

THE EFFECTS OF HOMEWORK GRADES ON THE OUTCOME OF STUDENT  
ASSESSMENT SCORES IN HIGH SCHOOL PHYSICAL SCIENCE

by

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## ABSTRACT

Science education faces many challenges in engaging students based on many internal and external factors: academic ability, grit, and social-economical. Students want instant feedback; they want the fastest way to learn the material, and some do not find value in education. This study investigated the impact of grading homework and classwork and its effect on the overall understanding of the material. This study also investigated the impact of graded homework on the students' attitudes on science, work, and grit the student might have. Through multiple forms of formative and summative assessments, surveys, and interviews, students found that they learned and retained the most information using paper and pencil, and when work was graded for credit. Results showed that students need both an internal and external reward to want to learn. This action research project demonstrated that grading students' homework and classwork with positive feedback resulted in the highest scores on assessments causing a positive attitude in physical science.

## INTRODUCTION AND BACKGROUND

### Context of the Study

Hilliard Davidson High School is one of three local public high schools in Hilliard, Ohio. The school is composed of grades 9 through 12 with students enrolled in Tolles Career & Technical Center, and the Innovative Learning Center (ILC). Students can enroll in Advanced Placement classes as well as College Credit Plus to receive college credits while still in high school. Hilliard Davidson educates approximately 1700 students annually, making the faculty-student ratio 1 to 18. Within our population, 20% of the students are on Individual Education Plans (IEP), and 24% of the students are minorities - majority Hispanic and Asian. During the 2019-2020 academic year, 23% of the population were eligible for free lunch, and 4% qualified for reduced lunch. Hilliard Davidson values academics, the arts, and sports, which creates an atmosphere of respect among the community members: faculty, students, parents, and staff.

Physical Science, or Science 9, is one of the three courses in which science students need to graduate high school in the state of Ohio. Science 9 is the transition class from middle school to high school science. This course highlights higher-order scientific thinking that middle school teachers did not emphasize. Students leave middle school with a fundamental understanding of science, studying Newtonian Mechanics, genetics in Biology, and Earth Science. However, while in middle school, students are moved to the next grade even if they do not pass the course. Not passing, achieving less than 60%, causes a dilemma when they arrive in high school because those students have not

established problem-solving skills, study skills, or self-motivation. The fundamental understanding of science is not there. Freshman teachers have attempted several times to connect with the middle school to change this mindset but have failed. Incoming freshmen believe high school teachers will "pass" them onto the next grade because it has already occurred before in middle school.

Freshman science courses at Hilliard Davidson explore the basic understanding of chemistry and physics. While in the first semester, the curriculum emphasizes the chemistry: structure of the atom, periodic table, matter, chemical reactions, and nuclear reactions. Within the science department, students are allowed multiple retakes on assignments as well as they can turn work in late. This policy was based on the culture shock of high school between not having to turn in work in middle school to having grades go their transcripts. The second semester focuses more on physics: exposing students to the study of the universe, thermodynamics, and Newtonian Physics.

The Science 9 data group had developed a gradual process of allowing students to turn work in throughout the first quarter for full credit with no late penalty to no late work. The team also allowed open-note tests for students' first, second, and third quarters in hopes of students learning how to take clear and accurate notes. Fourth-quarter students were not permitted to use notes on assessments. Therefore, by fourth-quarter, students were able to take assessments clear and accurate notes to study from, resulting in no need for open-note assessments.

Science 9 curriculum allows students to learn through inquiry, laboratory experiments, readings, and lectures. The primary purpose is to formulate a solid

foundation of scientific knowledge and reasoning for these students and enhance their interest in science. As the standards in our district, state, and nation evolve into a more laboratory-based class, it is crucial to design an environment for students to ask questions, investigate, and grow. Self-confidence is vital for students to explore and have academic success.

However, although students have access to technology and other valuable resources, teachers have noticed a drop in the number of assignments turned in from students. Hilliard City Schools provided each student with an iPad for the year. iPad's allow teachers and students to use different online platforms for education. The primary platform used is Canvas. Canvas allows students to see what assignments they have on a To-Do list as well as allows teachers to upload multiple resources. Students are taught in primary school to upload their work into Canvas so teachers can grade and give feedback. Therefore, if students are not turning in material, teachers are under the assumption they either do not comprehend the material or have not mastered the content. Both situations cause a decrease in assessment scores.

These necessary life-skills, such as time management, follow-through, and a strong work ethic, should be established at a young age. Based on observations, several students have not mastered these life skills they need throughout high school and future careers. Students complain of being too busy and are lacking the responsibility for their academic knowledge and grades. I recognized that this problem could be solved by establishing more responsibility for the students by holding them accountable for their grades. As a result of professional development, coursework in college, graduate school,

as well as discussions with my colleagues, the question comes to mind, "do students need to turn in work to show they have mastered the content?"

#### Focus Question

My focus question was, How does having a homework and classwork grade in the class affect the outcome of the overall score on students' assessments?

My sub-questions include the following:

1. Does the rate of homework and classwork turned in change by having more than one teacher present?
2. Does having open-note assessments increase scores on assessments?
3. What is the effect of classwork and homework reminders on students?

## CONCEPTUAL FRAMEWORK

### Assessments in the Classroom

Assessing students is one of the necessary foundations of education. Teachers need to know what and how students are learning and retaining in the classroom. Acquiring what students have learned from the class is used by different techniques, and most of the time, homework is the primary source. “Homework is one of the most controversial educational activities nowadays” (Estévez et al., 2018, p. 15) because of the philosophy if homework should count as a grade.

Teachers stressed the importance of understanding content material through two different types of assessments: formative and summative assessments. Formative assessments are daily assessments, such as classwork and or homework, that link to the learning experience. These assignments can be kinesthetic, verbal, or visual. Homework and classwork frequently fall under this classification. “Homework refers to any tasks assigned by schoolteachers for students to carry out during non-school hours” (Zhou et al., 2020, p.1). Summative assessments are measuring the accountability of student learning: such as quizzes, tests, or end of year assessments. Using classwork and homework helps students develop time management skills and an understanding of the importance of practice.

Most research shows that students, especially adolescents, benefit from doing homework (Zhou et al., 2020, p.1). It establishes the structure, a routine, and a work ethic. Teachers also need to be able to communicate with their students to help build a

foundation of rapport and trust. Providing students with evidence of why the material is vital to their lives is highly essential in building rapport with students. According to Slocum and Jacobsen (2011), it is essential to know what the teacher is most comfortable teaching before students are satisfied. I am comfortable and confident with laboratory experiments and class discussions. Being a kinesthetic learner, I excel in this style of teaching. Movement and laboratory activities are essential. A way I can check for understanding after I demonstrate a lab is by using formative checks. If students do not complete the assignments in class, the result is homework. The more students expose themselves to this pattern, they become comfortable with it. Therefore, after students see that I am comfortable in front of them, Slocum and Jacobsen's study states that students follow my example.

### Application of Assessments

Bloom's taxonomy (remember, understand, apply) is essential in laboratory experiments and hands-on activities. These different types of formative assessments build into the summative assessments. Bloom emphasizes the need for understanding the content, and this allows for the development of scientific knowledge. If "engaging students inside and outside the classroom does make a difference" (Slocum & Jacobsen, 2011, p.1), building rapport with students increases their effort in the classroom. Slocum and Jacobsen (2011) stress the importance of engaging students. Higher-level thinking is met once rapport is established with students. Therefore, the more relatable the assignments are inside and outside the classroom, the higher the likelihood students will

put effort into them. Xu (2020) added, “Students are likely to place high value to a task on which they do well, and they are likely to accomplish a task when they consider it valuable” (p. 2). Therefore, when students do well on an assignment and find value or can find personal meaning, the level of motivation and accomplishment increases.

### Amount of Material

It is important to first design lessons that are using homework or classwork as practice or points of reinforcement. “The characteristics of homework that the teacher designs also affect student habits and engagement, and so, the results of their efforts” (Zhou, et al., 2020, p.1). According to Clemmit (2007), the amount of homework in elementary and middle school has dramatically increased, but in high school, it has stayed the same. The amount of homework causes an increase in stress levels in younger students. Research also stated that students are under “more pressure to score higher” on tests such as the ACT or SAT (Clemmit, 2007, p. 580).

Nevertheless, students who cannot do simple arithmetic or read at grade level are passed onto the next grade due to the No Child Left Behind Act (NCLB). I see evidence of this research in many articles as well as in schools. There are students in my freshman class that cannot compute fourth-grade mathematics problems. The foundation of basic mathematics is not present; therefore, how can they succeed and do ninth-grade science? Also, students without the modifications of IEP’s or 504 struggles to read at grade level. Lower reading levels and modified classes result in the district providing textbooks with

lower reading levels. When students do not have a basic understanding of mathematics or reading, it can cause the academic rigor of the class to slow down. At the "end of the day with material left," teachers will "send it home' as homework" (Clemmit, 2007, p. 580) to keep up with the standard pass set by the district or state. By sending work home, the idea is that students do the assignment and come back prepared for class. However, if they do not accomplish the independent task in class, the material at hand is likely more complicated than they can complete independently at home, causing students to either not do it or give up.

### Directions for Research

Depending on the unit, mathematics plays a crucial role in understanding the content in science based on the Science Technology Engineering and Mathematics (STEM). The topics co-exist based on needing each other to prove or supply evidence. Adopting a stable community in teaching encourages teachers to expand their knowledge inside and outside the classroom. King et al. (2014) stated, "The majority of studies on co-teachers yield similar results:" (p. 652); therefore, teachers must shift their attitude from isolation to communication. As mathematics and science work together, one can use co-teaching to build rapport in a classroom environment. When two educators work together, students can look to the teacher in which they connect more. Brosnsan and Sears (2016) suggest that "used the systematic process of improvement science" (p.145) to explain how this can work in the field. A successful co-taught classroom can uncover the internal motivation of students. Both teachers must validate the students as

individuals: allowing students to share their internal and external motivations. Both teachers must also value their strengths and weaknesses as educators. The roles of both teachers are to model how to work together and create a positive learning environment. Students are more willing to work and are more successful.

### Comparison between Studies

Not all studies shed a positive light on the relationship between homework and assessment scores. Boucher (2016) stated, “students are burned out,” and this is caused by the “pressure of perfection” (p. A28). Students compare themselves in the classroom and social media. Although school districts have more counseling centers and programs in place for students to assist them in their work, students fail to use them or take advantage of the system. Boucher wanted to take away deadlines to take mental stress away from school.

I am afraid I must disagree. If we take away the deadlines, then when and where do they learn responsibility? Lack of deadlines might impact my study because if more and more people say we need to ditch deadlines, then why do we have grades? Teachers must give “late” credit for work done three to four weeks late. If allowing for late work continues, then where is the responsible aspect of life taught? Deadlines are in careers, and school needs to prepare students for careers and college.

Many types of research have occurred based on the relationship homework has on different variables. Estévez et al. (2018) focused her research on why there is “no clear answer today about the degree of utility and its effects on student learning and

performance” (p.16). Estévez et al. (2018) found a positive correlation between homework and time management. The more students managed their time, their grades increased. By establishing the importance of time management at an early age, this benefitted their academic success.

An article from the New York Times by Seth Mydans (2009) emphasized how the government and future employers want educated young adults. Mydans tied in how, when students formulate relationships with one another, intellect is a circumstance. Even though the article is addressing students dating, the quote, “Our government wants smart ladies to meet smart guys to get smart children” (p. A9), emphasizes how fabricating relationships in a classroom can be a significant factor in how students learn. The article also explains how the workforce wants reliable employees (Mydans, 2009). As teachers, this reliable work ethic was established by holding students accountable. Even the workforce wants students to be smart, so at some point, they reproduce intelligent children. Girls of Singapore want more intelligent men, and therefore, causing boys to study. The theory was tested by conducting pre- and post-assessments. Results stated by having students study it caused their population to drop, but also graduation rates to increase. As a result, building rapport in the classroom and teaching strong work skills are essential for the students' future.

Further research has demonstrated that many students turn in homework because they know they have to, not because students understand it. Teachers assign homework or classwork as practice or types of formative assessments. If students do not finish, it

becomes homework. Therefore, teachers often spend time going over the homework in class the next day. When students do not finish or turn in their work, one of two things occurs: students are retaught when teachers are going over the homework, or students still do not understand the material. Based on a study by Madison (2005), merely being in the classroom should allow students to succeed. The essential question one can analyze is: if students are in the classroom, why aren't they doing the work? Is it internal or external factors?

Looking into the internal and external motivational factors of students on a psychological level is another research paper; however, it does need mentioning as limiting factors. Because I am working with high school adolescents, I must recognize that I cannot control things. I must recognize some of the data collected during this process skewed. During the data analysis, internal and external motivational factors could result in the standard deviation. All I can control is teaching and assessing of the students.

In summary, the literature cited provides valuable data collection strategies and observations when studying the uses of homework in the classroom. The various techniques used to assess students in homework as well as assessments. Qualitative data collecting techniques include interviews, surveys, and observations—, and quantitative techniques in formative assessment (homework or classwork) and summative assessments (pre- and post-assessments). Research also values the importance of co-teaching, deadlines, and rapport. Based on known scientific data, a relationship between homework and assessments is established.

## METHODOLOGY

Demographics

Data collection for this project occurred in a high school freshman science class from 2019-2020. Forty-nine students participated in this study over two classes: one class of twenty-six students (Second Period) and the other with twenty-three (Seventh Period). Second Period includes twenty females and six males, three students have Individual Educational Plans (IEP's), one student is gifted in mathematics, and nineteen students have early warning signs (EWS). An early warning sign at Hilliard Davidson involves behavioral issues, academic issues, and truancy. This class is taught before 10:00 am, and most are grouped throughout the day based on their math and English levels. The students with the early warning signs in this class have this classification because of their academic and attendance issues. Seventh Period (co-taught) includes ten females and thirteen males: six of the students on IEP and ten students have EWS. The ten students with the early warning signs have not passed a science class since 6th grade. Students in this class are also grouped on their math and English levels. Of the twenty-three students in this class, eight of them did not pass middle school science. English is the first language for the students, and many of the students come from middle-class families in the city. Students need to pass this course to get the first year of their high school science credit or they become credit deficient.

### Research Design

Without evidence, there is no way to support the findings in research.

Understanding data, reading it, and analyzing what is essential was critical in this action research project. Because I wanted to look at any possible relationships between homework turn in and assessment scores, I needed classes to compare. During this course of study, I had the opportunity to co-teach Science 9, which allowed a comparison between co-taught classes and traditional classes. A research study performed by King-Sears et al. (2014) states that “no co-teaching definitions found in the research and literature endorse that one teacher is always or primarily the lead with the other teacher in a supportive role” (p. 652). To obtain data, King-Sears et al. triangulated the data between a student survey, the co-teacher observation, and the co-teacher responses. They also used several forms of collecting data to include video recordings, interviews, and surveying the students. Using student surveys, interviews, and video recordings was an adequate way of collecting data based on the analysis methods of King-Sears et al.

### Treatment

The purpose of this study was to determine the most effective way to use homework to improve the scores on summative assessments. The research methodology for this project received an exemption by Montana State University's Institutional Review Board (Appendix A), and compliance for working with human subjects was maintained throughout the study.

In the fall, before the treatments, students were introduced to the classroom rules format, and expectations. This included that during the first semester, they could have open-note assessments as well as turn assignments in late up until the unit test for full credit. Daily assignments and reminders were posted on the blackboard, and messages were sent in Canvas to assist students in the transition between middle and high school. Students were familiarized with the classroom expectations - look at the board for the daily assignments, take notes during class, check Canvas for work, and turn in assignments. This process was used throughout the science department to establish consistent communication between the students, parents, and teachers.

Two treatment types occurred in this action research: one with graded homework and one without grading homework. The treatment section of this project occurred during the unit Conservation of Matter and the Universe Unit, where homework was counted as a grade. The non-treatment unit consisted of Matter and Nuclear Reactions because homework grades did not count towards their grades. In this project, many variables are being compared; therefore, the two different classes are being used for comparison. Within the sample set, the treatment and non-treatment set is compared to the co-taught class.

A two-week-long instructional period over Matter began in September of 2019. Students did not have any work graded during this unit making this the first non-treatment unit. Students started the unit with a ten-question pre-assessment over Matter (Appendix B). The process was the same in both the Second and Seventh-Period (co-taught). During this time, notes were taken in class through PowerPoint, and vocabulary

was assigned to students. Students also had time in class to ask questions on the notes as well as write essential information in their notebooks. Laboratory activities were performed in table groups, and class discussion occurred afterward. Students did not have to turn in work for credit, but some did for feedback. Assignments were reviewed the following day, and answer keys for each assignment were posted on Canvas (online platform) two days later. Over the two weeks, students were continuously reminded to do their homework, classwork still, and to write in their notebook. At the end of the unit, the same post-assessment questions were assigned.

A two-week-long instructional period over Conservation of Matter (COM) began after the Matter Unit. During this treatment unit, students' assessments are graded. Students began the unit with a ten-question pre-assessment over COM (Appendix C). During this unit, notes were taken on COM through PowerPoint, and vocabulary words were assigned to students. Students were to record the vocabulary in their notebooks. Each night, questions on COM were assigned to students ranging from article readings, vocabulary checks, and balancing equations. Any work students did during class, they could write in their notebooks. Laboratory activities were performed in table groups, and the assignments were graded. Feedback was given on work when it was turned in. Every day, students were sent a message on Canvas to remember to turn their work in. Assignments were reviewed in class, and answer keys for each assignment were posted two days later. If the answer key was posted, students could still turn work in, just not for full points. At the end of the unit, the same post-assessment questions were given. This process occurred in both the Second and Seventh Period.

A two-week-long instructional non-treatment period over Nuclear Reactions (Nuclear) began in November of 2019. During this non-treatment, students did not have constant reminders of turning in their work. Students started the unit with a ten-question pre-assessment over Nuclear Reactions (Appendix D). The process was the same in both the Second and Seventh Periods (co-taught). Following the same pattern of the Matter and COM unit, notes were taken in class through PowerPoint, and vocabulary was assigned to students. Students also had time in class to ask questions on the notes and to write essential information in their notebooks. Laboratory activities were performed in table groups, and class discussion occurred afterward. Students did not have to turn in work for credit, but some did for feedback. Assignments were reviewed the following day, and answer keys for each assignment were posted on Canvas (online platform) two days later. Over the two weeks, students only had reminders on the board to do work, do their homework, classwork, and to write in their notebook. At the end of the unit, the same post-assessment questions were assigned.

A two-week-long treatment instructional period over the Universe began after the Nuclear Unit. This process occurred in both the Second and Seventh Period. Students started the unit with a ten-question pre-assessment over (Appendix E). During this unit, notes were taken on the Universe through PowerPoint, and vocabulary words were assigned to students. Students were to record the vocabulary in their notebooks. Each night, questions on the Universe Unit were assigned to students ranging from article readings, vocabulary checks, and balancing equations. Any work students did during class, they could write in their notebooks; however, they were not allowed to use their

notebooks during the post-assessment. Laboratory activities were performed in table groups, and the assignments were graded. Feedback was given on work when it was turned in. Every day, students were sent a message on Canvas to remember to turn their work in. Assignments were reviewed in class, and answer keys for each assignment were posted two days later. If the answer key was posted, students could still turn work in, just not for full points. At the end of the unit, the same post-assessment questions were given.

### Data Collection and Analysis Strategies

Students took pre and post-assessment on the four units to assess the impact of student growth and determine the impact of the instructional treatment. The questions on the assessments were the same to measure if students mastered the content over the two weeks. The scores were calculated and analyzed in box and whisker plots, bar charts, and normalized gain—the significance of the normalized gain based on the findings of R.R. Hake. The statistical significance of the gain was analyzed with a paired t-test and a p-test.

Between the four units (Matter, Conservation of Matter (COM), Nuclear, and Universe), the focus was on the growth between the pre- and post-assessments scores and seeing if grading the students' homework had an impact. Students took the same multiple-choice questions within the pre and post-assessment at the beginning and the end of the unit (Appendix B-E). This was used to analyze the difference between treatments, establish the normalized gains, and was organized with box and whiskers plots to determine patterns. The normalized gain was calculated to determine differences in

student knowledge. Normalized gains of less than 0.3 were considered low gains 0.3 to 0.7 was considered a medium gain, and normalized gains greater than 0.7 were considered high gains (Hake, 1998).

During the treatments, students completed an anonymous Homework Science Survey (Appendix F), a Likert survey, to see if there was a relationship between their attitude towards homework, science, and assessments. The students responded to this survey with *Strongly Disagree* (1), *Disagree* (2), *Neutral* (3), *Agree* (4), or *Strongly Agree* (5) modeled after Zhou et al. research (2020). Questions were then isolated to find trends between homework and assessments, attitudes and homework, and reminders, and homework. This data was used to see if any trends occur between homework and assessments. Wilcoxon Signed-Ranks was used to analyze the survey data as well as organized in box and whisker plots, bar graphs, pie charts to analyze comparisons between units and treatments. The paired t-test was used to determine if there was a significant difference between pre- and post-treatment and displayed in a stacked bar chart. A pie chart was used to represent the student's attitude pre and post-treatment. Classroom discussions were analyzed for trends and used as supporting evidence. The results allowed me to understand if students related homework to assessment scores.

Ten students (five in each class period) were randomly selected to participate in a pre and post-interview, Homework Assessment Interview Questions (Appendix G), to obtain additional qualitative data. These questions were designed to gather further insight concerning student attitude on homework, co-teaching methods, reminders, and open note assessments modeled after King-Sear. These questions emphasized how educators

can increase the work ethic of students and how educators can be more supportive. They also emphasized ways students are responsible for their education. Data from the interview questions were written down and analyzed for common themes and supporting evidence.

Throughout the treatment and non-treatment periods, observations were recorded in Katie's Reflection Journal. The data from the journal had noted during Second Period and Seventh Period. In Seventh Period, the co-teacher also added additional observations. The qualitative observations were analyzed for trends and used as supporting evidence.

The data collection instruments were summarized in the triangular matrix below (Table 1). These instrumentations were vetted by fellow colleagues and the professor, thus validating the reliability.

Table 1. Data collection matrix.

Focus Questions	Data Collection Methods		
	Source 1	Source 2	Source 3
How does having a homework/classwork grade in the class affect the outcome of the overall score on students' assessments?	Pre and Post Assessments on Unit	Homework Science Survey	Katie's Reflective Journal
Does the rate of homework/classwork turned in change from having more than one teacher present?	Homework Science Survey	Katie's Reflective Journal	
Does having open-note assessments increase scores on assessments?	Pre and Post Assessments on Unit	Homework Science Survey	Katie's Reflective Journal
What is the effect of classwork/homework reminders on students?	Homework Science Survey	Katie's Reflective Journal	

## DATA ANALYSIS

Results

Estévez et al. (2018) collected data during school hours through many different forms of data collection (p.18). The results from the pre- and post-assessments over the treatments (Table 2) indicated that students had higher learning growth during the graded homework units ( $N=49$ ). The average normalized gain for graded homework units was consistently medium to medium-high from 0.46 to 0.61 compared to nongraded homework units ranged from 0.2 to 0.48 (Table 3) (Hake, 1998). When comparing between treatments, the sample set of students averaged 0.31 learning growth in the non-treatment contrasted to 0.55 in the treatment units convincing that graded homework provided added growth (Hake, 1998). Overall, in analyzing the co-taught and non-co-taught classes, the student gain in the non-treatment was between 0.2-0.29. In comparing the treatments, more growth displayed in the non-co taught classes was compared to the co-taught class; however, the ranges are still higher than those of the non-treatments. Overall, students scored higher on the post-assessment than the pre-assessment, with the most growth in the treatment units.

Table 2. Class pre and post assessment data 2019-2020, ( $N=49$ ).

Unit and Class	Treatment	Pre-Average %	Post-Average %
Matter (2)	Non-Treatment	49.3	63.2
Matter (7)	Non-Treatment	49.4	64
Nuclear (2)	Non-Treatment	33.8	66.5
Nuclear (7)	Non-Treatment	45.5	60.2
COM (2)	Treatment	44.2	76.8
COM (7)	Treatment	43.6	68.6
Universe (2)	Treatment	53	83
Universe (7)	Treatment	51.2	79.3

Table 3. Class average normalized gains 2019-2020, ( $N=49$ ).

Unit and Class	Treatment	Student Gain
Matter (2)	Non-Treatment	0.27 - low
Matter (7)	Non-Treatment	0.29 - low
Nuclear (2)	Non-Treatment	0.48 - med
Nuclear (7)	Non-Treatment	0.27- low
COM (2)	Treatment	0.61 - medium - high
COM (7)	Treatment	0.46 - med
Universe (2)	Treatment	0.63 - medium - high
Universe (7)	Treatment	0.5 - med

The average growth between test scores concluded that each unit was slightly higher on all treatments when homework was graded compared to homework not being graded. The average pre-assessment scores ranged from 33% to 51% during all treatments. During the non- treatments (Figure 1), the average post-assessment score average ranged between 60.2% to 66.5% having a demonstrated growth average of 18%. In each non-treatment, the potential gain of the students was the largest. In Second Period during the Nuclear Unit, the class displayed the most demonstrated gain of 31%. Compared to the other units, the Nuclear Unit is of average difficulty. The focus is on mathematics and two different processes. Students in Second Period have an overall higher understanding of mathematics compared to Seventh Period. This may account for the more considerable student gain in this class. In the treatments, students' score average ranged between 68.3% to 83%, with an overall average growth of 31% (Figure 2). The treatment units, COM and Universe, do not involve as much mathematics and the teaching style uses diagrams. Compared to the non-treatment units, the demonstrated gain was at least 10% higher in every class but Nuclear Period Two.

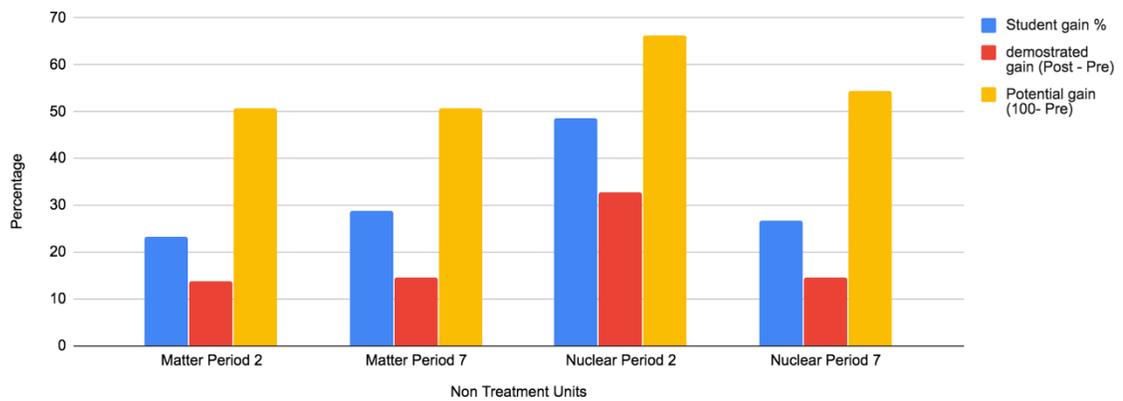


Figure 1. A comparison of average assessment scores before and after each non-treatment unit, ( $N=49$ ).

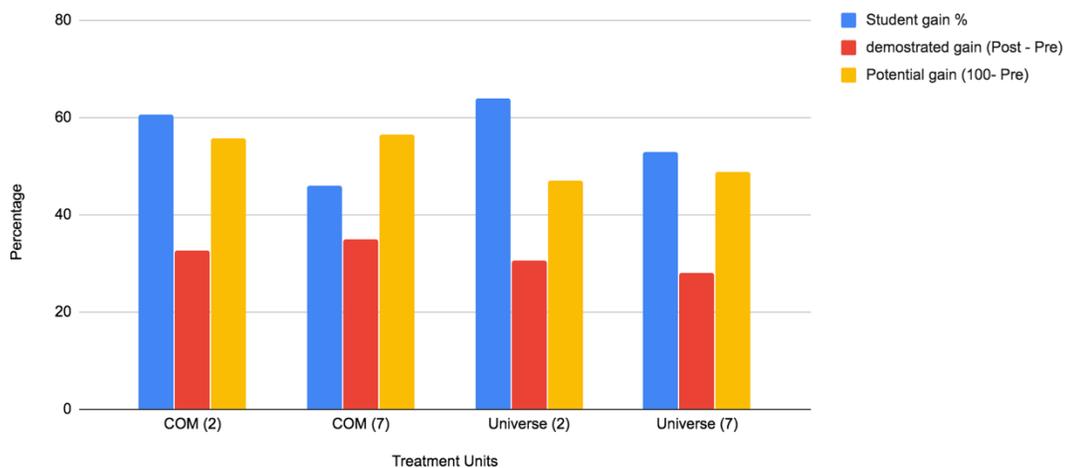


Figure 2. A comparison of average assessment scores before and after each treatment unit, ( $N=49$ ).

The results for a pre and post-assessment on the Nuclear Reaction unit are illustrated in a box and whisker plot (Figure 3). In the study, the Nuclear Reaction unit

was classified as a non-treatment group. Based on district learning targets, students are not exposed to nuclear reactions in middle school; therefore, high school is the first time they are exposed to this topic in a school setting. By comparing the lowest and highest scores between the pre and post-tests for Second Period, students did better on the post-assessment. The same trend appeared in period seven, when the lowest and highest scores were compared.

The highest score appeared both in the post-assessment for Second and Seventh Period. When comparing the pre-assessment averages, Second Period averaged 30%, while Seventh Periods averaged 51%. After the unit was taught in the post-assessment, the overall average for Second Period scored 70% compared to 66.5% in Seventh Period. The magnitude of the non-treatment effect was analyzed using a paired sample t-test in both classes. The average of the post-assessment minus the pre-assessment scores is not equal to the expected difference ( $\mu_0$ ). The difference between the post-assessment average minus the pre-assessment and  $\mu_0$  is big enough to be statistically significant. In Second Period, the test statistic  $t$  equals 7.32, is not in the 95% critical value accepted range: [-2.079: 2.079], compared to 2.66, is not in the 95% critical value accepted range: [-2.093: 2.093] in Seventh Period. The observed standardized effect size is large (1.56) in Second Period. That indicates that the magnitude of the difference between the average and  $\mu_0$  is large. In Seventh Period, observed standardized effect size is medium (0.60), indicating that the magnitude of the difference between the average and  $\mu_0$  is medium. By analyzing the quartiles, students did significantly better in the post-test than in the pre-assessments.

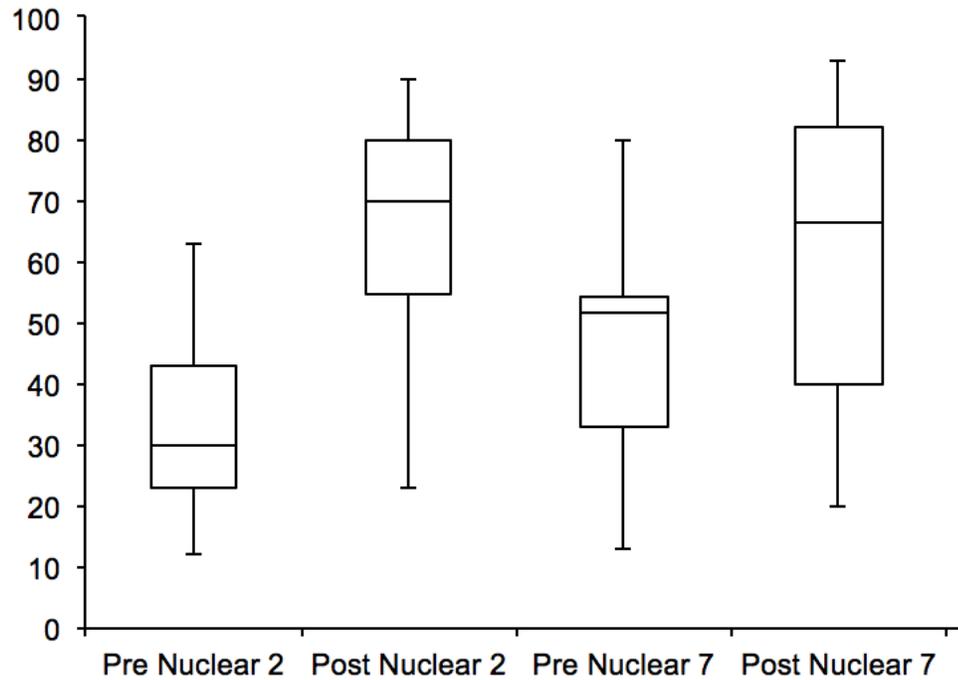


Figure 3. Score percentage distributions of the pre and post non treatment Nuclear Reaction assessment, ( $N=49$ ).

The results for a pre and post-assessment on the Universe unit are illustrated in a box and whisker plot (Figure 4). In the study, the Universe unit was classified as treatment. Based on district learning targets, students are not exposed to aspects of the universe in middle school; therefore, high school is the first time they are exposed to this topic in a school setting. By comparing the lowest and highest scores between the pre and post-test for Second Period, students overall did better on the post-assessment. The same trend appeared in Seventh Period when the lowest and highest scores were compared.

The highest score appeared both in the post-assessment for Second and Seventh Period. When comparing the pre-assessment averages, Second Period averaged 50%

while Seventh Period averaged 55%. After the unit was taught, the overall average for Second Period scored 85% compared to 80% in Seventh Period. The average of the demonstrated gain (post-assessment minus pre-assessment scores) is not equal to the  $\mu_0$ . The difference between the average of the post-assessment minus pre-assessment and  $\mu_0$  is big enough to be statistically significant. Both sets of data had p-values less than 0. In Second Period the test statistic t equals 9.4, is not in the 95% critical value accepted range: [-2.06: 2.06]. In Seventh Period, the test statistic t equals 6.01, is not in the 95% critical value accepted range: [-2.09: 2.09].

The observed standardized effect size is large, 1.92 compared to 1.34. That indicates that the magnitude of the difference between the average and  $\mu_0$  is large. Students in Seventh Period were asked in a class discussion if having another teacher in the room motivated them to turn their work in more. A student that was failing the class relied upon, "It doesn't matter how many teachers are in the room, I will not turn my work in." This reply demonstrates how, with some students, work is an internal factor. Another student, however, replied, "Having another teacher in the room makes asking questions easier. If one of you is busy, I can go to the other teacher." Between having a co-teacher and no co-teacher in the classroom, the overall average in the non-co-taught class was up 5%. With only a 5% difference, having a co-teacher in the classroom had no statistical difference in the assessment data.

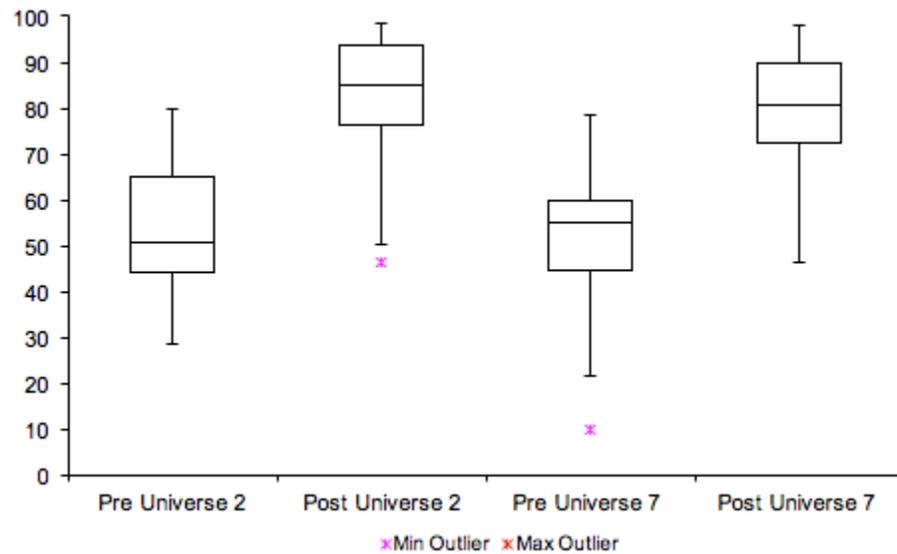


Figure 4. Score distributions of the pre and post assessment of the Universe Assessment. Homework was counted as a grade, (Note the stars are outliers,) ( $N=49$ ).

During the non-graded homework, students in both classes demonstrated again below 20 percent and an average of less than 0.3 on average student gain (Figure 5). Students were asked if they found value in the work, they were doing in class based on their low performance. Students replied, "If we are not getting graded, why should we do the work?" During the Matter unit, in both the co-taught and the regular class, students experienced the least amount of gain. The demonstrated gain for Second Period and Seventh Period was below 15%. The projected gain for Second Period was an average of 23.3%, and Seventh Period was 28.7%. During the Nuclear unit, the Second Period had a projected gain of 48.5% compared to Seventh period of 26.6%. Second Period had both the most substantial demonstrated growth and student gain over the non-treatment study. In the class discussion during Second Period, students commented on how if they did the

practice worksheets, it prepared them for the test; however, this was after seeing their grade fall in the other unit. The results from each of the units' post-assessments indicated that students did not reach their full learning potential. In both Second and Seventh Periods, the demonstrated gain was less than the potential gain over both treatments.

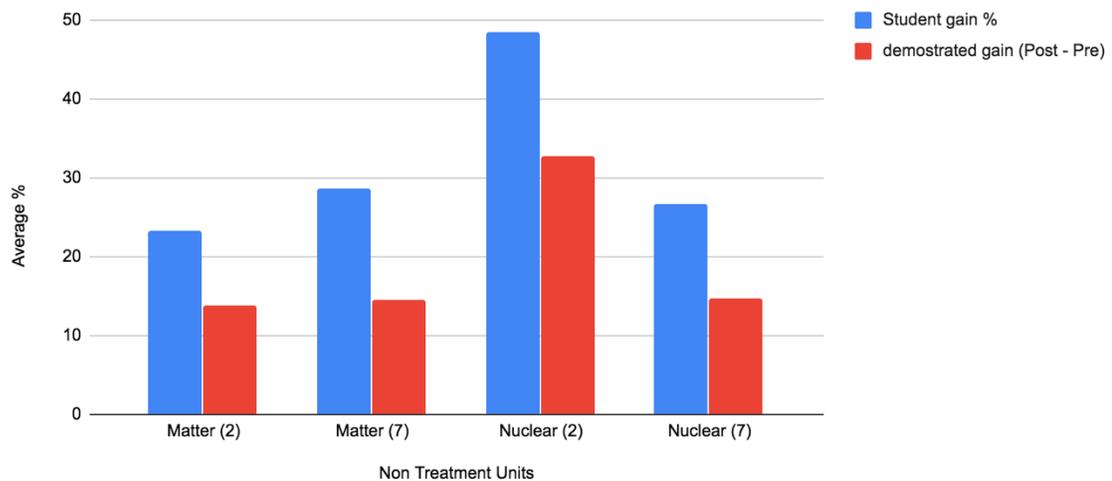


Figure 5. Results of the demonstrate gain percentage and student gain percentage of the non - treatment units, ( $N=49$ ).

In comparison, when homework was not graded, students demonstrated a range of 28% to 35% growth on average. Overall, the student gain ranged between 46% to 64%. Second Period had a higher student gain percentage compared to Seventh Period over both units in the treatment. When comparing the Conservation of Matter (COM) unit, Second Period's student gain was 13.5% higher than Seventh Period. However, the demonstrated gain was within 3%. During the Universe unit, Second Period had a student gain percentage of sixty-four compared to Seventh Period fifth-two. Like the COM unit, the demonstrated gain was within 3%. When comparing the Conservation of Matter and

Universe Units (Figure 6), both treatments where homework was graded; however, the Universe unit was a final note post-assessment. When comparing the post-assessment data, the distribution is approximately normal, with a W value of 379.5 in the Wilcoxon Signed Rank test. Therefore, the z-value of 1.5577 is used, not the p-value of 0.11876. When students were within the treatments, the student gain percentage and demonstrated gain was higher in both classes (Figure 5).

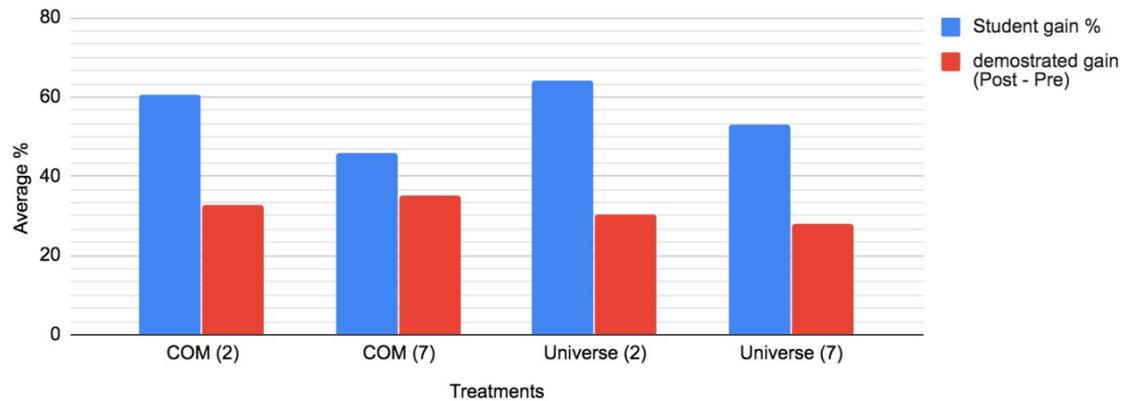


Figure 6. Results of the demonstrate gain percentage and student gain percentage of the treatment units, ( $N=49$ ).

The results from the Homework Science Survey indicated a shift towards students preferring grading homework over non-graded homework. Before the study, 38% of students *agreed* or *strongly agreed* that homework helped them learn. After the study, this changed to at least 70% of students *agreed* or *strongly agreed* that homework helped them learn (Figure 7). This correlation shows that homework usually does have a direct impact on how the students learn. Like Estevez et al. research, there is an “intrinsic motivation towards homework” (p. 18) as well as study. One student shared they strongly

agreed with having homework graded because “the feedback on their answered showed them if they were in the right direction.” When homework was graded during class discussions, more students participated in the activities compared to when homework was not a grade. Before one of the non- treatment units, 30% of the students *agreed* or *strongly agreed* that if they did not understand the homework, they would not do it. “Putting in the effort to try to figure the material out is too stressful,” a student shared when I asked why they did not try the homework assignment. One student shared, “If it is not graded, why should I try it?” This was a common theme when homework was not for a grade. When homework was for a grade, 21% of the students *agreed* or *strongly agreed* that if they did not understand the homework, they would not do it (Figure 6). In discussions with students, they felt that if the work was graded, they needed to try and attempt it to gain some understanding of the material.

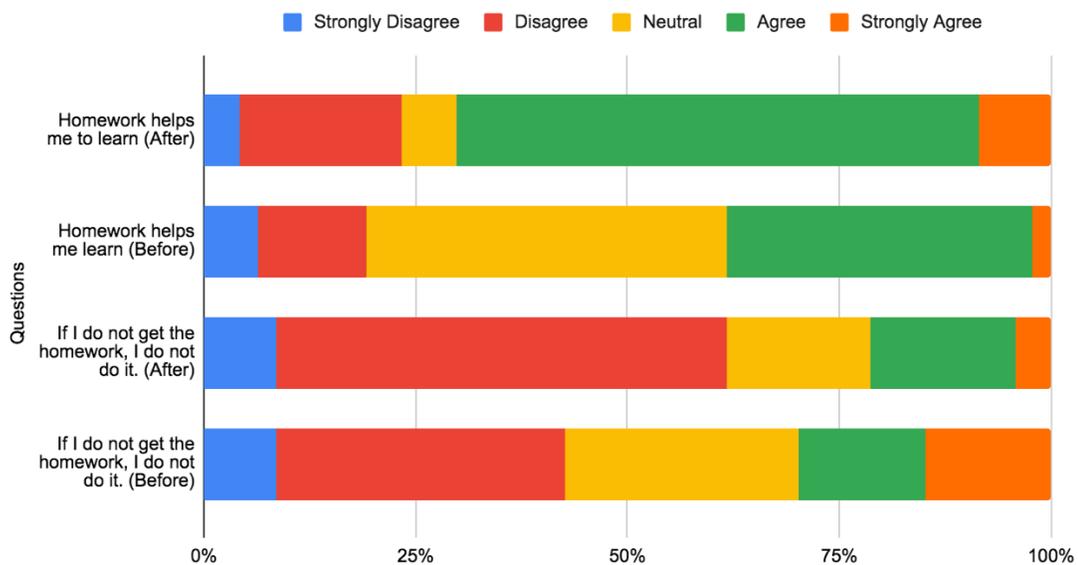


Figure 7. Comparison between before and after study involving homework, ( $N=49$ )

There was a significant change in the interest of using a type of organizer to remind students to do their homework (Figure 8). While homework was not being graded, more students did not use any aides to assist them in reminding themselves to do their work. A Wilcoxon Signed Rank test analyzed the data to see if there was a significant in using reminders. When using the Wilcoxon Signed Rank Test, the calculated W-value was 128, meaning the distribution is approximately normal. Because of this, the z-value (-2.35) was used, resulting in a p-value of 0.01879. The result of this question is significant at  $p < .05$ . One student, who chose neutral in the non-treatment survey, said, "I put neutral because you and Mr. Fout write the assignments on the board, and we get the list on Canvas."

In the treatment, the same student said, "Writing down my list helps me stay organized. I use the board now as a checklist." Students that chose to disagree on this question in the non-treatment stated, "Homework is not graded, so why should I use someone to organize?" However, during the treatments, most of these students changed their minds after their grades dropped from forgetting to turn in work. The penalty of low scores on homework grades caused students to write down the assignments. Students who agreed or strongly agreed that they used an organizer stated, "Writing things down reminds me to do the work. If I do my homework, I will do better on the tests." The main difference between the two treatments was if homework was graded, students used a type of organization tool. When asked in as a class discussion, students replied in the non-treatment, "I just do not remember to do the work, and if it is not graded, I do not care." However, in the treatment discussions, students replied, "The homework grade focuses us

on doing homework, so we need to stay organized. Staying organized helps me study for tests.” Another student added, “If I write down my homework, I do it and my grades go up.”

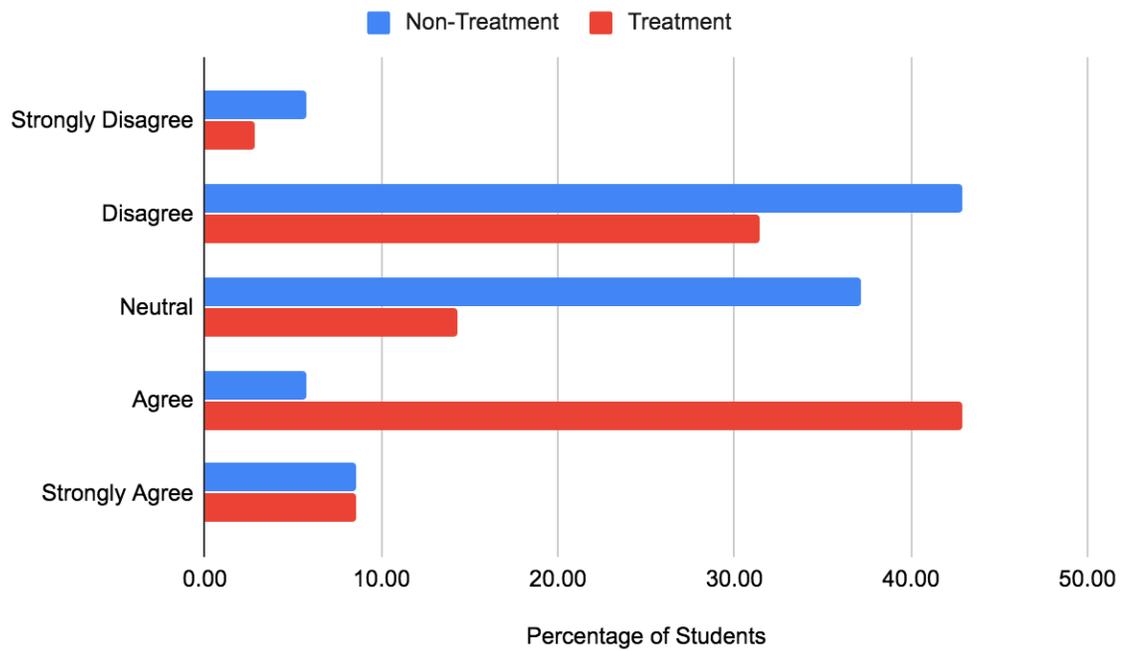


Figure 8. “I use my organizer to record my homework,” ( $N = 49$ ).

## CLAIM, EVIDENCE, AND REASONING

Claims from the Study

The goal of this action research project was to explore the connection between homework and summative assessment scores. Numerous amounts of quantitative and qualitative data collection methods were employed to establish trends, as well as multiple data analysis tools, were applied.

Students improved the most over the treatment periods based on the data analysis of the pre and post-assessments, survey questions, and interviews. When students had their homework graded, overall test scores improved. Their understanding of responsibility increases as well as seeing how there is a correlation between homework and test scores. When students find that doing work helps them get better grades, it forms independence and leadership in the classroom. As a result, students turned in homework to get feedback after seeing the difference in their test scores between the treatments. This was seen between the treatment and non-treatment unit post-assessment scores. Based on the understanding that homework improves test scores, the average normalized gain of the treatment units was 55%.

Hilliard Davidson changed its teaching assignments to have classes with co-teachers. As a result, co-teaching was used more at school. In this study, the added value of a co-teacher had no significant difference in the student's test scores. Seventh Period scored lower in the Conservation of Matter and Universe Unit than in second (Figure 5). Based on the students' academic background in Seventh Period, having a co-teacher in

the room was used more for behavior and small group work. With having ten students not passing middle school science, administrations valued building rapport with them was valued more than test scores.

During this investigation, students had the opportunity to have open-note assessments while their homework was being graded or not being graded. Based on having open-note assessments, one might conclude that those assessments would be higher than the non-open note assessments. Based on interviews, surveys, and comparing pre and post data, students stated that, "If they have open-note tests, they take too long looking for the answers in their notes." When comparing the Conservation of Matter and Universe Units, both treatments were homework was graded; however, the Universe unit was a closed note post-assessment. When comparing the post-assessment data, the distribution is approximately normal with a  $W$  value of 379.5 in the Wilcoxon Signed Rank test. Therefore, the  $z$ -value of 1.5577 is used, not the  $p$ -value of 0.11876. The difference between using any notes and not using notes was not significant because  $p < .05$ . Students that study will continue to study, no matter if it is an open note assessment or not. These students are academically driven. Students who are not academically driven do not use the resources given to them. However, students stated they have more confidence in their work when they do their homework because students have feedback and know their work; they are studying is correct.

### Values of the Study

In the past, homework was used as busywork, practice, or checks for understandings. Homework allows students to see if they understand the material and allows students to self-explore the content. Teachers have used homework as a tool to help students explore the value of the content and reinforce materials taught in class. A key thing I learned from this project is as a teacher, I must give value to the homework. By giving feedback and reasons why the homework is essential, the outcome of homework turn-in increases, and assessment results do as well. Also, for many students, homework allows an avenue to explore more topics within that subject matter. As a teacher that gives homework, going the extra mile to expand the curiosity of one mind is worth it.

Other students view homework as a form of stress. The outcome of not doing their homework reflects on assessment grades. During this project, students realized that if they put in work outside of school, their assessment scores increase. Students also need feedback or grades on their work and have it ~~been~~ be relatable to their lives. This treatment showed the most growth between the pre- and post-assessment. In each treatment, the students learned how there is a correlation between homework turn in and assessment scores. They used to see the value in the 'grade,' but need to see the value in the education. The failure occurred when students did not do the assignment, master

content, or come to school. Because of this, students need to develop the work ethic skills and understand the value of their education.

### Consideration for Future Research

My action research project has taught me students want feedback on their assignments as well as see value in their education. From the first treatment to the last, the general trend increased when they received feedback and tended to see the value of the material. When implementing this project in the future, I hope students keep track of their assessment scores. Students need to see the cause and effect of their actions, and by having them track their pre- and post-assessments, the work's value might increase. A benefit to this is parents and guardians can then see the scores as well. If a student scores a 7/10 on the pre-assessment and then fails the post-assessments, parents, and students need to see how this occurred. The data will show parental figures on how I am holding students accountable.

Another aspect of the study I want to further my research in is, "Does late work affect students' overall learning?" Boucher (2016) explained that deadlines are stressful for students, but I beg to differ. In the treatments, when homework was not graded, students did not perform as well on assessments. Therefore, I would like to investigate the positive and negative effects deadlines of late work have on assessments. To achieve this, I would need to restrict the parameters in the investigation: focus more on how late work is compared to them turning it in at all.

My project co-teaching did not have a significant effect on the relationship between homework turn in and assessment scores. However, having another adult in the classroom must have some impact on the students. King et al. (2014) stated "There are six different co-teaching models" (p. 653) and exploring each method to find the best method for test scores is something to study in the future. One of the co-teaching methods that I would like to study more is station teaching. This method allows teachers to divide students into smaller groups and instruct content. If needed, students with Early Warning Signs (EWS) would be grouped for more instruction.

Rapport is a significant influence on student behavior in and out of a classroom. A study between the rapport between teacher and student and assessment scores would be an interesting study. I would like to see if there is a relationship between rapport and homework turn in or rapport and assessment scores. Both would involve more surveys and interviews because I would need to get to know students more on a personal level.

This project has shown me that there are more factors associated when studying homework and grades. Internal motivation and the drive to do work is another point of a study that can have a significant impact on assessment results. Based on other research, rapport is critical when establishing a classroom. I want to study the relationship between internal motivation and homework. With that project, I would not know where to start because studying the students' internal motivation is more on a psychological level. However, it would be interesting to discuss the most common internal factor to get students to turn in their work.

### Impact of Action Research on the Author

The objective of this study was to determine a relationship linking homework turn in and assessment scores. I noticed my students did not see a purpose in working on homework at the start of the year. Recognizing that establishing an influential work ethic is a life-long skill, I wanted a project to challenge students and show them the correlation between work and reward. In this case, the reward is understanding the material and passing the assessments. I was able to provide students with data on why it is necessary to turn their work in. Over the year, students evolved into more responsible young adults and took ownership of their work. Based on this investigation, my students have benefitted from this research. Through this process, I learned that data collection is a powerful tool to understand your students better and be an effective educator. The data obtained from the pre- and post-assessments throughout the study, verified how vital homework is in the academic growth of high schoolers. It also illustrated what students already knew as well as showed misconceptions. Because of this, I intend to use this pre and post-assessments to formulate better lesson plans. I will stress more on using pre-test so I can construct my lesson plans on accurate information then be able to compare my results to the post-assessments.

This study has taught me to value the opinions of my students in the classroom when it comes to teaching styles. Student feedback provided by this study will be useful in the years to come. My students gave valuable insight into how and why they either do or do not do academic work. Within the surveys and interviews, I learned that how I present myself to my students is incredibly important. If I enjoy the material, the

classroom dynamic changes. When I emphasize how important it is, most students get on board and follow my lead. The interviews from this process also taught me that some students do not want to do work, no matter what motivation is given.

Until they find value in education, all educators can do is attempt to point them in the right direction. I implemented this study to show students that there is a positive relationship between doing homework and test scores. I feel my study demonstrated this to my students, and when they want to formulate a better and brighter future, they will use the strategies given to them.

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APPENDICES

APPENDIX A

MONTANA STATE UNIVERSITY'S INSTITUTIONAL REVIEW BOARD

**INSTITUTIONAL REVIEW BOARD**  
**For the Protection of Human Subjects**  
**FWA 00000165**



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**MEMORANDUM**

**TO:** Kaitlyn Bondy and Walter Woolbaugh

**FROM:** Mark Quinn *Mark Quinn et al.*  
 Chair, Institutional Review Board for the Protection of Human Subjects

**DATE:** October 28, 2019

**RE:** "The Effects of Co-teaching and Student Grades on High School Science Classrooms" [KB102819-EX]

The above research, described in your submission of October 26, 2019, is exempt from the requirement of review by the Institutional Review Board in accordance with the Code of Federal regulations, Part 46, section 101. The specific paragraph which applies to your research is:

- (b) (1) Research conducted in established or commonly accepted educational settings, involving normal educational practices such as (i) research on regular and special education instructional strategies, or (ii) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.
- (b) (2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless: (i) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability, or be damaging to the subjects' financial standing, employability, or reputation; and (iii) the information obtained is recorded by the investigator in such a manner that the identity of the human subjects can readily be ascertained, directly or through identifiers linked to the subjects, and an IRB conducts a limited IRB review to make the determination required by section 16.111(a)(7).
- (b) (3) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior that is not exempt under paragraph (b)(2) of this section, if: (i) the human subjects are elected or appointed public officials or candidates for public office; or (ii) federal statute(s) without exception that the confidentiality of the personally identifiable information will be maintained throughout the research and thereafter.
- (b) (4) Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available, or if the information is recorded by the investigator in such a manner that the subjects cannot be identified, directly or through identifiers linked to the subjects.
- (b) (5) Research and demonstration projects, which are conducted by or subject to the approval of department or agency heads, and which are designed to study, evaluate, or otherwise examine: (i) public benefit or service programs; (ii) procedures for obtaining benefits or services under those programs; (iii) possible changes in or alternatives to those programs or procedures; or (iv) possible changes in methods or levels of payment for benefits or services under those programs.
- (b) (6) Taste and food quality evaluation and consumer acceptance studies, (i) if wholesome foods without additives are consumed, or (ii) if a food is consumed that contains a food ingredient at or below the level and for a use found to be safe, or agricultural chemical or environmental contaminant at or below the level found to be safe, by the FDA, or approved by the EPA, or the Food Safety and Inspection Service of the USDA.

Although review by the Institutional Review Board is not required for the above research, the Committee will be glad to review it. If you wish a review and committee approval, please submit 3 copies of the usual application form and it will be processed by expedited review.

APPENDIX B

MATTER PRE/POST TEST

Points 10  Published[Details](#)[Questions](#) Show Question Details

 <b>Phase change</b>	<b>1 pts</b>
What is it called when a solid turns directly into a gas?	 
<input type="radio"/> sublimation	
<input type="radio"/> liquid	
<input type="radio"/> melting	
<input type="radio"/> condensation	

er

 <b>Phase Change</b>	<b>1 pts</b>
When a liquid changes into a gas, the phase change is called	
<input type="radio"/> Evaporation	
<input type="radio"/> melting	
<input type="radio"/> condensation	
<input type="radio"/> freezing	

er

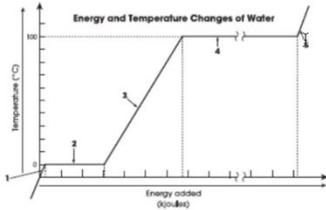
In which two states... Keep in mind, some students have already taken or started taking this quiz.

answer

- liquid and gas
- solid and liquid
- solid and gas
- liquid to plasma

**Phase Change** 1 pts

The following graph shows the change in temperature of a sample of H<sub>2</sub>O, which begins as ice, as thermal energy is added.



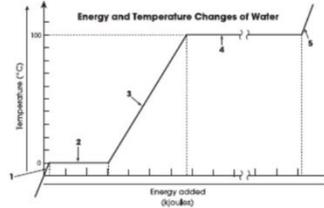
Which region of the graph represents water (H<sub>2</sub>O) in the solid form only?

answer

- 1
- 2
- 3
- 4
- 5

**Phase Change** Keep in mind, some students have already taken or started taking this quiz. 1 pts

The following graph shows the change in temperature of a sample of H<sub>2</sub>O, which begins as ice, as thermal energy is added.



Which phase change is taking place at stage 4?

answer

- vaporization
- melting
- freezing
- sublimation

**Phases** 1 pts

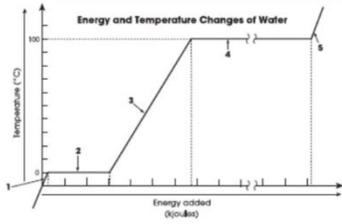
All phase changes (changing states) requires energy to be added or taken away.

answer

- True
- False

The following graph shows the change in temperature of a sample of H<sub>2</sub>O which begins as ice as thermal energy is added.

Keep in mind, some students have already taken or started taking this quiz



At stage 2, what would you see in your beaker?

- liquid water and ice
- liquid water only
- ice only
- water vapor

Exo and Endo 1 pts

What type of chemical reaction absorbs energy and requires energy for the reaction to occur?

- Endothermic
- Exothermic
- chemical reaction
- both

Exo and Endo 1 pts

Which of the following are examples of an exothermic chemical reaction? Check all that apply.

- freezing
- burning a piece of wood
- Melting ice cubes
- Evaporating liquid water

Kinetic Theory Of Matter 1 pts

Which of the follow is true about the Kinetic Theory of Matter - click all that apply.

- All matter is composed of atoms and molecules
- All matter is moving at a constant state of constant random motion
- the faster they move, the less space they need to move in and push the other molecules away.
- The colder a particular substance is, the faster the speed it moves.
- The slower the movement, the easier it is for the intermolecular forces to hold onto neighboring atoms and molecules.

+ New Question

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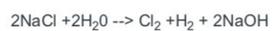
APPENDIX C

CONSERVATION OF MATTER PRE/POST TEST

[Details](#)[Questions](#) Show Question Details**MSSE CoM**

1 pts

A chemical equation is shown below:



Which of the following are the reactants? Check all that apply

ver

 2NaCl

ver

 2H<sub>2</sub>O 2NaOH Cl<sub>2</sub> H<sub>2</sub>**MSSE CoM**

1 pts

Which of the following statements best defines the law of conservation of mass?

ver

the mass of a closed system cannot be changed over time; mass cannot be created nor destroyed

when added to a system, energy can destroy mass

mass can be conserved during a chemical reaction; a little bit of mass is always lost

mass cannot be created but it can be destroyed under extreme pressures

⋮ MSSE CoM 1 pts

How many carbon atoms are in this ethanol example:  
6 C<sub>2</sub>H<sub>5</sub>OH

answer 12  
twelve

⋮ MSSE CoM 1 pts

Check the balanced equations.

answer  2 Fe + 3 Cl<sub>2</sub> → 2 FeCl<sub>3</sub>

answer  2 KMnO<sub>4</sub> + 16 HCl → 2 KCl + 2 MnCl<sub>2</sub> + 8 H<sub>2</sub>O + 5 Cl<sub>2</sub>

H<sub>2</sub> + O<sub>2</sub> → H<sub>2</sub>O

C<sub>7</sub>H<sub>16</sub> + O<sub>2</sub> → 5CO<sub>2</sub>+H<sub>2</sub>O

⋮ MSSE CoM 1 pts

Magnesium burns in air to produce a white powder. The white powder has been experimentally determined to be a compound of magnesium and oxygen. What is the chemical equation?

answer magnesium + oxygen → magnesium oxide  
magnesium + oxygen makes magnesium oxide  
magnesium + oxygen yields magnesium oxide  
magnesium and oxygen equals magnesium oxide

⋮ MSSE CoM 1 pts

Label the following types of Reactions below

answer A+B→ AB synthesis

answer AB→ A+B Decomposition

answer A+ BC Single Displacement

answer AB +CD → AC +BD Double Displacement

⋮ MSSE CoM 1 pts

Which of the following shows evidence of a chemical change? Check all that apply?

change of shape

answer  formation of a precipitate

answer  formation of a gas

answer  temperature change

answer  odor change

density

change of strength

changes to crystal form

⋮ MSSE of CoM 1 pts

What type of chemical reaction absorbs energy and requires energy for the reaction to occur?

answer  endothermic

exothermic

⋮ MSSE of CoM 1 pts

What type of reaction releases energy and does not require initial energy to occur?

answer  exothermic

endothermic

⋮ Question 1 pts

How many atoms are in this example?  
12 H<sub>2</sub>O

answer  36

thirty six

APPENDIX D

NUCLEAR PRE/POST TEST

Points 10 ✔ Published ⋮Details Questions Show Question Details

⋮ Nuclear MSSE 1 pts

What holds protons and neutrons together in a nucleus?

answer  strong nuclear force

like charges attracting

like charges repelling

atomic mass

⋮ Nuclear MSSE 1 pts

During fission, some of the nuclear mass is converted into

answer  energy

heavier nuclei

proton

critical mass

The process by which the sun produces energy is called

answer  nuclear fusion

critical mass

mass defect

nuclear fission

⋮ Nuclear MSSE 1 pts

The process of radioactivity occurs when

answer  the nuclei of atoms change

a substance gives off visible light

the valence electrons of atoms are removed.

a substance is placed near a radio antenna.

⋮ Nuclear MSSE 1 pts

Imagine that you have found a fossilized leg bone of some unknown mammal. Based on the size of the bone, you determine that it should have contained about 100 g of carbon-14 when the animal was alive. The bone now contains about 12.5 g of carbon-14. How old is the bone? Remember that every 5730 years, half of the carbon-14 in a fossil specimen decays or breaks down into the stable element nitrogen-14.

⋮ Nuclear MSSE 1 pts

A process in which a very heavy nucleus splits into 2 more stable nuclei of smaller mass is called:

answer  nuclear fission

nuclear fusion

a chain reaction

radioactive decay

⋮ Nuclear MSSE 1 pts

Potassium-42 has a half-life of 12.4 hours. How much of an 848 gram sample of Potassium-42 will be left after 62.0 hours?

⋮ Nuclear MSSE 1 pts

⋮ Nuclear MSSE 1 pts

The neutral particles that help most in holding an atom's nucleus together are

answer  neutron

proton  
 beta particles  
 alpha particles

⋮ **Nuclear MSSE** 1 pts

The process by which an unstable nucleus naturally releases energy or particles to form a different isotope of the same element or an entirely new element is called:

radioactive decay  
 fission  
 fusion  
 a chain reaction

answer

		1 pts
<b>answer</b>	<b>alpha particles</b>	a helium nucleus emitted by some radioactive substances
<b>answer</b>	<b>beta particles</b>	a fast-moving electron emitted by radioactive decay of substances.
<b>answer</b>	<b>gamma particles</b>	A narrow beam of photons

APPENDIX E

UNIVERSE PRE/POST TEST

Points 10 ✔ Published ⋮[Details](#) [Questions](#) Show Question Details**H-R Diagram**

1 pts

For a standard H-R diagram, what are the stars in the lower left region of the diagram? ✎ ✕

- white dwarfs
- main sequence stars
- supergiants
- giants
- I do not know

**Star**

1 pts

Order the following stars from coolest to hottest:



- star B, star A, star C
- star A, star B, star C
- star B, star C, star A
- star C, star B, star A
- I do not know

5/31/2020 Universe Pre-test 2020

**stars - matching** 2.5 pts

Part 1: Match the following "star" vocabulary words

15wer	a gigantic explosion in which a massive star collapses and throws its outer layers into space	Supernova
15wer	the last stage in a small or medium mass star, when it no longer gives off much heat or light	Black dwarf
15wer	a star in the main portion of its life cycle, in the middle of the H-R diagram	Main sequence star
15wer	small hot dim star that is the leftover center of an old star	White dwarf
15wer	a large reddish star that is late in its life cycle	Red giant

**universe vocab** 2.5 pts

Part 2: Match the following "star" vocabulary words

15wer	an object so massive and dense that not even light can escape its gravity	Black hole
15wer	a collection of stars, dust, and gas bound together by gravity	Galaxy
15wer	brightness of stars, measured in multiples of the Sun	Luminosity
15wer	a large cloud of dust and gas in interstellar space	Nebula
15wer	Star that has collapsed under such intense gravity that protons and electrons have smashed together to form neutrons	Neutron star

5/31/2020 Universe Pre-test 2020

**Big Bang Theory** 1 pts

In the current model of the Big Bang where the expansion of the Universe is accelerating, the age of the Universe is about \_\_\_\_\_

15wer

13.7 billion years old

14 million years old

12 years old

19 trillion years old

I do not know

**Evidence of the Big Bang** 1 pts

The Universe is expanding.

15wer

True

False

**Galaxy** 1 pts

What type of galaxy are we apart of?

15wer

spiral

elliptical

irregular

spiral barred

I do not know



APPENDIX F

HOMEWORK SCIENCE SURVEY

## Homework Survey

1 = strongly agree 2 = agree 3 = undecided/neutral 4 = disagree 5 = strongly disagree

- |   |   |   |   |   |   |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 11. My science teacher(s) cares about my progress as a student.           |
| 1 | 2 | 3 | 4 | 5 | 12. I use my organizer to record my homework                              |
| 1 | 2 | 3 | 4 | 5 | 13. Working with other students on cooperative activities helps me learn. |
| 1 | 2 | 3 | 4 | 5 | 14. I would rather do labs inside the classroom than go outside.          |
| 1 | 2 | 3 | 4 | 5 | 15. My teacher(s) expects me to complete my homework.                     |
| 1 | 2 | 3 | 4 | 5 | 16. My interest in a subject has no impact on my achievement.             |
| 1 | 2 | 3 | 4 | 5 | 17. If I do not get the homework, I do not do it.                         |
| 1 | 2 | 3 | 4 | 5 | 18. I think I learn better in the classroom than outside.                 |
| 1 | 2 | 3 | 4 | 5 | 19. My teacher makes time to help me when I ask for help.                 |
| 1 | 2 | 3 | 4 | 5 | 20. Homework helps me to learn  |

APPENDIX G

HOMEWORK ASSESSMENT INTERVIEW QUESTIONS

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

You will be asked questions about homework and how you think it relates to assessment scores.

Questions before the Treatment.

1. How do you feel about homework?
2. Are there courses where you like doing your homework more? Less? Does not matter?
3. What is the most challenging part about doing homework? Why do you feel this?
4. Do you think there is a relationship between homework grades and test scores?
5. Do you use anything to remind you to do your work?
6. Have you been in a co-taught class before?
7. Is there anything else you would like to share?

Questions to add after Treatment:

1. Do you think the units that homework was graded you did better?
2. What part of the graded homework units did you think was helpful? What makes you feel this way?
3. Did you do better in the units that homework was graded or not graded? Why do you think so?
4. Has your attitude towards homework or school changed?
5. Has your attitude towards reminders changed?
6. Do you like having a co-teacher?