

The Effect of Self-Assessment Questionnaires on Student Achievement in High School Science

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## Abstract

The purpose of this quasi-experimental study was to examine the impact of a self-assessment questionnaire of behavior on the science achievement of students in a general education high school class. The study compared the percent correct on a unit vocabulary assessment of 43 high school students varying from ninth to eleventh grade that received a traditional warm-up/closure lesson design and 44 high school students varying from ninth to eleventh grade that received the lesson design with an added self-assessment questionnaire. For seven class periods, spanning approximately three weeks, the questionnaire was implemented to the 44 students. The questionnaire had students analyzing their behaviors throughout the lesson and was provided at the end of each lesson. After taking the vocabulary assessment, the mean percent correct of the control group (mean = 77.78, SD = 24.40) did not differ statistically different from the mean percent correct of the experimental group (mean = 84.73, SD = 16.21) [ $t(85) = 1.57, p = .120$ ]. The results of the study failed to reject the null hypothesis, however the study had significant alterations due to the COVID-19 pandemic occurring approximately halfway through the study. The study suggested possible benefits to increasing student motivation and engagement. The exploration of the relationship between motivational techniques and academic achievement is essential to further the improvement of student success.

# CHAPTER 1

## INTRODUCTION

### Overview

The Next Generation Science Standards (NGSS) have distinguished a new approach towards the education and implementation of science curriculum. With the focus on inquiry-based instruction and content that is cross-curricular, the standards focus on more of a student-centered instructional practice (National Science Teachers Association, 2013). As teachers are focusing on more inquiry-based instruction, there has also been more of a focus to increase student motivation through lesson design. However, it has been noted by teachers in the researcher's high school, where the researcher is a science teacher, that both student motivation and overall achievement appear to be weaker compared to previous years since adopting the new standards, especially in the introductory science classes. Teachers in the researcher's school have noted, when comparing things such as work ethic, focus, or retention, that students expect high achievement with less effort. Furthermore, the administrators at the school have expressed concern with increasing student motivation and engagement rather than focusing primarily on student compliance to teacher requests.

Attempts have been made at increasing motivation by implementing more universal formative assessments. The administration has requested that students be asked pre-determined questions throughout the lesson to ensure content comprehension. To attempt to increase motivation, the administration has been placing a focus on more universal types of assessment where there is total pupil response. This could consist of physical movement to parts of the room to answer a question, raising a thumb up or down in agreement, using a whiteboard to individually responds to questions, or the use of technology to respond to a prompt. Although

there was an initial improvement of motivation noted by the staff of the school, in recent years the motivational impact of the techniques appears to have diminished. The current administration of the researcher's school is perusing other strategies that can be used to increase student motivation. Furthermore, educators use a variety of strategies in an attempt to improve motivation and achievement. "In the current era of standards-based education, student self-assessment stands alone in its promise of improved student motivation and engagement, and learning" (McMillan & Hearn, 2008, p.40). This researcher was particularly interested in self-assessment because it is a strategy that students can learn and practice in school and can then use outside of the educational environment. During the transition into the work force, it is not uncommon for a student to either perform or be involved with an assessment of performance.

### **Original Statement of Problem**

The purpose of this study is to determine the effect of implementing a motivational strategy, a self-assessment questionnaire, during class time versus utilizing instructional time in a traditional warm-up /closure design on high school student performance on physics and chemistry unit tests.

### **Modified Statement of Problem**

Due to the COVID-19 pandemic disrupting the completion of the study, the purpose of this study was modified to determine the effect of implementing a motivational strategy, a self-assessment questionnaire, during class time versus utilizing instructional time in a traditional warm-up /closure design on high school student performance on a physics unit assessment.

### **Hypothesis**

The null hypothesis for this study is that there will be no statistically significant

difference in science achievement posttest scores of students who utilize the self-assessment questionnaire than those who follow the traditional warm-up/closure design of instruction.

### **Original Operational Definitions**

**Unit assessment** refers to a test consisting of multi-typed content questions, such as true/ false, multiple choice, and short answer, relevant to the topics covered in the unit that were created in collaboration with all educators in the study prior to implementation of the unit. The topics of the assessment were taken from the county curriculum.

**Science achievement** is defined as the students' combined scores on the physics and chemistry unit assessments

**Motivational strategy** refers to a technique or strategy that can be produced in a classroom setting and is known to increase either the intrinsic or extrinsic motivation of the student. In this study, the motivational strategy will be self-assessment

**Self-assessment** is defined as the completion of a six-question survey during the final ten minutes of the instructional period. In this study, the self-assessment involved a combination of self-monitoring, self-evaluation, and identification of corrective behaviors.

**A warm-up** is defined as questions displayed for students to complete at the beginning of the instructional period to either recall previous content or to engage in a conversation leading towards new material. In this study, the experimental group's warm-up consisted of nearly identical questions. However, there was half the amount of questions and five minutes less time allotted towards the warm-up.

**A closure** is defined as summative questions for students to complete at the end of the instructional period to show mastery of the instructional outcome of the lesson. In this study, the experimental group's closure consisted of nearly identical questions. However, the experimental

group's closure consisted of half the amount of questions and had five minutes less time allotted towards the closure.

### **Modified Operational Definitions**

Due to complications created by the Corona pandemic during the study, the following operational definitions below were adjusted.

**Unit assessment** was altered to refer to a test consisting of matching vocabulary terms to their definition for a physics unit. One of the teacher's unit assessment is further defined as a test consisting of matching 17 vocabulary terms. One of the teacher's unit assessment is further defined as a test consisting of matching 16 of the 17 vocabulary terms with otherwise identical definitions.

**Science achievement** was altered to be defined as the students' percentage correct scores on the physics vocabulary test.

## **CHAPTER II**

### **REVIEW OF THE LITERATURE**

This literature review delves into how human motivation can be used to support achievement in science classrooms. The first section provides a definition of motivation as well as the different motivational types and known information about motivation. The second section introduces current theory and practices to increase the individuals' motivation. What is known about the connections between an individual's motivation and academic achievement is explored in the third section. In the final section, some other known influences of academic achievement are discussed that are separate from the motivation of the individual.

#### **Defining Motivation in a School Setting**

Motivation is defined as the tendency for an individual to maintain interest in a subject or topic until there is a sense of mastery of the topic (Al-Mutawah & Fateel, 2018). To define motivation, one must understand the two primary sources of motivation and the differences between them. Any individual can either be intrinsically motivated or extrinsically motivated. Extrinsic motivation involves encouragement or pressure from outside influences, such as parents, teachers, and social interaction with peers, whereas intrinsic motivation originates from personal encouragement that comes from inside an individual (Tokan & Imakulata, 2019). Intrinsic motivation creates a sense of personal satisfaction through the completion of tasks as well as promotes personal happiness of the individual (Froiland & Worrell, 2016). The difficulty that researchers face while analyzing motivation is that motivation is not possible to observe directly but rather must be inferred by observing the behaviors of students (Yalcinkaya, Boz, & Erdur-Baker, 2012). In addition to analyzing motivation through the use of observations, researchers have also used student surveys to collect data to study motivation.

As noted, there are two primary types of motivation, which include intrinsic and extrinsic motivation. Yalcinkaya et al. (2012) found in their research on case-based instruction that when students were intrinsically motivated students demonstrated more perseverance through any difficulties encountered while completing any task compared to those that were not intrinsically motivated. It has been further stated by Tokan and Imakulata (2019) that “extrinsic motivation has no direct effect on learning behavior” (p. 4), whereas intrinsic motivation did have an effect on learning behavior. They classified “learning behaviors” as behaviors including taking notes during instruction, completing assignments, and preparing for exams.

However, it can be noted that when students are motivated to follow instructions for a task, students were found to avoid the responsibility for the success or failures of their work (Keiler & Woolnough, 2003). It was also found that if the source of motivation for the student is to earn a grade, then students tended to consider learning content from such tasks secondary to their performance on the task.

Although motivation cannot be directly observed, it is known that there are several factors that affect the motivation of a student. For instance, the motivation of a student is determined by the student’s self-perception of their ability to do well on a specific task (McMillan & Hearn, 2008). In other words, when a student believes that they will be successful in the completion of a task, they will be more motivated to complete the task, even when faced with difficulties and challenges. Although the students’ view of success on a task will affect their motivation, Yalcinkaya et al. (2012) claim that students’ motivation for a given task is based on how much the student believes that the completion will lead to a positive result for themselves. To be motivated, the student must not only believe that they will be able to successfully complete a task, but they must believe that there is some sort of positive reward for the

individual. This could either be through internal satisfaction, as is the case of intrinsic motivation or through some kind of praise or affirmation by another or a physical reward, as is the case in extrinsic motivation. Even if the student feels a task is able to be successfully completed, the relevance of the topic to the individual will affect their motivation to actually try it. If a student finds the topic to be useful to themselves in reaching either a long-term goal or short term goal, they will have more motivation than if they deem the topic to have no meaning for themselves as an individual (Kotkas, Holbrook, & Rannikmäe, 2016).

Another factor which influences motivation is the prior achievement that a student has felt while engaged in the task previously. It was found that a student's prior achievement was positively related to the motivation of the individual (Froiland & Worrell, 2016). When a student has had previous success with a task, then the student will be able to feel that they can successfully perform similar tasks, which affects the motivation of the individual as found by McMillan & Hearn, (2008).

While there are known influences on students' motivation in school, unfortunately, students' motivation declines as they increase the years spent in school (Kotkas et al., 2016). Because of this, much research has been conducted to try to learn how to increase the motivation of students and consequently improve achievement.

### **Strategies for Increasing Motivation**

Although there is a plethora of instructional strategies present for educators to increase student motivation, most of the research focuses on increasing the intrinsic motivation of students. Many strategies focus on active participation of students throughout the task or lesson and the use of student-student interaction to increase motivation (Yalcinkaya et al., 2012). To create active participation Arguedas, Daradoumis, and Xhafa (2016) found in their research that

using cognitive dissonance to make students aware of the differences in any understanding or knowledge of a topic paired with a collaborative learning strategy increased their motivation and decreased their feelings of boredom compared to students who did not experience cognitive dissonance. Cognitive dissonance creates internal arguments for the individual student between what they believe is true versus what is true. A strategy to apply cognitive dissonance in a science classroom would be the use of case-based learning where students are given a case study or scenario and questions by which they are analyze the case. The case that students work on depicts real-world problems for which students must determine a solution (Yalcinkaya et al., 2012). If such a task were not to create cognitive dissonance, it would still be able to increase motivation if it were to have some sort of socio-scientific context that should be impactful on the student personally on either a local or global level (Kotkas et al., 2016). To increase the motivation of students, the task should be relevant to the student. The socio-scientific context could focus on a historical fact or a social view of a topic which students are to explore in completing the task (Yalcinkaya et al., 2012). In addition, the use of interdisciplinary connections from a science classroom to other classwork in other contexts was found to increase student engagement and motivation (Geller, Turpen, & Crouch, 2018). Interdisciplinary connections can be formed through the collaboration of teachers of different content areas to create cross-curricular concepts between all subjects. Another strategy used to increase student motivation is the use of feedback that is effective and meaningful to the student as well as the creation of goal orientation.

As noted by Papanthymou and Darra (2019), the use of rubrics, learning logs, portfolios, self-assessment tests, and forms can successfully increase both the student's self-esteem and motivation. It has, however, been noted that the feedback must be meaningful in order for an

increase in motivation to occur (Arguedas et al., 2016). The use of meaningful and effective feedback further relates back to the effect that student's self-perception of success and prior achievement has on motivation, as discussed in the prior section. Furthermore, when students are provided with a choice regarding the form of feedback, such as the use of a learning log or portfolio, then students have a perception of control and choice that increases overall motivation (Paterson, 1996). Paterson continues by stating that when students are provided with self-regulation in their learning, there is an increase in their motivation as well.

While performing self-regulation during learning, students conduct self-assessment as a primary component. This self-assessment has been found to improve student motivation, engagement, and overall quality of learning (McMillan & Hearn, 2008). McMillan and Hearn further describe that self-assessment has three main components, which are self-monitoring, self-evaluation, and then an identification and implementation of corrective behaviors in order to be successfully utilized in a classroom. Prior to using self-assessment, students need to be directed regarding the creation of learning goals so that there is a basis of success for any topic or task which they can both self-monitor and self-evaluate while working through a task. When learning goals are created and utilized during instruction, students rated themselves as having more enjoyment than those that were focused on task completion or performance rating for a grade (Froiland & Worrell, 2016). Froiland and Worrell also found that when students were explicitly taught to apply the use of learning goals to completing homework and other activities outside of the school setting, there was an increase in intrinsic motivation. Once learning goals are established, the use of self-assessment and self-monitoring of behaviors has been found to increase the persistence a student has through a task, the confidence students feel about their learning, as well as an increased responsibility of work (McMillan & Hearn, 2008). In using self-

assessment, students have a perception change that increases their internal locus of control, which can increase intrinsic motivation due to a sense of choice, control, and personal satisfaction with completing goals rather than extrinsic praise.

### **Relationship Between Motivation and Academic Achievement**

Increases in both intrinsic and extrinsic motivation have been found to indirectly increase achievement of students (Tokan & Imakulata, 2019). The effects that motivation has on academic achievement are not direct but rather are apparent through the effects that motivation has on learning behaviors which impact achievement. Research has found that intrinsic motivation has a strong positive association with engagement which is a predictor of achievement (Walker, Green, & Mansell, 2006). Furthermore, attitude and motivation have been found to be predictors of students' decisions regarding task completion in a student's science learning progress (Yalcinkaya et al., 2012). Intrinsic motivation has been associated with long term achievement, conceptual understanding, and learning mastery goals (Froiland & Worrell, 2016). Paterson (1996) further states that the use of motivational techniques has a high association with increased academic performance. As mentioned previously, Tokan and Imakulata (2019) found in their study of case-based instruction that any changes to a student's extrinsic motivation had no direct effect on the learning behaviors of the individual, meaning that extrinsic motivation may not have the indirect effect of increasing achievement as an increase in intrinsic motivation might.

### **Other Factors That Affect Achievement**

Although there is evidence of the connections between motivation and achievement, it must be noted that there are other factors that also influence the achievement of students. The educational level of parents as well as the family socioeconomic status are factors that have been

found to be connected to a student's achievement level (Froiland & Worrell, 2016). As parents increase their educational level, students are more prone to higher levels of academic achievement. Similarly, as the socio-economic status of the family increases, there is a higher probability of academic success compared with those of lower socio-economic status (Gobena, 2018). Furthermore, research has found that the attitudes of students towards both math classes and sciences classes are indicators of achievement in both subjects (Al-Mutawah & Fateel, 2018). When students were found to have a negative attitude towards a mathematics or science course prior to its start, they tended to have higher anxiety and overall lower performance in the course. In addition to initial attitude, Bircan and Sungur (2016) found that the overall value that students place on courses as being valuable predictors of science achievement. Bircan and Sungur discovered students who believed the information to be important to their future had higher achievement than those who placed less value on the course or content being taught.

### **Summary**

This review of literature suggests that there is an indirect relationship between motivation and academic achievement. Despite its indirect nature, there is purpose in increasing the intrinsic motivation of students as it may increase the learning behaviors of students and increase long term achievement of the student. The use of cognitive dissonance, collaborative strategies, and self-assessment have been shown to increase intrinsic motivation. With the introduction of the Next Generation Science Standards, strategies and concepts known to increase motivation have become integrated into science curriculum. For instance, the Next Generation Science Standards (NGSS) were created so that curriculum would be taught in the same way science is taught in the real world, using real work problems to create content understanding (National Science Teachers Association, 2013). In addition, one of the practices promoted by NGSS is to engage in academic

arguments to further evaluate and communicate information determined in a specific task (Brownstein & Horvath, 2016). Continued research is warranted to determine how to best motivate students to reach their goals and meet curricular standards in science.

## **CHAPTER III**

### **METHODS**

#### **Original Design**

This study used a quasi-experimental, nonequivalent control group design. Additionally, the study used a convenience sample of six science classes with three different teachers, with two classes each. For each teacher, using random classroom assignment to condition, there was one class designated to be in the experimental condition and one class designated to be in the control condition. The independent variable in this study was the delivery of the motivational strategy of self-assessment, which was either implemented or was not implemented. The dependent variable was the science achievement score based on students' combined performance on two separate unit assessments, one based on physics content and one based on chemistry content. A pretest-posttest design was used to compare the participants and to test the null hypothesis. The pretest consisted of the most recent previous chemistry unit and physics unit scores and was used to compare the six classes prior to the initiation of the study to determine if there were pre-existing differences in the groups in science achievement. Classes in the control and classes in the experimental group were compared on posttest results to determine the impact of the stated independent variable.

#### **Modified Design**

All six classes successfully began the study; however, due to COVID-19 shutting down schools, only four of the classes were able to have a meaningful implementation of the intervention. The students for one of the three teacher's classes were not used in the data analysis. Since the schools closed before the first of the posttests was administered, the dependent variable was changed to a vocabulary test that was taken during the physics unit. Due

to an inability to complete a chemistry unit, the pretest consisted of only the most recent physics unit score rather than a combination.

### **Original Participants**

The participants in this study were tenth through twelfth grade students in a suburban public high school of a Mid-Atlantic state. The study included 146 students, who were enrolled in an Integrated Physics Chemistry class. The course is a required class in one of two pathed high school science course sequences. The Integrated Physics Chemistry course is taken for students that have the chosen pathway of biology, integrated physics chemistry, and then earth and environmental science. The other high school pathway would consist of biology, chemistry of varying levels, and then physics. The Integrated Physics Chemistry course at the researcher's school has only one level of which varying students can be placed. The classes met either two or three times per week (i.e., A day/B day schedule) for 85 minutes of instruction and were taught by three different teachers, one of whom was the researcher. Each teacher taught two sections of the class, consisting of 22 to 28 students. Five of the six classes met in the morning and one class met in the afternoon. Each teacher randomly assigned one of the classes to the control group and the other class to the experimental group. The class was assigned through the use of a coin for their first scheduled class, having a head showing on the coin dictated the class to be in the control group. Otherwise, the class was in the experimental group and based off the results of the coin, the second class taught was placed in the opposite group for each teacher. The control group consisted of 74 students and the experimental group consisted of 72 students. The race, gender, and grade level of the students in each group are broken down in Table 1.

**Table 1**  
*Demographics by Grouping*

		Control Group		Experimental Group	
		Male	Female	Male	Female
<b>Race</b>	Caucasian	31	25	33	20
	Asian	1	0	2	2
	African-American	7	2	2	5
	Hispanic	2	4	1	2
	Multiracial	2	0	2	3
<b>Grade Level</b>	Ninth Grade	1	1	1	0
	Tenth Grade	37	26	31	25
	Eleventh Grade	4	3	8	7
	Twelfth Grade	1	1	0	0

### **Modified Participants**

Due to two classes not being used in the study due to COVID-19, the final study had only included 87 students. The control group had 43 students and the experimental group had 44 students. Due to no outcome data, three students from the control classroom were not included in the study and four students from the experimental classroom were not included. The race, gender, and grade level of the students in each modified group are broken down in Table 2.

**Table 2**  
*Demographics by Grouping of Students Able to be Utilized*

		Control Group		Experimental Group	
		Male	Female	Male	Female
<b>Race</b>	Caucasian	18	14	23	12
	Asian	1	0	0	1
	African-American	5	1	1	4
	Hispanic	1	2	1	1
	Multiracial	1	0	1	0
<b>Grade Level</b>	Ninth Grade	1	1	23	15
	Tenth Grade	21	13	30	23
	Eleventh Grade	4	3	4	5
	Twelfth Grade	0	0	0	0

### Original Instrument

The unit assessments consisted of multiple choice, true and false, as well as short answer questions created through collaboration with the other teachers at the researcher's school. Content standards and topics of the unit for assessment were pre-determined by the county curriculum of the course. These unit assessments were varied in length based off the length of time in each content. Tests were scored according to a rubric agreed upon by all teachers in the study. Each teacher scored the tests of their own students. The science achievement pretest score was based off the combined raw scores from the chemistry (34 available points) and physics (40

available points) unit tests immediately preceding the intervention. The science achievement posttest score was based off the combined raw scores from the chemistry (36 available points) and physics (38 available points) tests from the units taught during the intervention period.

### **Modified Instrument**

The pretest was changed to the previous physics unit test rather than a combination score of physics and chemistry. Since the students were not able to take the original physics posttest and the chemistry unit instruction had not started before school closure, the dependent variable was changed to a physics vocabulary test that had been taken during the course of the physics unit. The vocabulary test utilized a matching system for students to match a vocabulary term to their definition. The vocabulary test was developed by the county and was modified to meet the needs of the students of the school by both teachers. The test consisted of 16 words that were to be matched for one teacher and 17 words that were to be matched for the second teacher. The one teacher included one extra vocabulary word due to content coverage versus the other teacher. All other vocabulary words and definitions were identical for both teachers. Due to the custom nature of the vocabulary test, there is no reliability or validity data.

### **Original Procedure**

Student classes were created prior to the initiation of this study and remained consistent throughout the experiment. Three veteran teachers were used to assist with implementation. All three teachers were implementing the Integrated Physics Course for the first time during the study and taught two classes each. The three teachers co-planned every notes paper and activity for the course. As such, lesson delivery varied only through the tone and generalized questions posed outside of the notes and activities. The format of the class consisted of short lectures, group work, independent work, class discussions, discovery activities, demos performed by

students or by the teacher, physical labs, as well as online simulations. One of each teacher's classes was randomly assigned to being part of the control group and the other class was assigned to being part of the experimental group. Prior to beginning the intervention, the mean pretest scores of the control and experimental groups were compared using an independent samples t-test. The pretest unit for chemistry involved the basics of chemical reactions, how to read chemical reactions, and balancing chemical reactions. The pretest unit for physics involved content of momentum, impulse, and the conservation of momentum during a collision.

Beginning with the first day of implementation, the control group continued with the standard procedure of ten minutes of instruction spent on a warm-up activity while the experimental group had a shortened warm-up consisting of only five minutes and only half the questions. The warm-up consisted of questions for students to complete at the beginning of the instructional period to either recall previous content or to engage in a conversation leading towards new material. After the warm-up, all instructional time consisted of the same activities with the same allotted time for both the control and experimental groups. During the final fifteen minutes of the instructional time, the control group was provided a closure activity that utilized the allotted fifteen minutes to complete. The closure activity involved summative questions for students to complete to show mastery of the instructional outcome of the lesson. The experimental group was provided a shortened closure activity that included half of the questions and lasted only ten minutes. The other ten minutes of instructional time was provided for students to complete the self-assessment. The self-assessment consisted of a six-question survey that involved self-monitoring, self-evaluation, and identification of corrective behaviors. The questions on the survey asked for students to analyze their focus during the lesson, their persistence, and discussions done through the class period. Students were asked to elaborate on

why they chose the rating that they did. Furthermore, students were asked about their strongest behavior and behaviors that could be improved before asking students to determine a plan to better their behavior. The experimental group was provided with the expectation to complete the survey honestly and truthfully and to take time to think of their responses (see Appendix A).

The intervention period, in which the control group had the full warm-up and closure activities while the experimental group had shortened warm-up and closure but also completed self-assessments, lasted for seven classes during the physics unit; then testing for the unit on the eighth class took place, where a self-assessment was not utilized and a similar procedure for seven classes in the chemistry unit with testing on the eighth class. Both the control group and experimental group completed the two identical unit assessments; one assessment focused on a physics content unit and one focused on chemistry content. The physics content consisted of static electricity and circuits and the chemistry content consisted of chemical bonding and trends in the periodic table. The science achievement posttest scores were compared using an independent samples t-test.

### **Modified Procedures**

The groups were compared on the previous physics unit test as the pretest measure to evaluate whether the groups differed in physics ability prior to the intervention. The mean number correct out of 40 of the control group (Mean = 29.58, SD = 9.49) did not differ significantly from the mean percentage correct of the experimental group (Mean = 32.52, SD = 6.91) [ $t(85) = 1.66, p = .101$ ]. Consequently, it was not necessary to control for pre-existing differences.

Due to COVID-19, the students had instruction for the physics unit but never took the physics posttest. They never had the chemistry unit. The students had taken six of the seven

classes for the physics unit with the vocabulary test occurring on the sixth day along with instruction and a final self-assessment questionnaire. Students were aware of the vocabulary test prior to taking it and took approximately 5 to 10 minutes to complete. The vocabulary covered all terminology associated with the physics unit in electricity. Both teachers utilized nearly identical vocabulary tests, but with one teacher having one extra vocabulary term and definition. All other definitions to be matched and vocabulary terms were identical between the two different tests. Due to one extra vocabulary term on one teacher's test, the percentage correct scores on the vocabulary test were compared using an independent samples t-test.

## CHAPTER IV

### RESULTS

The purpose of this study was to determine the effect of implementing a motivational strategy, a self-assessment questionnaire, during class time versus utilizing instructional time in a traditional warm-up /closure design on high school student performance on a physics unit assessment. An independent samples t-test was conducted with the independent variable being the delivery of the motivational strategy of self-assessment, which was either implemented or was not implemented, and the dependent variable being modified to a percentage correct on a vocabulary test that was taken during the physics unit. The mean percentage correct of the control group, those without the motivational strategy, (Mean = 77.78, SD = 24.40) did not differ significantly from the mean percentage correct of the experimental group, those with the motivational strategy, (Mean = 84.73, SD = 16.21) [ $t(85) = 1.57, p = .120$ ]. Consequently, the null hypothesis, that there will be no statistically significant difference in science achievement posttest scores of students who utilized the self-assessment questionnaire when compared to those who follow the traditional warm-up/closure design of instruction, was retained. Please see Table 3.

**Table 3**

*Means, Standard Deviations, and t-statistic for Grouping Means, Standard Deviations, and t-statistic for percentage correct on vocabulary test*

<b>Condition</b>	<b>N</b>	<b>Mean</b>	<b>SD</b>	<b>t-statistic</b>
Control	43	77.78	24.40	1.57 (NS)
Experimental	44	84.73	16.21	

NS = non-significant at  $p \leq .05$

## **CHAPTER V**

### **DISCUSSION**

The purpose of this study was to determine the effect of implementing a self-assessment questionnaire as a motivational strategy during instruction time on high school student performance on a physics unit compared to a traditional warm-up/closure design. The null hypothesis that there will be no statistically significant difference in the achievement posttest scores between the two groups of students, those who utilized the self-assessment questionnaire versus those that retained the full use of the warm-up/closure design, failed to be rejected.

#### **Implications of Results**

Upon an analysis of the results of this study, there is no significant statistical evidence to support the use of self-assessment questionnaires in lieu of the full use of traditional warm-up/closure design for increasing scientific achievement. Although the use of the self-assessment questionnaire did not show statistical significance to support the use, both teachers implementing the questionnaire, including the researcher, believe that the questionnaire had an effect on the motivation and general behavior of the students in the experimental group compared to the control. The differences in behavior and motivation were noticed in how students acted during open-ended discovery labs and during classroom discussions and activities. During group and class discussions, more students appeared to be willing to share their thoughts or state if they agree or disagree with what was proposed by another student compared to the control group. In addition, students appeared to remain on task more often during labs and posed more questions about the content with discovery labs than compared with the students in the control group, who tended to be off task. Furthermore, corrective behaviors and refocus provided by the teacher appeared to be implemented quicker and was needed less often in the experimental group

compared to the control group for both teachers. Due to the observational differences, it may be useful for teachers to implement the self-assessment questionnaire to increase motivation and discussion participation, as well as to help with implementation time of corrective behaviors or redirection. However, results suggest that implementing a questionnaire for self-assessment would not promote student achievement more so than traditional academic instruction.

Although there was not enough of a significant statistical difference to reject the null hypothesis, the experimental group did have a general upward trend towards achievement compared to the control group. The study was forced to be modified due to COVID-19 pandemic, causing schools to become distance learning approximately halfway through the implementation of the research study. Furthermore, the planned assessment had to be modified to account for the transition. If this study persisted for the full length of time, the observational differences between the experimental and control group that were noted by both teachers may have translated into differences in the data significantly different to reject the null hypothesis.

### **Theoretical Consequences**

McMillan and Hearn believed that self-assessment is a way to increase both student motivation and achievement (2008). The results of the study do not support the belief that self-assessment is a means to increased academic achievement. However, anecdotal evidence from both teachers, including the researcher, shows that implementing the study does help support the assumption that self-assessment increases motivation. The use of a self-assessment questionnaire as it relates to student behavior was no more effective on student achievement than the use of the traditional warm-up/closure design. The results indicate that achievement levels on physics assessments are based more on instructional delivery and student preparation, as well as other factors, rather than the use of the motivational technique of self-assessment.

The anecdotal results that occurred during this study continue to support Bandura's views on social cognitive theory. In Bandura's theory, there is an interplay of personal influences, environmental influences, as well as behavioral influences that lead to how people develop their capabilities and regulate their own life (Hoy, 2012). As the experimental group was performing their self-assessment, their behavioral conduct in the class was observed by both teachers to be improving. The experimental group was observed to remain on task easier, and corrected misbehaviors at a quicker rate without argument with the teacher when compared with the control group. The use of the self-assessment is a way to positively influence the students' personally and, as a result, their behavior was influenced and improved, showing the "dynamic interplay among three kinds of influences." (Hoy, 2012, p. 399)

### **Threats to Validity**

One of the most significant threats to validity in this study is the unforeseen modifications due to the COVID-19 pandemic that caused school systems to close physically beginning on March 16, 2020 and remaining throughout the rest of the 2019-2020 school year. Due to the sudden closures announced March 12, 2020, the study had to be altered to utilize non-ideal assessments to analyze differences. This creates concerns about instrumentation, which is a threat to internal validity. The dependent variable assessment was changed to a matching vocabulary test that students knew about in advance. The teachers had slightly different vocabulary assessments, resulting in non-uniformity for analysis. However, due to each teacher having one control and one experimental group, the threat of non-uniformity of assessments was minimized. Because achievement was only able to be measured by the performance on a single vocabulary test in the implemented study, the achievement data was not able to sufficiently measure total achievement. This is due to it not reflecting all of the content learned during the

science unit besides vocabulary and definitions. The vocabulary assessment would only be able to measure students' content learning and understanding of the terminology, but would not be able to measure content in practice or in the higher measures of Bloom's Taxonomy besides the lowest level of "remember". This limits the extent to which results can be generalized to broader aspects of achievement.

Furthermore, the study originally was planned for 146 students spanning six classes and three teachers. However, due to the shift to distance learning as a result of the pandemic, one teacher could not begin the study, causing the participant number to reduce to 87 students to start the study. In addition, the vocabulary assessment was provided to students during March 12th and March 13th, the last days of the school year before shifting to distance learning. As a result of this, three students in the control group and four students in the experimental group could not be included in the study due to no posttest data available. This reduced the power of the study. This also limited the ability to generalize the results, which is a threat to external validity.

The alterations secondary to COVID-19 also caused the intervention to be concluded only after seven classes rather than the planned fourteen classes. This changed the length of the study from six weeks to three weeks. This impacted the integrity of the intervention, which is a risk to internal validity. If the study had been implemented for the full length of time as originally planned, the difference between the two groups may have been larger and could have led to significant statistical differences.

An external validity concern for this study is the fact that the results could not be generalized to all types of high school science students. The sample did not include students taking the most demanding science track (e.g., Advanced Placement courses) and also did not include students with significant learning problems. As such, the students were generally

representative of middle ability and middle motivation, or students only taking the course as a graduation requirement, and cannot be generalized to other types of students.

### **Connections to Previous Studies/Existing Literature**

The results of this study differ from the results of studies presented by Thrasher (2012) as well as Nikou and Economides (2015), both of which found that self-assessment had a positive impact on student achievement. The results of this could differ due to the amount of time that the study was implemented as well as the topic of self-assessment being used. For example, in Thrasher's study, the self-assessment strategy was implemented for five units rather than the single unit used in this study. Similarly, the study conducted by Nikou and Economides (2015) also spanned a longer time period of seven weeks rather than the approximate three weeks of this study. If this study were to be implemented for a longer period of time, it may have resulted in similar results as seen by Thrasher and Nikou and Economides. Furthermore, both studies conducted by Thrasher and Nikou and Economides included a self-assessment of content knowledge rather than the self-assessment of behaviors as was the case in this study. The study conducted by Nikou and Economides utilized only self-assessment of content for students using the same content-based question throughout the study and the study conducted by Thrasher utilized a behavioral self-assessment similar to this study with a rating scale. However, the study by Thrasher also included surveys of students' personal understanding of lesson objectives as well as a survey on student attitudes of studying habits, which was not included in this study. This study only focused on the self-assessment of behaviors rather than content, as was with the other studies that yielded positive increases on achievement.

The design of the self-assessment questionnaire utilized the definition presented by McMillan and Hearn (2008) regarding the process of self-assessment. Self-assessment is defined

as “a dynamic process in which students self-monitor, self-evaluate, and identify correctives to learn” (McMillan & Hearn, 2008, p. 48). The questionnaire utilized in this study has a scale system for students to self-evaluate their performance on specific behaviors, which also required students to be self-monitoring their behaviors throughout their class. To ensure they were becoming more cognizant to self-monitor during the class, after each rating there was a space for students to explain their rating on the specific behavior. To include the portion of identifying correctives, the final question on the survey was created to have students identify a behavior they could improve on and design a plan to improve on said behavior.

### **Implications for Future Research**

The study was not conducted as originally planned due to the COVID-19 pandemic. Future researchers could conduct this study as originally designed to determine if the longer period of time would yield different results than what occurred with this modified study. In addition, future researchers may want to investigate the timing of the implementation, such as during the beginning of the school year, to determine if there are different results than what occurred during this study, which occurred during the third quarter of the school year.

Due to anecdotal information obtained during the intervention, future researchers may want to include data collection and analysis of behavioral outcomes. This data could include time on task versus time off task, average student participation per task or open question posed, or classwork and homework completed. The data could then be compared for the control and experimental group to document behavioral changes due to the implementation of the self-assessment.

Because this study targeted a specific population of students, further research could focus on multiple schools or a higher variation of student population in science courses to generalize the

results. Future research could be conducted on students of varying achievement levels, such as those in AP science courses as well as students in special education classes to allow the results to be generalized to a larger population of high school science students rather than the current generalization of students taking general science education requirement courses.

Because this study focused only on the motivational technique of self-assessment to increase achievement, future research may be conducted to investigate other motivational techniques to determine their effect on achievement. Furthermore, research could be conducted to determine if motivational interventions have a long-term effect on student achievement even after the questionnaire intervention has finished. This study was designed to have the motivational strategy continue until the day of assessment.

In addition, future research could be conducted to focus on varying achievement outcomes rather than performance on unit assessments as it was in the original study. By focusing on varying achievement outcomes, such as overall grade in science class, achievement on alternative forms of assessment like a project, or the achievement on cumulative tests that require students to analyze current content as well as the ability to recall previous content, researchers will be able to determine the effects of motivational strategies on a broader range of aspects of achievement rather than only performance on traditional assessments.

### **Conclusions/Summary**

This study did not provide statistical evidence that implementing a self-assessment questionnaire on behavior has a significant impact on science achievement, as measured by a vocabulary test, compared to utilizing time spent on the questionnaire on a longer warm-up/closure. However, there was observational data suggesting that there were improvements in behavior that could be a result of the implementation of the questionnaire provided to the

experimental group. It must be noted, there were significant changes to the original study design due to the global pandemic that impacted the intervention as well as the outcome measure, which negatively impacted the ability to examine the question whether self-assessment on behavior improves science achievement. Future research should address these concerns, such as examining the length of the self-assessment questionnaire intervention as well as other motivational techniques and their effect on student achievement. The use of motivational strategies to improve achievement provides interesting topics for future research to assist with student comprehension of scientific concepts and their ability to demonstrate and apply this understanding.

## Appendix A

Date: \_\_\_\_\_

Period: \_\_\_\_\_

### Self-Assessment Questionnaire

*Directions: From each category, select a rating about each statement.*

- 1) I was on task (listened during instruction, completed notes, etc..) during the period.

Not at all      A few times      Sometimes      Most of the Time      All the time

Why did you select this rating? Explain below:

- 2) I tried my best and persisted on tasks that we did during the period.

Not at all      A few times      Sometimes      Most of the Time      All the time

Why did you select this rating? Explain below:

- 3) I participated in discussions about the content with my classmates and the teacher during the period when appropriate.

Not at all      A few times      Sometimes      Most of the Time      All the time

Why did you select this rating? Explain below:

- 4) Which behavior do you believe was your best behavior today—being on task, trying your best/persisting, or participating in discussions? Why do you think this?

- 5) Is there any behavior you could have done better today-being on task, trying your best/persisting, or participating in discussions? Why do you think this?

- 6) Make a plan: What is one thing you could do to improve on your behaviors during class?

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