

ALTERNATIVE ASSESSMENT TO ENGAGE STUDENT LEARNING IN A  
SCIENCE CLASSROOM

by

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**ABSTRACT**

In this investigation the use of alternative assessment was used in the science classroom to help improve student engagement as well as course satisfaction. Activities included research projects, student presentations, and self-guided learning activities. The goal was to move away from testing to check for learning and use authentic activities to do so. The project showed that by moving to authentic assessment student engagement in and outside the classroom increased.

## INTRODUCTION AND BACKGROUND

Pawnee City School in Pawnee City, Nebraska is a preschool through grade twelve school district. We are predominately white with a few minorities. Pawnee City School is also located low socio-economic area where most students receive either free or reduced lunch (2011-2012 State of the Schools Report, 2012). Many students in our school come from single parent families where it is not uncommon for the parent and child not to see each other during the week due to inflexible work schedules. In some cases, the teachers at school are the only authority figures, or adults, with whom the students have contact. The average class size is about twenty students and there is about an equal split between boys and girls. The class I focused on is the eighth grade class ( $N = 18$ ). This group focuses on the standards in science rather than specific coursework, since they are tested during this year.

Students in the school have struggled with science concepts and retention of these concepts for the last five years. With the introduction of authentic assessments, students worked through the course's content and were able to better learn scientific terms and concepts. Along with terms, scientific method and problem solving skills also improved due to students actually working through activities instead of just reading about them. This process of hands-on instruction and the use of authentic assessment improved learning; consequently, also improving test scores.

### Focus Statement

The purpose of the study was to improve student learning and engagement with alternative or authentic assessments. I monitored their learning through alternative as well as standard assessments. During this study, I answered the following questions:

- Do students learn better individually or in groups?
- Will allowing more academic freedom during the course translate into increased academic engagement?

### CONCEPTUAL FRAMEWORK

In our nation's schools, we compare students with their classmates, students across the state, and students across the country. In order to do fair comparisons, schools must give assessments that align to the standards. A standard is a statement that outlines what a student is to understand about a subject. Each state has a list of standards and students must score high enough to be considered proficient. These standards are broken down into sub categories so that teachers can better focus on different tasks. In Nebraska, the science standards are broken down into chemistry, physics, life science, and Earth and space science (Nebraska Department of Education, 2012).

Along with science, students are compared by their math, reading, and writing abilities. In addition to teaching their course material, teachers are also charged with teaching such that students perform well on standardized tests. These tests are given one time during the year and require students to perform well in many areas that could have been taught over several years. Teachers feel pressure from administrators, parents, and the community for students to perform well at these standards. However, they are tested

only once during the year. Students are tested at several levels, but most commonly, they are tested at fifth, eighth, and eleventh grade. There are an ever-increasing number of assessments students are required to take. Junior level students in the Pawnee City Schools, take the Measure of Academic Progress Tests (MAP), the Armed Services Vocational Aptitude Battery Test (ASVAB), as well as college entrance exams like the ACT and SAT, and, the required Standardized Exams (E. Spitzer, personal communication, February 15, 2011).

With the goal being every student having to meet every standard, classroom teaching and assessment has to change and learning needs to happen within the classroom. Too often, teachers are worried about high stakes tests and how their students are going to perform, forcing the teachers to teach to the test. This method is merely memorization and does not set a solid foundation for learning. Professionals are seeing the changes in education, and are developing alternative assessments as a way for teachers to help students get the information and to take interest in and responsibility for their learning. By taking away some monotony within the classroom, students will stay engaged. When students are engaged, learning improves. Academics need to reach beyond colleagues, students, and policy-makers. Their expertise needs to become visible, yet clearly open to discussion and modification within the school community (Buhagiar, 2007).

Alternative assessment strategies are a way to show student learning without having students simply perform a standardized assessment. Authentic assessment advocates champion the need for standards that are easily adapted to a variety of circumstances (Tanner, 2001). Alternative assessment is very broad, and it can include,

but is not limited to: journaling, blogging, discussion board dialogs, project performance, peer assessment, and self-assessment. Alternative assessment is philosophically, goal-oriented (Kirikkaya & Vurkaya, 2011). Rule (2006) lists example of authentic assessment as real-world problems, open-ended inquiry, and thinking skills. Authentic assessment offers to engage students in social learning and to encourage students' ability to direct their own learning. Learner participation in their own assessment is increasingly felt to be an important feature of today's views toward teaching and learning (Birjandi & Tamjid, 2011). Alternative assessment in the classroom is one way to improve student involvement and accountability towards their learning. Teachers who use these kinds of alternative assessments will naturally teach in ways that emphasize reflection, critical thinking, and personal investment (Liskin-Gasparro, 1997). Promotion of self-assessment by students, as a component of strategies to develop their capacity to take responsibility for their own learning, should be fundamental to the development of productive formative assessment (Black, Harrison, Lee, Marshall & Wiliam, 2003). Black and Wiliam (1998) define formative assessment as all activities undertaken by teachers, and/or by students, which provide information to be used as feedback to modify the teaching and learning activities.

Students need not be judged by the end product, but rather by the process. In life, individuals will ultimately be judged by the end product of their work, but if they do not have the tools to get to that end product, then they may never be successful at what they do. Students who have the most talent are typically thought of as the best students. They will be the ones who are the most successful, and will put the most back into the economy (Torrance, 1995).

Students are expected to be good learners and to test well. Once students graduate, they are expected to become functioning and productive members of society. During this age of testing, students are missing several necessary keys to be able to be functioning members of society. Students are missing thought processes needed to solve problems in real life. As Buhagiar (2007) points out:

Assessment experts have for the past couple of decades recognized and argued in favor of assessment as an essential component of learning. This theoretical shift away from 'measuring' learning and towards assessment that is explicitly designed to promote learning came primarily in response to our growing understanding of learning as a meaning-making process in which, contrary to our prior understanding that knowledge, can be passed directly from one head to another, much depends on the learner's constructions of his or her own experiences. (p. 40)

Buhagiar (2007) argues that traditional classroom assessment (lecture and test) is learner unfriendly, curriculum unfriendly, teacher unfriendly, and student unfriendly. Traditional, or summative, assessment tried to show the learning of students through benchmarks. Summative assessments are given periodically to determine at a particular point in time what students know and do not know (Garrison & Ehringhaus, 2007). This is similar to what standardized testing is doing to students today. Their learning is graded upon how well they know what they are told they have to know. The idea that every student learns the same is the same notion as every student being the same. However, different students, while taught the same material, do not score the same. Students labeled as English as a Second Language, or more currently English Language Learners (ELL),

lose in traditional assessment, as they find it harder to comprehend questions. Providing the opportunity to choose assessments encourages student use of higher level thinking skills (Schraeder, 1996). This statement gives ELL students the power to learn and perform rather than to try and fail on traditional assessments.

When students take their learning into their own hands and take ownership in what they are doing and learning, the educational process becomes more interesting to the student. Self-assessment therefore enhances learner autonomy (Liang, 2006). When students are responsible for their learning, it makes everyone accountable. Promotion of self-assessment by students, as a component of strategies to develop their capacity to take responsibility for their own learning, should be fundamental to the development of productive formative assessment (Black et al., 2003). In this type of environment, teachers are facilitators for the material rather than the main source of the information. By using self-assessment and peer assessment, a student's work is judged by more than just the teacher. Self-assessment has become not only a means to an end (autonomous life-long learning), but an end itself (a crucial component of autonomy) (Birjandi & Tamjid, 2011). As students begin to act on the basis of genuine interest, they sense the unlimited opportunities in the classroom, and as they practice reflective self-assessment they in turn become more reflective in their practice (Ellis, 2001).

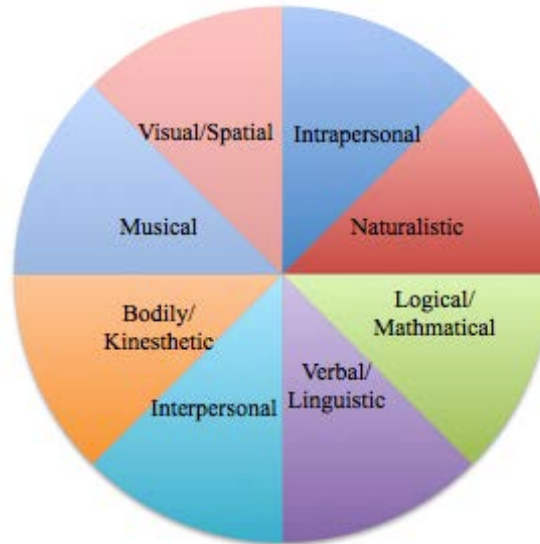
With any assessment, there are factors that need to be taken into consideration when deciding if an assessment is to be used effectively for learning. Buhagiar (2007) lists these qualities as: credibility, transferability, dependability, and authenticity. If these criteria are met, then the assessment's validity holds. An assessment is credible when it is used many times and the data show improvement in learning. It is transferable when it

can be used to demonstrate understanding within the context of the material being taught. It is dependable when analyzed and shows credibility. An assessment is authentic when all aspects of the topic are covered completely without bias (Buhagiar, 2007). Authentic achievement is not something that is readily forgotten when a skill is truly mastered. It is something that stays with the student and goes beyond the constructs of the classroom (Cumming & Maxwell, 1999).

## METHODOLOGY

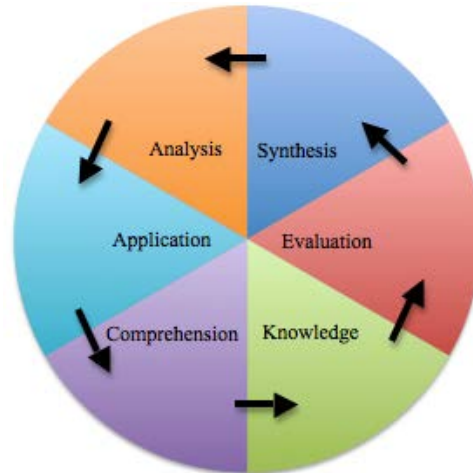
This treatment was conducted with 18 eighth grade Earth Science students. The research methodology for this project received an exemption by Montana State University's Institutional Review Board and compliance for working with human subjects was maintained. During the treatment, students were completing different types of assessments throughout the duration of several units that ran from November to March. Assessments included journaling, creating a presentation based on the material, check for learning quizzes, and group projects (Table 1). Prior to treatment, the Student Survey was administered to create a baseline data set (Appendix A). The data from the student survey was self-reported.

In order to adapt to the classroom and use authentic assessment styles, it was necessary to know how students learned best. Different learning styles were discussed, as was adapting to learn better using these styles. The multiple intelligences included intrapersonal, visual-spatial, musical, bodily-kinesthetic, interpersonal, verbal-linguistic, logical-mathematical, and naturalistic (Figure 1). By discussing these multiple intelligences with the students, the classroom was adapted to a place in which students could thrive, rather than struggle.



*Figure 1.* Multiple intelligences (Adapted from Armstrong & Armstrong, 2009).

The goal was for students to move through Bloom's Taxonomy. The ultimate goal was this cyclical learning and increased comprehension (Figure 2). If students could not apply the knowledge, they did not get to the phase of comprehension. Through the authentic assessment, the task was done with a hands-on, student-led approach. The application and analysis were done in the same step during the inquiry activity. As students were doing those activities, synthesis was slowly taking place until they completed an end product. This product was the evaluation piece. From there, they had the knowledge needed to reapply the concept. Through these pieces, a student would better be able to comprehend the information.



*Figure 2.* Bloom's Taxonomy (adapted from Heacox, 2002).

After each unit, a section test was administered to see how the students scored. During the units, I recorded interview responses and journal entries on student attitudes. By comparing student scores and general views towards the class, I could conclude the best way the students learned.

The first unit was dealing with rocks, and more importantly, the rock cycle. This unit had a time frame of three weeks. Students were given basic information about rocks, and then were to do research and put together a rock song, "Are You Ready To Rock!?" (Appendix B). Once finished, the song was presented and students were quizzed on the rock cycle with the Rock Unit Test (Appendix C). During the quiz, each student was given two additional assessments. For the first assessment, Rocks – Self-Assessment, students gave themselves a score on time management and learned content (Appendix D). For the second assessment, Rocks – Peer Assessment, students scored their peers on their involvement in the project (Appendix E). This was the first time that they were asked to do this during the treatment. After this unit, the Student Survey was administered again to see if attitudes had changed (Appendix A).

After each unit, a section test was administered to see how the students scored. These tests assessed the students' ability to recall information that they had gathered during the investigation. These assessments were given at the beginning of the period and typically took 15 minutes. Questions included on the test dealt with the understanding of vocabulary terms, the Earth science processes that were involved in the unit, and open-ended responses to address and monitor recall.

During the units, I recorded interview responses and journal entries on student attitudes. The journals were done at least once a week and were collected to see the students' attitudes and understanding toward the specific assignment. They also were to write about how they felt about the presentation of the unit. One prompt during the first unit was, "Do you feel that you are learning the rock cycle better by researching or would it be more beneficial to do assigned activities instead?" As I read the responses, I would ask some students to tell me more about why they answered the way they did to get a better understanding of the answer.

The second unit, during the treatment, was a unit dealing with tectonic plates, earthquakes, and volcanoes. The culminating activity was a Discovering Plate Boundaries Activity (Appendix F). This unit had a time frame of six weeks. Students had learned about volcanoes, earthquakes, and plate movement due to convection currents. They then were to analyze maps and design what a new supercontinent would look like if the plates continued to move. The project was scored on Discovering Plate Boundaries Rubric (Appendix G). Students were also given a Plate Tectonics Unit Test to check for understanding (Appendix H).

The Student Survey asked questions of the students about their attitudes toward school, learning, and science (Appendix A). This survey was given pre-treatment, mid-treatment, and post-treatment. The Student Survey was administered electronically through Google forms and filled out during class. The data from the three assessments were then analyzed to see if class preference and preferred learning style changed. Along with class and learning style, data were collected to see time spent on homework, classroom engagement, and study time outside of class. This was done to see if the addition of alternative assessment allowed for the student to be able to do most of his or her classroom work and learning during the allotted time during the school day. Course satisfaction was analyzed and the mean of the responses was graphically analyzed. Open-ended questions were analyzed and reported based upon trends and themes within them.

Parent Surveys were delivered to parents during the treatment (Appendix I). These surveys were administered electronically through email. These parent survey questions provided a gauge of what kind of involvement there was for learning at home. Collected responses were saved in a document and evaluated for trends, time spent at home on schoolwork, and any concerns that arose from their student during the school day. Additionally, these parent surveys revealed issues parents had with the education process with their student.

During the treatment, Teacher Interviews were done with teachers (Appendix J). The interviews allowed for a comparison of the students in different classroom settings. Questions dealing with time, engagement, and likeability of classes were asked and analyzed to see if there were any trends that arose in different classes. Questions were

administered to the teachers electronically, and participation in the interviews was completely voluntary. The responses received were then analyzed to see if the treatment was affecting any of the schoolwork outside the science classroom.

Student Interviews were done through random selection of students several times throughout the treatment. The interviews were done informally during class and responses were recorded. The other type of informal collection was during the journaling. All of these treatments were done while allowing students freedom to learn through expression. During the treatment, attitudes and productivity in the classroom were also recorded.

After the treatment, when grades were collected on the unit tests, I was able to make a comparison between grades over the last three years. Accessing the grading program that our district uses did this comparison.

Table 1  
*Triangulation Matrix*

Research Questions	Data Source		
	1	2	3
Average Scores	Student Survey	Grade book Check	
Preferred assessment method	Student Survey	Give students creative freedom	Look at averages from different types of assessment
Learning Style	Student Survey	Teacher Survey	Classroom Observation
Time spent outside of class on homework	Student Survey	Parent Survey	Assignments outside of class

## DATA AND ANALYSIS

Results of the Student Survey showed that when students were given the opportunity to be assessed authentically, the time they spent engaged during class increased 5% ( $N = 18$ ). When looking at the results of the survey and then comparing it to my focus questions, it is apparent that alternative assessment does in fact translate to better academic engagement. Time spent engaged during class, spent on homework, and spent on studying all increased during the treatment (Figure 3).

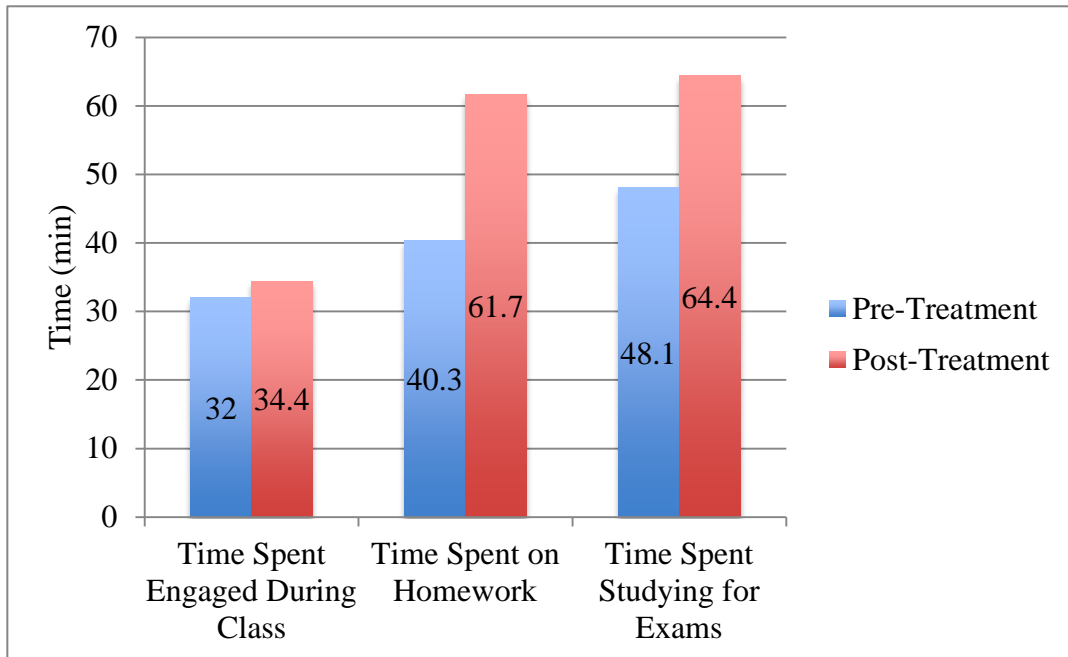


Figure 3. Time study results, ( $N = 18$ ).

Prior to treatment, students were engaged 32 minutes of a 50-minute period, or 64% of class time. After treatment, students were academically engaged for 34.4 minutes. Time spent on homework increased nearly twenty minutes per day. Consequently, the increase in time spent outside of class on homework resulted in an increase of one hour and forty-seven minutes per week.

Students' views or preferences on social learning shifted to a more social learning environment rather than solitary one. Prior to treatment, 28% of students preferred to learn on their own rather than in groups (Figure 4). Post-treatment, however, 100% of the students preferred to learn in interpersonal situations.

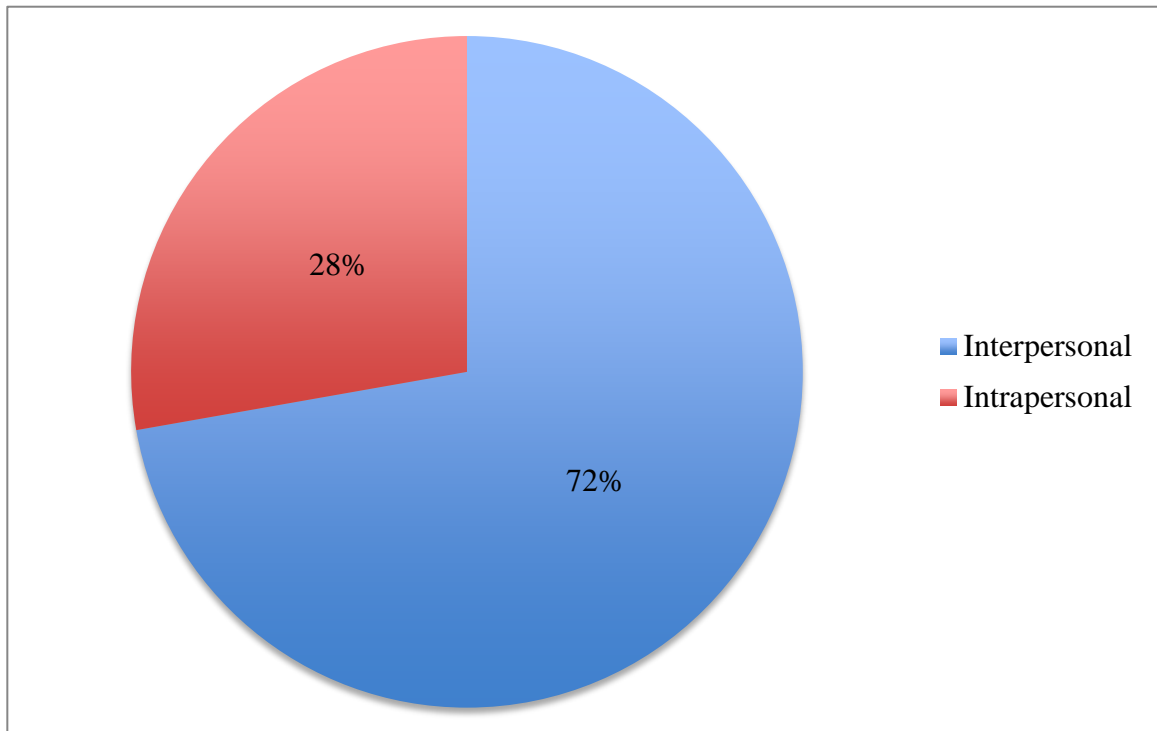


Figure 4. Student social learning style pre-treatment, ( $N = 18$ ).

From pre-treatment to post-treatment, the overall learning style changed (Figure 5). Both showed that a physical learning style was the dominant learning style, but they also showed that musical, as well as verbal learning were heavily preferred among students (Figure 6). In both surveys, pre-treatment and post-treatment, the logical/mathematical style of learning remained at zero percent.

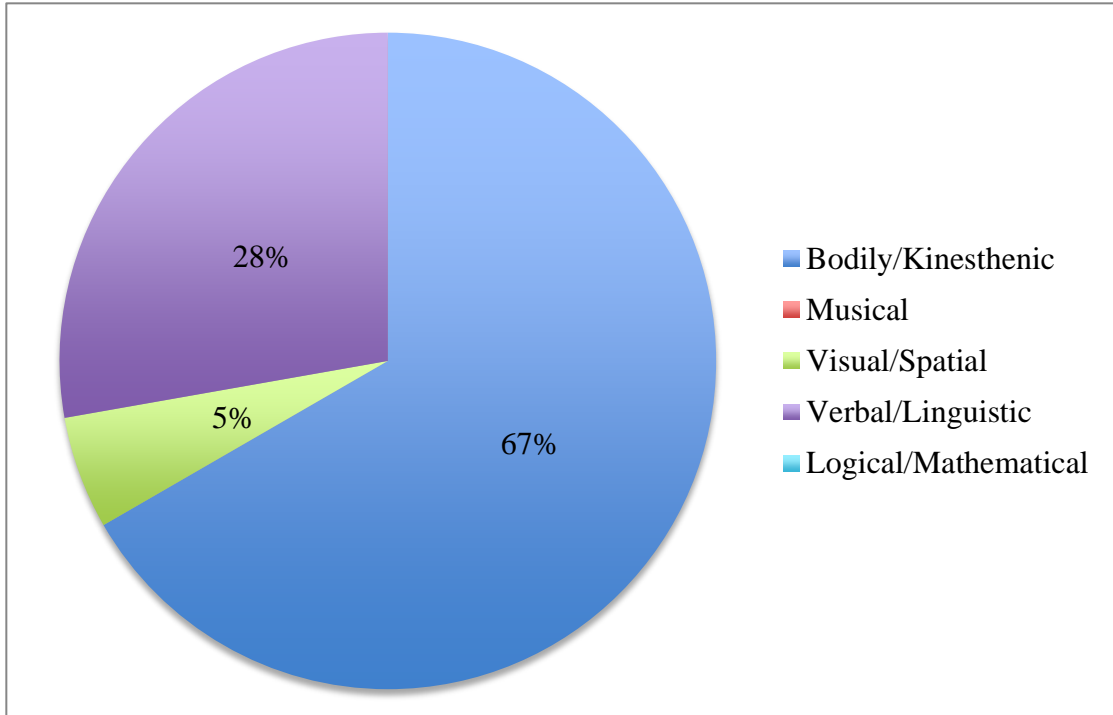


Figure 5. Preferred learning style pre-treatment, ( $N = 18$ ).

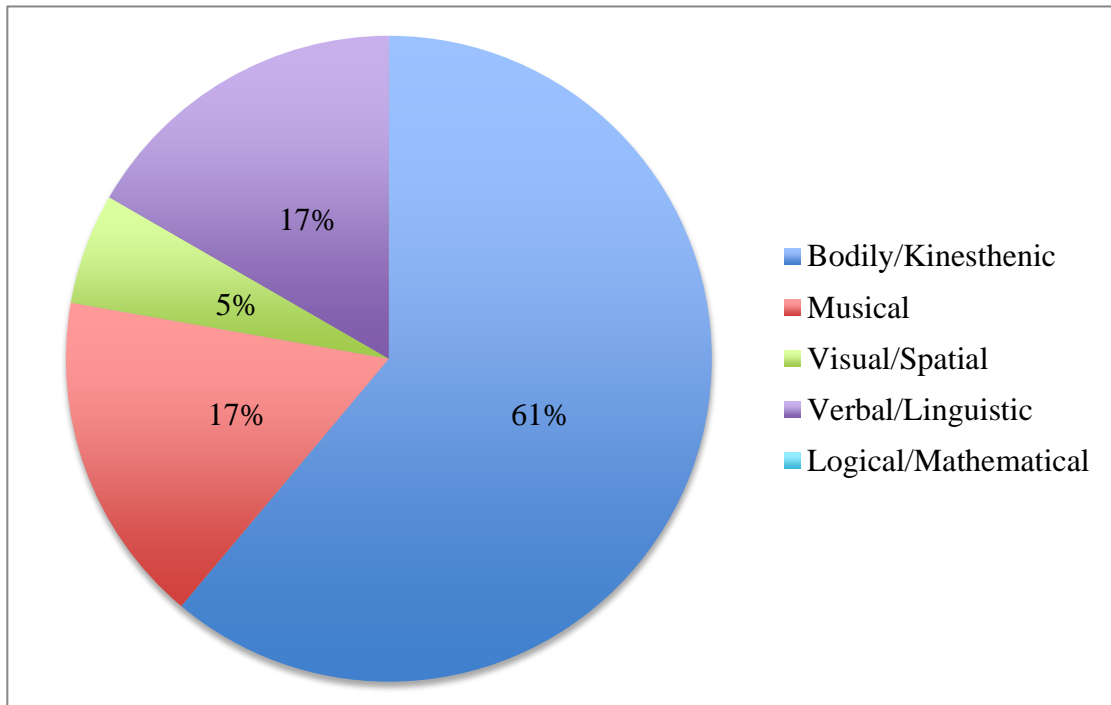


Figure 6. Preferred learning style post-treatment, ( $N = 18$ ).

When looking at student grades, the results were mixed. The same grade scale was used pre-treatment and post-treatment. This scale was composed of weighted

percentages where the final grade was 35% tests and quizzes, 25% homework, 25% labs and projects, and 15% self/peer/teacher assessment of student work. Term scores dropped from 89% to 84%. However, the median class score went from 89% to 90%, and the mode, went from 87% to 99%. When looking at the test scores pre-treatment to post-treatment, the trend reversed. Scores went from 83% prior to treatment to 78% post-treatment. However, the student scores from the same unit prior years showed a slight increase in the plate tectonics unit (Table 2).

Table 2  
*Unit Test Scores*

	Plate Tectonics
2010-2011	69.7%
2011-2012	75.6%
2012-2013	77.8%

Teachers reported that student attitudes toward class varied. Respondents of the Teacher Survey responded that their students enjoy doing activities more than sitting in lecture (Appendix I). However, many also reported that they are not sure if the proper amount of learning is being done. One teacher responded, “I love giving students academic freedom, but the amount of time prepping, presenting, and grading makes covering content difficult as the end of the year creeps up.” A history teacher responded, “Using alternative assessment methods and allowing students to work at their own pace with their own ideas has really allowed me to be able to see what students are interested in and that keeps them engaged.” All agreed that students responded better when they were allowed to express themselves in their own individual way.

Students assessed themselves as well as their peers. At first students did not like this idea. They thought that their friends would be mad at them if they got a bad grade.

One student responded, “I really want to give them all of the points, but I know that they didn’t do very much work. They made me do most of it.” Another student replied, “I only gave myself a 70% because I didn’t think the quality of the work was good enough.” The impact of self-evaluation was hard to measure, but it appears students were torn in how to do this, but were honest in their scoring.

### INTERPRETATION AND CONCLUSION

This study has shown me that when students have more academic freedom they tend to stay on task better, which leads to better engagement academically. When students were able to do hands-on activities, they remained engaged for a longer time during class.

Students found that self-assessment put more emphasis on the finished project and not just the grade. It also allowed them to assess their peers, which then made them work harder so that they would receive fair assessment from their classmates. This meant that the overall product was better, and it kept students engaged during the activity. Students found that they preferred to learn in groups rather than work solitarily. When students worked together they got several viewpoints on the content, and allowed them to express themselves to their peers and instructors in a more proficient manner.

As I journaled during this time, I found two things that really appealed to me. The first was that allowing students to work in groups made them think as a team, which is certainly a great real-world skill. The second was that the amount of engagement and the overall attitudes during class improved when we were completing tasks rather than

learning through lecturing. The students responded to cues better and they demonstrated a feeling of accomplishment when they were done with the task.

## VALUE

From completing this project I have learned a couple of things: First, I can confirm that no two students are the same. Altering my classroom helped many, but hindered some as well. In fact, one of the better students in my class struggled with this new format. When a student has been trained to learn one way it is difficult to convince them that there are other ways that work. Second, you cannot make everyone happy all the time. Students, regardless of what you are doing, will combat your classroom presentation.

One of the more staggering things that came out of this study is I found students generally want to work in groups. I think this has been a transformation since I started teaching seven years ago. At the start of my teaching career, I had to work really hard to convince students to collaborate with one another to complete the task at hand, whereas now, I cannot get them to work on their own. I learned that parents, as well as teachers, want this collaboration. Parents linked the hands-on activities and group work as tasks that have “real-world” implications. However, scoring students on their ability to work together or on a hands-on activity is much more difficult than scoring a quiz or a test given where the student is either right or wrong. Students in this class did score higher on the state standardized test than the students in the previous year. This improvement may not necessarily be due to the authentic assessment. I believe it contributes some, as scores in math did not reflect the improvement. These are not the same students, but their

ability and demographics are very similar. They also received the same classroom instruction with the exception of the authentic assessments.

Ultimately, what I discovered throughout the study was that the willingness of both teachers and parents to provide insight on students was incredible. This, to me, shows the dedication that our community has to educating our youth. Not once did I have any resistance towards questioning, only help and assistance.

Consequently, in my classroom this study has provided me a starting point to continue to grow. Learning means constantly changing; no one teacher can keep up. In the classroom, we constantly research our students and the best ways they can learn, so we can then adapt to those styles. In my short career, the amount of things I do in my classroom has changed incredibly. As I continue to grow as an educator, I can see that my classroom as a first-year teacher will look completely different as a retiring teacher. The process of collecting data is ongoing. If my students are struggling, the question I have to address is, “what can I do to make them better learners?” I found that collaboration between colleagues is the best indicator of student need. If a student only struggles in science, then I need to adapt to correct the struggle. If a student is struggling in all classes, then what can the entire staff do collectively to encourage this student to be a better learner? The action research process is wonderful in the sense that you can see if it is or is not working almost immediately and you have data to back up your methods.

To further adapt to the students I have, I will need to find a way to balance authentic assessment as well as lecture learning. I found from this study that I will need to continue to push my students to engage academically outside of the school day.

Regardless of where education goes in the future, I must be able to adapt. I believe the era of standardized testing is here to stay. I will need to be able to find a way to check their learning without putting another test in front of them. I'm not sure that authentic assessment will be able to replace testing in my classroom, but it at least gives me another alternative.

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APPENDICES

APPENDIX A  
STUDENT SURVEY

## STUDENT SURVEY

All surveys are voluntary. In no way will it effect your grade or standing in the class. It will, however, help to understand how to adjust class so that you can better learn.

- 1.) How do you best learn?
  - a. Physically – (kinesthetic): You prefer using your body, hands and sense of touch.
  - b. Aural (auditory-musical): You prefer using sound and music.
  - c. Visual (spatial): You prefer using pictures, images, and spatial understanding.
  - d. Verbal (linguistic): You prefer using words, both in speech and writing.
  - e. Logical (mathematical): You prefer using logic, reasoning and systems.
- 2.) Do you prefer to learn:
  - a. Socially – in groups
  - b. Solitarily – by yourself
- 3.) Rank each subject on how well you like it 1 is highest
  - a. English
  - b. Math
  - c. Science
  - d. Social Studies/History
  - e. Art
  - f. Ag Ed
  - g. Music (Band/Chorus)
  - h. PE (PE/Weights/Fitness)
  - i. Technology Class
- 4.) How much time do you spend outside of school on homework?
- 5.) In a 50-minute class period how many minutes are you engaged academically? (How long are you working on schoolwork or working through a lesson?)
- 6.) If you have a test coming up how long do you spend studying prior to the assessment?
- 7.) What are some things do you enjoy about school?
- 8.) What are some things you do not like?

APPENDIX B

ARE YOU READY TO ROCK ACTIVITY

# **ARE YOU READY TO ROCK!?!**

You and a partner are to compose original lyrics about your rock. Keep in mind this is school so nothing too bad. Remember to include the following...

- 1.) What kind of rock is it? (more than just the 3 types)
- 2.) How is it formed?
- 3.) Where is it found?
- 4.) How is it used?
- 5.) What is in it?
- 6.) What is unique about it?
- 7.) What does it look like?

These are just a few ideas...come up with more!

The more effort the better the grade...be creative!

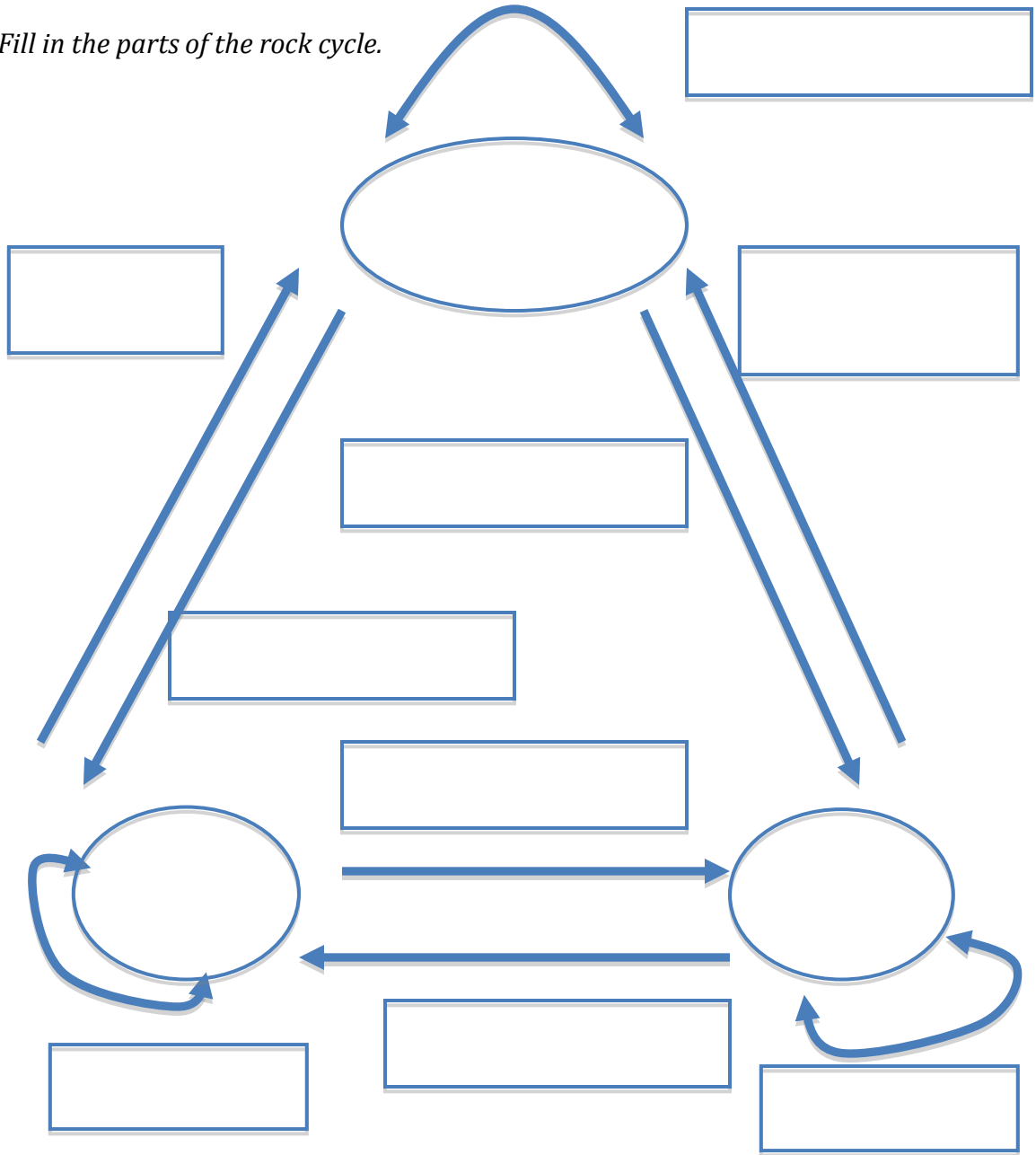
Music not required, but recommended.

APPENDIX C  
ROCK UNIT TEST

Name: \_\_\_\_\_

### Rock Unit Test

*Fill in the parts of the rock cycle.*



APPENDIX D

ROCK ACTIVITY SELF ASSESSMENT

Name: \_\_\_\_\_

Rocks – Self Assessment

1.) How effectively did you use your time to research your rock?

5      4      3      2      1

2.) How well did you use your time to put together your lyrics and song?

5      4      3      2      1

3.) Do you feel that by researching your rock you learned something that you wouldn't have by just reading the text and doing the packet?

5      4      3      2      1

APPENDIX E

ROCK ACTIVITY PEER ASSESSMENT

Your Name: \_\_\_\_\_

Group Members Name: \_\_\_\_\_

Rocks – Peer Assessment

1.) How well did this group member work on the project?

5      4      3      2      1

2.) How well did he/she use time to put together the lyrics for your song?

5      4      3      2      1

APPENDIX F

DISCOVERING PLATE BOUNDARIES ACTIVITY

## Discovering Plate Boundaries

Dale S. Sawyer, Earth Science Professor at Rice University, Houston, Texas  
(Adapted: 31 January 2013)

You have been (or will be) assigned to one of three Scientific Specialties.  
The Scientific Specialties are:

- A. Seismology
- B. Volcanology
- C. Geography

Each Scientific Specialty group has been provided a world map showing data relevant to locating plate boundaries and understanding plate boundary processes. Each student will be provided two Plate Boundary Maps. There are a number of colored pencils or markers available in the room for your use.

### **Period 1:**

Assemble in your Scientific Specialty groups with your group's map.

Task 1. Look at your group's map and talk about what you see. What you look for will vary with data type. For the point data (volcanoes and earthquakes) you are looking for distribution patterns. For surface data (topography and seafloor age) you are looking for where the surface is high and where it is low, where it is old and where it is young. Work as a group. Let everyone talk about what they see. During this period concentrate on the whole world.

Task 2 . Now focus your attention on the plate boundaries. Identify the nature of your data near the plate boundaries. Is it high or low, symmetric or asymmetric, missing or not missing, varying along the boundary or constant along the boundary, and etc. As a group, classify the plate boundaries based on your observations of your group's data. Restrict yourselves to about 4-5 boundary types. At this point, do not try to explain the data; just observe!

Discovering Plate Boundaries Dale S. Sawyer Rice University 30 Jan 2003

Task 3 . Assign a colored pencil color to each boundary type in your classification scheme. Color your first Plate Boundary Map to locate your group's boundary types. If the data are asymmetric at a particular boundary type, devise a way of indicating that on your plate boundary map. Each person should mark the boundary types identified by the group on their own map. Each person should write down descriptions of the group's plate boundary classifications on the back of their map. These maps and descriptions will be turned in at the end of the exercise.

**Period 2:**

## Whole Class Discussion

Within your groups finish discussion of plate boundaries. We will then assign appropriate boundaries at this point and then finish up the map movement. The instructor will conclude the exercise by summarizing the students' observations and placing them in the context of accepted plate boundary types and plate boundary processes.

**Period 3 and 4:**

Working with a partner cut out the continents (label the back side of each continent). Looking at the data predict what a new supercontinent would look like. Glue them onto a piece of poster-board and name you new landmass.

Using the journal prompt describe what you learned throughout the process.

(Adapted from <http://plateboundary.rice.edu/home.html>, 31 January 2013.)

APPENDIX G

DISCOVERING PLATE BOUNDARIES RUBRIC

## Discovering Plate Boundaries Rubric:

	10	7	4	1
Did the student follow directions?				
Is the product of high intellectual value?				
Does the defense of the argument make justified sense?				
Teacher Assessment of time and learning.				
Self and Peer Assessment of learning.				

APPENDIX H

PLATE TECTONICS UNIT TEST



APPENDIX I  
PARENT SURVEY

## PARENT SURVEY

All surveys are voluntary. In no way will it effect your grade or standing in the class. It will, however, help to understand how to adjust class so that you can better learn.

- 1.) How often does your student bring schoolwork home per week?
- 2.) How many hours, on average, per week does your student spend doing schoolwork or studying?
- 3.) Does you student talk with you about school? Including issues, concerns, excitement, etc. Please elaborate.
- 4.) Is science a struggle for your student?
- 5.) What are some aspects of school that your student enjoys?
- 6.) What are some of your concerns in the education of your student?

APPENDIX J

TEACHER INTERVIEW

Teacher Interview:

Could you please give me some feedback on our eighth grade students? I need some information from other classroom teachers for my research proposal. My research is dealing with using authentic assessment to increase student engagement and learning. Responses are voluntary, and will be anonymous.

- 1.) What strategies do you use to keep them engaged in class?
- 2.) What strategies work to help retention of concepts?
- 3.) Do you feel that they stay better engaged in groups or individually?
- 4.) Are they more accepting to traditional classroom assessment methods or alternative methods?

If you could give me any other insight that would help me with my research I would appreciate it.

APPENDIX K  
IRB TRAINING

## CITI Collaborative Institutional Training Initiative

### Social and Behavioral Research Investigators/ Faculty Curriculum Completion Report Printed on 3/18/2012

**Learner:** Tyler Ferebee (username: tyler.ferebee)

**Institution:** Montana State University

**Contact Information** Phone: 402-852-2179

Email: tyler.ferebee@ecat.montana.edu

**Social & Behavioral Research - Basic/Refresher:** Choose this group to satisfy CITI training requirements for Investigators and staff involved primarily in Social/Behavioral Research with human subjects.

#### Stage 1. Basic Course Passed on 03/18/12 (Ref # 7648000)

Required Modules	Date Completed	
Belmont Report and CITI Course Introduction	03/15/12	3/3 (100%)
Students in Research	03/15/12	8/10 (80%)
History and Ethical Principles - SBR	03/15/12	4/4 (100%)
Defining Research with Human Subjects - SBR	03/15/12	3/5 (60%)
The Regulations and The Social and Behavioral Sciences - SBR	03/15/12	4/5 (80%)
Assessing Risk in Social and Behavioral Sciences - SBR	03/17/12	5/5 (100%)
Informed Consent - SBR	03/17/12	3/5 (60%)
Privacy and Confidentiality - SBR	03/17/12	3/5 (60%)
Conflicts of Interest in Research Involving Human Subjects	03/18/12	5/5 (100%)

**For this Completion Report to be valid, the learner listed above must be affiliated with a CITI participating institution. Falsified information and unauthorized use of the CITI course site is unethical, and may be considered scientific misconduct by your institution.**

Paul Braunschweiger Ph.D.  
Professor, University of Miami  
Director Office of Research Education  
CITI Course Coordinator

[Return](#)

APPENDIX L

ADMINISTRATOR APPROVAL OF RESEARCH

Administrator Approval

I, Don Jacobs, Principal of Pawnee City Public School, verify that I approve of the classroom research conducted by Tyler Ferebee.

Don Jacobs Principal  
Signed Name, Title of Position

Don Jacobs  
Printed Name

10.10.12  
Date

APPENDIX M

EXEMPTION REGARDING INFORMED CONSENT

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Exemption Regarding Informed Consent

I, Don Jacobs, Principal of Pawnee City Schools, verify that the classroom research conducted by Tyler Ferebee is in accordance with established or commonly accepted educational settings involving normal educational practices. To maintain the established culture of our school and not cause disruption to our school climate, I have granted an exemption to Tyler Ferebee regarding informed consent.

Don Jacobs

(Signed Name)

Don Jacobs

(Printed Name)

10.10.12

(Date)