would students do on topic assessments from the curriculum if clicker presentations and quizzes were used to support the material, rather than the traditional paper pencil type resources? These are areas that could benefit from further research.

After doing my action research I now realized I could have included a few sub questions. Some examples of sub questions I could have included in my action research could have been something like this Does the material covered effect the engagement and performance of the students? or How does increased engagement affect performance levels?

I would like to track if engagement decreases as clicker usage increases. Students did fill out the pre and post questionnaire willingly, but I wondered if some just quickly chose an answer without putting much thought into it because of how quickly they finished circling their answers. Also I am not sure that everyone understood the
statements. I had a couple put question marks or leave statements blank because they
didn’t know how to answer.

This study allowed me the opportunity to introduce a different type of assessment
to my class and for me to appreciate the importance of continually improving my
teaching and myself. I was able to see the connection between my students’ success and
my performance as a teacher. In the past I had felt if everyone did well on my
assessments then perhaps I hadn’t made them challenging enough. My entire thinking
changed through this process and I realized that isn’t the case at all. When my students
succeed then I have succeeded as their teacher.

Conducting my research helped me see the importance of immediate feedback to
gear my future lessons and assignments. Seeing that connection between grade level
standards and student mastery was exciting and a great tool for student success. I will
continue to use clickers in my classroom to assess my students’ understanding throughout
the year and to steer my teaching to better serve my students. During the presentations
and clicker quizzes it was easier to observe student engagement and in most cases the
student engagement increased by at least one level. When lack of attention is a common
problem using clickers is a great resource for my students to get valuable information
presented to them in a different format and for me to be able to quickly assess their
understanding. I will continue to monitor engagement and performance and work on
other avenues to keep my students interested and participating in their educational
process. Learning is something we can always do and we should never stop striving to
improve ourselves for the benefit of our students.
REFERENCES CITED


APPENDICES
APPENDIX A

CLICKER QUESTIONNAIRE
Clicker Questionnaire

Please circle the response that most closely reflects your opinion about the each statement: (SA) strongly agree, (A) agree, (D) disagree, or (SD) strongly disagree.

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
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<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Using clickers on a daily basis will help me focus on the subject matter.</td>
<td>SA</td>
<td>A</td>
<td>D</td>
</tr>
<tr>
<td>2</td>
<td>Clickers can be used with every subject.</td>
<td>SA</td>
<td>A</td>
<td>D</td>
</tr>
<tr>
<td>3</td>
<td>Clickers are easy and fun to use.</td>
<td>SA</td>
<td>A</td>
<td>D</td>
</tr>
<tr>
<td>4</td>
<td>Using the Smart Board lessons and clickers makes difficult material easier to understand.</td>
<td>SA</td>
<td>A</td>
<td>D</td>
</tr>
<tr>
<td>5</td>
<td>I would like to take all my tests using clickers.</td>
<td>SA</td>
<td>A</td>
<td>D</td>
</tr>
<tr>
<td>6</td>
<td>Using clickers is a great use of technology and should be used by every teacher.</td>
<td>SA</td>
<td>A</td>
<td>D</td>
</tr>
<tr>
<td>7</td>
<td>I would rather have clickers in my classroom than laptops.</td>
<td>SA</td>
<td>A</td>
<td>D</td>
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<tr>
<td>8</td>
<td>I get nervous when using clickers and feel a lot of pressure to answer questions too quickly.</td>
<td>SA</td>
<td>A</td>
<td>D</td>
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<tr>
<td>9</td>
<td>Using clickers too often makes them boring.</td>
<td>SA</td>
<td>A</td>
<td>D</td>
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<tr>
<td>10</td>
<td>Using clickers in the classroom increases student engagement and participation.</td>
<td>SA</td>
<td>A</td>
<td>D</td>
</tr>
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</table>

*Participation in this research is voluntary and participation or non-participation will not affect a student’s grades or class standing in any way.*
APPENDIX B

HEALTH SUMMARY WORKSHEET
CHAPTER 1

Name __________________________

Body Systems at Work

Directions
• Use lesson vocabulary in the Word Bank to complete each Summary.
• Read the section directions to complete each Lesson Details.

Word Bank

<table>
<thead>
<tr>
<th>brain</th>
<th>cell</th>
<th>nerves</th>
<th>nutrients</th>
<th>trait</th>
</tr>
</thead>
<tbody>
<tr>
<td>bronchi</td>
<td>diaphragm</td>
<td>nervous system</td>
<td>skeletal system</td>
<td></td>
</tr>
<tr>
<td>capillaries</td>
<td>esophagus</td>
<td>nucleus</td>
<td>spine</td>
<td></td>
</tr>
</tbody>
</table>

Lesson 1  pp. 4-9

Summary  A characteristic passed on to you from your parents is a __________.

The ____________ of each cell contains your inherited plan. The smallest working part of your body is a ____________.

Lesson Details  Use pages 6 and 7 in your text to complete the graphic organizer to show how the body is organized.

Lesson 2  pp. 12-14

Summary  The body system that coordinates all your activities is the _____________. Thinking, movement, and heart rate are controlled by the organ known as the _____________. _____________ are bundles of fibers that carry messages through the body.

Lesson Details  Use the information on page 13 of your text to complete the chart.

<table>
<thead>
<tr>
<th>Part of Brain</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>controls thinking, _____________</td>
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<tr>
<td>cerebellum</td>
<td>controls _____________, growth</td>
</tr>
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</table>

Chapter 1  Body Systems at Work
APPENDIX C

NERVOUS SYSTEM QUIZ
Name ____________________

Nervous System Quiz

1. The ________ is/are the command center of the nervous system.
   a. heart
   b. brain
   c. kidney
   d. nerves

2. The nervous system controls both the voluntary and involuntary movements.
   True       False

3. The ____________ consists of a network of nerves that connect the central nervous system to all parts of the body.
   a. central nervous system
   b. peripheral nervous system

4. ____________ neurons are responsible for collecting information from the environment outside the body.
   a. Inter
   b. Sensory
   c. Connect
   d. Motor

5. The ____________ is the largest part of the brain.
   a. cerebrum
   b. cerebellum
   c. brain stem
   d. spinal cord
APPENDIX D

POSSESSIVE NOUNS QUIZ
Name __________________

Possessive Nouns Quiz

1. True or false, the possessive form of a singular noun ends with ‘s?
   True  False

2. Which sentence is written correctly?
   a. The spiders web fluttered in the breeze.
   b. The spider’s web fluttered in the breeze.
   c. The spideres’ web fluttered in the breeze.
   d. The spiders’s web fluttered in the breeze.

3. Which sentence is written correctly?
   a. I enjoy eating Aunt Marthas’ pie.
   b. The cars’ engine idled loudly.
   c. Carl was the cousins’ favorite uncle.
   d. The girls sled was bright red.

4. The _______ opened their gifts at the party.
   a. boys’
   b. boy’s
   c. boys

5. I went to my __________ house after school.
   a. friends
   b. friend’s
   c. friends’

6. Did you see _______ new haircut?
   a. Davids
   b. David’s
   c. Davids’

7. The two ___________ baseball cards were in an album.
   a. brothers
   b. brother’s
   c. brothers’

8. Which sentence is not written correctly?
   a. The whale’s pool was very large.
   b. My friend’s shirt is green.
   c. 9 and 11 are my son’s ages.
   d. My parents’ room is full of books.
9. Possessive nouns are used to make singular nouns plural.
   True    False

10. Which of the following is a plural possessive noun?
   a. mooses’s
   b. mooses’
   c. moose’s
   d. none of the above

11. How do you make a singular noun possessive?
   a. add an apostrophe
   b. add an –s
   c. do nothing
   d. add an apostrophe and an –s

12. Which sentence contains two possessive nouns?
   a. I can’t find Jacob’s books.
   b. Don’t forget to ask for mom’s permission.
   c. Julie’s and Darren’s reports were accurate.
   d. Brad and Lester’s joke was funny.

13. Fill in the blanks with the correct possessive nouns:
    ________ mom went to ________ grocery store.
    a. Joey’s; Edwards’
    b. Joeys’; Edwards’
    c. Joey’s; Edward’s
    d. Joey’s; Edward’s

14. Fill in the blanks with the correct possessive noun:
    My ________ family came to visit us.
    a. friends’
    b. friend’s
    c. A or B

15. Add “‘s” to make an irregular plural noun, such as men, possessive.
   True    False

16. Fill in the blanks with the correct possessive nouns:
    ________ and ________ dads always pick them up from school.
    a. Mia; Mary’s
    b. Mia’s; Mary’s
    c. Mia, Marys’
    d. Mais’; Marys’
APPENDIX E

EQUIVALENT FRACTIONS WORKSHEET
Circle the number of any fraction that is equivalent to the fraction given in the black boxed area. Complete all twelve problems on both the front and back of this worksheet.

A
Which of the fractions is equivalent to \( \frac{2}{3} \)?
1. \( \frac{1}{3} \)
2. \( \frac{1}{2} \)
3. \( \frac{2}{3} \)
4. \( \frac{3}{4} \)

B
Which of the fractions is equivalent to \( \frac{3}{5} \)?
1. \( \frac{2}{3} \)
2. \( \frac{7}{12} \)
3. \( \frac{10}{12} \)
4. \( \frac{8}{12} \)

C
Which of the fractions is equivalent to \( \frac{8}{12} \)?
1. \( \frac{10}{12} \)
2. \( \frac{3}{4} \)
3. \( \frac{5}{6} \)
4. \( \frac{4}{6} \)

D
Which of the fractions is equivalent to \( \frac{6}{8} \)?
1. \( \frac{10}{12} \)
2. \( \frac{8}{12} \)
3. \( \frac{9}{12} \)
4. \( \frac{3}{4} \)

E
Which of the fractions is equivalent to \( \frac{3}{4} \)?
1. \( \frac{5}{6} \)
2. \( \frac{6}{8} \)
3. \( \frac{4}{6} \)
4. \( \frac{5}{8} \)

F
Which of the fractions is equivalent to \( \frac{4}{6} \)?
1. \( \frac{5}{8} \)
2. \( \frac{1}{3} \)
3. \( \frac{6}{8} \)
4. \( \frac{2}{3} \)
A  Which fractions are equivalent to $\frac{8}{12}$?
   1. $\frac{2}{3}$
   2. $\frac{6}{9}$
   3. $\frac{4}{6}$
   4. $\frac{3}{4}$

B  Which fractions are equivalent to $\frac{9}{12}$?
   1. $\frac{4}{6}$
   2. $\frac{4}{8}$
   3. $\frac{6}{8}$
   4. $\frac{3}{4}$

C  Which fractions are equivalent to $\frac{3}{9}$?
   1. $\frac{2}{6}$
   2. $\frac{2}{3}$
   3. $\frac{1}{3}$
   4. $\frac{6}{12}$

D  Which fractions are equivalent to $\frac{5}{10}$?
   1. $\frac{2}{5}$
   2. $\frac{3}{6}$
   3. $\frac{2}{4}$
   4. $\frac{4}{8}$

E  Which fractions are equivalent to $\frac{3}{12}$?
   1. $\frac{2}{4}$
   2. $\frac{1}{4}$
   3. $\frac{2}{8}$
   4. $\frac{1}{3}$

F  Which fractions are equivalent to $\frac{5}{8}$?
   1. $\frac{6}{12}$
   2. $\frac{9}{12}$
   3. $\frac{3}{4}$
   4. $\frac{2}{4}$
APPENDIX F

TOPIC 10 TEST QUESTIONS 9, 10, AND 11
9. What is the missing number which makes the fractions equivalent?

\[
\frac{5}{6} = \_
\]

A. 12  
B. 30  
C. 18  
D. 36

10. Quillermo cut his orange into 3 pieces. Huy cut his orange into 6 pieces. They each ate an equal amount of their orange. If Quillermo ate 2 pieces or \(\frac{2}{3}\) of his orange, how many pieces did Huy eat?

A. 6 pieces  
B. 4 pieces  
C. 3 pieces  
D. 2 pieces

11. Which fraction is NOT equivalent to the shaded area of the rectangle?

\[
\begin{array}{c c c}
\hline
1 & 2 & 3 \\
\hline
\end{array}
\]

A. \(\frac{8}{12}\)  
B. \(\frac{4}{6}\)  
C. \(\frac{2}{3}\)  
D. \(\frac{1}{2}\)
APPENDIX G

EQUIVALENT FRACTIONS QUIZ
Question 1

- These two fractions are equivalent.

True

False

Question 2

- Which fraction is the odd one out?

A

B

C

D

Question 3

- Enter the missing numerator.

\[
\frac{5}{10} = \frac{?}{40}
\]
- Enter the missing denominator.

\[ \frac{3}{5} = \frac{2}{?} \]

Question 4

- These two fractions are equivalent.

True

False

Question 5

- Which fraction is not equivalent to a half?

A

B

C

D

Question 6
Question 7

- How many eights are equivalent to three fourths?

Question 8

- How many fifths are equivalent to four tenths?
APPENDIX H

PRACTICE 11-2 HOMEWORK
Name ________________________________

**Adding Fractions with Unlike Denominators**

Write the answers in simplest form.

1. \( \frac{1}{6} + \frac{1}{3} = \) ________
2. \( \frac{1}{5} + \frac{1}{10} = \) ________

3. \( \frac{1}{4} + \frac{1}{2} = \) ________
4. \( \frac{2}{5} + \frac{1}{6} = \) ________

5. \( \frac{1}{4} + \frac{2}{5} = \) ________
6. \( \frac{1}{4} + \frac{1}{6} = \) ________

7. \( \frac{2}{5} + \frac{1}{6} = \) ________
8. \( \frac{1}{4} + \frac{5}{8} = \) ________

9. \( \frac{5}{12} + \frac{1}{4} = \) ________
10. \( \frac{1}{5} + \frac{3}{10} = \) ________

11. \( \frac{3}{8} + \frac{1}{2} = \) ________
12. \( \frac{1}{12} + \frac{2}{3} = \) ________

13. A recipe calls for \( \frac{1}{2} \) cup of whole wheat flour and \( \frac{1}{3} \) cup of white flour. How many cups of flour are needed in all? ________

14. **Reasoning** To trim a costume, you need \( \frac{1}{2} \) yard of lace at the neck and \( \frac{1}{6} \) yard for both wrists. How much lace is needed? ________

15. **Algebra** If \( n = \frac{9}{14} \), then \( n + \frac{2}{7} = \) ________

16. For the addition \( \frac{1}{6} + \frac{2}{3} \), which sum is **NOT** correct?

- A \( \frac{9}{12} \)
- B \( \frac{5}{6} \)
- C \( \frac{15}{18} \)
- D \( \frac{20}{24} \)

17. **Writing to Explain** What common denominator would you use to add \( \frac{1}{3} \), \( \frac{1}{4} \), and \( \frac{1}{12} \)? Explain.
APPENDIX I

TOPIC 11 TEST QUESTIONS
6. Find \( \frac{1}{4} + \frac{3}{5} \). Simplify if possible.

A. \( \frac{4}{5} \)
B. \( \frac{4}{9} \)
C. \( \frac{17}{20} \)
D. \( \frac{20}{20} \) or 1

7. Find \( \frac{4}{5} + \frac{1}{10} \).

A. \( \frac{1}{15} \)
B. \( \frac{1}{10} \)
C. \( \frac{9}{10} \)
D. \( \frac{4}{5} \)

8. Shemaya ate \( \frac{1}{3} \) of a plain bagel and \( \frac{1}{5} \) of a poppy seed bagel. How much did she eat altogether?

A. \( \frac{4}{5} \) of a bagel
B. \( \frac{8}{15} \) of a bagel
C. \( \frac{14}{15} \) of a bagel
D. \( \frac{2}{3} \) of a bagel
At Jefferson Elementary, \( \frac{1}{5} \) of the fourth graders are learning about the U.S. Constitution. Another \( \frac{1}{10} \) of them are learning about the Declaration of Independence. What fraction of students are learning about the U.S. Constitution or the Declaration of Independence?

A \( \frac{7}{10} \) of the students
B \( \frac{1}{10} \) of the students
C \( \frac{1}{5} \) of the students
D \( \frac{3}{10} \) of the students

Cyrus and his cousin walked along the Shadyside Trail and the Cinnamon Trail. The Shadyside Trail is \( \frac{1}{6} \) mile long and the Cinnamon Trail is \( \frac{7}{12} \) mile long. How far did they walk along the trails?

A \( \frac{7}{10} \) of a mile
B \( \frac{3}{4} \) of a mile
C \( \frac{1}{6} \) of a mile
D \( \frac{7}{12} \) of a mile

Katy mixed \( \frac{2}{9} \) cup of blue paint with \( \frac{2}{3} \) cup of red paint. In simplest form, how much paint does she have altogether?

A \( \frac{4}{9} \) cup of paint
B \( \frac{8}{9} \) cup of paint
C \( \frac{1}{3} \) cup of paint
D \( \frac{4}{12} \) cup of paint
Ryan practiced piano for $\frac{3}{10}$ of an hour and soccer for $\frac{1}{2}$ an hour. In simplest form, how long did he practice altogether?

| ? | $\frac{1}{2}$ | $\frac{3}{10}$ |

A $\frac{8}{10}$ hour  
B $\frac{1}{5}$ hour  
C $\frac{4}{5}$ hour  
D $\frac{1}{3}$ hour
APPENDIX J

ADDING FRACTIONS QUIZ
Question 1

\[-\frac{1}{4} + \frac{1}{4} = \frac{2}{4}\]

True
False

Question 2

\[-\frac{1}{2} + \frac{1}{8} = ?\]

A. \(\frac{3}{4}\)
B. \(\frac{1}{4}\)
C. \(\frac{3}{8}\)
D. \(\frac{5}{8}\)

Question 3

\[-\frac{1}{4} + \frac{3}{8} = ?\]
Question 4

- $\frac{1}{4} + \frac{2}{16} + \frac{1}{8} + \frac{7}{16} = ?$


Question 5

- $\frac{1}{8} + \frac{1}{8} = \frac{1}{2}$

True

$\frac{1}{8} + \frac{1}{8} = \frac{1}{2}$

False

Question 5

- $\frac{-2}{16} + \frac{3}{8} = ?$

A  1/2
B  1/4
C  4/16
D  4/12
- Enter the answer as a fraction in simplest form.

\[
\frac{1}{15} + \frac{2}{15} + \frac{3}{15} = ?
\]

Question 7

- \(-\frac{1}{2} + \frac{1}{3} + \frac{1}{6} = ?\)

Question 8
APPENDIX K

CHAPTER 4 LESSON 1 ASSESSMENT
Reviewing Concepts: Sentence Completion
Complete each sentence by choosing the correct word or phrase. Write the correct word or phrase on the line before each sentence.

1. When the Earth rotates, it _____. (spins like a top, rolls like a ball)
2. The Earth rotates once each _____. (week, day)
3. The Earth also travels in a path around the sun called _____. (an axis, an orbit)
4. The trip the Earth takes around the sun is also called a _____. (season, revolution)
5. The force of attraction that keeps the Earth revolving around the sun is called _____. (gravity, direction)
6. The Earth’s tilt is caused by the line of its _____. (orbit, axis)
7. Sunlight is a form of the sun’s _____. (weather, energy)
8. When the sun hits the Earth with indirect light there is ____ heat than when it shines directly on a part of the Earth. (more, less)
9. The tilt of the Earth causes the ____ to change. (rotation, seasons)

Applying Strategies: Making Predictions
Use complete sentences to answer question 10.

10. What would be the effect on your daily life if the Earth rotated more slowly?

_________
APPENDIX L

SEASONS AND EARTH’S TILT AND ROTATION QUIZ
Name ____________________________

Seasons and Earth’s Tilt and Rotation Quiz

1. The amount of sunlight reaching the Earth changes the temperature during the different seasons.
   True    False

2. Earth is ________________ on its axis as it revolves around the sun.
   a. straight
   b. tilted
   c. crooked

3. The Earth gets different amounts of sunlight during different times of a year because ____________.
   a. the Earth spins
   b. the Earth moves
   c. the Earth spins and moves
   d. the Earth is round

4. What is the day of the year that receives the least amount of sunlight and marks the beginning of winter?
   a. the summer solstice
   b. the winter solstice
   c. the spring equinox
   d. the fall equinox

5. This day of the year has equal amounts of daytime and nighttime.
   a. the summer solstice
   b. the winter solstice
   c. the spring equinox
   d. the December solstice

6. On which day does the winter solstice start in the Northern Hemisphere?
   a. December 15th or 16th
   b. December 1st or 2nd
   c. December 21st or 22nd
   d. December 30th or 31st

7. The Northern Hemisphere tilts away from the Sun during the summer solstice.
   True    False
8. Around September 22\textsuperscript{nd} or 23\textsuperscript{rd}, both hemispheres are equally tilted towards the Sun. What are we talking about?
   a. the summer solstice
   b. the winter solstice
   c. the spring equinox
   d. the fall equinox

9. The fall equinox starts on June 21\textsuperscript{st} or 22\textsuperscript{nd}.
   True False

10. The spring equinox starts on:
   a. March 21\textsuperscript{st} or 22\textsuperscript{nd}
   b. March 15\textsuperscript{th} or 16\textsuperscript{th}
   c. April 21\textsuperscript{st} or 22\textsuperscript{nd}
   d. April 15\textsuperscript{th} or 16\textsuperscript{th}
APPENDIX M

TEACHER OBSERVATION LOG
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<th>Performance - Score</th>
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APPENDIX N

CLICKER INTERVIEW QUESTIONS
Clicker Interview Questions

1. Have you ever used clickers before using them in our class? If so, when?
   ________________________________________________________________
   ________________________________________________________________

2. What do you like about using clickers? ______________________________
   ________________________________________________________________

3. How often would you like to use clickers during the week? ______________

4. What other ways do you think clickers can be used in the classroom? ______
   ________________________________________________________________

5. What subjects do you think clickers should be used with and why? _________
   ________________________________________________________________

6. Would you like to continue using clickers this year? Why? ______________
   ________________________________________________________________

7. What didn’t you like about using clickers? _____________________________
   ________________________________________________________________

8. Is there anything else you would like to add about using clickers in the classroom?
   ________________________________________________________________

This statement will be read to all participates. Participation in this research is voluntary and participation or non-participation will not affect a student’s grades or class standing in any way.