EFFECTS OF PEER REVIEW ON STUDENT PERFORMANCE AND ATTITUDE IN AN URBAN EIGHTH GRADE PHYSICAL SCIENCE CLASSROOM

by

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ABSTRACT

This research centered on the effects peer review had on the students of an urban eighth grade physical science classroom. Students were first taught how to use rubrics to assess their own products, and then they used this skill to review products of their peers. Diagram assignments, quizzes, tests, surveys, and interview tools were all used to collect data on how the process affected the students' academic performances and attitudes. Phases of research were set in six-week cycles with the first and third as non-treatment units and the second and fourth as the treatments. Two or three rubric-based diagram assignments, two quizzes, and one test were used every six weeks to collect data. The results indicated there was an improvement in the students' attitudes towards cooperative learning but there was no significant increase in assignment or assessment performances.

INTRODUCTION

I teach at James Denman Middle School in San Francisco, California. There are currently 576 students enrolled at James Denman, which offers instruction in grade levels 6 through 8. The populations of students in my eighth grade physical science courses are very diverse. According to Riverside Publishing (2012) the students' ethnic background are 37% Latino, 25% Filipino, 22% Chinese, 8% African American, 4% Caucasian, 2% Vietnamese, and 2% Indian retrieved from www.98.achievedata.com/sfusd.

I currently teach two sections of a seventh grade life science and two sections of eighth grade physical science. My eighth grade physical science students were the focus of this research. This student body exhibits the same diversity of the school and has a wide range of academic capabilities. With such a varied collection of academic capabilities it can be quite challenging to customize instruction to meet the individual need of every student.

One strategy I have found useful is placing the students into heterogeneous groups based on their academic strengths. I persistently instruct them to support each other's learning by checking for understanding and discussing the reasonableness of their answers. This has been moderately successful depending on the student groups involved and how well the individuals within the group understand the assignment. I have come to the conclusion that cooperative learning can be a powerful educational tool if the students are held accountable for their participation and the assignment's objectives are apparent.

If my students are not held accountable for their contributions to the group, or if the objectives of the task are unclear, then cooperative learning will not take place. The purpose of this research was to discover how structured cooperative learning groups affected the constituents of my classroom. Students were instructed how to collaborate in groups to enhance their learning experience. They were then asked to use these skills to review the products of their peers' learning, complete group laboratory reports, and reflect on their attitudes toward these activities. It was hoped this would improve performance on different types of assignments and assessments, while inducing a positive change in their attitudes.

National educational research has a tendency to introduce a new buzzword strategy that lasts only as long as it takes to implement at the school level. The failure of many of these new policies is a result of impracticality when applying them in different classrooms. Teachers already have a great deal of responsibility, and in many cases a new strategy handed down from above increases the workload without any benefits. What educators need is a way to accomplish their monotonous tasks in a more time efficient manner so they can focus on the improvement in the delivery of their instruction. They also need to encourage the students to be active participants in their learning so both the teacher and students are held accountable for their education.

Peer review is the method introduced here that may offer solutions to both of the aforementioned issues. Aside from preparing students for their future professions, educators have the responsibility of evaluating student products to get a sense of the content comprehension. The amount of time needed to make these judgments depends on the class size and the number of sections the instructor teaches. Most courses assign more than one task per week. If an extrapolation is made for the time it would take to get through all of this grading, it is clear that quality of feedback would be sacrificed for the quantity one has to give. It is evident the workload educators take on is unreasonable.

The process of peer review has allowed some responsibility of providing feedback to be on the students. Students could provide meaningful constructive feedback almost immediately.

Teachers will always have more to do no matter what they get done. When the amount of work takes longer than the time available to accomplish it, they must begin to prioritize their responsibilities. The necessary tasks get accomplished first, and the rest is undertaken if time allows. Grading is a requirement for all educators. This is first on the list of priorities for teachers to keep an account of student's academic performance. This arduous chore is time consuming and leaves little room to look for trends that can inform future instruction. Students can benefit from teachers with time to discover patterns, be reflective and improve their pedagogy. With the time intensive task of grading, students are less likely to get back their assignments in an expedient manner that will make their feedback meaningful. Prompt feedback is essential for students in the learning process. This research project was centered on the following four focus questions:

1. How will peer review affect student performance on unit test summative assessments?
2. How will peer review impact student performance on rubric-based assignments?
3. How will peer review influence student performance on formative assessments?
4. How will peer review change student/teacher attitudes on cooperative learning?

CONCEPTUAL FRAMEWORK

Peer review is a method that may offer solutions to the everyday issues faced in the classroom. Peer review is defined by Topping, Smith, Swanson, and Elliot (2000) as an activity where people of similar status evaluate the quality of each other's learning products. Peer review offers many benefits to all of the constituents within the classroom. The teacher who is overburdened by the amount of papers to grade has much time to gain from student peer review (Harris, 2001). The student who has their assignments reviewed by their peers has one last chance to make improvements before their final submission (Cho & Cho, 2010). Finally, the student who does the peer reviewing learns to identify the characteristics of high and low quality products using critical thinking skills (Lan & Steckelberg, 2004).

Peer review is something that many professionals take part in as a requirement of their occupation (Langfeldt & Kyvik, 2010). Aside from the act of reviewing the products of peers, most professionals must also be able to have positive communication with their coworkers and participate in some form of collaboration to reach a common goal. Individuals who lack these skills are less likely to be successful in the working world. Because of this, many organizations encourage the professional development of these skills (Bangart, 2001; Brill & Hodges, 2011; Mills & Cottel, 1998). Educators have the responsibility of ensuring that students leave the classroom ready for their future. Learning how to collaborate and cooperate with coworkers is a skill that will help prepare students for their future professions. Students exposed to the practice of peer review will develop these essential skills (Hancock 2004).

Peer review has been shown to significantly reduce the amount of time an instructor spends reviewing student work (Harris, 2001). Johnson (2001) acknowledges the unreasonable amount of time an educator must spend providing feedback and offers peer review as an alternative to the perpetual hours spent grading student assignments. The more time it takes for an educator to provide feedback the longer the students have to wait to receive meaningful feedback on their assignments. The National Survey of Student Engagement (2000) reports quick feedback can then be used to revise student products (retrieved from http://nsse.iub.edu). This feedback can then be used to improve student performance on the assignments (Lan & Steckelberg, 2004).

Students who have their assignments reviewed by peers have much to gain from the feedback offered (Topping, 1998). Students have the ability to communicate to their peers in a common language that is less academic but in many ways more meaningful. By getting students involved in the peer review process, Harris (2001) states that they are able to learn the valuable skill of accepting criticism from peers and revising their own products accordingly. If these revisions are thoughtful and taken into consideration, they can lead to an improvement of product quality. This causes an increase in academic performance and one less mark the instructor must make on the final submitted product.

Another skill students can develop when they are constructing a product to be reviewed by their peers is their ability to compose it in a way that accommodates more than one audience (Johnson, 2001). Students have been conditioned to create a product for their instructor alone. When their peers are reviewing the assignments then they will learn to perform for a more broad audience. Students are more motivated to produce a higher quality of work if they know peers will review it (Pope, 2001). They can be more mindful of their products when it is subject to criticism from those of equal stature. In addition, peer review promotes positive interdependence by allowing students to support each other in a shared goal through face-to-face interaction (Hancock, 2004).

The students who have their assignments reviewed by their peers have an advantage, as do the reviewers. Johnson and Johnson (1996) report students participating in the peer review process claim to have lower levels of anxiety. Anxiety can form when an individual is worried about the outcome of an unknown event. Peer reviewers learn to identify the characteristics of high and low quality work (Cho & Cho, 2010). Students who are given rubrics with the responsibility of reviewing the products of their peers already know what the teacher is looking for when they grade their own assignment. This relieves their anxiety. Students make the learning and assignment objectives part of their thought process when reviewing their peers' assignments (Johnson, 2001).

Cho and Cho (2010) demonstrated in their research students that were involved in peer review are able to detect the problems of their peers' products and then help formulate solutions. Problem solving and critical thinking are skills that grow in the process of peer review. When students become active participants in the assessment process, Price, O'Donovan, and Rust (2005) assert they must understand the requirements of the assignment. In order for a student to properly make suggestions, they must have a clear understanding of what an exemplary finished assignment looks like. Price, O'Donovan, and Rust (2007) report that students found it very useful to provide feedback to their peers. Students found that peer review required them to reflect on their own performance of assignments and then assess their own products (Harris, 2011). Students are able to use their own assignments as a reference so it is natural for self-assessment to follow after the assessment of their peers. Students participating in peer review have a deeper understanding of the information presented and as a result obtain long-term retention of it (Hanrahan & Isaacs, 2001).

There are many reasons for peer reviews to be utilized within the classroom. The instructor is able to facilitate expedient feedback to all students for the improvement of their instruction. It also teaches the students how to cooperate and collaborate by practicing the necessary skills of offering and accepting constructive criticism. The students with their assignment reviewed have the ability to make improvements before final submission. Students who do the reviewing learn the objectives of the assignment, essential skills of cooperative learning, and how to communicate with their peers. The prior investigations conducted on the effects teaching and practicing cooperative learning skills in a middle school physical science class inspired the motivation for the six month collection of data that would allow the examination of the treatment effects referenced.

METHODOLOGY

In the course of this 24-week data collection process there were 2 treatment units and 2 non-treatments alternating throughout 4 separate 6-week units. The first and third units were the non-treatment units while the second and fourth were the treatment units. The first of these units started with an introduction of how to write a lab report and included states of matter along with transitions between each state. This first unit ended with a focus on the ideal gas laws. The second unit, which was a treatment unit, began with reviewing matter and its basic physical properties. This led into the atomic structure, element organization within the periodic table, and reactivity. The end of this second unit finished with chemical bonding and reactions. The third unit started with using the rules of organic chemistry to draw structural diagrams of carbon-based compounds. Then solution chemistry was presented in the third unit, which ended with acid base chemistry. The fourth and final unit of this research centered on motion and energy. Speed and acceleration were the initial focus. Then various forms of energy, their transformations, and how this relates to motion were emphasized towards the end.

The first six weeks of this six-month study was spent teaching students to assess their own learning. This was accomplished by showing students how to use rubrics to assess their performance, how to reflect on their learning, and how to set learning goals based on their performance using the first three Non-Treatment Diagram Rubrics (Appendix A). For students to assess their peers, they first had to learn how to assess themselves. In this first six week non-treatment phase, students were instructed how to use the rubrics to complete diagrams illustrating their understanding of scientific concepts. They first were shown how to use rubrics to guide the construction of their diagrams. Next they were taught how to use the rubrics to check over their products for revisions. Students graded their assignments using the rubric, and then I checked for accuracy and consistency. An additional activity implemented in the first non-treatment unit was the setting of learning goals using the learning objectives from the Non-Treatment Pre-Tests (Appendix B). Students received their graded Pre-Test back along with the learning objectives for the unit. I then reviewed the correct answers along with corresponding objectives. After this the students set learning goals based on scores. This taught the ability to assess learning.

Students had to learn how to practice cooperative and collaborative skills prior to the treatment. These skills included interdependence, face-to-face interaction, individual and group accountability, small-group and interpersonal skills, and group processing. To teach the students these skills, they participated in a laboratory activity during the non-treatment phase before the treatment began in the second six weeks of data collection.

Assigning group activities that required the students to choose from a list of roles in laboratory activities such as developing a hypothesis, writing procedures, collecting and organizing data, or writing a conclusion allowed them to practice interdependence. During this activity, they had face-to-face interaction that allowed them to assess their peers' understanding. Individual and group accountability was practiced during this activity. These cooperative learning laboratory activities in the first six weeks allowed students to develop collaboration skills and scientific skills in groups of three to four. Students were accountable for their own individual lab reports in the non-treatment phases. These scientific skills were assessed throughout the year in unit tests. This allowed the first six weeks to be a non-treatment unit and provided the necessary time to teach the students the skills for peer review. In the second and fourth six-week cycle, students used the skills learned in the first six weeks to review the assignments of their peers and participated in collaborative laboratory activities where individual scores were based on the groups' performance. In these treatment units, only one report for each group was submitted and each member of the group shared the same final score assigned.

The lab reports were graded in the same way as the unit tests. Students needed a hypothesis making a prediction regarding a cause and effect relationship related to the scientific question given. They had to write a procedure list with detailed steps of how to use a set of tools to test their hypothesis making reference to the manipulated, responding and controlled variables. The report required provided data to be organized in a graph or table with correct units. The report conclusion included a claim about the validity of their hypothesis, specific evidence to support the claim, a justification explaining the reasoning for using data as evidence to support claim, and a final question to guide further research.

The tools used to answer the primary focus question regarding summative assessment performances were given every six weeks using the four Unit Tests (Appendix C). Student performances on rubric-based assignments were assessed bimonthly during the intervention using the Treatment Diagram Rubrics (Appendix D). Two formative assessments were given biweekly during both non-treatment and treatment phases to assess the students' concept comprehension using Content Quizzes (Appendix E).

A Cooperative Learning Pre-Survey was given at the end of the first unit, a non-treatment phase, to help determine the students' attitudes toward cooperative learning (Appendix F). Data gathered in these surveys were used comparatively after they were re-administered and analyzed at the end of the fourth unit, the second treatment phase. I kept a record of written reflection to detect any change in my personal attitude toward this cooperative learning process. My students' attitudes toward collaborative learning were re-assessed at the end of the final treatment using the Post-Cooperative Learning Survey (Appendix G). Unit tests focused on the practice of scientific skills due to the variation of knowledge-based content between each unit. The variation in content could have caused changes in student performances that would have affected the outcome of the results so the practice of scientific skills was emphasized in the summative Unit Tests even though the context was based on the current learning objectives.

The second six weeks was the first treatment unit. Students had already learned how to use rubrics and what to look for. They then used these skills to assess the learning of their peers. The use of rubrics was critical for the collection of data in this research because it provided a guideline for students to assess the performance of themselves and their peers. Formative assessments, based on the content within each unit, were given throughout the unit. This provided multiple opportunities to collect data on student understanding of content before and after the sessions of peer review. This was done twice during the treatment units. The summative assessment of a unit test included the assessment of practicing scientific skills to provide comparative data from the last unit test. Laboratory activities were carried out in each unit, and lab reports were peer reviewed before they were handed in during both of the treatment phases. At the end of this unit, an almost identical survey was administered, and a group of students were asked to participate in an interview once subcategories were identified based on their ratings. The students chosen to interview were based on the trends and outliers found from the survey results. A set of prompts was used to probe deeper into the reasons for a change in enjoyment, comfort, or confidence as I recorded responses of my students using the

Interview Questionnaire (Appendix H). The surveys and interviews detected for a shift in student attitudes and the reason for if any. The assignments and assessments gave me insight on students' understanding of the content and the scientific skills practiced.

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. The collection tools were used to gather comparative data to determine if peer review had the desired effects. Changes in the median of responses from the Cooperative Learning Pre-Survey and Cooperative Learning Post-Survey were assessed using a non-parametric alternative to a paired t-test called a Wilcoxon Signed Rank due to the ordinal nature of the data. The statistical results provided quantitative data that was supplemented by the qualitative data gathered in my observations, recorded reflections, and interviews. These analyses provided insight using many instruments (Table 1).

Table 1
Triangulation Matrix

Focus Questions	Data Source 1	Data Source 2	Data Source 3
Primary Question: 1. How will peer review affect student performance on summative assessments?	Unit Test #1	Unit Test #2	Unit Tests # 3 & 4
1. How will peer review affect student performance on formative assessments?	Unit # 1 Quizzes	Unit # 2 Quizzes	Units #3 & 4 Quizzes
1. How will peer review affect student performance on rubric based diagram/ lab assignments?	Diagram Rubrics	Lab Reports Performances	Teacher Observations
How will peer review change student and teacher attitudes toward peer review?	Teacher Reflections	Cooperative Surveys	Interview Questionnaire

DATA AND ANALYSIS

Students (*N* = 58) showed no signs of meaningful improvement in performances on Unit Tests after each of the treatment units. There was a decrease of 7% in test averages from the first non-treatment unit (*M* = 82, *SD* = 16) to the second unit (*M* = 75, *SD* = 17) that was a treatment unit. In the third unit, which was the second non-treatment cycle, students scored an average of 86 (*SD* = 15). In the fourth and final treatment phase of collection cycles, students decreased in performance by 5% (*M* = 81, *SD* = 13) from the third unit. Overall performances improved in the second half of the study (Figure 1).

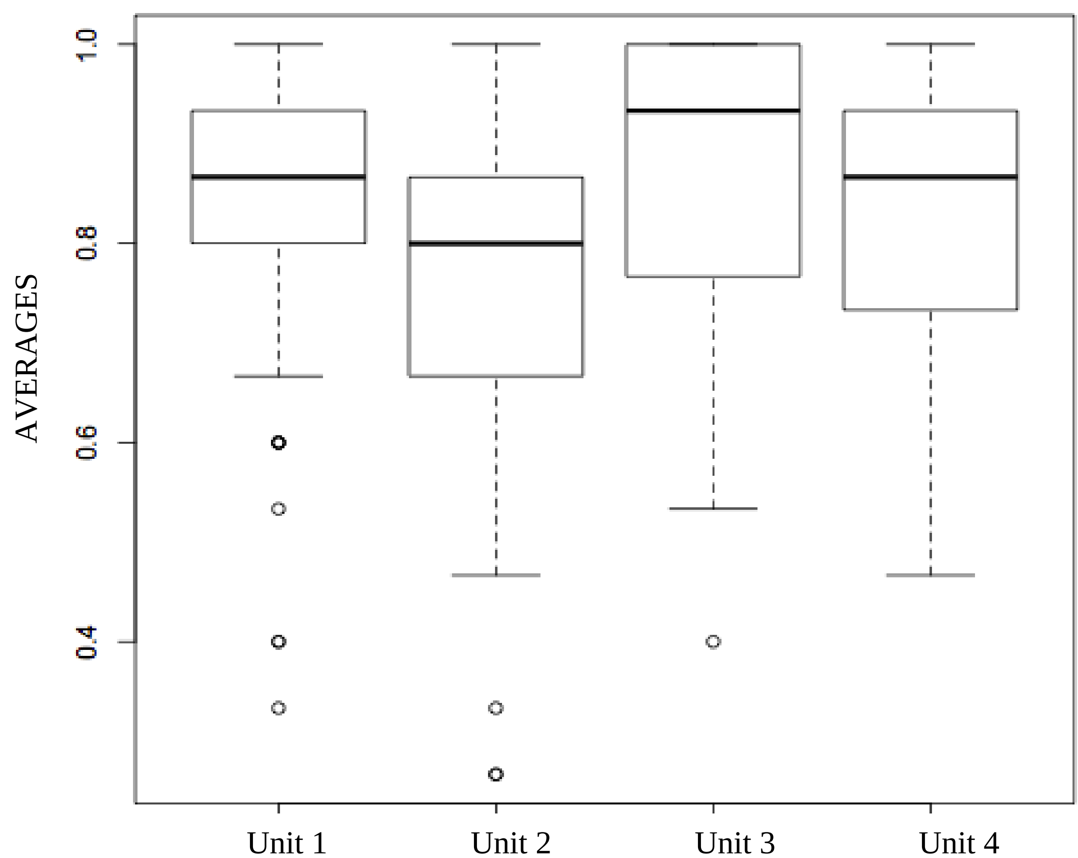

Figure 1. Unit test performance averages, (*N* = 58).

Students showed no substantial progress in their performances on Unit Quizzes throughout each of the collection phases. There was a 6% decrease in quiz scores from the first unit (*M* = 73, *SD* = 20) to the second (*M* = 67, *SD* = 20). In the third, students' scores decreased (4%) to an average of 63 (*SD* = 17). In the fourth unit, students scored an average 65 (*SD* = 19) showing a small 2% increase in performance. The student's performed better in general on quizzes in the first two cycles of data collection (Figure 2).

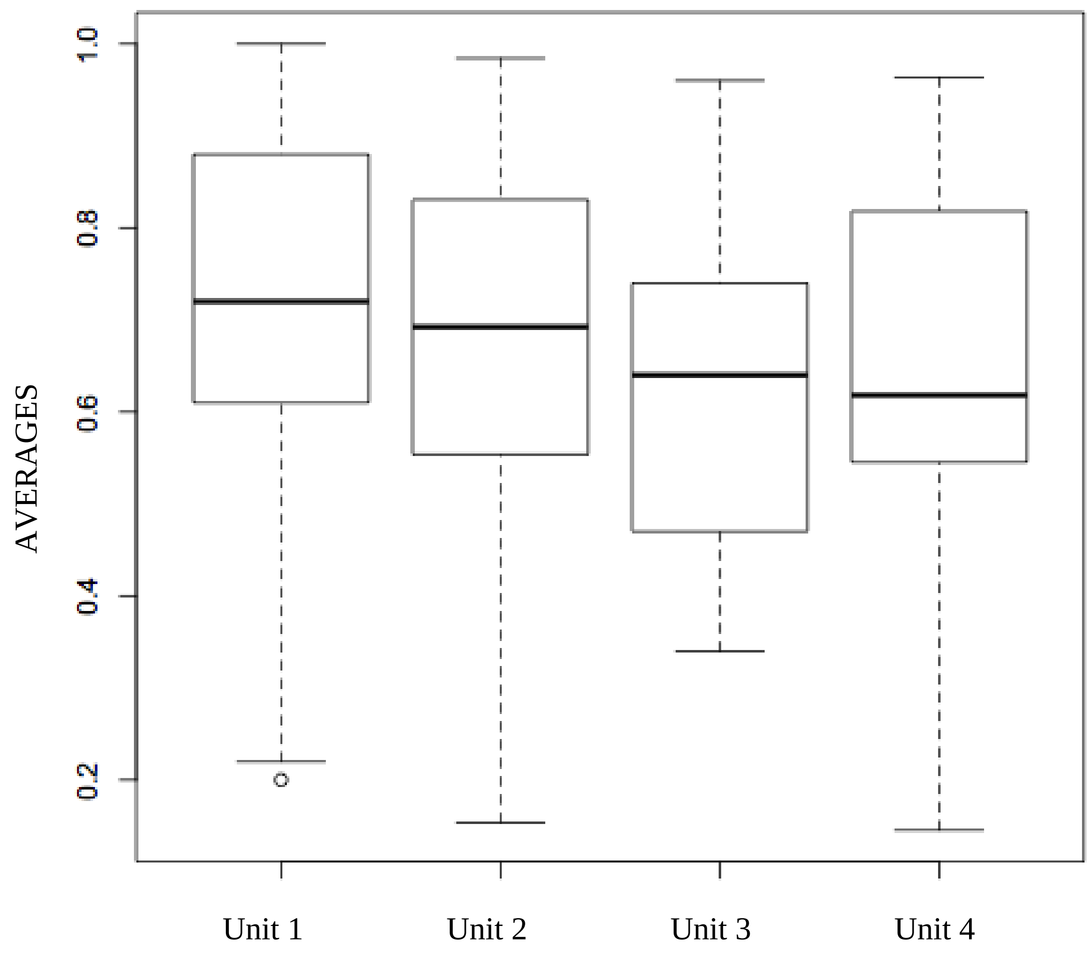

Figure 2. Unit quiz performance averages, (*N* = 58).

Students did not show a considerable improvement in performance on Diagram Rubrics during the treatment units. Student scored an average of 87 (*SD* = 9) in the first unit and an average of 88 (*SD* = 10) in the second unit. Scores increased 5% in the third unit (*M* = 93, *SD* = 8) from the second. Student scores decreased 5% in the fourth unit (*M* = 88, *SD* = 12) from the third. Students performed slightly better on rubric based diagram assignments in the second two of the four phases of collection cycles (Figure 3).

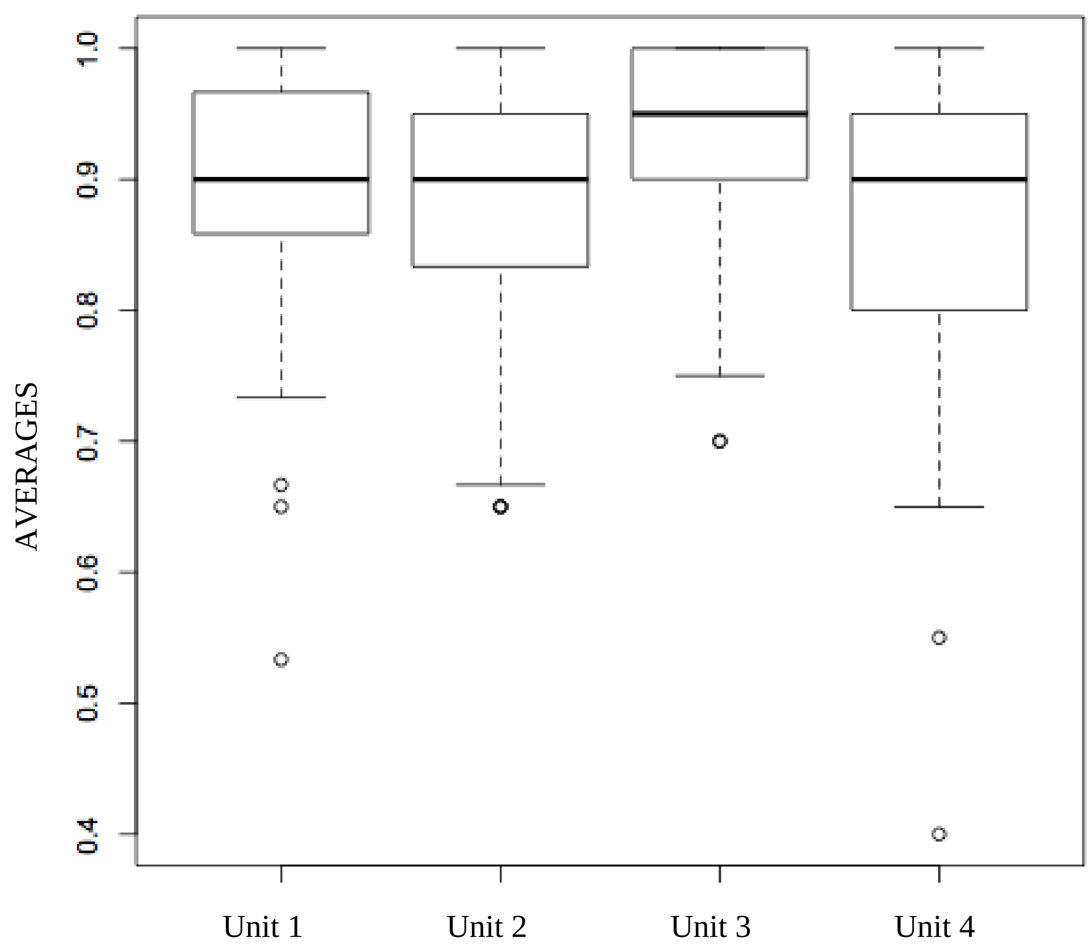

Figure 3. Diagram rubric performance averages, (*N* = 58).

Students did not improve in performance on lab reports over the course of the data collection phases. In the first unit, students scored an average of 91 (*SD* = 11), and in the second unit the average was 93 (*SD* = 7). In the second unit, students scored an average of 90 (*SD* = 13), and in the fourth unit the average was 92 (*SD* = 7). The students' overall performance averages on laboratory reports did not change during each of the four units. The medians of the students' scores were lower in last two phases (Figure 4).

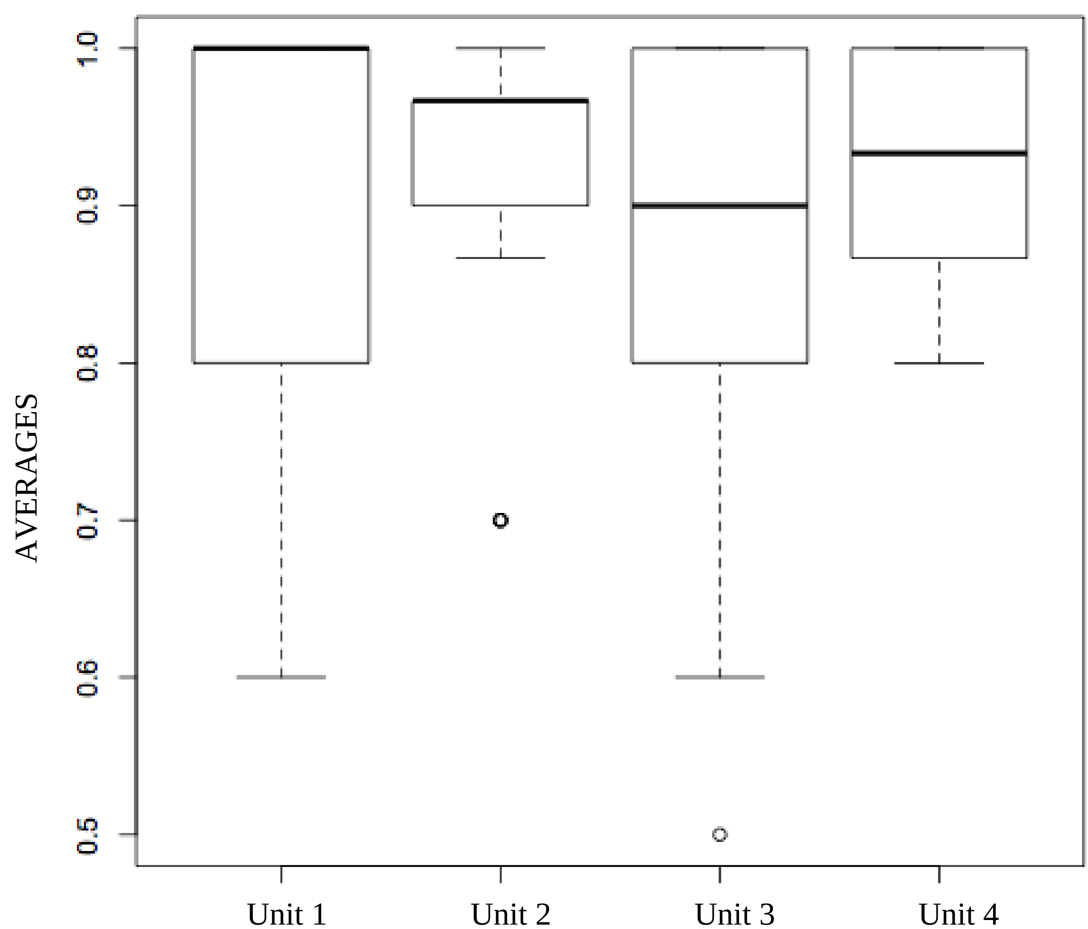

Figure 4. Laboratory report performance averages, (N = 58).

When a student was asked by another student to get help completing assignments, a significant increase in comfort level, $W(58) = 4.5$, $p = 0.003$, was reported after the two treatment units. There was 95% confidence the median of survey ratings increased from one to two on this item. Six of the students who scored a ten in the Pre-Survey stated they like helping people. One of the students who scored a ten justified their rating by writing, “I feel smart when I help people.” A student who gave ratings that increased considerably between the Pre and Post-Surveys claimed, “I did not really know anyone before but after a while I got to know them.” The mode ratings for the Pre-Survey were a 10 and a 5 and the mode for the Post-survey was also rated a value of 5 (Figure 5).

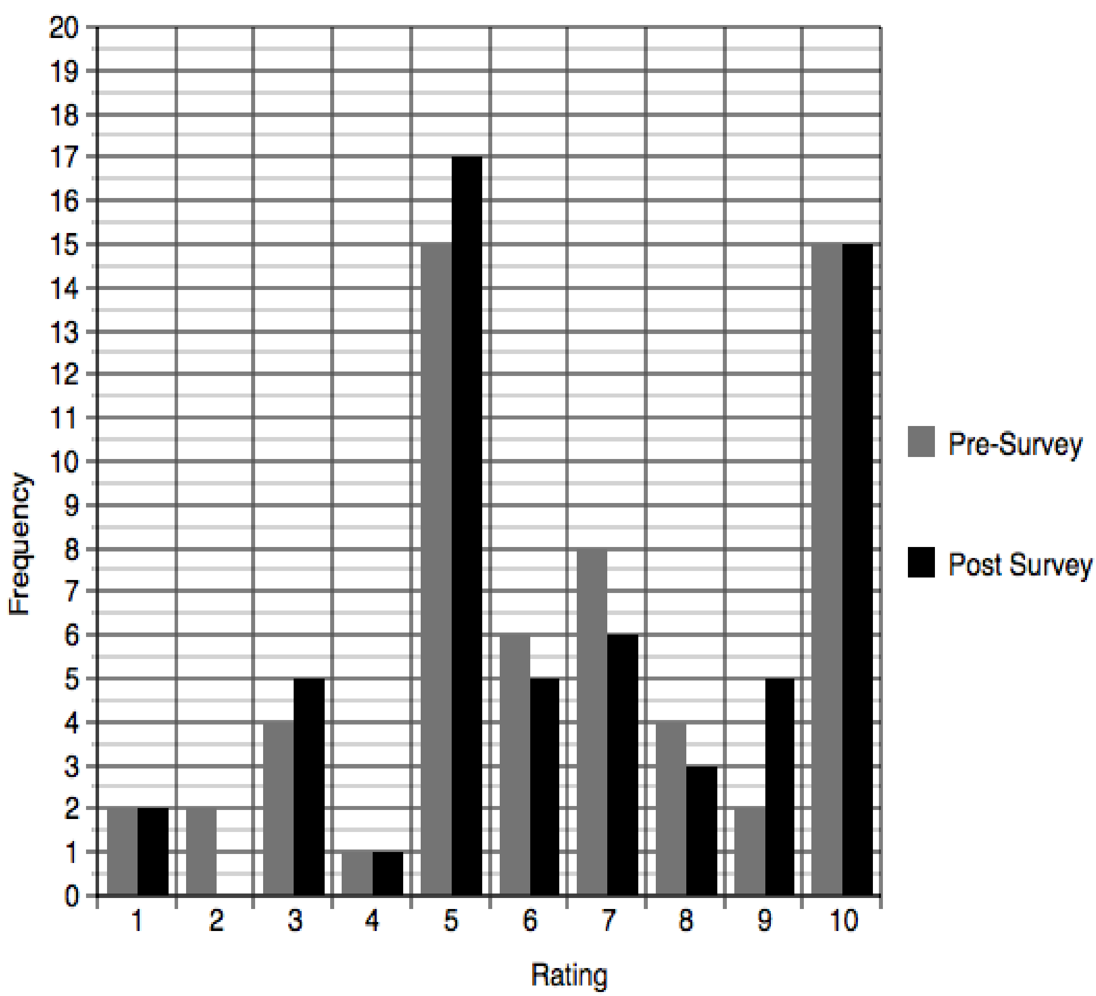

Figure 5 Survey Question Two comfort levels, ($N = 58$). 1= Lowest, 10 = Highest.

When asking another student for help in understanding a scientific concept, students showed a significant increase in comfort level, $W(58) = 22$, $p < 0.001$, after the two treatment units. There was 95% confidence of an increase in a rating of the median by a value of one. The mode for both of the Surveys was 10 however the frequency of students who rated this value increased from 17 to 22 (Figure 6). A student who rated a value of ten in the Post Survey stated, "It is good so then you will not be confused." Another student who also rated a ten wrote, "It helps me improve in that subject." An interviewed student who increased their ratings by a value of four reported, "I was uncomfortable at first but then I started getting used to everybody in the class."

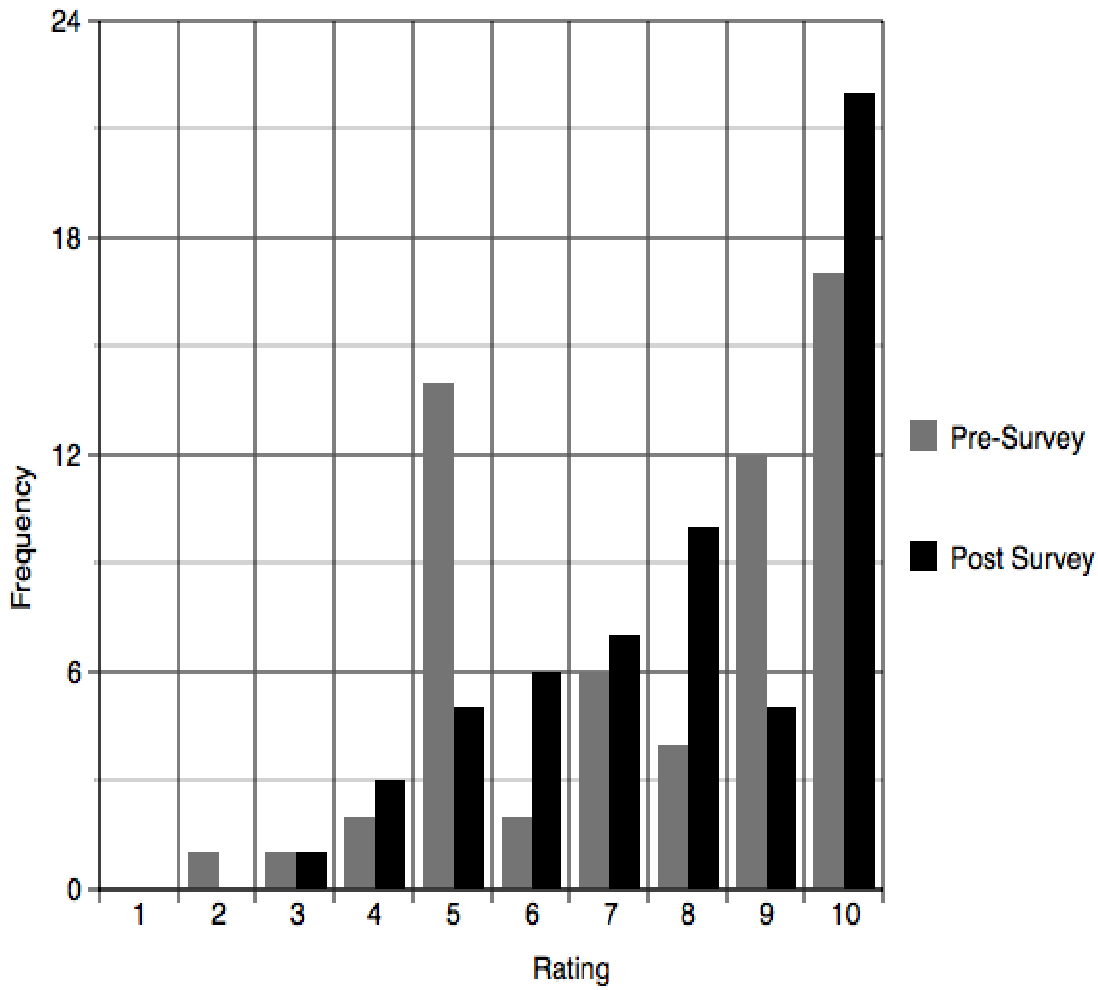

Figure 6. Survey Question Three comfort levels, (N = 58). 1= Lowest, 10 = Highest.

When asked by a teacher to help another student understand a scientific concept, students had the most significant increases in comfort level, *W* (58) = 8, $p < 0.001$, after the treatment cycles. The mode was found at the same value of ten for both of the Surveys, although there was 95% confidence the median increased from 6 to 8 (Figure 7). A student's explanation for a chosen ten rating on the Post-Survey wrote, "I feel good that the teacher thinks that I am smart enough to help." One other student who rated a ten on the Post-Survey stated, "I want that person to learn and understand it." An interviewed student asserted, "I was not really used to physical science but now I am." Another student said, "I got more comfortable because I got to know people more."

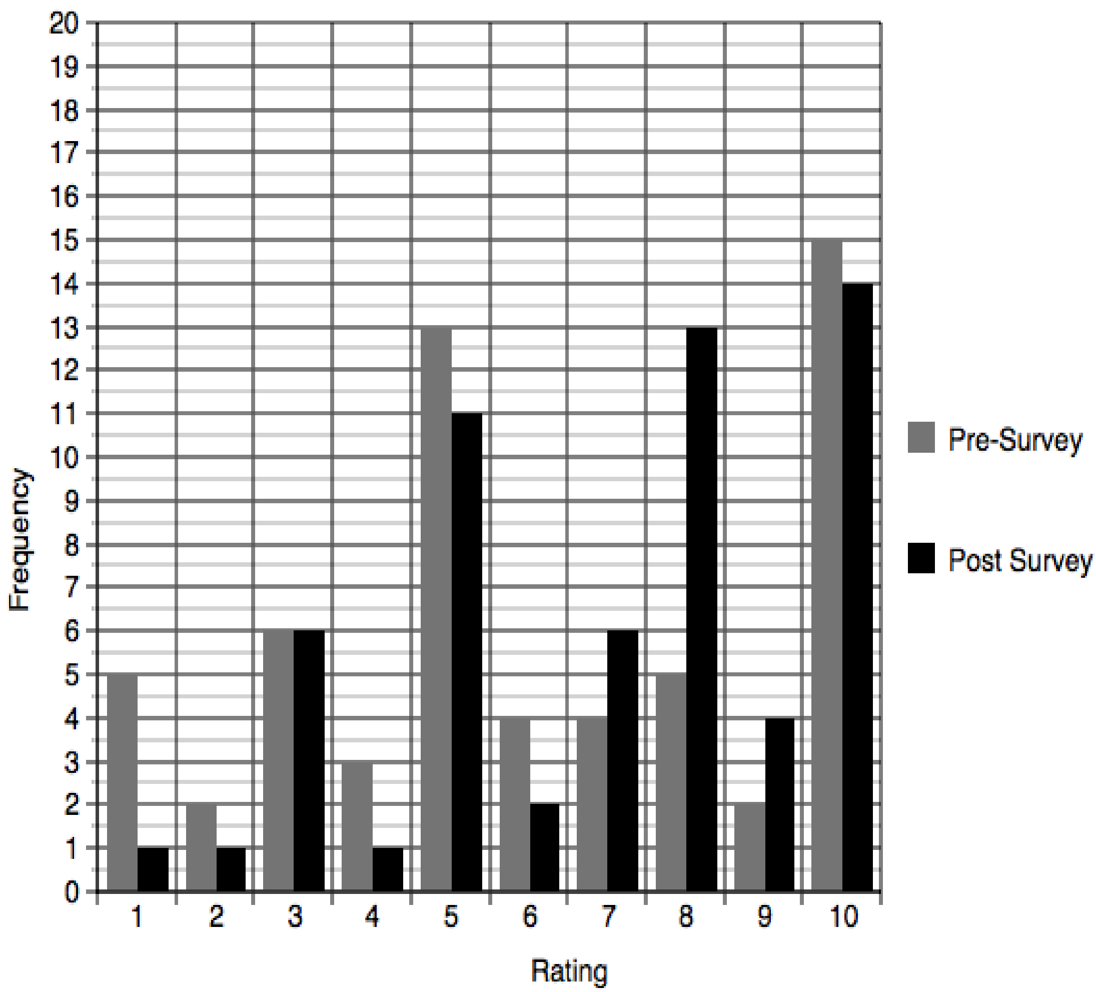

Figure 7. Survey Question Four comfort levels, (*N* = 58). 1= Lowest, 10 = Highest.

Student ratings between Pre and Post Surveys displayed a significant increase in comfort level, W (58) = 23, $p < 0.001$, when a teacher asked another student to help the surveyed student to understand a scientific concept. The mode of ten was the same for both Surveys, yet there was 95% confidence the median increased by a value of one (Figure 8). A student justified their rating of ten on the Post-Survey stating; "It is better because I do not have to ask for help." Another student who rated a value of ten wrote, "When I don't understand something I do not ask for help." One more stated, "I feel like they will help me understand it better than learning it by myself." An interviewed student whose comfort ratings increased claimed, "I got more comfortable when I got to know the class." Another student stated, "I got to know everyone so I got more comfortable."

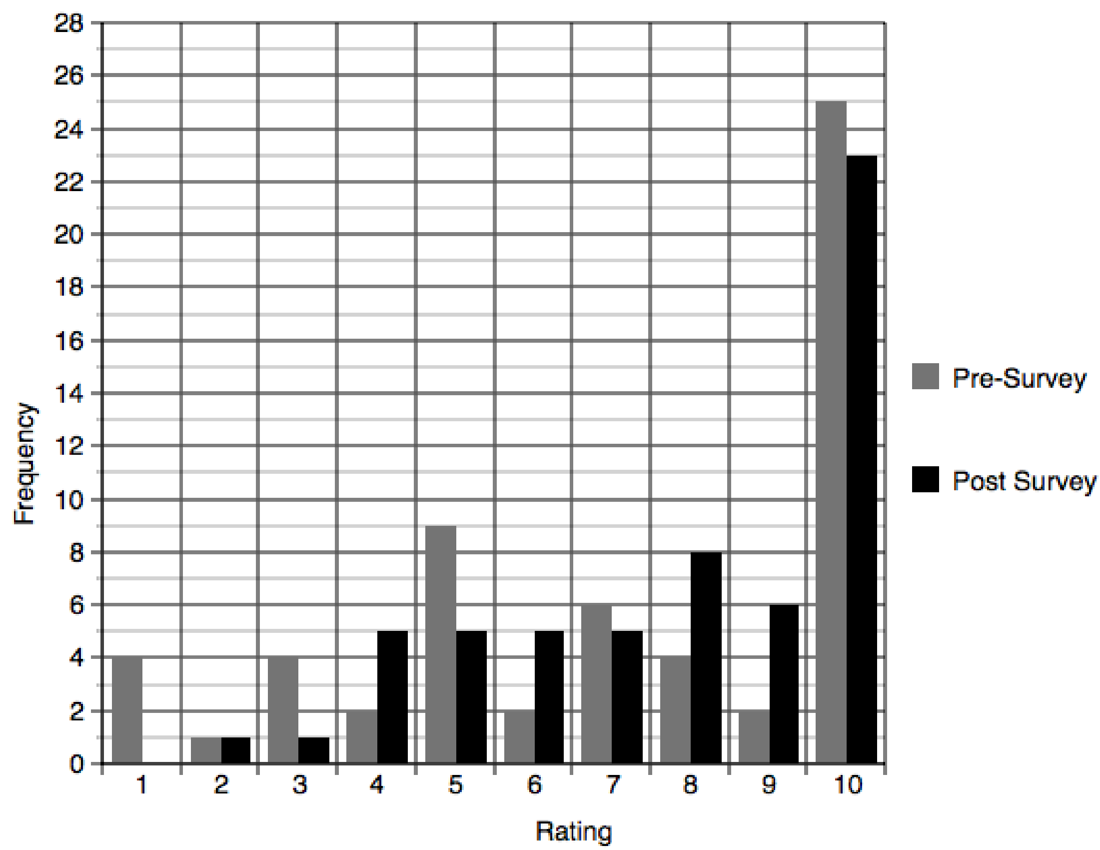

Figure 8. Survey Question Five comfort levels, (N = 58). 1= Lowest, 10 = Highest.

A significant decrease in confidence levels, W (58) = 253, $p < 0.001$, was shown by students after the treatment phases on quiz performances before receiving feedback. There was 95% confidence the median decreased by a value of one from six to five (Figure 9). The mode was found to be five for the Pre-Survey and the Post-Survey had a mode of one and five. A student who rated a value of one on the Post-Survey wrote, "Sometimes I think I did good but then I get it wrong." One who rated a value of five on the Post-Survey stated, "I never think I did good, it just sets me up for disappointment." Two students defended their ratings by stating that it depended on how much they studied, if at all. A student showing a large decrease in confidence from the Pre to Post-Survey said, "At the beginning of the year, assessments were easier and I didn't have to study as much but now they are harder and I procrastinate on studying. I can get really confused when I have lots of stuff to study."

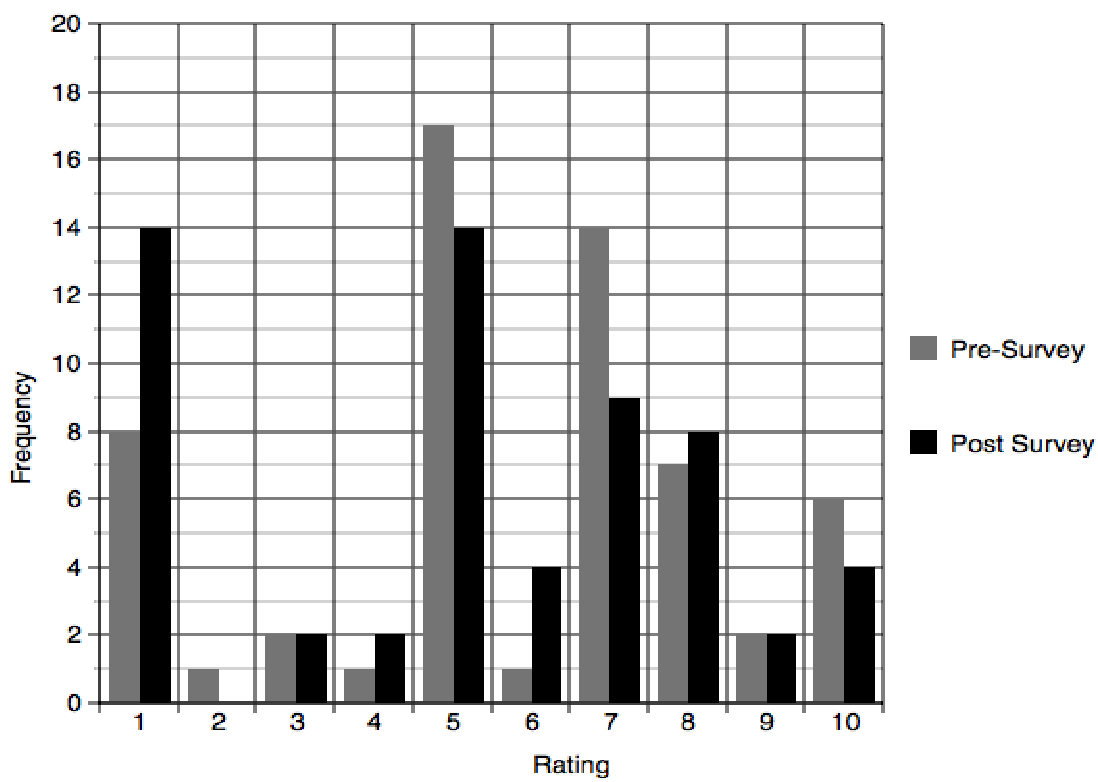

Figure 9. Survey Question Nine comfort levels, (N = 58). 1= Lowest, 10 = Highest.

One relevant observation made through the cycles of data collection included the type of dialogue overheard as students reviewed the assignments of their peers. Students generally told each other the components were missing on assignments rather than verify parts they were able to complete. Another critical observation made during the collection cycles was the relationship between the inaccuracies of peer grading and low scores on diagram assignments. Students unable to correctly fill out the rubrics when grading the assignments of their peers also tended to score lower on the assignments themselves. An additional observation made was during the second non-treatment unit when the students were instructed to refrain from reviewing assignments of their peers before submission. There were a number of instances where students were caught looking over each other's assignments after being asked not to as I was circulating around class collecting them.

The entries recorded in my professional reflection journal indicated a number of meaningful insights related to the process of peer review. The thoughts logged at the end of the four phases of data collection cycles were essential. A March 22, 2013 entry read:

> The process of data collection is time consuming and asking my students to do it outside of class is impossible. The time taken to review the products of peers in the last five to ten minutes of class is the only time available for these activities. Many struggling students are unable to finish before the reviews begin so they are waiting until the last minute to do their reviews. This leads to rushed reviews and compromises the quality of feedback to those reviewed. The students with feedback advising to revise assignments rarely make the corrections to improve their score. It seems as if once the classroom time to finish has passed, students are not willing to dedicate more time to change mistakes on their assignments.

INTERPRETATIONS AND CONCLUSIONS

The data collected over these six months indicated peer review did not affect my students' performances on assignments and assessments. Students showed no apparent change on Unit Tests during the treatment units in comparison to the non-treatment units. The means of scores decreased while the distributions remained. This could have been because they only had to complete one part of the whole group's laboratory report during the treatment units, while in the non-treatment units they were responsible for writing up an entire report. Student may have benefited from individual reports. The analysis showed no substantial evidence for group and individual reports being any different.

Overall students gradually decreased in performances on Unit Quizzes. This was most likely due to the progression of complexity in the content within each successive unit. As the content of the course became more difficult, the student's scores went down. This has always been the case for my students in the past. This was true here for each unit except for the fourth, when we transitioned from chemistry into physics. For my previous students, the foundational concepts for physics presented in the fourth unit have been easier to grasp than the ideas of organic and acid/base chemistry in the third unit.

Student performances on Diagram Rubrics remained the same for each unit. Students were able to perform similarly on these assignments whether they graded the assignments of their peers or their own. The only unit showing an increase was the third, which was a non-treatment. One observation made in this unit was of students grading each other's assignments even when instructed not to. This made me wonder whether or not they were clear on my instruction to refrain from reviews. This could have been the case, or they could have become familiar to the process so they preferred to practice it.

Five questions from the Pre and Post-Survey results did show some effects that may be attributed to the peer review process. Four of these effects displayed an increase in comfort when helping or getting help from another student. This help was either for completing an assignment or understanding a scientific concept. Both the students and a teacher could have initiated this assistance. The survey results demonstrated evidence for an increase in comfort level when asking for and receiving help from students whether it was student or teacher motivated. The process of peer review could have played a role in increasing this comfort, however the students' interviews suggested my students became more familiarized with their peers and this contributed to an increase in comfort levels.

The final survey item emphasized in the analysis provided evidence for a decrease in confidence on assessment performance before any teacher feedback was given. It was hoped the cooperative learning strategies would increase the students' ability to rate their performance on assignments and assessments, but the progression of content complexity could have contributed to the decrease in confidence levels. One of the interviewed students explained how the change in content negatively affected their assessment scores. This notion is also supported by the gradual decreases of their Unit Quiz performances.

The observations and reflections recorded over the six months gave me some indications on how my attitude was negatively affected by the process of peer review. Most observations made were of students doing an inadequate job in reviewing their peer's products. These students appeared to be just filling in the values of performances without even looking to see if their peers had actually accomplished the components. My reflections were usually expressed feelings of frustration due to the lack of time available for the product review or because of many students not participating within their groups.

VALUES AND CLAIMS

For my students, and also me, many valuable lessons were learned over the six months spent cycling between six-week intervals of treatment and non-treatment units. Whether or not peer reviews and group laboratory reports directly affected my students' science skills and knowledge, they still showed an increase in comfort when helping their peers and getting help from them. The conversations induced by peer reviews and group reports most likely played a role in producing the quantitative results of the surveys and their justifications heard in the interview explanations. Teaching students to practice the cooperative skills was challenging and measuring their ability to practice them was nearly impossible. Most observations made were unfavorable behaviors, but when circulating my classroom, I usually looked for something that seems of place. My reflections were usually a record of aggravation during data collection process. The two issues I was presented with were a lack of time and unmotivated students. However these are two hardships that are constantly dealt with in my profession regardless of the circumstances.

In the early stages of planning the data collection phases, I was presented with a decision that would undoubtedly affect the outcome of my results. The choice of using dependent and paired data presented the issue of varying content, while the alternative use of independent and separate groups would lead to a variation between samples. The choice to select the paired data was persuaded by ethical considerations. If one of my student groups showed positive results and I decisively excluded this strategy from the other, for the sake of research purpose alone, I would have not found it acceptable. This was not the case on assignment and assessment performances, nevertheless my students did learn how to use each other as resources for learning which is an essential skill.

The decision of implementing the treatment for all of my students had two major effects on the process of data collection. One of them included the large amounts of data I was able to collect. This was congruent with my ethical viewpoint and also allowed for a larger sample size. The amount of data collected took a longer time for me to analyze but more accurately reflected the population of students in my community. The other aspect affecting results of my data was variation in content. Progression of chemistry content complicatedness, in the second and third unit, prevented me from controlling the variables being used to measure performances of my students with the collection tools.

I learned the change in content made the effects of the treatment more difficult to detect. If I was able to spend a longer amount of time collecting data, these effects could be gradually diluted over time. A look back in performances of students from my three previous eighth grade physical science courses, who come from the same background, could supply motivation for the continuation of practicing cooperative learning skills in the context of science education. The progression of my teaching skills over these last few years may have had more of an effect, just as the development of my students' level of comfort when helping each other in my classroom over the course of this school year. Using the dependant variable of time brings forth many other uncontrollable variables.

As a professional educator, my ability to analyze the performance of my students has changed dramatically. Initially in the planning and implementation of my treatment, I was under the impression this process would be much easier to carry out. I realized that the analysis of students under varying conditions such as the content, skill abilities, and physical maturity, makes precise investigations complicated. Knowing my students, their capabilities and the group's dynamics allows cooperative learning to endure in my class.

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APPENDICES

APPENDIX A

NON-TREATMENT DIAGRAM RUBRICS

Name: ____ Date: ________________

Room Decoration Rubric

______ Decoration displays the full name of the student who has creating it (2 points)

______ Decoration illustrates cultural heritage of the student who created it (2 points)

______ Decoration illustrates activities student participates in after school (2 points)

______ Decoration is neat, organized, colorful and demonstrates creativity (2 points)

______ Decoration uses all the available space on the paper used to create it (2 points)

Name: ____ Date: ________________

States Diagram Rubric

______ Diagram illustrates the density and motion of particles in a solid (2 points)

______ Diagram illustrates the density and motion of particles in a liquid (2 points)

______ Diagram illustrates the density and motion of particles in a gas (2 points)

______ Diagram explains how liquids can be changed into gases and solids (2 points)

______ Diagram explains how gases and solids can be changed into liquids (2 points)

Name: ____ Date: ________________

Gas Laws Diagram Rubric

______Illustrates & explains relationship between gas temperature vs. volume (2 points)

______Illustrates & explains the relationship between gas volume vs. pressure (2 points)

______Illustrates & explains relationship between gas temperature vs. pressure (2 points)

______Drawn graph & given expression of two directly proportional relationships (2 pts)

______Drawn graph & given expression of an inversely proportional relationship (2 pts)

Name: ____ Date: ________________

Structural Formula Diagram Rubric

______ Structural formula of saturated hydrocarbon w/ chemical formula caption (2 pts)

______ Structural formula of unsaturated hydrocarbon w/ chemical formula caption (2)

______ Structural formula of an organic alcohol with chemical formula caption (2 points)

______ Structural formula of an organic acid with a chemical formula caption (2 points)

______ Structural formula of substituted hydrocarbon with chemical formula caption (2)

Name: ____ Date: ______________

Neutralization Diagram Rubric

_____ Diagram includes chemical formula and structural formula of an acid. (2 points)

_____ Diagram includes chemical formula and structural formula of a base. (2 points)

_____ Diagram shows how acid produces hydrogen ions in water mixtures. (2 points)

_____ Diagram shows how base produces hydroxide ions in water mixtures. (2 points)

_____ Diagram shows balanced neutralization equation making water and a salt. (2 pts)

APPENDIX B

NON-TREATMENT PRE-TESTS

Name: ____ Date: __________________

States of Matter & Sate Transitions Pre-Test

1. What state of matter has definite shape and volume?
A. Gas B. Solid C. Liquid D. None of these

2. What state of matter has definite volume but no definite shape?
A. Gas B. Solid C. Liquid D. None of these

3. What state of matter has no definite shape or volume?
A. Gas B. Solid C. Liquid D. None of these

4. Name the state of matter where particles are locked in position and vibrating.
A. Gas B. Solid C. Liquid D. None of these

5. Particles are kind of close and slide past each other in which sate of matter?
A. Gas B. Solid C. Liquid D. None of these

6. Particles that are separated and can collide with each other are called what?
A. Gas B. Solid C. Liquid D. None of these

7. Substances can be found in this state of matter at their highest temperatures.
A. Gas B. Solid C. Liquid D. None of these

8. Substances can be found in his sate of matter at their lowest temperatures.
A. Gas B. Solid C. Liquid D. None of these

9. Substances in this state take the shape of their container and can be seen easily.
A. Gas B. Solid C. Liquid D. None of these

10. Substances in this state of matter have the lowest density compared to others.
A. Gas B. Solid C. Liquid D. None of these

11. Which of the three states of matter has the highest density compared to others?
A. Gas B. Solid C. Liquid D. None of these

12. Which of the three states has a density in between the other two states?
A. Gas B. Solid C. Liquid D. None of these

13. Which state transition occurs when gases lose enough thermal energy?
A. Freezing B. Melting C. Condensation D. Vaporization

14. What state transition occurs when liquids lose enough thermal energy?
A. Freezing B. Melting C. Condensation D. Vaporization

15. Name the state transition that occurs when solids gain enough thermal energy?
A. Freezing B. Melting C. Condensation D. Vaporization

16. The state transition that occurs when liquids gain enough thermal energy is called
A. Freezing B. Melting C. Condensation D. Vaporization

17. Solids changing into liquids are which of the following state transitions?
A. Freezing B. Melting C. Condensation D. Vaporization

18. When a liquid changes into the gas state what state transitions occurs?
A. Freezing B. Melting C. Condensation D. Vaporization

19. Gases turning into liquids are which of the following state transitions?
A. Freezing B. Melting C. Condensation D. Vaporization

20. When a liquid changes into a solid it is called this state transition.
A. Freezing B. Melting C. Condensation D. Vaporization

______21. (T/F) If the temperature of a gas is increased its volume will decrease.

______22. (T/F) If the volume of a gas is decreased its pressure will increase.

______23. (T/F) If the temperature of a gas is increased its pressure will increase.

______24. (T/F) The pressure and volume of a gas are directly proportional.

______25. (T/F) The temperature and pressure of a gas are directly proportional.

APPENDIX C

UNIT TESTS

Name: ____ Date: ________________

Unit # 1 Test

Asking Questions: You are trying to find out which of the two different metal substances will take a longer time to melt. Aluminum has a melting point of 660°C and lead has a melting point of 330°C. You are given 100 grams of aluminum, 50 grams of lead, two beakers, two hot plates with high/med/low settings, two thermometers and a stopwatch. Use information provided to answer the question about which takes a longer time to melt.

Forming a Hypothesis: Make a testable prediction for how you think that changing the substance will affect the time it takes to melt. Your prediction should be in the form of an if-then statement where the "if" explains the cause and the "then" explains the effect. (4 points)

Developing Procedures: Use the material listed above to create a detailed procures list of how to test you hypothesis. Be sure to include all of the variables (what could change). This includes the independent or manipulated variable (what you change), the dependant or responding variable (what changes in response to another change), and the controlled variable (what could change but you want to keep constant). List you procedures in the correct sequence and make them clear enough for other scientists to other to repeat them. (4 points)

<u>Data Analysis</u>: Use the data collected below to create a chart or a graph that allows you to make conclusions about your hypothesis. Be sure to include given units in your analysis. (3 points)

After 1 minute aluminum was at 20°C and lead was at 20°C
After 2 minutes aluminum was at 180°C and lead was at 90°C
After 3 minutes aluminum was at 340°C and lead was at 160°C
After 4 minutes aluminum was at 500°C and lead was at 230°C
After 5 minutes aluminum was at 660°C and lead was 300°C

<u>Drawing Conclusions</u>: Use your chart or graph to make a claim about your hypothesis. Justify your claim with the evidence gathered in the experiment. Justify how the evidence supports or contradicts the claim. Finally, ask another question to guide further research. (4 points)

Name: ____ Date: _________________

Unit #2 Test

State the Problem: You are given four cups of unknown substances and you are trying to find out which is which. Substance A is flammable, mixes in water, has the lowest density, and has the highest boiling point. Substance B is not flammable, does not mix with water, has the highest density, and has the second lowest boiling point. Substance C is flammable, does not mix with water, has the second lowest density, and has the second highest boiling point. Substance D is flammable, does mix with water, has the second highest density, and the lowest boiling point. You are given a lighter, four cups of water, a stirring stick, a balance for measuring mass, four beakers and a hot plate. Use all of the information and supplies above to test your hypotheses.

Forming hypotheses: You need to make four different hypotheses for which of the four cups will be which of the four unknown substances. Each cup is labeled as one, two, three, and four. The properties of the unknown substances are described above. Your four hypotheses should predict which of the four numbers on these cups would match up with the four letters of the substances. (4 points)

Developing procedures: You need to write a list of steps that will allow you to test each of your four hypotheses. The procedure list should include the use of all the materials mentioned above. Make sure the procedures are listed in the correct sequence and they can be followed by anyone. Your procedures should test all properties of the four substances described above in the problem. (4 points)

Data Analysis: Use the observations recorded below to make a table that organizes the data into a format that allows you to draw conclusions about which substance is which. Make sure that the table includes all four substances and all four ways the properties were tested in this experiment. (3 points)

Cup #1: is flammable, didn't mix in water, a mass of 50 grams, and boiling point of 70°C
Cup #2: is flammable, mixed in water, had a mass 25 grams, and a boiling point of 80°C
Cup #3: not flammable, didn't mix in water, had a 100 grams mass, & 60°C boiling point
Cup #4 was flammable, mixed in water, had 75 grams mass, and a boiling point of 50°C

Drawing Conclusions: Use all the data collected and organized above to draw conclusions about which of the four cups are which of the four unknown substances. Your conclusion should make claims about each of your hypotheses and also should be supported with evidence in the form of the data collected. You need to make justification statements for each of your claims explaining how the data can be used as evidence to support your claims. Finally, end you conclusion with a final question that will guide further research and provide a better understanding of information. (4 points)

Name: ____ Date: ________________

Unit # 3 Test

Asking Questions: You are trying to find out how the temperature of a water solvent changes the time to dissolve a salt solute when put into solution. You are given two grams of salt, two liters of hot and cold water, two thermometers, and two stopwatches. Form a hypothesis that predicts how a changing temperature will affect the different times it takes for the water to dissolve the salt, develop procedures for an experiment to test it, and then analyze the data provided to make a conclusion about your hypothesis.

Forming a Hypothesis: Make a testable prediction for how you think that changing the temperature will affect the time it takes to dissolve. Your prediction should be in the form of an if-then statement so "if" explains the cause and the "then" explains the effect. (4 points)

Developing Procedures: Use the material listed above to create a detailed procures list of how to test you hypothesis. Be sure to include all of the variables (what could change). This includes the independent or manipulated variable (what you change), the dependant or responding variable (what changes in response to another change), and the controlled variable (what could change but you want to keep constant). List your procedures in the correct sequence and make them clear enough for other scientists to other to repeat them. (4 points)

Data Analysis: Us the data collected below to create a chart or a graph that allows you to make conclusions about your hypothesis. Be sure to include all of the information given. (3 points)

After 1 minute the salt in both the hot and the cold water were not dissolved at all.
In 2 min salt in cold water was not dissolved & salt in hot water was a little dissolved.
In 3 min salt in cold water was a little dissolved & salt in hot water was half dissolved.
In 4 min salt in cold water was half dissolved & salt in hot water was mostly dissolved.
In 5 min salt in cold water was mostly dissolved & salt in hot water was totally dissolved.

Drawing Conclusions: Use your chart or graph to make a claim about your hypothesis. Justify your claim with the evidence gathered in the experiment. Justify how the evidence supports or contradicts the claim. Finally, ask another question to guide further research. (4 points)

Name: ____ Date: ________________

Unit # 4 Test

Asking Questions: You are trying to discover how changing the height of a ball dropped from above the ground will change the height the ball bounces back up from the ground. You are given a ladder, a meter stick, and a basketball. Form a hypothesis that predicts what you think will occur, use the materials to write a detailed procedures list, analyze the data given in the chart, and then write a scientific conclusion about your discovery.

Forming a Hypothesis: Make a testable prediction for how you think that changing the dropped height will change the height of the bounce. Your prediction should be in the form of an if-then statement where “if” explains a cause and “then” explains an effect. (4 Points)

Developing Procedures: Use the material listed above to create a detailed procures list of how to test your hypothesis. Be sure to include all of the variables (what could change). This includes the independent or manipulated variable (what you change), the dependant or responding variable (what changes in response to another change), and the controlled variable (what could change but you want to keep constant). List your procedures in the correct sequence and make them clear enough for other scientists to other to repeat them. (4 points)

Data Analysis: Us the data collected below to create a chart or a graph that allows you to make conclusions about your hypothesis. Be sure to include given units in your analysis. (3 Points)

When dropped from a height of 6 meters, the ball bounced back up 1 meter
When dropped from a height of 7 meters, the ball bounced back up 2 meters
When dropped from a height of 8 meters, the ball bounced back up 3 meters
When dropped from a height of 9 meters, the ball bounced back up 4 meters
When dropped from a height of 10 meters, the ball bounced back up 5 meters

Drawing Conclusions: Use your chart or graph to make a claim about your hypothesis. Justify your claim with the data gathered in the experiment. Justify how the data is used as evidence to support your claim. Finally, ask another question to guide further research. (4 Points)

APPENDIX D

TREATMENT DIAGRAM RUBRICS

Name: ____ Date: _________________

<u>Atomic Diagram Rubric</u>

_____ Title has element name/symbol with the correct atomic number/mass. (2 points)

_____ Nucleus contains the correct proton amount and illustrates their charge. (2 points)

_____ Explains how to find atomic mass & illustrates correct neutron number. (2 points)

_____ States if it is an isotope or not & explains how you can tell if an atom is. (2 Points)

_____ Explains if it is ionic & illustrates the correct amount of electric charge. (2 Points)

Graded by: ____

Name: ____ Date: ____________

<u>Periodic Table Diagram Rubric</u>

______ Drawn and labeled all elements found in periods 1- 4 and groups 1-18 (2 points)

______ Each square contains element name, symbol, atomic number and mass. (2 points)

______ Each square shows element type & which state of matter it is found in. (2 points)

______ Key is given to explain meaning of the numbers & colors of diagram. (2 points)

______ Explains how the periods & groups of the periodic table are organized. (2 points)

Graded by: ____

Name: ____ Date: _________________

<u>Bonding Diagram Rubric</u>

_____ Covalent bond between non-metal elements is illustrated and labeled. (2 points)

_____ Bond shows the shared pair or pairs of electrons held between atoms. (2 points)

_____ Ionic bond between a metal & a non-metal element is illustrated/labeled. (2 points)

_____ Bond shows the gain/loss of electrons and the ionic charge or the atoms. (2 Points)

_____ Covalent double or triple bond held between atoms is drawn & labeled. (2 Points)

Graded by: ____

Name: ____ Date: __________________

Room Scale Model Rubric

_____ Model illustrates all of the significant objects found in the classroom (2 points)

_____ Model illustrates the accurate sizes of the objects found in the classroom (2 points)

_____ Model illustrates accurate distances between objects in the classroom (2 points)

_____ Model illustrates accurate distances between objects & walls of the class (2 points)

_____ Model labels all of the significant objects found within the classroom (2 points)

Graded by: ____

Name: _______________________________________ Date: ____________________

Energy Conversion Concept Map

_____ Map shows kinetic/potential energy transformation into & from another (2 pts)

_____ Concept map shows thermal energy transformation into and from another (2 pts)

_____ Concept map shows chemical energy transformation into & from another (2 pts)

_____ Concept map shows electrical energy transformation into and from another (2 pts)

_____ Map shows electromagnetic energy transformation into and from another (2 pts)

Graded by ____

APPENDIX E

UNIT QUIZZES

Name: ____ Date: ________________

Scientific Process Quiz

Asking Questions: You are trying to find out how adding salt to water will change the temperature water will boil. You are given two identical pots, two stove burners with low/medium/high settings, four liters of water, 1000 grams of salt, a stopwatch, and a thermometer. Use all of the information and materials provided to answer this question.

Forming a Hypothesis: Make a testable prediction for how you think adding salt to water will change the temperature the water will boil. Your prediction should be in the form of an if-then statement where the "if" explains the cause and the "then" explains the effect. (4 points)

Developing Procedures: Use the material listed above to create a detailed procures list of how to test you hypothesis. Be sure to include all of the variables (what could change). This includes the independent or manipulated variable (what you change), the dependant or responding variable (what changes in response to another change), and the controlled variable (what could change but you want to keep constant). List you procedures in the correct sequence and make them clear enough for other scientists to other to repeat them. (4 points)

Data Analysis: Us the data collected below to create a chart or a graph that allows you to make conclusions about your hypothesis. Be sure to include given units in your analysis. (3 points)

After 1 minute salt water was at 35°C and no salt was at 35°C
After 2 minutes salt water was at 51°C and no salt was at 50°C
After 3 minutes salt water was at 68°C and no salt was at 66°C
After 4 minutes salt water was at 86°C and no salt was at 83°C
After 5 minutes salt wat6er was boiling at 105°C and no salt was boiling at 100°C

Drawing Conclusions: Use your chart or graph to make a claim about your hypothesis. Justify your claim with the data gathered in the experiment. Justify how the evidence supports or contradicts the claim. Finally, ask another question to guide further research. (4 points)

Name: ____ Date: ________________

States, Transitions, & Gas Laws Quiz

1. Describe the shapes and volumes of three states of matter under no stress. (6 points)

2. Explain particle motion in each state & compare their relative temperatures. (6 points)

3. Illustrate and compare the relative density of matter in the three states. (6 points)

4. Name the solid into liquid transition & describe changes in thermal energy. (2 points)

5. State the liquid into gas transition & describe changes in thermal energy. (2 points)

6. Name the gas into liquids transition & describe changes in thermal energy. (2 points)

7. State the liquid into solid transition & describe changes in thermal energy. (2 points)

8. Explain gas temperature vs. volume with words, a graph, and an expression. (3 points)

9. Explain gas volume vs. pressure with words, a graph, and an expression. (3 points)

10. Explain gas temperature vs. pressure with words, graph, and an expression. (3 points)

Name: ____ Date: _________________

Atoms Quiz

Directions: Write the appropriate label on the lines given below and use the information to draw a diagram of an atom that displays the correct amount of all subatomic particles.

14 ____ (1 point)

6 ____ (1 point)

2 ____________________________ (1 point)

C

(1 point)

12 ____

Draw a diagram of an atom below that represents the information in the periodic square.

Correct proton number and charge (2 Points)

Correct neutron number and charge (2 Points)

Correct electron number and charge (2 Points)

Atom ___________ an isotope because ______________________________ (2 points)
(is or is not) (reason for the choice you made)

Atom __________ an ion because ____
(is or is not) (reason for the choice you made)

so therefore it has an overall net charge of ____________________________ (3 points)

Atoms Quiz Continued

______1. Which of the following is the study of matter and how it changes?
A. Physics
B. Biology
C. Chemistry
D. Geology

_______2. What are the basic building blocks of the type of matter we understand the most?
A. Atoms
B. Molecules
C. Compounds
D. Mixtures

_______3. Name the center of an atom made of two different types of particles.
A. Neutron
B. Electron
C. Proton
D. Nucleus

_______4. What is the positively charged particle found in the center of the atom?
A. Neutron
B. Electron
C. Proton
D. Nucleus

_______5. Name the negatively charged particle found in the space around the nucleus.
A. Neutron
B. Electron
C. Proton
D. Nucleus

_______6. What is the particle in the center of an atom that has no electric charge?
A. Neutron
B. Electron
C. Proton
D. Nucleus

_______7. Atoms of the same element with different numbers of neutrons are called…
A. Electrons
B. Negatively charged ions
C. Isotopes
D. Positively charged ions

_______8. The particles that atoms share when they react are which of the following?
A. Electrons
B. Negatively charged ions
C. Isotopes
D. Positively charged ions

_______9. What is formed when atoms lose an electron and have one more proton?
A. Electrons
B. Negatively charged ions
C. Isotopes
D. Positively charged ions

_______10. What is formed when atoms gain an electron and then have one less proton?
A. Electrons
B. Negatively charged ions
C. Isotopes
D. Positively charged ions

Name: ____ Date: _________________

Compounds and Reactions Quiz

Use the periodic table to illustrate elements with the correct amounts of valence electrons (1 point each), the right way bonds are formed (1 point), and charge atoms have (1 point)

1. Draw an electron dot diagram of the molecule Hydrogen Iodine with a formula HI (3)

2. Draw an electron dot diagram of a diatomic molecule Bromine with a formula Br_2 (3)

3. Draw an electron dot diagram of a diatomic molecule Selenium with a formula Se_2 (3)

4. Draw a dot diagram of a diatomic molecule Phosphorus with a formula of P_2 (3 pts)

5. Draw a dot diagram of an ionic compound Potassium Chloride with a formula KCl (4)

6. Draw a dot diagram of an ionic compound Magnesium Sulfate a the formula MgS (4)

7. Draw a dot diagram of an ionic compound Aluminum Nitride with a formula AlN (4)

Write the coefficients for the number of molecules to conserve the number of atoms.

8. _____ SiO_2 + _____ HCl → _____ $SiCl_4$ + _____ H_20 (4 points)

9. _____ $AlCl_3$ + _____ H_2 → _____ Al + _____ HCl (4 points)

______10. The force of attraction that holds atoms together in compounds is called what?
A. Valence electrons
B. Chemical formulas
C. Chemical bonds
D. Dot diagrams

______11. These particles are gained, shared, or lost when atoms react with each other.
A. Valence electrons
B. Chemical formulas
C. Chemical bonds
D. Dot diagrams

______12. How do you illustrate the electron number in an atom's highest energy level?
A. Valence electrons
B. Chemical formulas
C. Chemical bonds
D. Dot diagrams

______13. What symbols are used to show the ratio of elements in a compound?
A. Valence electrons
B. Chemical formulas
C. Chemical bonds
D. Dot diagrams

______14. Name the types of bonds that form between metal and non-metal elements?
A. Polar bonds
B. Double/Triple bonds
C. Covalent bonds
D. Ionic bonds

______15. The types of bonds between two non-metal elements are known as what?
A. Polar bonds
B. Double/Triple bonds
C. Covalent bond
D. Ionic bonds

______16. These types of bonds form when atoms share more than one pair of electrons.
A. Polar bonds
B. Double/Triple bonds
C. Covalent bond
D. Ionic bonds

______17. When atoms are attracted to each other's opposite charges what is made?
A. Polar bonds
B. Double/Triple bonds
C. Covalent bond
D. Ionic bonds

Name: ____ Date: _________________

Carbon Chemistry Quiz

1. Draw a structural formula of the saturated hydrocarbon pentane with the formula:

C_5H_{12}

2. Draw an isomer of the saturated hydrocarbon above that has the same formula.

3. Draw a structural formula of the unsaturated hydrocarbon pentene with the formula:

C_5H_{10}

4. Draw a structural formula of the unsaturated hydrocarbon pentyne with the formula:

C_5H_8

5. Draw a structural formula of the substituted hydrocarbon butanol with the formula:

C_4H_9OH

6. Draw a structural formula of the substituted hydrocarbon butaonic acid with formula:

C_3H_7COOH

7. Draw a structural formula of the substituted hydrocarbon chloroethane with formula:

C_2H_5Cl

_______8. Which of the following is NOT one ways carbon chains can be arranged?
A. Straight B. Branched
C. Spiraled D. Ringed

_______9. What form of pure carbon has the carbon atoms arranged in crystals?
A. Fullerene B. Graphite
C. Nanotube D. Diamond

_______10. What form of pure carbon has carbon atoms arranged in flat layers?
A. Fullerene B. Graphite
C. Nanotube D. Diamond

_______11. What form of pure carbon has the carbon atoms arranged into a hollow tube?
A. Fullerene B. Graphite
C. Nanotube D. Diamond

_______12. Name the small molecules that are combined to make larger molecules.
A. Alcohols B. Monomers
C. Organic acids C. Polymers

_______13. Name the large molecules made of many smaller molecules bonded together.
A. Alcohols B. Monomers
C. Organic acids C. Polymers

_______14. What ringed shaped organic compounds provide organisms with short-term energy?
A. Proteins B. Lipids
C. Carbohydrates D. Nucleic acids

_______15. What branched chains of organic compounds provide organisms w/ long-term energy?
A. Proteins B. Lipids
C. Carbohydrates D. Nucleic acids

_______16. What organic compound is an amino acids polymer & makes most living structures?
A. Proteins B. Lipids
C. Carbohydrates D. Nucleic acids

_______17. What polymer of nucleic acids contains the code of life found in all organisms?
A. Proteins B. Lipids
C. Carbohydrates D. DNA

_______18. What organic compounds are found in fats, oils, and dairy products?
A. Proteins B. Lipids
C. Carbohydrates D. Nucleic acids

_______19. What organic compounds are found in meats, fish, eggs, and milk?
A. Proteins B. Lipids
C. Carbohydrates D. Nucleic acids

_______20. What organic compounds are found in sugars, breads, grains, and pastas?
A. Proteins B. Lipids
C. Carbohydrates D. Nucleic acids

Name: ____ Date: _________________

Acid & Base/Solution Quiz

______1. What are mixtures that contain one or more substances dissolved into another?
A. Suspensions B. Solutions
C. Solvents D. Solutes

______2. The substances in solutions that are present in the smaller amounts are what?
A. Suspensions B. Solutions
C. Solvents D. Solutes

______3. Name the substances in solutions that are present in the larger amounts.
A. Suspensions B. Solutions
C. Solvents D. Solutes

______4. Mixtures of un-dissolved substances large enough to be seen in another are…
A. Suspensions B. Solutions
C. Solvents D. Solutes

______5. Solute particles broken apart and separated to small to see in solution are what?
A. Colloid B. Dissolved
C. Concentrated D. Dilute

______6. How can a solution with a small amount of amount of solute be described?
A. Colloid B. Dissolved
C. Concentrated D. Dilute

______7. How can a solution with a large amount of amount of solute be described?
A. Colloid B. Dissolved
C. Concentrated D. Dilute

______8. A mixture of particles too small to see but large enough to scatter light is what?
A. Colloid B. Dissolved
C. Concentrated D. Dilute

______9. What are substances that have a value from 8 – 14 on the PH scale?
A. Acids B. Bases
C. Neutral D. Salts

______10. Name the substances that have a value from 1 – 6 on the PH scale?
A. Acids B. Bases
C. Neutral D. Salts

______11. How are substances like water with a PH value of 7 described?
A. Acids B. Bases
C. Neutral D. Salts

______12. Name the substances that are produced in the reactions between acids and bases.
A. Acids B. Bases
C. Neutral D. Salts

13. State what acids produce in solution & give an example of a common one. (2 points)

14. State what bases produce in solutions & give an example of a common one. (2 points)

15. Describe differences of weak & strong acids by ion concentration & pH value. (2 pts)

16. Describe differences of weak & strong bases by ion concentration & pH value. (2 pts)

17. Name colors acids & bases turn indicators when they are dipped into solution. (2 pts)

18. Explain relationship between pressure and solubility of gas solutes in solution. (2 pts)

19. Explain the link between temperature and solubility of gas solutes in solution. (2 pts)

19. Describe how adding a solute changes a solution’s freezing & boiling points. (2 pts)

20. Describe differences found between a saturated & an unsaturated solution. (2 points)

Name: ____ Date: ___________________

Motion Quiz

1. Draw a dot in a random point of the space below and describe its position by stating the distance it is from two reference points and the direction it is from them. (4 points)

2. Draw a line in the space below that changes direction two times at right angles and then measure the total distance and displacement of the tip of your pencil. (4 points)

3. An object moves 16 meters from reference point in 2 seconds. Calculate speed. (2 pts)

4. Then moves 8 meters back to the reference point in 2 seconds. Calculate speed. (2 pts)

5. Calculate the average speed of the objects motion in the two last questions. (2 points)

6. Calculate the acceleration of the objects motion from questions three & four. (2 points)

7. Graph the motion from questions three and four and label each of the axes. (4 points)

Name: ____ Date: ________________

Motion Quiz Continued

______8. When an object's distance is changing to another object this event is occurring.
A. Speed B. Position
C. Motion D. Distance

______9. When you describe the location of an object in comparison to another its is…
A. Speed B. Position
C. Motion D. Distance

______10. What measures distance an object travels divided by time of observed motion?
A. Speed B. Position
C. Motion D. Distance

______11. Name the place of comparison used to determine the position of an object.
A. Vector B. Reference point
C. Distance D. Displacement

______12. What is the total length of the path through space that an object travels?
A. Vector B. Reference point
C. Distance D. Displacement

______13. Name the length of space an object moves from its starting to ending point.
A. Vector B. Reference point
C. Distance D. Displacement

______14. The total distance an object travels divided by the total time it takes is called...
A. Acceleration B. Velocity
C. Average speed D. Instantaneous speed

______15. Name part of the distance an object moves in a chosen time of its' movement.
A. Acceleration B. Velocity
C. Average speed D. Instantaneous speed

______16. What value describes the speed and direction of an objects' movement?
A. Acceleration B. Velocity
C. Average speed D. Instantaneous speed

______17. Which of the following measures the change of an object's speed & direction?
A. Acceleration B. Velocity
C. Average speed D. Instantaneous speed

Name: ____ Date: ______________

Energy Quiz

______1. When an object with mass is accelerated a distance what is done on it?

A. Joules B. Energy
C. Conservation of energy D. Work

______2. Which of the following is defined as the ability to cause change?

A. Joules B. Energy
C. Conservation of energy D. Work

______3. Name the units that are used to measure mass accelerating a certain distance.

A. Joules B. Energy
C. Conservation of energy D. Work

______4. What law states that energy is never created or destroyed but only transformed?

A. Joules B. Energy
C. Conservation of energy D. Work

______5. The energy of an object due to its motion in space is which type of energy?

A. Gravitational potential B. Kinetic
C. Elastic potential D. Mechanical

______6. Which of the following is the energy of an object due to its position in space?

A. Gravitational potential B. Kinetic
C. Elastic potential D. Mechanical

______7. Name total energy that an object has due to its motion and position in space?

A. Gravitational potential B. Kinetic
C. Elastic potential D. Mechanical

______8. The energy that is held in the atomic bonds is which of the following?

A. Electrical B. Thermal
C. Chemical D. Electromagnetic

______9. Name the energy caused by the movement of electrons through materials.

A. Electrical B. Thermal
C. Chemical D. Electromagnetic

______10. What is the energy due to the random motion of an object's particles?

A. Electrical B. Thermal
C. Chemical D. Electromagnetic

______11. Which of the following is energy caused from waves moving through space?

A. Electrical B. Thermal
C. Chemical D. Electromagnetic

12. An eight-kilogram object has a velocity of two m/s. Calculate kinetic energy. (2 pts)

13. The object is two meters above earth. Calculate gravitational potential energy. (2 pts)

14. Calculate total mechanical energy using answers from the last two questions. (2 pts)

15. Explain how energy can transform into and be converted from thermal energy. (2 pts)

16. Explain how energy can transform into & be converted from chemical energy. (2 pts)

17. Explain how energy can transform into & be converted from electrical energy. (2 pts)

18. Explain how energy can be transformed into & be converted from EM energy. (2 pt)

APPENDIX F

COOPERATIVE LEARNING PRE-SURVEY

Name: ____ Date: _________________

Cooperative Learning Pre-Survey

Directions: Rate your level of enjoyment, comfort, or confidence on each and explain with at least one sentence why. Participation in this research is voluntary and participation or non-participation will not affect any student's grades or class standing in any way at all.

1. On scale from 1-10 (ten the most and one the least) rate your level of enjoyment on activities that involve completing assignments and learning in groups. Justify rating.

2. On scale from 1-10 (ten the most and one the least) rate your level of comfort when another student asks you to help them complete an assignment. Justify your rating.

3. On scale from 1-10 (ten the most and one the least) rate your level of comfort in asking another student to help you in understanding in a scientific concept. Justify your rating.

4. On scale from 1-10 (ten the most and one the least) rate your level of comfort when a a teacher asks you to help a student understand a scientific concept. Justify your rating.

5. On scale from 1-10 (ten the most and one the least) rate your level of comfort when a teacher asks another student to help you understand a scientific concept. Justify rating.

6. On scale from 1-10 (ten the most and one the least) rate your level of comfort on group projects where your grade is based on the involvement of all members. Justify rating.

7. On scale from 1-10 (ten the most and one the least) rate your level of comfort when you have to fill out a rubric and grade your own assignments. Justify your rating.

8. On scale from 1-10 (ten the most and one the least) rate the confidence level of your performance on submitted assignments before you get teacher feedback. Justify rating.

9. On scale from 1-10 (ten the most and one the least) rate the confidence level of your performance on completed assessments before getting teacher feedback. Justify rating.

10. On scale from 1-10 (ten the most and one the least) rate your level of confidence in preparing for quizzes and tests before you are given them to take. Justify your rating.

APPENDIX G

COOPERATIVE LEARNING POST-SURVEY

Name: ____ Date: _________________

Cooperative Learning Post-Survey

Directions: Participation in this research is voluntary and either participation or non-participation will not affect any student's grades or class standing in any way at all.

1. On scale from 1-10 (ten the most and one the least) rate your level of enjoyment on activities that involve completing assignments and learning in groups. Justify rating.

2. On scale from 1-10 (ten the most and one the least) rate your level of comfort when another student asks you to help them complete an assignment. Justify your rating.

3. On scale from 1-10 (ten the most and one the least) rate your level of comfort in asking another student to help you in understanding in a scientific concept. Justify your rating.

4. On scale from 1-10 (ten the most and one the least) rate your level of comfort when a a teacher asks you to help a student understand a scientific concept. Justify your rating.

5. On scale from 1-10 (ten the most and one the least) rate your level of comfort when a teacher asks another student to help you understand a scientific concept. Justify rating.

6. On scale from 1-10 (ten the most and one the least) rate your level of comfort on group projects where your grade is based on the involvement of all members. Justify rating.

7. On scale from 1-10 (ten the most and one the least) rate your level of comfort when you have to fill out a rubric and grade another student's assignment. Justify rating.

8. On scale from 1-10 (ten the most and one the least) rate the confidence level of your performance on submitted assignments before you get teacher feedback. Justify rating.

9. On scale from 1-10 (ten the most and one the least) rate the confidence level of your performance on completed assessments before getting teacher feedback. Justify rating.

10. On scale from 1-10 (ten the most and one the least) rate your level of confidence in preparing for quizzes and tests before you are given them to take. Justify your rating.

APPENDIX H

INTERVIEW QUESTIONNAIRE

Name: ____ Date: _________________

Interview Questionnaire

Directions: Use the responses from the student surveys to write more about the ratings originally given and the justifications written to explain each value of students' ratings.

1. Please elaborate on your rating and justification for survey inquiry number one.

2. Please elaborate on your rating and justification for survey inquiry number two.

3. Please elaborate on your rating and justification for survey inquiry number three.

4. Please elaborate on your rating and justification for survey inquiry number four.

5. Please elaborate on your rating and justification for survey inquiry number five.

6. Please elaborate on your rating and justification for survey inquiry number six.

7. Please elaborate on your rating and justification for survey inquiry number seven.

8. Please elaborate on your rating and justification for survey inquiry number eight.

9. Please elaborate on your rating and justification for survey inquiry number nine.

10. Please elaborate on your rating and justification for survey inquiry number ten.