

THE EFFECTS OF PROJECT-BASED LEARNING ON STUDENT ACHIEVEMENT
IN A FOURTH GRADE CLASSROOM

by

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July 2014

TABLE OF CONTENTS

INTRODUCTION	1
CONCEPTUAL FRAMEWORK	4
METHODOLOGY	9
DATA ANALYSIS.....	21
INTERPRETATION AND CONCLUSION	33
VALUE	42
REFERENCES CITED.....	45
APPENDICES	46
APPENDIX A: IRB Exemption.....	47
APPENDIX B: Unit Overview	49
APPENDIX C: School Data Report	54
APPENDIX D: School Report Card.....	57
APPENDIX E: Lesson Observation Sheet	59
APPENDIX F: Survey	62
APPENDIX G: Interview Questions	67
APPENIDIX H: Reading Levels	69

LIST OF TABLES

1. Earth and Space Essential Questions	10
2. Research Question and Data Collection Matrix.....	15
3. t.test Results	27
4. Student Survey Responses	32
5. Matthew's Class Points.....	36

LIST OF FIGURES

1. Negative Point Categories.....	20
2. Positive Point Categories	21
3. Pretest and Posttest Means.....	23
4. Non-Treatment Pretest and Posttest Box-and-Whisker Plot.....	25
5. Treatment Pretest and Posttest Box-and Whisker Plot	25
6. Total Positive Points	28
7. Total Negative Points.....	30

ABSTRACT

In this action research, project-based learning was implemented with the purpose of improving student achievement and student engagement within the science classroom. Students participated in project-based learning activities in addition to their traditional instruction. Students' achievement in science and attitudes toward science and school were measured throughout the action research through assessments, observations, attitude surveys, and daily tasks. Academic growth was seen in students who typically perform below grade level. In addition student engagement and attitudes were positively impacted.

INTRODUCTION

I have thoroughly enjoyed my seven years as a teacher in an urban environment, especially when teaching science. I began my career teaching second and third grade, but I chose to make a move to fourth grade because there is a greater focus on science at that grade level due to Illinois State Achievement Testing, also referred to as the ISAT. In Illinois, fourth grade is the first year that science is tested statewide. In addition, science is only tested in fourth and seventh grade, which places significant pressure on teachers at those grade levels to perform well and represent the school positively. My passion for teaching science motivated me to take on an active role in driving student achievement in that subject area, but I did not realize how challenging that undertaking would turn out to be.

Throughout my years of teaching science I observed that students lacked motivation and drive to be successful in science class. At an under performing urban school, students consistently struggle to grasp science concepts, frequently form their own misconceptions, and have little to no experience with the many topics covered in elementary science. Initially, my fourth grade students had essentially no interest in science class and seemed to believe that success in that class would be too difficult. In prior grades, students rarely received science on a consistent basis because teachers must prioritize literacy and mathematics to catch students up to grade level, 89% of my fourth grade students are reading two or more levels below grade level. Adding to that difficulty, the science textbook that Herzl School of Excellence, which is a part of the Academy of Urban School Leadership (AUSL), provides is written at a level at least two

years above what a majority of my students can independently read. These factors make achieving student engagement in science a particular challenge and teaching in a traditional ways, such as direction instruction, proved ineffective.

In science, student achievement seemed to be stagnant and disengagement was noticeable in the science classroom compared to other subjects such as math. With this action research project I strived to implement a new teaching practice in the science classroom that would be more effective in raising student achievement and, at the same time, improve student engagement in science. I implemented project-based learning in my science classroom to promote more hands on learning to attempt to meet those goals. Through project-based learning, students were exposed to the school-issued science curriculum, but it was enhanced with hands on project-based tasks a minimum of three times per week. For purposes of this action research, project-based learning is defined as teacher facilitated projects in which student groups work together to seek out information and synthesize ideas to complete the task. For example, during this action research one of the tasks required students to explain Earth's rotation to a sibling who believed that the Earth did not spin because people on Earth could not feel it spinning. Students worked as a group and used a variety of resources to model and explain Earth's rotation. Due to the nature of project-based tasks, I assumed more of a facilitator role in the classroom and allowed students to take the lead. Students demonstrated their learning through completing a variety of tasks while working with others.

The action research was implemented in Earth and space science unit. Students explored and researched the learning objective themselves and reached their own

conclusions through group discovery and minimal guidance from me. This action research also included a non-treatment phase where students were not participating in project-based learning, which was implemented during a science unit on matter.

Research Proposal

In this action research project I asked the question: how will implementing project based learning impact student achievement in the classroom? In addition to this question I asked the following sub-questions:

- How does project-based learning affect student motivation in the classroom?
- How will the implementation of project-based learning affect behavior management in the classroom?
- What impact does project-based learning have on positive behavior in the classroom?

The action research questions were developed around my concern for my students in science. Overall, as a teacher, I was concerned about their academic growth in science, but I also was highly concerned about student motivation, and behavior in the classroom. Thus, I wanted to design an action research project that could also affect behavior management in the classroom. In order to address all of the action research questions, a variety of quantitative and qualitative data collection methods were used.

Students participated in conflict resolution lessons and character building lessons to develop cooperative learning skills that were used in this capstone prior to the implementation of the treatment phase. This was done to prepare them for project-based

tasks and in conjunction of lessons to improve the culture and climate of the classroom and school.

CONCEPTUAL FRAMEWORK

Prior to implementing my action research I analyzed other studies to help guide my own action research. This analysis informed and guided my efforts to implement a treatment for students in my classroom.

During the action research cooperative learning groups needed to be set up in the classroom. As a teacher it is imperative to understand the full meaning and value of cooperative learning and convey its importance to my students. To help deepen this understanding I turned to a synthesis of cooperative learning conducted by E.G Cohen that defines cooperative learning as “students working together in a group small enough so that everyone can participate on a task that has been clearly assigned” (Cohen, p.2). A clear definition to implement is important. Cohen notes that students who were not taught how to effectively participate in cooperative learning continued to work in an individual manner even when placed in group settings (Cohen, 1992). Thus, I took time to introduce cooperative learning to my students and allowed time for development of a cooperative learning culture. Cohen also discusses the importance of giving students authentic tasks that promote interdependence in the group during cooperative learning activities, observing that students engaging in cooperative learning groups can still be very independent if they are not given tasks that require a variety of skills and responsibilities to occur within the group.

Cohen's perspective served as a starting point of thinking to construct goals for what I wanted implement during my small group lessons. Small group instruction can only live up to its learning potential with a well-prepared teacher. Cooperative learning groups can be assigned straightforward tasks or tasks that foster higher order thinking skills. Cohen's article clarifies the strategic choices that arise when one implements new teaching methods. Cohen believes that teachers must be deliberate with their intention when implementing cooperative groups through assignment of direct tasks that gradually progress to high order thinking tasks as students learned how to work in cooperative groups effectively. Cooperative groups are a constant work in progress and teachers, coaches, and administrators must consistently make efforts to manage and improve the overall quality of cooperative groups. Cohen states, "effective implementation in the classroom is associated with principals who provide instructional leadership by setting high expectations that teachers will follow through after the initial workshop" (Cohen, p.5). Expectations of cooperative groups need to be clear, organized, and set in order to maintain effectiveness.

Another insightful resource that provided direction for creation of the treatment phase for the action research question was a study that looked at cooperative learning in the science classroom. In 2003, researcher, Mary Randsell, looked at teacher and students' perspectives and attitudes regarding cooperative learning in the classroom. Six teachers participated in Randsell's study. Throughout the study Randsell met with teachers to gauge their perspective of cooperative learning groups and looked for trends amongst the teachers. Based on teacher interviews, Randsell found that many teachers

struggled with relinquishing control to cooperative learning groups (Randsell, p.7). One teacher was quoted as saying, “If I don’t give them enough structure within the group it fails” (Randsell, p.11). Also, teachers and students both believed they were participating in cooperative learning but had vastly different definitions of cooperative learning and participation (Randsell, 2003). There was evident miscommunication in the definitions of cooperative learning between teachers and students with respect to some of the teachers participating in the research (Randsell, 2003). However, all teachers who participated in the Randsell study agreed that cooperative learning groups worked best when heterogeneous (Randsell). Gradually letting go of a direct instruction teaching style needed to be well planned and effectively communicated to make the transition to cooperative learning groups a successful one.

When considering whether to implement the action research it was important to confirm the view student-centered learning in small groups is expected to yield academic gain in a classroom. An action research study completed by several researchers compared a Science-Technology-Society approach (STS), which is student-centered, and a non-Science-Technology-Society, which is teacher-centered (Yager, Choi, Yager, Akcay, 2007). Several teachers participated in this study and taught classroom units that used either an STS approach or a non-STS approach. The results revealed that, in most areas, students showed significant gain when taught with an STS approach, and the researchers found a statistically significant difference between pre- and post-test scores for application of new concepts ($t(25)=6.91$, $p<0.01$) (Yager, Choi, Yager, Akcay, 2007). The students engaging in an STS approach were more successful in the classroom during

this study; the researchers concluded that the STS approach yielded higher academic gains than the non-STS approach, and that students who participated in the STS approach were better equipped to apply knowledge and describe new contexts to use the concepts taught than the students participating in the non-STS approach (Yager, Choi, Yager, Akcay, 2007).

The STS approach engaged students in small group activities and presented them with problems or issues that required a solution through cooperative work. The teacher's role was to build on students' experiences as they worked through problems (Yager, Choi, Yager, Akcay, 2007). Overall, this article supports the view of a teacher's role in student-centered learning that is being used in this action research.

Another discussed using performance assessments as a means to evaluate students. Performance assessments can be broken down into different types of assessments to measure student growth: close, proximal, and distal (Primo, Wiley, and Rosenquist, 1998). The study examined whether or not hands-on instruction has any impact on students' performance. Researchers looked to answer this by comparing test data over two units using the, Full Option Science System or FOSS, curriculum. Students completed pretests and posttests for each unit and growth was measured. Findings showed that student achievement is sensitive to the type of instruction students receive. Close assessments are more likely to show how the impact of instruction affects student achievement (Primo, Wiley, and Rosenquist, 1998).

In addition, this report provided insight into administering and evaluating performance assessments. Throughout the study researchers gave a variety of

assessments during the units and analyzed trends. The use of different assessments can conclude different findings. Using difference types of assessments can erroneously lead to changes in curriculum or make reform to look ineffective (Primo, Wiley, and Rosenquist, 1998). When creating instructional reform or change there needs to be consideration given to the expected outcomes and how such reform or change can be measured. In other words, the researchers concluded that the type of assessment outcome should be significant in a variety of assessments, not only one such as a close assessment (Primo, Wiley, and Rosenquist, 1998). If the instructional impact can only be seen through administering one type of assessment the reform can be considered questionable (Primo, Wiley, and Rosenquist, 1998). This study assists led me to use a triangulation of data collection to ensure that I do not rely on one type of data collection to analyze the impact of the treatment.

An article written by Yilmez and Turkmen in 2008 investigated students' perspectives on their science classes through Draw-A-Science-Teacher-Test-Checklist. In this investigation researchers analyzed how students viewed their science instruction based on their drawings (Yilmez and Turkmen, 2008). Drawings were collected and analyzed. Researchers look at how students grouped their class, placed their teacher, and represented the lesson being taught. Through these drawings researchers drew conclusions about students' attitudes on science class. Students participating in the investigation overwhelmingly viewed science as a teacher directed class, 73% of students viewed themselves as answering teacher questions in seats (Yilmez and Turkmen, 2008). The study also found patterns among teachers. 58% of teachers or pre-teachers viewed

themselves as talking at the students in a direct instruction type setting versus a facilitator role (Yilmez and Turkmen, 2008). From this study it is apparent that most students and teachers view the teaching of science in more traditional direct instruction sense. During this action research the direct instruction approach was challenged, and student perspectives will be measured and analyzed through student surveys and interviews.

METHODOLOGY

This section describes the treatment that was implemented, the class demographics, and the instrumentation that took place during the action research. These items encompass the heart of the action research and data collection. 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 during Winter 2014 (Appendix A).

Treatment

The treatment was designed to be taught in conjunction with the traditional curriculum on Earth and space that was provided by the school. Herzl School of Excellence and the AUSL network use Pearson Interactive Science curriculum in all of their science classes. Therefore the treatment was intertwined with this curriculum. Prior to the treatment the curriculum was implemented with fidelity. Occasional supplements were added, but that was infrequent and the types of supplements varied greatly. The Earth and space unit was a three-week unit that covered one essential question and several sub questions (table 1). The essential question was tailored to have students recognize the many different patterns that occur in space such as the rotation and

revolution of Earth, the phases of the moon, and the patterns of the stars we see in the sky. Each sub-question naturally led into some discussion of patterns in space.

Table 1
Earth and Space Essential Questions

Unit 6: Earth and Space		
Essential Question: What are some patterns in space?		
Week 1	Week 2	Week 3
• How does Earth Move?	• How do star patterns change? • What are the phases of the moon	• What are the phases of the moon? Cont. • What is the solar system?

The daily objective was created from the school curriculum and lesson plans were created using an *I do*, *we do*, and *you do* format. The *I do* portion of the lesson is where I introduce the objective, questions, and new material, the direct instruction part of the lesson. During the *we do* portion the students and I work through the objective and material in a shared manner. This also can be referred to as the guided instruction. For example, if we read from the textbook, the activity would be a shared reading where each student has the text and we read and discuss the material together. I would assist students with clarification, ask questions, and lead a Socratic discussion. Finally, the *you do* portion is where the students are work independently, applying the concept what is taught on a given task. This part of the lesson is where the treatment was implemented. Prior to the treatment, students would complete an independent assignment, such as a worksheet

that came with the curriculum or a simple lab that required little to no teamwork or critical thinking. During the treatment phase this part of the lesson is where I incorporated project based learning activities and tasks (Appendix B). While the treatment was taking place, the *you do* required students to work together to solve a task or a challenging problem that would require students to seek an answer or solution. For example, one lesson that students completed in a project based setting was to explain the cause of the seasons to a person in a younger grade. Students were given lab materials and research materials (library books, computer, textbook, etc) to determine the cause of the seasons. Not only did the task require them to write an explanation but to work together and model the seasons using a variety of materials, such as a lamp or light bulb as the sun (students decided and chose how to represent objects in space). The lesson began with an overview of Earth's tilt and revolution around the sun. The students needed to figure out what causes the seasons on their own during the *you do* portion of the lesson.

At the conclusion of a daily lesson there is an exit ticket to measure the daily objective. This exit ticket is usually given in a standardized form, which allowed me to see if students internalized and could apply what they discovered during their project based task. Students completed an exit ticket at the conclusion of the lesson and the data collected from this would be to check for understanding on a daily basis. Working in a data driven school, it was important that I collected data to support any teaching changes. Leadership requires data to support teaching in the classroom. If a teacher is doing something, there should be a reason for it, especially if it steers off the typical structure of

an AUSL lesson plan. A weekly tracker of student mastery data on skills is submitted each week in core subjects; since there was a change in teaching I tracked the exit ticket data during the treatment phase. Per administration whole class mastery is set at 70 percent, meaning that 70 percent of the students receive a 70 percent or higher.

This action research was implemented using problem-based learning covering two units: one unit that includes the implementation of the treatment, project-based learning, and one unit that did not contain the treatment of project-based learning. That unit was taught using the curriculum with fidelity. The treatment was implemented during the unit on Earth and space the non-treatment was implemented during the unit on Matter. It took place over six weeks. During both units data were collected to analyze the effectiveness of using project-based learning in the classroom.

The Class

I teach two sections of fourth grade science. In this action research each section underwent a treatment phase and a non-treatment phase, all data was analyzed as one fourth grade group. The decision to create one large group was due to the fact that I am the only fourth grade science teacher and the classes are split by academic test scores generated from the Northwest Evaluation Association Measures of Academic Progress, NWEA MAP, test. Instead of having two homogeneous groups I combined both to create one heterogeneous group that had a range of all academic levels and behaviors. This created a fourth grade sample of 43 students in an urban turnaround school, which is part of the AUSL network. AUSL is a network within Chicago Public Schools, CPS, which means that Herzl School of Excellence is still considered a neighborhood public school; it

is not a magnet or charter school. AUSL is a network within CPS that will enter a school that is considered failing based on consistently below average test scores over long periods of time and replace the current staff and administration with new teachers, security, support staff, and administration many, of whom have trained with AUSL special residency programs in some way. When Herzl School of Excellence, my current school, was “turned around” two years ago, only one teacher and one clerk remained from the old staff; everyone else was new and personally selected by the newly appointed principal and assistant principals. This is done to completely change the climate and culture in the school, a core promise of AUSL when they turnaround a school. The school is also given new goals to promote student academic growth. An example of how climate and culture is addressed is the increased amount of security that is present at the school. Prior to a school being turned around the climate and culture is not monitored. Students have no structure and fights are not uncommon on a daily basis. Once it is turned around security and teachers ensure that the climate and culture remain calm, safe, and conducive to learning. There are a few opportunities that would allow behaviors that were seen before the turnaround to occur.

Herzl School of Excellence is located on the west side of Chicago in the North Lawndale neighborhood. It has been a part of the AUSL network for two years and is seeing academic growth and a climate and culture change. According to the Illinois School Report Cards that are issued each year Herzl improved test scores in core subjects by 8.1 percentage points (Chicago Tribune, 2013). Other students in the same neighborhood saw declines of scores or scores with gains under four percentage points

(Appendix C). With the first year of operation under AUSL, science scores improved by fourteen percentage points from 38 percent of students testing at or above grade level to 52 percent of students at or above grade level. In reading, the gains were smaller with a gain of 4 percentage points from 19 percent of students reading at or above grade level to 23 percent of students reading at or above grade level (Appendix D).

Moving into more specifics of the sample class, ninety-five percent of the class is African-American and 5 percent of the class is Hispanic. Of the 43 students 21 are boys and 22 are girls; the classroom is 100 percent free and reduced breakfast and lunch. There are six students with individualized education plans, IEPs, and there is one student currently in the Response to Intervention, RTI, process due to concerns about academic progress. There are no English language learners in the class. Eleven percent of the class is reading at or above grade level, and 89 % of the class is reading below grade level.

The class is made up of a diverse group of learners, so this project was partly inspired to better address this varied group of students who have been educationally neglected prior to attending a school turned around by AUSL. Herzl, students were denied the full education that so many other students receive. When I first entered this school, my students had not experienced enough success in school to take pleasure in learning or to see value in it, because they were not given the opportunity. In addition to making academic gains this action research was designed to give these students an opportunity to learn in a way that could change their outlook on learning. I strived to create a project that would move students academically and foster an interest in learning.

Instrumentation

During the implementation of problem-based learning, data instruments were created to collect data. Data was collected in a variety of ways to address the research question and sub questions. Throughout the action research, data was tracked and analyze in order to draw conclusions regarding the research questions. Instruments were used during the treatment and non-treatment phase consistently to ensure reliability. Validity was ensured by creating tools that could collect data that measured the research question and sub-questions. Instruments were used during the treatment and non-treatment phase consistently to ensure reliability. The instruments were able to collect data that could compare the treatment phase to the non-treatment phase.

Table 2
Research Questions and Data Collection Matrix

Action Research Questions and Sub-Questions	Unit Assessment	Project Assignments	Exit Tickets	Student Surveys	Participation Rubric	Class Dojo
How will implementing problem based learning impact student achievement in the classroom?	4	4	4		4	
How does problem based affect student motivation in the classroom?				4	4	4

How will the implementation of problem-based learning affect behavior management in the classroom?				4	4	4
What impact does problem-based learning have on the positive behavior in the classroom?			4	4	4	4

One instrument that was used to collect data is a lesson observation sheet that was custom created for classroom use (Appendix E). It was used throughout all the lessons in the treatment and non-treatment phases. It was an interactive instrument that recorded data about student engagement, student understanding, and student collaboration. Each lesson was monitored with a teacher observation sheet to track items that contributed to student achievement and engagement. It also contained an area to track student understanding of a lesson's objective through exit tickets. At the end of each lesson students received an exit slip to check for understanding of the daily objective. After the exit ticket was administered the lesson observation sheet was an area to track exit slip data for easy reference. It also allowed me to collect some formative data regarding mastery of the daily learning objective or any particular items that would stand out. For example, after the lesson and the exit ticket were completed, I could easily note how many students mastered the daily objective and the level of confidence or struggle I observed. On one particular reflection sheet I noted that students would smile when they read the question because they were confident and excited that they knew the answer. In

other words, the lesson reflection allowed me to reflect and analyze the overall effectiveness of the lesson both qualitatively and quantitatively.

To formatively analyze student achievement, daily exit tickets were administered that tracked the mastery of daily objective. Exit tickets allowed checking understanding on a daily basis and served as a reference point for planning and preparing each lesson. Many of the exit tickets were written in a standardized format to help students prepare for the Illinois Standard Achievement Test, ISAT, test in science. The results of the exit tickets written in this format allowed analysis of student application and internalization of what they were learning during project-based tasks.

The primary focus of this action research is academic achievement, which resulted in data collection heavily surrounding the research question, “How does project-based learning impact student achievement?” When the unit began, students were given a pretest on the material to serve baseline for analyzing the effect of project-based learning. At the end of the unit students were given a posttest. The results of the pretest and posttest were analyzed to measure the overall student progress and the effect of the treatment implemented. Collected pretest and posttest student averages from the treatment and non-treatment phases were compared and contrasted to address the research question. Both assessments were generated by the curriculum provided so ensure that the difficulty and questioning type was equal, also, this helped to ensure the validity of the assessment data.

Another instrument that was used was a student survey that was administered at the beginning and the end of the treatment phase. This was administered to track student opinions of science class, school, and different styles and techniques of learning. It was a Likert Style Survey. During data analysis student responses were tracked to identify any trends. This data was tracked at the beginning and end of the treatment phase. In addition to multiple choice questions students answered some open-ended questions to allow me a better understanding of their views (Appendix F).

Student interviews were also conducted to gauge student interest and engagement during the treatment and non-treatment phases. This allowed for conversations to take place around the different teaching styles students were experiencing. Students were able to compare and contrast the treatment and non-treatment phases. As a facilitator to these interviews I constructed a list of questions and follow-up questions to stimulate discussion around my sub-questions (Appendix G). These candid conversations allowed for data collection around student perspectives to be possible. Students were interviewed in small groups throughout project-based tasks and outside of class.

During instruction, the Internet website/program, Class Dojo was used as a data collection tool to collect data on positive and negative behaviors in the classroom. Class Dojo is a website that allows teachers, students, and parents to monitor student behavior. Students are awarded positive points for behaviors that exhibit excellence in the classroom and receive negative demerits when they exhibit behaviors that are not conducive to a learning environment. Throughout the Herzl school, many teachers and classrooms use Class Dojo, and the fourth grade was one of the grade bands that adopted

its use. Because students are familiar with and motivated by Class Dojo, I modified the behaviors within the Class Dojo program in order to collect data relevant to the research question and sub questions. For example, on the demerits, or negative points, I was able to create a redirection demerit (figure 43). This allowed me to collect data on how many times I was giving redirections to a student during science instruction after the initial instructions and plus provided a friendly reminder. If there was a student who needed an additional redirection I would document that redirection through Class Dojo. Students received demerits when I needed to narrate their specific behavior, positive or negative. Positive points were given if I noticed a student displaying excellence during the lesson. For instance, if there was a student doing an exemplar job helping a group member during a project-based task I would narrate what he or she was doing and give them a helping others positive point. Students could earn positive points for a variety of reasons. After lessons, I also used a lesson reflection that allowed for additional qualitative data to be collected from myself regarding that lesson. On the lesson reflection sheets I could note significant pieces of the lesson that impacted instruction or student behavior that I could not track with Class Dojo, but was relevant to student engagement. The additional annotation from the lesson reflection sheet helped aid in the analysis of the total negative and positive points. Also, data from Class Dojo was transferred to an Excel spreadsheet to better track the data for easier use and manipulative of the data. Transferring Class Dojo data into an Excel spreadsheet allowed for totaling up the positive and negative points students earned during the treatment and non-treatment phases. Class Dojo was used consistently throughout the treatment and non-treatment phase to ensure reliability.

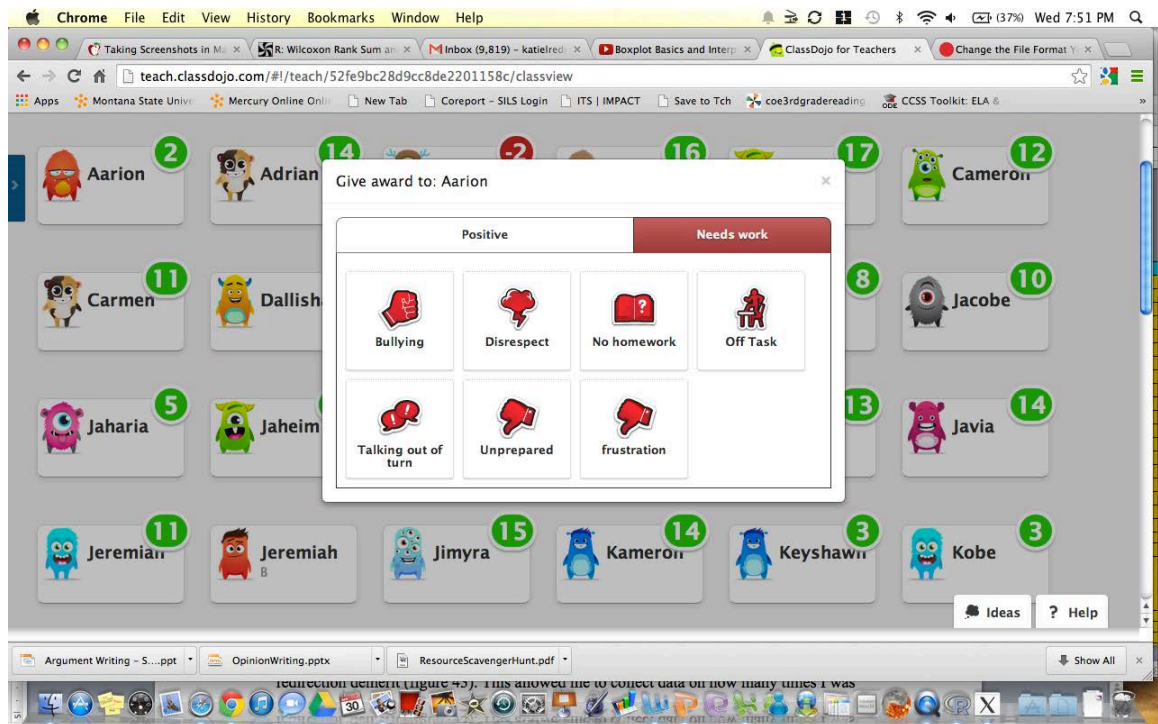


Figure 1. Negative Point Categories.

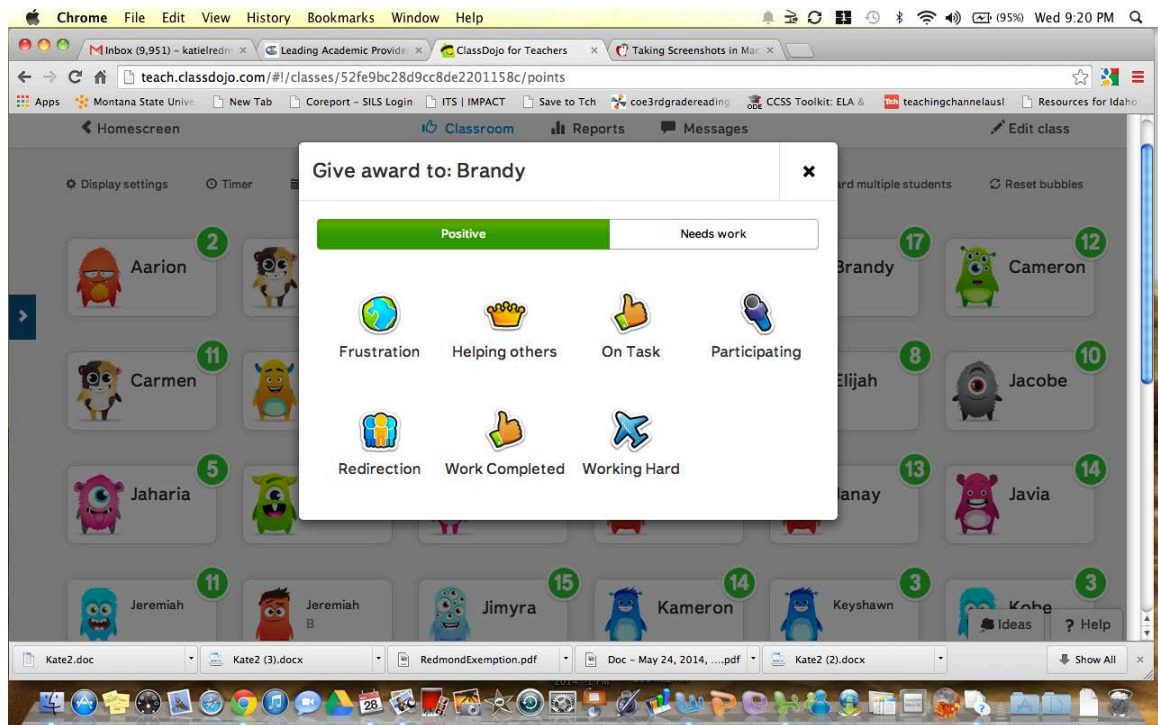


Figure 2. Positive Point Categories.

All instruments that were created allowed for the collection of qualitative and quantitative data. The qualitative and quantitative data that was collected was used to analyze how the treatment impacted the research questions. The variety of the instruments gave me insight to the impact of the action research from many different angles and perspectives. This created a triangulation of data that allowed me to determine how the class was impacted during the treatment and non-treatment phase. Using this triangulation of data led me to more concrete data based conclusions.

DATA ANALYSIS

Throughout the implementation of the treatment and non-treatment phase data were collected that allowed me to see the differences between the treatment phases and non-treatment phases, and provided insight to the research questions that would allow me

to draw conclusions from this action research. The data tools were used to collect the data and then much of that data was tracked into spreadsheets and used to create charts, tables, and graphs for analysis. Both quantitative and qualitative data were collected and tracked through the treatment and non-treatment phases.

Student Achievement

The focus point for this action research strives to find out the impact project-based learning has on student achievement in the science classroom. During the course of the treatment and non-treatment phases students took unit pretests and unit posttests to measure academic growth. Upon looking at only the increase of mean from the pretest to the posttest for the treatment and non-treatment it appears the treatment phase was ineffective because the increase in the mean during the treatment phase was 7 percent and the increase in the mean during the non-treatment phase was 12 percent. Upon initial glance, one could easily conclude that the treatment phase was not effective in positively impacting student achievement. A 12 percent gain leads to the conclusion that the treatment did not have much of an impact, if any, on student achievement in the classroom. However, when looking at the actual percents, the class mean during the treatment phase was 55 percent and only 46 percent during the non-treatment phase. While the class mean increased more during the non-treatment phase the overall mean for the treatment posttest was higher. However, it is important to note that the overall pretest mean during the treatment phase was higher than the overall mean for the non-treatment posttest mean.

From an observational standpoint this data collection was quite surprising during my initial review. During the treatment unit, students were engaged and eager to learn about the topics covered in the Earth and space unit. I made an early assumption that their eagerness would transfer into mastery. However, after the posttest data was available, and I could review the completed observational logs, exit tickets, and behavior data, the results were less of a surprise. Sifting through observational logs there were many notes such as, “a ton of questions,” and “group 3 didn’t understand for ten minutes,” that potentially foretold the posttest mean data from the treatment phase, if I would have sufficiently reflected on that. However, since I was using a variety of collection methods I was able to return to those notes to help solidify my data analysis.

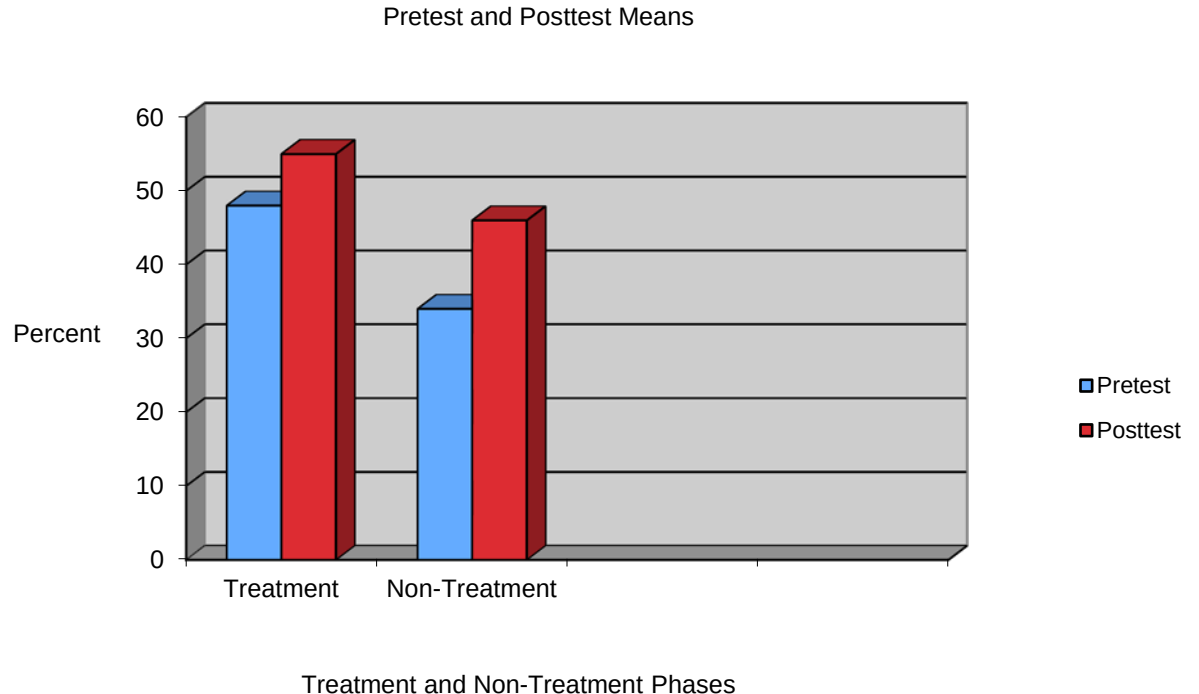


Figure 3. Pre and Post Test Means (N=43).

While only the analysis of the means indicated the treatment phase did not impact student achievement, I wanted to know what else the data demonstrated. By delving beneath the surface of the mean scores I was able to examine this data more closely. There were additional conclusions from the pretest and posttest data for the treatment and non-treatment phases. I wanted to analyze the spread of my data. I decided to create box-and-whisker plots of the pretest and posttest data from the treatment and non-treatment phases. Figures 3 and 4 show the box-and-whiskers plots of the pretest and posttest data from each phase. While the non-treatment phase data had a higher percentage gain in class mean than the treatment phase of the posttest, the box-and-whisker plot labeled 2 in figure 4 has a narrower spread compared to the box-and-whisker plot labeled 2 in figure 3. Knowing that a box-and whisker plot breaks data into quartiles it is worth examining the bottom quartile. The class mean's increase during the treatment phase was not as significant as the class mean's increase during the non-treatment phase, but there was somewhat of an interesting increase in the lowest quartile. Looking at the box plot, the lowest quartile made more gains during the treatment phase than the lowest quartile in the non-treatment phase. This data shows that the students performing in the bottom quartile made more academic gains during the treatment phase than they did during the non-treatment phase. This is important to note because the students performing in the bottom quartile are performing significantly below grade level and it is crucial they make significant gains to help them "catch up" with their peers.

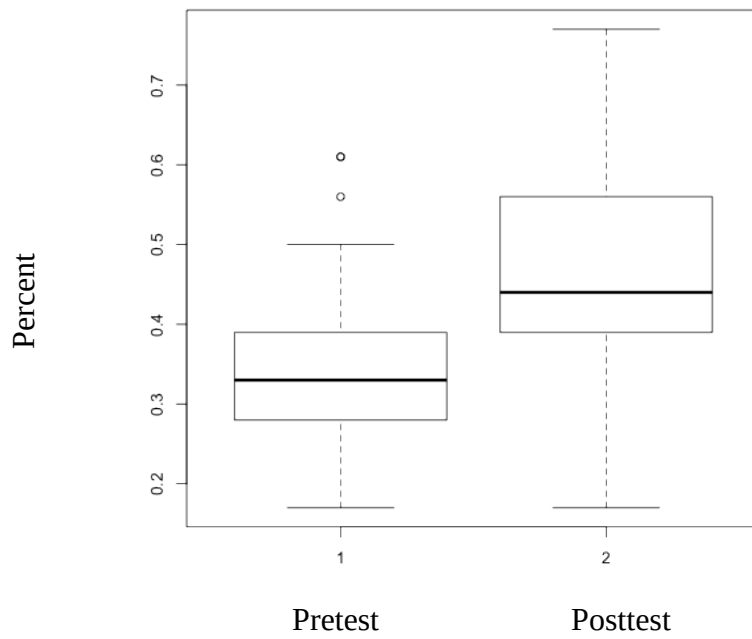


Figure 4. Non-treatment Pretest and Posttest Box-and-whisker Plot.

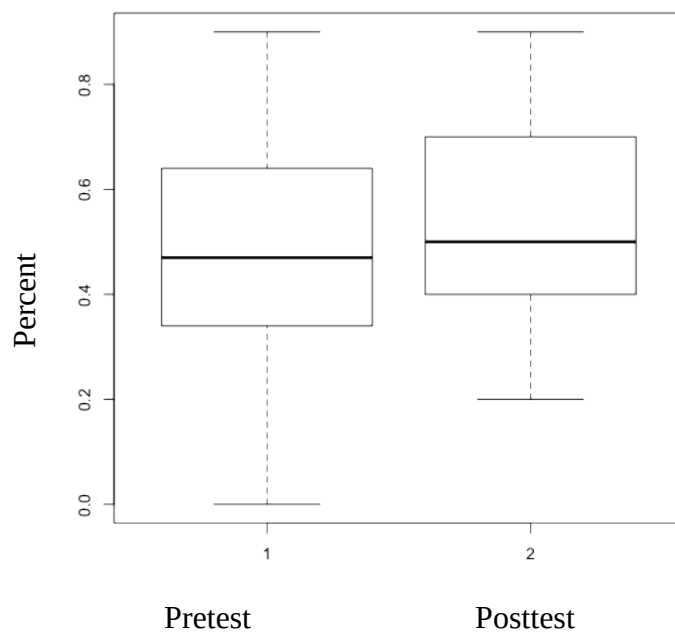


Figure 5. Treatment Pretest and Posttest Box-and-whisker Plot.

I also wanted to compare the two sets of posttest data to take note of any statistical significance between the two sets of data. I chose to administer a t-test to see if the means were reliably different from each other. As previously discussed, the means from treatment and non-treatment posttests are different, but I wanted to see if there was a statistical significance between the means, to ensure reliability of the results. In other words, is there a statistical significance in regards to the posttest scores during the treatment and non-treatment phases? This information was important because the class mean during the treatment phase was 9 percentage points higher. As a researcher, I wanted to know if that was due to the treatment that was put in place or was it purely by chance because 9 percentage points is a large difference in testing data. Knowing that the data was reliable and not due to chance would help support the idea that incorporating project-base learning tasks in science class would also impact student achievement when used in other science units.

When completing the t-test, data was input into the R Console application. The R Console application is a computing program that calculates many statistical tests, such as a t.test. The results of the t-test can be found in table 2. The t-value was 2.6, which tells me that the treatment and non-treatment posttest data groups are 2.6 times as different from each other as they are from within each other. In addition to looking at the t-value, I had to ensure that the p-value would indicate that the difference between the scores would show a statistical significance. The p-value in this t-test was 0.011, falling between 0.01 and 0.05, which is usually the acceptable range for considering data as statistically significant for noting the difference between the means.

After completing the t-test and interpreting the p-value I am able to conclude that the means are statistically different. While it was noted before that the overall increase of the class mean was larger during the non-treatment phase, the class mean increased to 55 percent during the treatment phases, making it statistically significant. The treatment phase did impact student achievement.

Table 3. *t.test Output from R Program*

Paired t-test	
data: treatmentpost and nontreatmentpost	
t = 2.6407, df = 42, p-value = 0.01157	
alternative hypothesis: true difference in means is not equal to 0	
95 percent confidence interval:	
0.01847776 0.13826643	
sample estimates:	
mean of the differences	
	0.07837209

Culture and Climate

One sub question that was particularly important to my classroom was, what impact does project based learning have on positive behavior in the classroom? Using Class Dojo to track my narration allowed me to see the types of narration I was giving my students. I defined narration using AUSL's definition of the type of specific reminders I give to students after the initial directions and expectations. For example, if I were to say, "Mathew is having a great science conversation with his group," after I give whole group directions for beginning a project-based learning task I would go into Class Dojo and give a positive point to Mathew. This had the purpose of making me more cognizant of all types of student behaviors and to serve a positive management system in the classroom. To examine this question more closely I relied on qualitative data from

personal observations and the data that I received from Class Dojo. In addition to Class Dojo allowing me to track individual data on each student, I could examine my positive narration during whole group instruction. Figure 6 shows the total number of positive narrations I had given each week of the treatment and non-treatment phases. Tracking and graphing data yielded some interesting results. From the data, I cannot conclude that project based tasks led to more positive narration in the classroom. When examining figure 6 more positive narrations was given during the non-treatment phase than during the treatment phase.

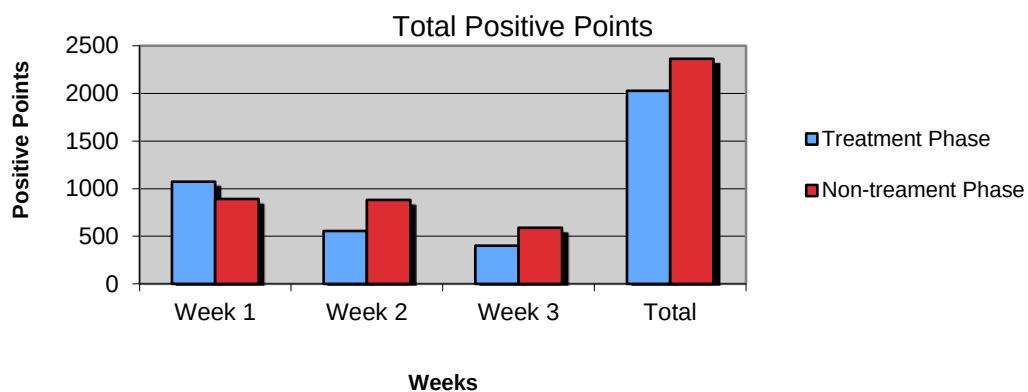


Figure 6. Positive Points (N=43).

Despite the data, I believe that the positive point data is inconclusive. While it may seem obvious to say that the treatment did not impact positive behavior in the classroom due to the fact that on most weeks during the treatment and non-treatment phases more positive points were given out during the non-treatment phase, I question that conclusion when I analyze my student videos, interviews and observation logs. This

data led me to a completely new conclusion and now has me questioning the type of data the positive point tracking provided. From this data a new question arose, what impact does project-based learning have on the need for a teacher to narrate student behavior? In AUSL schools it is customary for a teacher to narrate, or verbally describe positive behavior in order to encourage other students to follow suit. For example, when I need students to return to their seats before I negatively redirect a student I verbally acknowledge the students who are following the expectation. From this project I began to reflect on my narration of directions that I gave, did I give more positive points during the non-treatment phase because it was necessary to positively narrate students to keep them focused on a less engaging lesson? It is entirely plausible that I had to give more positive points during the non-treatment phase in order to prevent an increase in negative behaviors due to the less engaging and relatively hands-off teaching that occurred during the non-treatment phase. It is possible that during the treatment phase that more students were engaged and both my students and me did not have to be as aware of positive behaviors because positive narration was not as needed to encourage students to remain focused. Also, it is important to think how “hands-on” activities are more informal and may naturally lend itself to more negative behaviors or behaviors that need more redirections, especially in early phases of implementation.

The negative point tracking system was not subject to the same perplexity as the positive point tracking system because negative behaviors that disrupt the learning environment cannot really be overlooked. However, the total negative points did not lead to a conclusive result that the treatment impacted student motivation and behavior in

class, like I was striving to answer with my sub question: How will the implementation of project-based learning affect behavior management in the classroom? According to the data there was no impact, in fact it could be argued that behavior management was more challenging during the treatment phase due to the data indicating that the total number of negative points given out during the treatment phase was marginally more than during the non-treatment phase, there were 41 more negative points given out during the non-treatment phase.

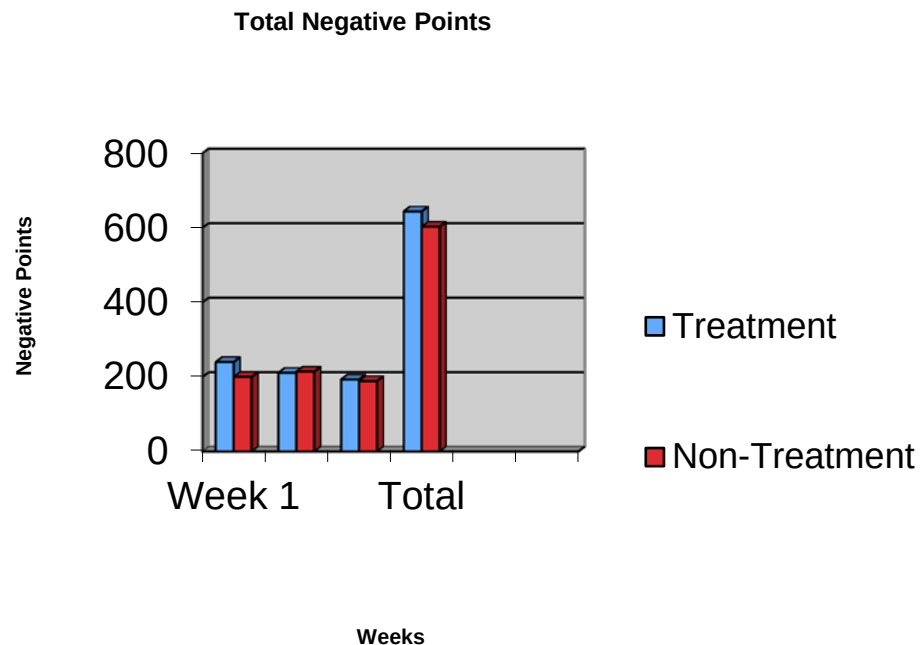


Figure 7. Negative Points, (N=43).

Students were given their first student survey a day prior to beginning the treatment phase of the action research. Students were asked 20 questions and had variety of answers that measured how they feel about school, science, and their thoughts about their academic abilities, both multiple choice and short answer. The multiple-choice questions were written as a Likert survey (Appendix F). Students were given the survey and all responses were anonymous and participation was voluntary. Students were able to choose the answer that best corresponds with their feelings about the statement or question. The survey data was tracked and compared with survey responses at the end of the treatment phase in order to look for changes student attitudes over the course of this action research. The survey was given to assist in answering the sub question: How does project-based learning affect student motivation in the science classroom? The survey allows for students to share their opinions about their attitudes toward motivation in the science classroom.

After giving the survey I was able to get a clearer picture of how my students felt about certain things regarding their learning, the science classroom, and the school. Questions 2, 4, 9, and 16 were looked at closely since they specifically focus on student motivation. In table 3 each focus question is listed and the percent of students selecting a specific answer on the pre-treatment survey and the survey given post-treatment.

Overall the results were very positive. The treatment phases helped students improve their motivation toward work, science, and, school. Going into the treatment students generally enjoyed coming to school to learn new things. Prior to the treatment phase 76% of the fourth graders agreed or strongly agreed that they came to school

because they wanted to learn more things, which is a very positive statistic, but at the end of the treatment phase there were 91% of fourth graders that either agreed or strongly agreed with that statement (table 4). Through the course of three weeks of implementing a new teaching practice there was a 15% increase in the belief that students come to school because they want to learn new things.

Table 4
Student Survey Responses (N=43)

Question 2: I come to school because I want to learn new things.	Pre	Post
Strongly Disagree	15%	0%
Disagree	3%	3%
Neutral	6%	6%
Agree	9%	26%
Strongly Agree	67%	65%
Question 4: I like to participate and share my ideas in class		
Strongly Disagree	18%	6%
Disagree	6%	13%
Neutral	6%	16%
Agree	27%	32%
Strongly Agree	43%	33%
Question 9: I am motivated to work hard in science		
Strongly Disagree	3%	13%
Disagree	12%	3%
Neutral	3%	9%
Agree	15%	32%
Strongly Agree	67%	43%
Question 16: I enjoy working in small groups to complete work		
Strongly Disagree	9%	0%
Disagree	6%	3%
Neutral	13%	3%
Agree	15%	23%
Strongly Agree	57%	71%

Overall, I learned that my students want to come to school, despite the behaviors that they exhibit during the school day. From observations of how I see them respond to

adults and school expectations I would have assumed that they felt otherwise, due to the display of negative behaviors and disrespect. This survey reminds me that student actions do not always reflect student beliefs, especially in an urban school.

This survey helps prove the need for student input in this project. Student motivation may not always be observable due to the way students want to carry themselves in front of their peers. Tracking their feelings will be important for answering question one: How does problem based learning change student motivation in the classroom?

INTERPRETATION AND CONCLUSIONS

The data collected and the data analysis allowed me to make conclusions to my research question and sub questions. First, I will look at how the sub questions were answered and then look at the main focus question related to academic gains.

Alongside researching for academic gains, I hoped to improve student motivation in science class. With a majority of students performing below level and often not engaged in class, the goal was to begin to see students flourish in the classroom through motivation and student engagement. Through observations, I can attest that this did happen. When looking at my first sub-question on how does project-based learning affect student motivation in that classroom, it was found that it did impact student motivation in the classroom by using observational notes, survey data, and student interviews.

Throughout the class students who were quiet, uninvolved, and unmotivated slowly began to emerge as eager learners. Delilah, a student who receives special services and has verbalized her dislike of science in student interviews and through her grandma was a

wonderful example of this. Prior to the treatment Delilah did not enjoy science and would try incredibly hard to not participate. Throughout the course of the treatment phase it was wonderful to watch Delilah become more vocal and take a leadership role when working with other students. Looking at her Class Dojo positive points Delilah had a total of 63 positive points, the second highest of all the fourth grade students. This high total of positive points help illustrate how many students became positively invested during project-based tasks. Recently after the treatment phase Delilah had her annual IEP meeting and her grandmother even commented on Delilah's newfound enjoyment on science. Many students, like Delilah, actively sought out their own information and used a variety of sources to synthesize and create conclusions.

Class Dojo was a vital part in my data collection on negative and positive behaviors. The information that I collected from Class Dojo allowed me to make conclusions on my third sub-question. Based on the data collected in this study, project-based learning did not increase positive behavior in the classroom when analyzed as a whole. However, I did see some improvements when I look at individual Class Dojo data. There were some students who did not usually participate who began to earn more positive points during the treatment phase (Matthew's class points, table 5).

At the beginning of the action research students were apprehensive to take part in a new style of learning, but were soon eager to participate. By the end of the treatment phase it became very difficult for me to continuously track participation but there was mostly one hundred percent participation. Stronger students were helping students who were struggling with reading, quiet students were taking initiative, and students who

typically had behavior problems were suddenly completely engaged. For example table 5 that shows Matthew's behavior points. Matthew is a student who has struggled in school throughout every grade and many teachers have experienced challenges regarding how to effectively educate him. According to Class Dojo data, Matthew had 43 positive behavior points during the treatment phases, and 30 positive points during the non-treatment phase. These data shows that Matthew did begin to have more positive interactions in the classroom. For Matthew and for me this was a huge improvement that dramatically shifted the dynamic of the class. During instruction I did not have to spend as much class time waiting for Matthew to behave appropriately, which allowed for the rest of the class to run more fluently. Prior to the treatment and during the non-treatment phase other students would become irritated waiting for Matthew to stop disrupting the class, which would often lead into a domino effect where everyone would begin to yell at Matthew out of frustration. This would eventually lead to Matthew having to be removed from the classroom. From a daily observer's standpoint having Matthew be able to remain in class during the duration of science class was a huge improvement. When I interviewed Matthew about the change he replied, "I like it when I can talk more in science and work on my own. Sitting and listening to you (me) gets boring." Overall, implementing this action research improved the relationship that I had with Mathew a great deal. However, I do note that Matthew had 69 negative points during the treatment phase, so I cannot say that the treatment phase completely eliminated Matthew's negative behaviors, but it did help to increase Matthew's positive interactions in the class. In addition to the Class Dojo data for Mathew, when I looked at my lesson reflection notes there are notes indicating

the improvement in Matthew's engagement during project-based activities. One lesson observation log included the annotation; "Matthew is actually completing the task with his group." Prior to the treatment phase it was not uncommon to receive a completely blank paper from Matthew. Again, while Matthew's negative points indicate that Matthew is struggling in class with his behavior, there are small successes for Matthew and me from the implementation of the treatment phase.

Table 5

Matthew's Class Points

Matthew's Negative and Positive Points

Treatment Phase		Non-Treatment Phase	
Positive Points	Negative Points	Positive Points	Negative Points
43	69	30	58

In response to my first question and my main focus question on how project based-learning impacted student achievement in that classroom, student achievement was not heavily impacted for the whole class. However, based on my finding it was more effective for my students who perform in the bottom quartile. Quantitatively the gains made on the science tests did not prove to be as significant in the treatment phases as I hoped for the class. Student achievement did improve but it did not move or change every single student into As and Bs students, or even Cs. When analyzing the averages, there was more of a gain during the non-treatment phase. However, I still observed positive changes in the classroom and amongst individual students. For example, many students who perform at or above grade level enjoyed embracing the challenge that project based

learning presented. Kameron, the highest performing fourth grader commented that learning in groups (completing project-based learning assignments) was important because it allowed her to learn more information on her own than was in her textbook. In other words, she got to learn and synthesize more information than what is normally taught through using the traditional curriculum. As an observer, I was able to see this in Kameron and many other students. Kameron enjoyed the freedom to learn and pursue the project-based tasks in her own way. Many times I was left astonished at the creativity and initiative that my students showed while working on project based tasks. For example, during the project based learning task where students were presented with task of finding out if human life could be sustained on other planets, many students took the next step of coming up with ways they could make human life sustainable on other planets such as Mars with no prompting or urging from me or began suggesting living on the moon as opposed to another planet. For example, one group thought of ways they could get oxygen to mars so people could live there. It was as if students learned what prevented people from living on other planets and then were determined to find ways to make it a possibility. Considering the struggle I have had with science participation in the past this observation was completely overwhelming and really showed me how much of an impact the treatment was having on the dynamic of the science class.

Prior to the action research, many students in this class had previously experienced little success, had little prior knowledge on more topics, and were low achieving students. Anthony Gabriele wrote about how achievement goals affect constructive activity of low achieving students (Gabriele, 2007). This article discussed

how small group learning is not always beneficial for lower achieving students because the information they get from peers is not understandable to them. It looked at high achieving students helping low achieving students and average achieving students helping low achieving students (2007). It discussed how low achieving students received better help from higher achieving students than they did average achieving students. The study's conclusion seems logical, however, prior to reading Gabriele's article I had not given much thought to this issue. During my action research I considered the make-up of the project-based groups and had to address the problem of having a considerably higher number of low achieving students than high achieving students. Grouping my students into effective groups took consideration in order to make project-based groups more meaningful. After observing the project-based task on sustaining human life on other planets, I was able see first hand what Gabrielle was describing in his study. My students who perform below grade level were able to think critically alongside their peers who typically perform above grade level. The students achieving above grade level were able to emerge as leaders and help almost all of the students performing below grade level, even with a considerable number of students reading below grade level, 89%, (Appendix H). Another interesting observation that I had from carefully listening and observing a majority of students who perform below grade level is how many of them rose to the challenge of being a leader despite academic challenges. One lesson observation sheet notes, "Adrian is the leader of his group and is passing out tasks to each student in his group. He's making all the decisions of what to include (in the project)." Adrian is

reading over two years below grade level, but if an outsider was observing him that day they would have never suspected that.

Through completion of this action research I learned how to create the type of groups Gabrielle discusses. Prior to this action research when I wanted to complete a “project-based” assignment I would randomly throw groups together without much consideration. Now, and in the future, project-based learning activities will be much more deliberately planned. I am aware of how to group students that will effectively bounce off each other and put students who normally would not be considered leaders in positions where they can rise to the occasion.

Also, Gabriele mentioned the setting of achievement goals for students. My school currently uses the practice of setting learning goals and student data tracking to promote student motivation and accountability. This article discussed how these particular goals might not always be effective among low achieving students, a concept with which I agree. It is more difficult to set learning goals with my low achieving students because they often set unrealistic goals or do not fully understand how to set a meaningful goal. Many of my students say, “my goal is to get an A” when they have a D average in all their classes and are reading significantly below grade level. Throughout the course of this action research students were able to more effectively set goals on project-based tasks. Students who perform below grade level began to make more manageable and short-term goals. For example, during interviews conducted while students were working on the sustaining human life on other planets task, Louis, a student performing and reading more than two years below grade level, did not focus on getting

and A on the post test but said, “My goal is to find out if people can live on Saturn.”

Louis set a manageable goal (and an academic goal related to the objective) and was able to see the success in that goal by the end of the class period. As a student who typically performs below grade level and consistently receives below average grades, meeting that goal served as a huge confidence boost for him. At the end of the task, it was very inspiring and moving for me to see Louis meet a goal and to see Louis so motivated by meeting his goal. While Louis’ pre and posttest averages improvement was not significant, Louis’ small qualitative successes were significant. Also, as his teacher, seeing Louis set a goal to seek out academic knowledge was much more meaningful than having Louis set a goal to receive an A on class work.

My second sub-question looked to answer the question how does project-based learning affect the behavior management of the classroom. Again, Class Dojo helped to answer this question by tracking negative behaviors in the classroom. In response to this question it was found that I needed more negative redirection or narration in the classroom during the treatment phase. While the room was transformed into a student-led, teacher facilitated environment the students needed more support from me. However, the data did show that each week the amount of negative narration decreased. The article, *Steps to Fostering a Learning Community in the Primary Science Classroom*, sets up the basics of what I wanted to accomplish with the change in my teaching. This article focused on setting up a learning community, (Prissick-Kilborn, 2009). It discusses setting up an environment where students are able to learn and grow and focuses on how the teacher can change a learning environment and model exemplar learning. With seven

years of teaching experience this action research served as a pivotal point to change my role in the classroom. As a beginning teacher much of my instruction was teacher-centered. Through this action research, I was able to design and create a more student-centered classroom. To accomplish this I fostered a learning community that can support my goals and research questions. In this article it states, “the teacher is the leader but leads by virtue of being a more expert learner without their own knowledge limiting what is learnt or investigated” (Prissick-Kilborn, p.27). At first it was a difficult transition to embrace a more facilitator role, but after seeing the enjoyment that my students had learning on their own and the many, many positive comments I received during interviews, I became excited to step back from teaching whole group and to let the students discover on their own. For the first time in a long time, teaching became less stressful for me as well. In addition, as an urban teacher seeing students who typically get labeled as hard to manage and impossible to teach manage themselves and learn very powerful to watch. Two years ago this was a failing school where students would “jump off the walls” and teachers would sleep during class (according to student accounts) and now I created a class that can work and learn in student-centered classroom peacefully.

Completing this action research journey has required me to scrutinize my daily teaching practices. Throughout this journey, I have rekindled my thirst for data to drive my instruction, both quantitative and qualitative data. While not all data could support the idea that the treatment significantly impacted student achievement in the classroom, there was substantial observational evidence that project-based learning is a better, more effective teaching practice for students due to the way it positively changed their

behavior, motivated students, and enhanced their learning environment. This was true for students performing at or above grade level and students performing below grade level. Also, there is evidence that project-based learning is a more effective teaching practice to help my low performing students grow and achieve more. I have confidence in stating that implementing project-based learning is a more effective teaching strategy for my classroom than solely following the school issued curriculum with fidelity. Even though this action research has concluded, I have intentions to continue to design science units around project-based learning, implement systems to track student involvement in the classroom (Class Dojo), and intensively track student data through exit tickets and interviews. I even look forward to making changes to enhance and improve project-based learning in future units.

VALUE

Completing this action research challenged me to improve my teaching practices in the classroom. From completing this project I became a stronger teacher even though I stepped away from taking a direct lead in the classroom. The data that I have collected support my decision to continue to teach with a project based learning approach because when it was implemented I obtained statistically significant means in regards to student achievement (t.test, fig.3). Again, I acknowledge that the non-treatment grew more percentage from the pre-test to post-test, but the distribution of test scores was more condensed. Students who performed in the bottom quartile of the class received higher posttest scores during the treatment phase and that is important for my classroom (box-and-whisker plot, fig.4 and fig.5). These students have been struggling to make academic

growth and it was rewarding to see a new teaching strategy make a difference. Academic growth is a primary concern in the classroom, so when a teaching technique is yielding positive results it should continue to be implemented. In the next school year, science units will continue to be planned around the school curriculum, but it will be supplemented with project based tasks that require students to work together to obtain their own information. Project based learning will be seen more frequently in the science classroom, and preparation for it will be taught in the beginning weeks of school. The success of this project inspires me to further push what project-based learning can be in my classroom. I think the key to intensifying project-based learning is to begin to implement project based tasks at the beginning of the year and build them into another classroom routine that students know how to participate in. For example, at the beginning of the year the first two weeks of the school year students learn the vocabulary routines for learning the weekly words. Students spend a lot of time learning appropriate behaviors for vocabulary works, the important purpose for vocabulary work, and practice under my guidance. As the routine develops students become independent and can fully participate in vocabulary work on their own. In the next school year project-based learning will be fully implemented and rolled out as a common routine in the classroom. Students will come to expect working on project based tasks independently and will develop the skills to participate in the tasks with knowledge and confidence. I want to continue to develop what I have done in this action research in the upcoming school year. I want to determine if students who participate in project-based learning tasks from the beginning of the school year can achieve more over time and develop even stronger

critical thinking skills than occurred in this action research. If project based learning tasks are implemented at the beginning of the year and with a gradual release of responsibility can I obtain better results? This action research will turn into an on going project, I can continue to use the instruments that I have created such as class dojo, exit tickets, and student surveys to collect data for personal analysis. I take the charge to continue what has started in this action research and look forward to watching the transformation in upcoming classes.

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APPENDICES

APPENDIX A

IRB EXEMPTION APPROVAL



INSTITUTIONAL REVIEW BOARD

For the Protection of Human Subjects

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MEMORANDUM

TO: Katie Redmond and Walt Woolbaugh
FROM: Mark Quinn, Chair *Mark Quinn*
DATE: February 17, 2014
RE: "Implementing Problem-Based Learning in the Science Classroom" [KR021714-EX]

The above research, described in your submission of February 17, 2014, 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.
- (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.
- (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.
- (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.
- (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, or agricultural chemical or environmental contaminant at or below the level found to be safe, 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
UNIT OVERVIEW

Science Weekly Lesson Plan					
Date:	Day 1:	Day 2:	Day 3:	Day 4:	Day 5:
Big Ideas	How does the Earth move? How do star patterns change? What are the phases of the moon? What is the solar system?				
Objective(s)	I will know Earth revolves around the sun and rotates on its axis. I will know Earth's rotation is related to the apparent movement	I will know Earth revolves around the sun and rotates on its axis. I will know Earth's rotation is related to the apparent movement	I will know Earth revolves around the sun and rotates on its axis. I will know Earth's rotation is related to the apparent movement of the sun, moon, and stars.	I will know Earth revolves around the sun and rotates on its axis. I will know Earth's rotation is related to the apparent movement	I will know Earth revolves around the sun and rotates on its axis. I will know Earth's rotation is related to the apparent movement
Treatment	Your little sister tells you on the way home from school that Ms. Redmond said the Earth spins on its axis but she thinks Ms. Redmond is wrong. If the Earth was spinning we would feel it. What would you tell your sister?	Your little sister tells you on the way home from school that Ms. Redmond said the Earth spins on its axis but she thinks Ms. Redmond is wrong. If the Earth was spinning we would feel it. What would you tell your sister?	Bill Nye has asked you to star on his latest episode on space. Your role is to answer the e-mail question: If we all live on the same planet why is it night on the other side of the world.	No Treatment	Nasa has just discovered a planet exactly like Earth that revolves around a similar star, the sun, from the same distance. The only difference is that it is not tilted on its axis. Model how the seasons would compare and contrast. Be able to verbally explain.
Do Now	My planet Diary Worktext pages 258	ISAT Science questions	Isat Science question	Why do our shadows change in size throughout the day?	Vocabulary Review
I do	Move into project based groups. Introduce assignment	Introduce project based task, rubric, and supplies	Introduce/review electrical current Introduce conductors and insulators	Teacher demo on electrical energy. Present the question: What is the relationship between batteries and motors? Students write hypothesis.	Review the vocabulary for solar system.
We Do	Model and discuss how students to think about explaining a phenomena to students.	Cont. from yesterday	Read and complete worktext page 260.	Go through the procedure together. Students Begin with the hand generate flashlight. Try to describe how it works.	Review rotation and revolution with student models

You do	Students work in project based groups to complete the task	Continue from yesterday	Students break off into groups and complete work.	Students answer: How does a motor work? Read what was really happening in the science notebook.	Students break off into groups.
Formative Assessment	Write one cause and effect related to Earth's movement. Draw an arrow on the Equator to model the Earth rotating	Exit Ticket ISAT Questions Group work rubrics	Show photo. Circle the photo that was taken closer to noon. How do you know?	Questions about the lab.	ISAT questions

Science Weekly Lesson Plan

Date:	Day 1:	Day 2:	Day 3:	Day 4:	Day 5:
Big Ideas	How does the Earth move? How do star patterns change? What are the phases of the moon? What is the solar system?				
Objective(s)	I will learn that patterns in the sky stay the same but appear to change nightly and throughout the year.	I will learn that patterns in the sky stay the same but appear to change nightly and throughout the year.	I will learn that patterns in the sky stay the same but appear to change nightly and throughout the year.	I will describe the phases of the moon.	I will describe the phases of the moon.
Treatment	No Treatment	Create a constellation map for view constellations following a set of instructions.	Teach a group of students/audience to use a star gazer. Inform them why stars/constellations appear during different times of the year.	No Treatment	There was a new moon on January 1 st . When will there be another new moon. Create a calendar of moon phases for the month of January.
Do Now	Review of rotation and revolution	What is a star? What is the star in our solar system?	Why can't you see all the constellations at a specific time?	Review questions of all Earth and space covered.	Vocabulary Review
I do	Introduce stars with clip	Introduce constellations and history of them. Show clip.	Review constellations. Show clip #2.	Introduce the moon and moon phases.	Introduce project bases task.

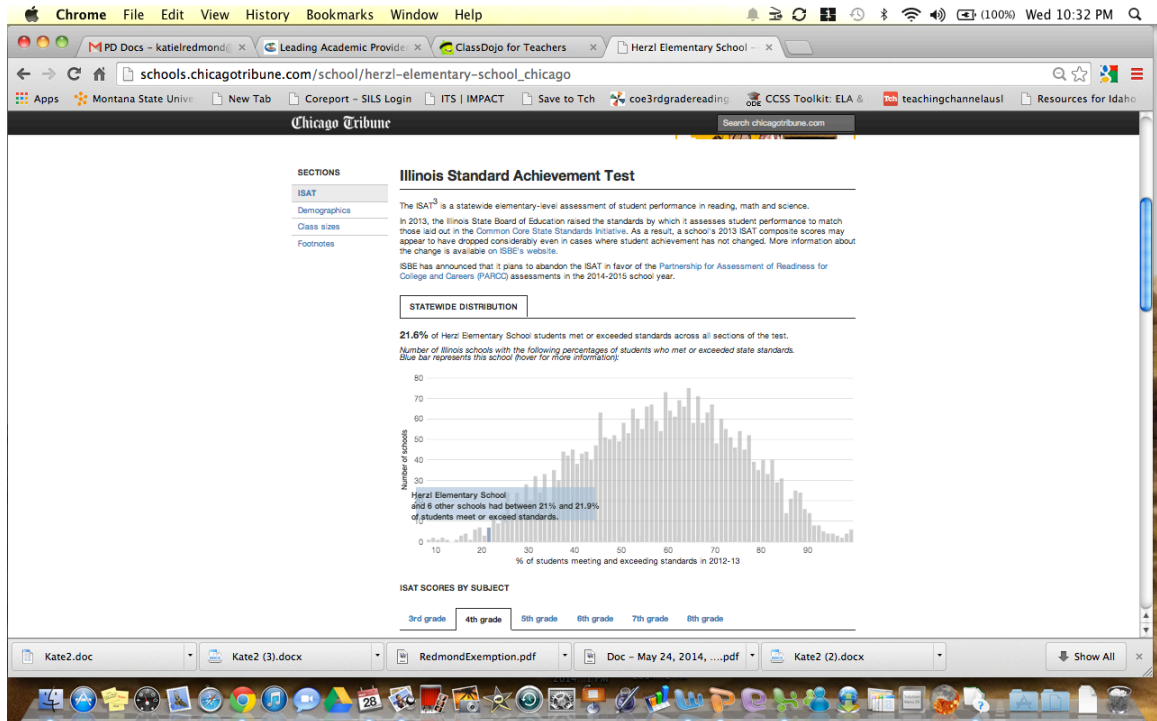
We Do	Read page 267 in worktext on stars.	Read worktext page 268-69	Review project based task.	Read work text page 271-273 While completing the graphic organizer.	Review moon phases and discuss available resources.
You do	Cause and effect from the last paragraph in the worktext.	Students break into project based learning groups.	Students complete task.	Worktext page 272	Students break off into groups.
Formative Assessment	What tool would a scientist use to see stars. What is one way we can learn more about stars in the milky way?	Stars and Constellations.	Rubric. ISAT Questions.	Explain and full moon and a new moon.	ISAT questions

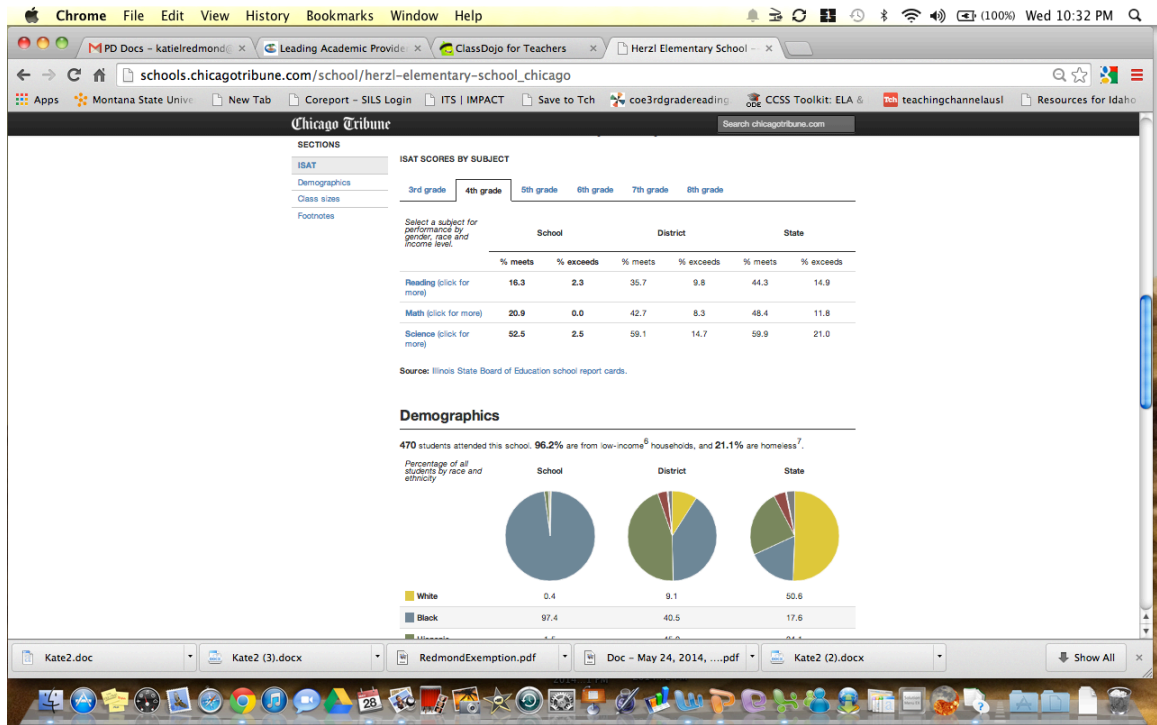
Science Weekly Lesson Plan					
Date:	Day 1:	Day 2:	Day 3:	Day 4:	Day 5/6
Big Ideas	How does the Earth move? How do star patterns change? What are the phases of the moon? What is the solar system?				
Objective(s)	I can describe eclipses.	I can describe eclipses	I will know that the sun, the planets and their moons, and other objects are part of the solar system	I will describe the phases onf the moon.	All big questions.
Treatment	No Treatment	Many cultures used to fear solar eclipses because it would cause temporary darkness during the daylight, many though the world was ending. Imagine you were a scientist who was in charge, how would explain the phenomena.	Determine if another planet could sustain human life.	Determine if another planet could sustain human life.	No Treatment.
Do Now	Review of Earth and Space concepts.	What is a star? What is the star in our solar system?	My Planet Diary in Worktext	Review solar system and other space questions.	Vocabulary Review/Chapter review

I do	Introduce eclipses with clips/images	Review eclipses	Introduce solar system.	Review expectations for project bases assignment.	Discuss essential questions/ review objectives.
We Do	Read pages 275-76 in worktext on eclipses	Work Text	Read worktext pages 277 and complete questions.	No We Do	Chapter review in worktext.
You do	Compare and contrast lunar and solar eclipses.	Students break into project based learning groups.	Students break into project based learning groups.	Students continue to work on project bases task.	Assessment.
Formative Assessment	What tool would a scientist use to see stars. What is one way we can learn more about stars in the milky way?	ISAT Questions Rubric	Rubric. What causes the planets to revolve around the sun.	A planet's atmosphere can hold in warmth from the sun. Mercury has almost no atmosphere. How does this affect the planet's temp?	Assessment.

APPENDIX C

CHICAGO SCHOOL REPORT CARD





APPENDIX D
SCHOOL DATA REPORT

Herzl School Goals



2012-2013

- ISAT Composite 28.8% (25.3%) 9.1 Gain
- ISAT Reading 22.9% (19.9%) 3.6 Gain
- ISAT Math 28.8% (23.8%) 13.4 Gain
- ISAT Science 50.9% (47.9) 13.1 Gain

- Student Attendance 92% (91%)
- Staff Attendance 95%

APPENDIX E
LESSON OBSERVATION SHEET

Data observation journal

Date _____

Time _____

Student Objective:

Brief overview of lesson: (explain the PBL or non-treatment that is happening)

Redirection tally for typical student misbehavior: (mark a tally for each time teacher needs to redirect a student.

Record of major behavior disruptions:

Number of students removed from the classroom for behavior disruptions/issues.
Describe the issue:

Check 1: Groups check

- _____ groups are talking and discussing about science
- _____ groups are working collaboratively
- _____ groups are engaged at the task at hand
- _____ groups are not working
- _____ groups are arguing

Check 2: Groups that are majority on task

- _____ groups are talking and discussing about science
- _____ groups are working collaboratively
- _____ groups are engaged at the task at hand
- _____ groups are not working
- _____ groups are arguing

Exit ticket data: (analyze the exit ticket to see how well students are demonstrating knowledge academic content at the end of the class period.

Did a majority of students meet the daily objective? _____

APPENDIX F
STUDENT SURVEY

Student Questionnaire

Please do NOT put your name on this

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

Answer the following opinion questions and statements about school and science class. This is a survey to learn about your thoughts and feelings in science class. Please answer the questions honestly; there are no correct answers on this survey. Circle the answer you want to choose.

1. I enjoy coming to school.
 - a. Strongly Disagree
 - b. Disagree
 - c. Neutral (no feeling)
 - d. Agree
 - e. Strongly Agree
2. I come to school because I want to learn new things
 - a. Strongly Disagree
 - b. Disagree
 - c. Neutral (no feeling)
 - d. Agree
 - e. Strongly Agree
3. I enjoy coming to science class
 - a. Strongly Disagree
 - b. Disagree
 - c. Neutral (no feeling)
 - d. Agree
 - e. Strongly Agree
4. I like to participate and share my ideas in class
 - a. Strongly Disagree
 - b. Disagree
 - c. Neutral (no feeling)
 - d. Agree
 - e. Strongly Agree
5. I like to listen to the ideas of other students in the class.
 - a. Strongly Disagree
 - b. Disagree
 - c. Neutral (no feeling)
 - d. Agree

- e. Strongly Agree
-
- 6. I can learn from other students in the classroom
 - a. Strongly Disagree
 - b. Disagree
 - c. Neutral (no feeling)
 - d. Agree
 - e. Strongly Agree
-
- 7. I think I am capable to do independent work well
 - a. Strongly Disagree
 - b. Disagree
 - c. Neutral (no feeling)
 - d. Agree
 - e. Strongly Agree
-
- 8. I make sure to complete all my schoolwork
 - a. Strongly Disagree
 - b. Disagree
 - c. Neutral (no feeling)
 - d. Agree
 - e. Strongly Agree
-
- 9. I am motivated to work hard in science
 - a. Strongly Disagree
 - b. Disagree
 - c. Neutral (no feeling)
 - d. Agree
 - e. Strongly Agree
-
- 10. I ask questions to learn about new things
 - a. Strongly Disagree
 - b. Disagree
 - c. Neutral (no feeling)
 - d. Agree
 - e. Strongly Agree
-
- 11. I know what it means to use critical thinking
 - a. Strongly Disagree
 - b. Disagree
 - c. Neutral (no feeling)
 - d. Agree
 - e. Strongly Agree

12. I can use critical thinking to think about ideas that I learn in class
 - a. Strongly Disagree
 - b. Disagree
 - c. Neutral (no feeling)
 - d. Agree
 - e. Strongly Agree
13. When I don't know something I try to figure it out myself
 - a. Strongly Disagree
 - b. Disagree
 - c. Neutral (no feeling)
 - d. Agree
 - e. Strongly Agree
14. I am good at solving problems in science
 - a. Strongly Disagree
 - b. Disagree
 - c. Neutral (no feeling)
 - d. Agree
 - e. Strongly Agree
15. I enjoy finding solutions to problems in science
 - a. Strongly Disagree
 - b. Disagree
 - c. Neutral (no feeling)
 - d. Agree
 - e. Strongly Agree
16. I enjoy working in small groups to complete work
 - a. Strongly Disagree
 - b. Disagree
 - c. Neutral (no feeling)
 - d. Agree
 - e. Strongly Agree
17. I know how to work well in a small group
 - a. Strongly Disagree
 - b. Disagree
 - c. Neutral (no feeling)
 - d. Agree
 - e. Strongly Agree

18. I learn more when I work with other students in the class
- a. Strongly Disagree
 - b. Disagree
 - c. Neutral (no feeling)
 - d. Agree
 - e. Strongly Agree
19. What is one thing you like about science class?

20. What is one thing you do not like about science class?

21. Do you agree with the idea that students should work on projects together? Why?

APPENDIX G
INTERVIEW QUESTIONS

Interview Questions

1. How do you feel about science class?
 - a. What is your favorite part?
 - b. What is your least favorite part?
2. How do you feel about working with groups?
 - a. Why?
 - b. Can you give an example?
3. How is learning on your own different than learning from listening to your teachers?
 - a. Do you like it more?
 - b. How has it helped you?
4. How do you think you learn best?
 - a. Can you give an example?
 - b. Why?
5. Describe a project that we recently did in class. How did you feel about it?
 - a. Do you think you learned from the project?

APPENDIX H

4th GRADE READING LEVELS

Fountas and Pinnell Student Reading Levels:

Fourth Grade Norms

Beginning of year: P/Q

Middle of Year: R

End of Year: S

Name	Fountas and Pinnell Levels
Laurice	E
Louis	K
Latonya	J
Jamarius	R
Sharonda	M
Ayanna	L
Brandy	I
Jeremiah	J
Jeremiah	A
Adrian	K
Xavier	M
Jaheim	M
Joseph	T
Lashonda	C
Lashone	M
Matthew	J
Jamyra	L
Jamal	O

	Fountas and Pinnell Levels
Elijah	P
Kameron	P
Aarion	L
Janay	M
Jacobe	N
Peyunney	
Shatoria	O
Andre	J
Victoria	P
Cameron	M
Roquan	M
Kobe	P
Tamarion	N
Daryl	P
Martell	N
Yazmine	M
Jaharia	M
Tywaun	O
Rachanel	M
Marissa	Q