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ACT Reading performance and science performance: The influence of science teachers’ self- efficacy and emphasis of terminology strategies during instruction

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By

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Reading ability impacts "high stakes" standardized tests that science students need to graduate, to enter college or to enter the work force. As a result, the Next Generation Science Standards (NGSS) require science teachers to implement vocabulary techniques amongst other reading strategies for improved content comprehension and test performance. Simple linear regression was applied to determine the effect of average ACT reading scores on average ACT science scores. Path analysis was utilized to explain the impact of science teacher self-efficacy (X1SEFF) and teaching of important terms/facts (N1TERMS) on average ACT reading scores (AVGACTREAD) and average ACT science scores (AVGACTSCI). Those students who have higher average ACT reading scores tend to have higher average ACT science scores. Path coefficients showed that for every standard deviation in X1SEFF, AVGACTREAD scores increased by .25 standard deviation units. Also, for every standard deviation in X1SEFF, AVGACTSCI scores increased by .20 standard units. On the other hand, science teachers' emphasis on important science terms produced a statistically nonsignificant negative relationship with students'

average ACT reading scores and average ACT science scores. Thus, for every standard deviation in N1TERMS, AVGACTREAD scores decrease by -.09 standard units

Additionally, for every standard deviation in N1TERMS, AVGACTSCI scores decrease by -.06 standard units. The results implied that when science teachers feel confident about their ability to teach science, there students' standardized reading and science test scores are higher. On the other hand, when science teachers placed moderate to heavy emphasis on teaching important science terms and facts, science students' standardized test scores decreased. As a result, quality professional development on effective reading strategies particularly vocabulary could improve science teachers' instructional practices on teaching science terms and facts to improve students' standardized test scores.

DEDICATION

This momentous task could not have been accomplished if not for my strong faith that strengthened me through those darkest hours. I also dedicate this task to my husband, Thurman Suggs, who has supported me in every way through this process. You believed in me often when I doubted myself. I love you and will forever be grateful for your unconditional love, patience, and perseverance. To my daughter Jaterrica, I cannot thank you enough for the times you sacrificed moments with me to allow for this process to happen. To my parents, Edna and Lorenzo Bailey, and my extended family: your encouragement and motivation pushed me to the finish line—the sentiment—"when are you going to be done with school" echoed in my psyche so the fear of disappointment harnessed me to this victory. My special friend, Uricka Stewart, your well wishes, phone calls and genuine concern meant so much through such a trying time in my life, thank you! My brothers and sisters in law, thank you and your families for the support, wisdom and words of encouragement.

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CHAPTER I

INTRODUCTION

Background of the Study

Since the reauthorization of the Elementary and Secondary Education Act of 1965, also known as the No Child Left Behind (NCLB) Act of 2001, high stakes standardized testing has been the measuring stick of student performance and school success. "High–stakes testing is the process of attaching significant consequences to standardized test performance with the goal of incentivizing teacher effectiveness and student achievement" (Nichols, Glass, & Berliner, 2012, p. 3). Testing was also implemented to hold individual states accountable for providing quality instruction to areas with the most at risk for impoverished youth by rating the performance level of schools and districts (Riley & Cantu, 2000). In addition to gauging students' content area knowledge in grades three through eight in the areas of reading and math, NCLB required school districts to identify and remediate young struggling readers so they could read efficiently by third grade.

The need to remediate reading is great. Despite the effort of such federal government initiatives like Reading First and Early Reading First, statistics show that there is still a reading gap that exists between at risk children and their peers and this gap widens as students get older (Chatterji, 2006). Even more alarming, the black and white reading achievement gap continues to grow even during school hours (Burchinal, 2011). Eventually, young children from low socioeconomic backgrounds who experience limited reading achievement and growth mature into adolescents who cannot read well enough to perform academically (Aikens & Barbarin, 2008; Hernandez, 2011).

The deficiency of reading ability amongst our nation's high schoolers is evident in the science standardized testing area. Results for the Programme on International Student Assessment (PISA) 2012 revealed that only eight percent of fifteen year olds in the United States scored at a proficiency level 5 or above which denotes being able to "locate and organize several pieces of deeply embedded information, inferring which information in the text is relevant" (Kelly et al., 2013, p. 6). The 2013 results for the National Association of Educational Progress (NAEP), which monitors the status of education in the United States, showed that 65% of fourth graders were reading at basic or below while 64% of eighth graders were reading at these low levels. The nation's eighth graders are entering high school with reading deficiencies. Another devastating common thread is that African Americans, Hispanics and low socioeconomic students perform at an even lower level than their peers.

When our nation's students walk into their science classrooms, they are at a disadvantage. Science students are not only being assessed on their content knowledge on standardized tests, but they are being assessed on their reading ability as well (Cromley, 2009).

Biology students are expected to use various reading skills in order to perform well on the biology standardized test. For example, they are expected to critically read text in order to analyze scientific information and they are required to use inferences while expressing themselves in writing or speaking (Balgopal & Wallace, 2013; Hoskins, 2010). With decreased focus on learning to read in high school, biology students who are struggling readers will go unidentified and un-remediated and may fail the biology high stakes test, one of the four key assessments that determine whether high school students graduate in the state where this study was conducted. When biology students are reading on a low-grade level, their ability to learn course content that is critical to their performance on the biology high stakes test is hindered (Greenleaf et al., 2010; Visone, 2009).

Science students' performance on the biology high stakes test is gauged by their scale score which ranges from below basic, basic or minimal, proficient, and to advance. Not possessing advanced literacy skills can have a devastating effect on high school science students. Visone (2009) utilized regression analysis to explore the relationship between the reading for information subtest (RfI) and the science portion of the Connecticut Academic Performance Test (CAPT) among tenth grade students from three separate high schools. He concluded that there was a significantly strong correlation between RfI and science performance.

This relationship is also seen in international assessments. Cromley (2009) calculated correlations for three data sets from the PISA assessment for the years 2000, 2003 and 2006 and determined a strong relationship between reading and scientific literacy. Reading ability has been linked to the ability to select correct responses on a standardized science test (Visone, 2010). Adolescents who cannot read well enough to score well on science standardized exams, like that in biology, risk that chance of not graduating from high school when the assessment is linked to graduation requirements.

The dropout rate among high school adolescents has soared (Chapman, Ifill, & KewallRamani, 2011). One factor that may be contribute to the dropout rate among high school students is that they do not possess the reading skills required to perform well on the biology high stakes standardized exit exam (Greenleaf et al., 2010; Visone 2009). When reading is not mastered by third grade, students begin to struggle academically through middle school and may enter high school with poor grades and little experience with fluent reading or academic achievement (Lesnick, Smithgall & Gwynne, 2010). The relationship between third grade reading literacy skills and high school graduation rate has been documented. Students who fail to read by third grade are six times more likely to drop out of high school than those who are proficient readers (Annie E. Casey Foundation, 2010; Hernandez, 2011). The trend toward struggling academic performance and eventual drop out is progressive. As mentioned previously, acquiring early reading literacy skills is the foundation on which all other learning will take place. Children who do not learn to read by third grade often go on to experience the "fourth grade slump" (Chall & Jacobs, 2003) and continue academic failure through middle school. Struggling readers enter high school with very little experience and confidence at being a successful reader.

The lagging science performance of American students has played out on international and national stages. Statistics show that American students do not fare well on standardized science tests when compared to students from other countries (Kastberg, Chan, & Murray, 2016). The science achievement gap is more prominent among students who experience adverse circumstances such as poverty, limited access to quality schooling and programming, and low literacy and are considered at-risk of failing to succeed at the same pace as their peers. The following summary of standardized tests results will explain the status of science performance for American students.

Trends in Mathematics and Science Study (TIMSS)

TIMSS assesses science and math students in the fourth and eighth grades internationally every four years. Testing began in 1995 with a representative sample of students from 63 countries with the most recent testing in 2015. To gauge science achievement, four International Benchmarks along the science achievement scale are utilized as reference points. A score of 625 is advanced and indicates that students can communicate understanding of complex concepts related to biology, chemistry, physics and earth science in practical, abstract and experimental contexts. A score of 550 is considered high and indicates that students can apply and communicate understanding of concepts from the previous content areas in everyday and abstract situations. A score of 475 is considered intermediate and represents students who demonstrate and apply their knowledge of biology, chemistry, physics, and earth science in various contexts. A score of 400 is designated as low, and reflects some basic knowledge of biology, chemistry, physics and earth science. In the 2015 assessment year, the United States' eighth grade science students scored 530 on the science achievement scale which is average. Even though there has been an increase in mean scores of our nations' eighth graders, from 513 in 1995 to 520 in 2015, the United States scores have not surpassed the average rating in over 20 years (Martin, Mullis, Foy & Hooper, 2016).

Programme of International Science Assessment (PISA)

PISA compares reading, math, and science literacy performance scores of 15- year-olds of numerous educational systems throughout the world every three years. PISA was arranged by the Organization for Economic Cooperation and Development (OECD) in 2000 with 32 countries participating. In 2009, 65 education systems around the world took part. The number of participating countries vary due to new members being accepted annually.

Assessment results from 64 countries in 2012 revealed that on a scale of 1 to 6, only 7% of 15-year-olds in the United States scored at a proficiency level 5 or above, denoting an ability to engage in higher level science literacy skills. Eighteen percent of U.S. students scored below level two, demonstrating low science literacy competency. The United States' level two percentage was lower than 29 other OECD educational systems (Kelly et.al, 2013). Most of the tested students did not possess the scientific competence needed for real-life problem solving.

National Assessment of Educational Progress (NAEP)

NAEP is a project authorized by congress in 1969 to monitor and evaluate student achievement across various subjects in the United States. NAEP assessments are conducted periodically in Grades 4, 8, and 12 for reading, mathematics, science, writing, U.S. history, civics, geography and other subjects among elementary and secondary students nationally and at the state level. NAEP results are called the "nation's report card" because they inform the public about the academic achievement which it used to indicate the status and progress of education in the United States.

NAEP science results are reported as average scores on a 0–300 scale. The scale score also indicates the achievement levels which are basic, proficient and advanced. *Basic* conveys partial mastery of content. *Proficient* suggests solid academic performance and *advanced* represents superior performance on challenging subject matter. The framework for the NAEP science assessment consists of the following areas: life science, physical science, and earth and space science with four science practices: (1) identifying science principles, (2) using science principles, (3) using scientific inquiry, and (4) using technological design. Approximately 115,400 fourth-grade students, 110,900 eighth-grade students, and 11,000 12th grade students participated in the 2015 science assessment. State results are available for 46 states and The Department of Defense at Grades 4 and 8. Only national results are available at Grade 12. The 2015 NAEP science results depicted a 4 point (150/154) national increase between 2009 and 2015 in both Grades 4 and 8, but there was no significant change (150/150) at Grade 12 (U.S. Department of Education, 2015). Even though there has been an increase in science scores for eighth grade, there are still 66% of students scoring at the basic level. As these students enter high school to take more science courses, their science performance continues to lag—78% of 12th graders scored at basic or below on the NAEP assessment. Seemingly, high schoolers begin with basic knowledge of science in the ninth grade but a small percentage of them go on to excel to the proficient or advanced comprehension levels.

Standard Based Curriculum and Reform

To combat the waning of American academic superiority internationally and nationally, the federal government has proposed several education initiatives in the last three decades. Two of the most influential federal government responses to the status of public education were the Nation at Risk report and standards-based curriculum. In 1983, the National Commission on Excellence in Education examined the present condition of public education, warranted by then-President Ronald Regan. Among several recommendations, findings relevant to my study were that about 13 % of all 17-year-olds in the United States were considered functionally illiterate; that percentage increased to 40% for minority youth. The report also highlighted that there was a decline in science achievement scores as shown by national assessments in 1969, 1973 and 1977.

The Nation at Risk report has had a large impact on how educational systems are managed today with a focus on increased rigor. After magnifying the condition of public education another initiative garnered much attention: standards. By the early 2000's every state had a set of standards that outlined what students in grades 3-8 and high school should be able to do. Standards-based assessments gained steam in the 1990's and reached a plateau during the Bush administration. President George W. Bush signed into law the No Child Left Behind (NCLB) Act of 2001 which demanded states build an assessment system to track student achievement against a common set of high instructional standards (Jorgensen & Hoffman, 2003). The premise of this amendment to the Elementary and Secondary Education Act (ESEA) of 1965 was to provide financial and technical support to states to apply research-based practices for instruction. This new assessment system led to “high stakes” testing in targeted content areas (including science) to determine whether students were reaching curriculum goals on the path to graduation. This focus on standards-based assessment has had a negative impact. For example, in a comparative analysis of seven nationally representative studies, Doll, Eslami, & Walters (2013), identified the possibility that students were being pushed out of school due to rising standards and testing requirements from NCLB.

The most recent adopted curriculum change that derived from the historical report is the Common Core State Standards. This was an effort by the National Governors Association (NGA) and the Council of Chief State School Officers (CCSSO) to create standards that ensured all students, regardless of where they live, graduate from high school prepared for college, career and life (Common Core State Initiative Standards, 2010).

Reform Emphasized Reading

Another aspect of the increasing focus on standards was a push to have all children reading on grade level by third grade. Third grade has been identified as a critical point in reading development and extended learning. Hernandez (2011) concluded this point when he examined the National Longitudinal Survey of Youth 1979 (NLSY79) of about 4,000 students. The results showed that “a quarter of African-American and Hispanic students in the survey who are not reading proficiently in third grade don’t graduate from high school, compared to 13 percent of other students” (p. 9). Also, “one in six children who are not reading proficiently in the third grade fail to graduate from high school on time, four times the rate for children with proficient third grade reading skills” (p. 3). For that reason, there is a strong focus on third grade as a transitional period because not acquiring reading skills at this point has been linked to poor academic performance in middle and high schools and the dropout rate among adolescents (Lesnick et al., 2010; Lloyd, 1978). When there is not a strong reading foundation, comprehension is limited which may affect academic performance (Cain & Oakhill, 2011). Data suggested that the literacy demands of students after the third grade were not being met. Therefore, there was a need for literacy instruction in the content areas after third grade.

The effects of low literacy are felt long after high school. About 1.2 million students drop out of school yearly and their literacy skills are lower than most industrialized nations (Brozo, 2010). The National Center for Education Statistics (United State Department of Education, 2012) concludes that dropouts experience several negative effects including less income and unemployment; they are also more likely to engage in criminal activity and become institutionalized. Additionally, about 40% of high school graduates lack the literacy skills employers seek (Brozo, 2010). According to Peter D. Hart Research Associates (2005) nearly 40% of high school graduates are not prepared for college or entry level jobs. Because of the dire results of low literacy performance in the workplace and college, the CCSS revised the subject area curriculums to include English Language Arts (ELA) Literacy standards that require the reading and comprehension of increasingly complex informational text (Common Core State Initiative Standards, 2010). Reading informational text in science, social studies and other content areas provides a challenge to comprehension because academic language is used to describe various ideas and concepts.

Reading in Science

Literacy skills are important in building science knowledge and standards have emerged to reflect this. To ensure that the science curriculum is aligned with the new Common Core State Standards, the National Science Teacher Association (NSTA) collaborated to create the Next Generation Science Standards (NGSS). These standards incorporate literacy skills including reading, writing, speaking and listening with the standards related to the learning of science. Now, literacy standards are included in both the CCSS and the NGSS across all domains of science and cover Grades 6-12. For example, the Common Core Reading anchor standards state that students must be able to "read and comprehend complex literary and informational texts independently and proficiently" (Next Generation Science Standards, 2013, p. 15) Therefore, by the end of 10th grade, a student should be able to read and comprehend science and technical texts. This literacy standard is in accordance with the NGSS science standard RST.9-10.10 Obtaining, Evaluating and Communicating Information which states, "when reading scientific and technical texts, students need to be able to gain knowledge from challenging texts that often make extensive use of elaborate diagrams and data to convey information and illustrate concepts" (Next Generation Science Standards, 2013, p. 15).

As a result of these revised standards, science texts become even more challenging as students move into their secondary school years. The information becomes more technical and words become more academic. Science learners must become more aware of science terms that are used in their discipline. Science texts often uses a type of writing called academic language. Because academic language is meant to express exactness and accuracy or detail, sophisticated words and concepts are used (Snow, 2010). Therefore, the language of science text found in lab reports, standardized science assessments, classroom tests and assignments contain academic vocabulary. Consequently, vocabulary knowledge is a major component of science text comprehension because students are required to read and comprehend it at various complexity levels, independently and proficiently. For learners to become scientifically literate, they need instruction on how to decipher meaning from the words utilized in scientific writing laden with specific and unfamiliar technical language. For example, Shanahan & Shanahan (2012) suggest that instruction in analyzing the Greek and Latin roots of science terms can aid in comprehending science concepts.

According to the American Academy of Science (AAAS), science communication involves interpreting data and communicating facts and ideas through various modalities including writing, speaking, debating, visualizing, listening and especially reading (Hines et al., 2010). If students are unable to grasp the meaning of high-density academic language or vocabulary, then the transmission of knowledge is hindered which may result in students avoiding science altogether (Groves, 1995). Technical vocabulary is used to describe science concepts in classroom lessons and text. When learners are not taught to figure out vocabulary terms, their comprehension and subsequent ability to explain a science concept via writing diminishes (McDonnell et al., 2016).

Problem Statement

American students are not performing well on standardized tests in science. With the recent implementation of "high stakes" testing, if science students cannot pass the required high school biology subject area test, they will not be able to graduate. Because there is a positive relationship between reading ability and science, students who are reading on grade level or above may have higher scores in the science test. However, those who are struggling readers may have lower science test scores (O'Reilly & McNamara, 2007). Those struggling science readers who did not master the foundation of reading by third grade go on to experience academic challenges in high school, including not graduating on time (Hernandez, 2011). Because science text contains specialized vocabulary, if students are not aware of how to decipher word meaning and concepts, comprehension of the text is hindered. This limits the learners' ability to select correct answers on a standardized assessment (Visone, 2010). Even more detrimental, most teachers are not prepared to or confident in teaching reading strategies in their specific content area (Wood, Vintinner, Hill-Miller, Harmon, & Hedrick, 2009).

Statement of Purpose

This study is designed to examine the relationship between reading and science performance and how this relationship is influenced by science teacher's self-efficacy and emphasis on teaching important terms and facts.

Research Questions

1. How much of the variability in the average ACT science reasoning sub-score can be explained by the average ACT reading sub-score for the 2009 ninth grade cohort?
2. How does science teacher's self-efficacy influence students' performance on their average ACT science reasoning sub-score and student's performance on their average ACT reading sub-score?
3. How does science teacher's emphasis (1 = no emphasis, 2 = minimal emphasis, 3 = moderate emphasis, 4 = heavy emphasis) on teaching important terms and facts influence student's average ACT science reasoning sub-scores and student's average ACT reading sub-score?

Theoretical Framework

The theoretical framework informing this study is self-efficacy (Holzberger, Phillip, & Kunter, 2013). Teachers who are confident in teaching science are also more confident when teaching students reading strategies (Crow, 2016). This relationship hinges on the foundations of Albert Bandura's theory of self-efficacy. According to the American Psychological Association, self-efficacy refers to a person's beliefs in their ability to perform behaviors necessary to produce specific outcomes. One's perceived self-efficacy can influence thought patterns, actions and emotional arousal (Bandura, 1982). For example, science teachers that think or feel they can show students how to simplify science terms well will perform the task more often and not become emotionally aroused or deterred by efforts to promote these practices in their classrooms.

Perceived self-efficacy may contribute to the academic development of teachers, faculties and students. When teachers believe in their abilities to impact learning, the learning environment and students' academic achievement benefit (Bandura, 1993). High efficacious teachers are likely to participate in various instructional tasks even though they are challenging. They also tend to expend more effort and persevere even when the task proves difficult. Students that believe in their own self-efficacy will manage their learning and eventual academic accomplishments. Therefore, the more science teachers feel capable at implementing effective vocabulary strategies in their classrooms, the more comfortable they will become in assisting students with mastering complex vocabulary to comprehend scien0ce text. Eventually, when faculty members or other teaching staff, including other content area teachers, curriculum specialists, counselors and principals witness the impact of science teachers reading strategies on standardized tests and other academic assessments, the faculty's beliefs in their collective efficacy may increase. All teachers and support staff may become more proactive in learning new literacy practices to improve their students' learning and academic performance.

Content area teachers play a large role in how information is delivered in their classes. Due to the literacy demands of today's science instruction and assessments, the NGSS have been aligned with literacy standards outlined in the CCSS (Next Generation Science Standards, 2013). The literacy standards in science state that students must determine the meaning of key terms and other domain specific words and phrases as they are used in specific scientific contexts relevant to their grade and topic. As a result, science teachers are not only to communicate disciplinary knowledge and concepts, but they are now expected to teach science learners how to read and critically evaluate text (Hoskins, 2010). Some pre-service and in-service content area teachers feel that it is not their responsibility to implement reading in their instruction but rather the responsibility of English and reading teachers (Hall, 2005). Because science teachers may not feel prepared or responsible for including effective vocabulary strategies in their instructional practices, they often resort to the superficial method of defining vocabulary words from a dictionary for students to memorize (Wood et al., 2009). Rote memorization does very little to assist students in becoming critical science learners and may hinder their performance in the classroom and or on science assessments.

Considering what we already know about the relationship between reading and science performance on standardized tests, this study will further explore the nuances by evaluating how vocabulary knowledge and teachers' feelings about implementing vocabulary instruction may influence the discussion of how to better prepare students for science learning and particularly the reading demand of high stakes standardized tests.

Limitations

The data utilized in this study was collected fall 2009 by the Institution of Education Services (IES) with a follow up in 2013. Therefore, the data are between 7 and 11 years old. Also, the self-efficacy scale used in this study did not provide information about how teachers felt about teaching vocabulary strategies but rather it accounted for how science teachers managed the classroom and behavior. What I initially wanted to measure was how teachers felt about implementing literacy strategies, including vocabulary, in their instructional practices. Therefore, I adjusted the question to include the available large-scale data that had already been collected. Also, the variables implementation of science terms/facts (N1TERMS) and science teacher self-efficacy (X1SEFF) were self-reported so teachers could exaggerate the degree to which they implemented science terms/facts or could have felt embarrassed to reveal various details. This may impact reporting results. Additionally, this study is not meant to indicate causation but is correlational in nature.

CHAPTER II

LITERATURE REVIEW

Based on data analyzed from the Current Population Survey (CPS), the Common Core Data (CCD) and the General Education Development Testing Services (GEDTS), in 2009, about 3.0 million 16-24-year old were not enrolled in high school (Cataldi, Laird, & KewalRamani, 2009). The report also indicated trends amongst this population: males had a higher status drop-out rate than females and minorities than non-minorities. Researchers have categorized drop out factors into three categories: push, pull and fall out factors (Doll, Eslami, & Walters, 2013). Push factors were those that resulted from school consequences on tests, attendance, poor behavior or discipline; pull factors were those that entice students to leave school, like a job, finances, illness or parenthood. Fall out factors resulted from disengagement when a student does not show significant academic progress in schoolwork, so they lose interest because of a lack of support. While all factors deserve our utmost attention, push factors involving the consequences of tests are of concern because they partially explain why students leave high school as early as ninth grade. Ninth grade is a critical stage in the lives of students because high school academic performance at this stage has been linked to third grade literacy (Lesnick, Smithgall & Gwynne, 2010). It is also during this time that students entering high school are attending their first high school science class. Because performance on a science standardized test is linked to reading ability, those students who do not have proper reading skills may not perform well enough on the "high stakes" science test that is required for graduation. One way that teachers can help struggling science students who may have a difficult time passing the required standardized test to graduate is to teach reading skill such as vocabulary because science in particular biology contains technical vocabulary that is important to comprehending major science concepts and ideas.

Vocabulary is referred to as “the kind of words that students must know to read increasingly demanding text with comprehension” (Butler et al., 2010, p. 1). Science text is saturated with technical vocabulary words that students are expected to master in order to comprehend scientific concepts. Becoming scientifically literate requires that the learner possess abilities and skills that will help them comprehend technical vocabulary in order to critically read and analyze scientific information (Hoskins, 2010). Scientific literacy is defined as “an individual’s scientific knowledge and use of that knowledge to identify questions, to acquire new knowledge, to explain scientific phenomena, and to draw evidence based conclusions about science-related issues” (Kelly et al., 2013, p. 4). Fang & Wei (2010) extended the reading and science relationship by stating that when inquiry-based science instruction is coupled with reading strategies, students can comprehend advanced science content. The reading ability and science performance correlation has been well established (Cromley, 2009; O’Reilly & McNamara, 2007; Visone, 2009). Possessing word knowledge abilities or being able to utilize word knowledge skills will maximize science learners’ vocabulary awareness while also improving their comprehension of science text.

Students who are versed in scientific vocabulary are better prepared to engage in higher order processing of scientific information which puts them on the path to becoming scientifically literate. According to Cromley, Syner-Hogan and Luciw-Dubas (2010), vocabulary knowledge is a strong indicator of biological concept comprehension. In an effort to better explain the relationship of prior topic knowledge, inference, reading strategy use, reading vocabulary and reading fluency on reading comprehension, the researchers using structural equation modeling (SEM) and determined that vocabulary knowledge was a strong predictor of biology concept comprehension.

Comprehending advanced science content requires that students can understand word meanings. Technical words are commonplace in expository text from which most science information is relayed; textbooks, science magazines, trade books are examples of expository text resources that learners will encounter in school and beyond. Shokouhi and Maniati (2009) determined the importance of understanding science terminology when they conducted a study that determined learners exposed to expository text as opposed to narrative text experienced a superior level of vocabulary gains when assessed with three types of vocabulary tests: form recognition, meaning translation and multiple choice items. Even more so, the degree to which students understand science terms can influence science assessment performance. Preparing science students with effective literacy instruction including vocabulary learning may improve their performance on science assessments. Greenleaf et al. (2010) supported this point when they conducted a study that concluded that biology students who received effective literacy instruction, including vocabulary strategies, out-performed others on the state biology standardized assessment.

Teaching reading, including vocabulary strategies, may improve students' self-efficacy when encountering science content and motivate them to perform better on science assessments (Braten, Anmarkrud, & Stromso, 2013). Direct instruction of vocabulary strategies not only improves reading fluency when reading science text but may improve comprehension of complex science concepts thus improving performance on science assessments (Grillo & Dieker, 2013; Seifert & Espin, 2012). One specific example of effective reading skills instruction, including decoding multisyllabic words and learning the meaning of academic words in a content area, occurred in a U.S. History class. Beach, Sanchez, Flynn, & O'Connor (2015) utilized expository history text to teach reading skills, including learning meanings of academic words, to 38 eighth grade readers who were reading between a second and fourth grade level. After receiving the reading intervention, students in the intervention group displayed stronger gains in vocabulary and comprehension strategies compared to their peers.

Including vocabulary reading instruction in the content areas for secondary students is critical to their performance in the future because higher order thinking and analysis are required for students to participate in the world around them while addressing everyday matters that may affect them; twenty percent of 15-year-old students do not possess scientific competence needed for real life problem solving. Even more so, as noted by Smith, Holliday, and Austin (2010), first year college students in an introductory science course were not prepared to comprehend informational text, which assumedly contains content specific vocabulary terms. Yildirim, Yildiz and Ates (2011) investigated the relationship between vocabulary and comprehension; there was a larger correlation between vocabulary and expository text as opposed to vocabulary and narrative text. Including effective vocabulary strategies in science instruction for high school students could greatly prepare them for the critical reading and comprehension of informational science text required at the next level, whether college or career.

The National Reading Panel identified the teaching of vocabulary words as one of five key components of effective reading instruction. There are numerous word learning or vocabulary strategies that teachers can utilize during content area instruction particularly science to improve reading comprehension and critique of complex science text. For example, word mapping, graphic organizers, and vocabulary exposure through multiple texts. Word Mapping is also called a morphological analysis strategy where morpheme—including suffixes, prefixes and root words—are analyzed. Harris, Schumaker, and Deshler (2011) conducted a study with 230 mostly low performing public school ninth graders who received vocabulary instruction with word mapping. Test results revealed that word mapping students scored higher than others.

Utilizing graphic organizers when reading expository text is another effective strategy in helping learners retain vocabulary for long term use. Adam and Pegg (2012) concluded when teachers taught vocabulary words with graphic organizers students were better able to comprehend mathematical and science concepts. Wide reading of multiple texts is also an effective strategy. Exposing students to numerous opportunities to encounter content specific vocabulary in expository text while modeling how to identify word meanings can enrich students with skills to use when they encounter unfamiliar vocabulary words (Fisher, Frey, & Lapp, 2008; Kamil, 2003). Being equipped with literacy strategies to comprehend vocabulary words in science text is vital in reading grade level science information.

What it Means to Be a Successful Science Learner?

According to the Program for International Student Assessment (PISA), an organization that assesses 15-year-old science learners in various counties. The number of participating countries change due to the ongoing acceptance of members. In 2015, 72 countries participated to evaluate competent science learners in applying scientific knowledge and concepts in a real-world setting. They are expected to comprehend scientific phenomena and interpret data. Therefore, science performance as measured by PISA requires critical thinking and reading skills. This point was made evident in the following study: Cromley (2009) calculated correlations for three data sets from PISA for the years 2000, 2003 and 2006. Mean correlations at the individual student level across countries were .840 for the 2000 data set, .805 for the 2003 data set, and .819 for the 2006 data set. Even though correlations varied among countries, the reading-science relationship was weakest in countries with the low mean reading scores. Consequently, the same skill set that is needed for reading literacy supports or drives scientific literacy.

There are other studies that document important relationships between reading comprehension and science achievement on standardized exams. For example, O'Reilly and McNamara (2007) used correlations and linear regression models to examine the impact of science knowledge, reading comprehension skill and reading strategy knowledge on measures of science achievement for 1,651 students from various high schools across Virginia, Georgia and Kentucky. Science achievement was analyzed based on the comprehension of a science passage, student grades, and standardized science exams. Multiple choice test assessed science knowledge while commercial tests measured reading comprehension and metacognitive reading strategy knowledge. The results showed that science knowledge and reading comprehension skills were statistically significant (>.50). The assessment of reading skill (reading comprehension) compared to science knowledge scores explained more of the variance on the standardized science test.

Additionally, the NAEP which provides a common measure of students' science achievement across the U.S. defines a proficient science learner as one who is able to identify and utilize science principles during inquiry and technological design; physical science, life science and earth and space sciences are the discipline areas evaluated. Even though the 2015 NAEP results indicate that science scores were up for eighth graders entering high school, there were still 66% of our nation's eighth grade science students performing at the basic level or below. As these students continue through various science curricula through high school, their science comprehension seems to diminish over time, with only 22% of 12 grade science students scoring proficient on the national standardized assessment.

Science learners are expected to utilize reading skills that are vital to selecting correct responses on standardized tests. Visone (2010) utilized a qualitative approach to investigate the relationship between reading and standardized science assessments. Five released questions from the CAPT, state standardized assessment, were shown to students from three different high schools for oral and written responses to questions. Semi-structured focus group interviews and coding identified key themes and conclusions. Results showed that the inability to read for detail impedes students' ability to select the correct answers.

Reading and Science Relationship

Reading ability can determine how well students perform on standardized science assessments. Visone (2009) utilized regression analysis to explore the relationship between the reading for information subtest (RfI) and science portion of the CAPT, a state standardized assessment given to tenth grade students from three separate high schools. For correlations between RfI raw scores and both science section raw and scale scores, which are continuous variables, Pearson's r was used. Spearman's Rho was used for correlations between RfI raw scores and science performance levels because the performance level was an ordinal variable. Results showed a positive, moderate-to-strong relationship between Eastville students' achievement on the science section and RfI subtest; statistically significant positive correlations were obtained for all three pairing across all subgroups. The correlations ranged from .49 ($p<.05$) for Asian students' relationship between science performance level and RfI raw score to .76 ($p<.001$) for students who received free or reduced lunch. Merryport High Schools' data revealed positive and statistically significant at the .01 level for all three correlations. The strongest correlation ($r=.51$) to moderately strong ($r=.41$) exist between students' science section and RfI subtest performances. As for Susan B. Anthony High School, the correlations ranged from .56 ($p<.01$) between science performance level and RfI subtest raw score among students with special needs to .97 (p<.01) for science raw and RfI scores for Asian students and between science performance level and RfI subtest raw scores for ELLs. Reading informational science text requires critical thinking and reasoning skills.

Additional studies have examined the relationship between reading ability and mastery of science content knowledge. For example, Cromley (2009) calculated correlations for three data sets from Programme on International Student Assessment (PISA) for the years 2000, 2003 and 2006. Mean correlations at the individual student level across countries were .840 for the 2000 data set, .805 for the 2003 data set, and .819 for the 2006 data set. Even though correlations varied among countries, the reading-science relationship was weakest in countries with the lowest mean reading scores. Consequently, the same skill set that is needed for reading literacy supports or drives scientific literacy.

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Vocabulary and Science Text

Vocabulary instruction will be the focus of this study because not only is informational science text rife with vocabulary, even more so, the National Reading Panel identified vocabulary as one of five key components of effective reading instruction. Vocabulary knowledge is critical to the reading and the comprehension of science text (Seifert & Espin, 2012). Vocabulary learning can imply knowing the pronunciation or identification of a word or phrase. However, according to the National Reading Technical Assistance Center (NRTAC), reading goes beyond recognizing words. If text contains words that one can pronounce but not understand, reading comprehension is hindered.

Vocabulary preparation and extended time for literacy instruction are key areas identified as having a positive effect on students' literacy skills and performance (Biancarosa & Snow, 2006; Marchand-Martella et al., 2003). By recognizing the role vocabulary has in comprehending information text, teachers can then implement effective vocabulary strategies to better assist students in learning content subject matter. Because teachers may not be aware of how to intervene with effective instruction, vocabulary learning in most classes often involves superficial learning of definitions and rote memorization (Wood et al., 2009). When students are not taught vocabulary learning strategies, the gap in ability between "good" and "poor" readers may widen (Cain & Oakhill, 2011).

In the literature, this outcome is referred to as the "Matthew Effect." The Matthew Effect concept was taken from an account in the bible book of Matthew 25:29 which states, "For everyone who has will be given more and he will have an abundance. But, the one who does not have, even what he has will be taken away from him." It describes the poor getting poorer and the rich getting richer. That same illustration can be applied to struggling readers. Those readers who are struggling continue to struggle and even become more deficient readers. On the other hand, those readers who are independent readers continue to become stronger and more efficient readers.

Vocabulary and Informational Text

Common Core Literacy Standard: CCSS.ELA-Literacy.RST.9-10.4 states that students should be able to "Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 9-10 texts and topics*" (Common Core State Initiative Standards, 2010, p. 62). Science learners should be able to analyze the relationship between concepts including terms (e.g., force, friction, reaction force, energy; Common Core State Initiative Standards, 2010). Knowledge of science terminology and the ability to use reading strategies to decipher words impacts how well students comprehend informational text. Science and other content areas contain plenty of specialized terminology (Beck, McKeown & Kucan, 2008). Being able to identify the parts of science terms and categorize them according to their usage in context can be applicable to the reading demand of science text. Words can be separated into three categories or tiers (Beck et al., 2008): Tier I words are basic vocabulary or everyday words, Tier II consists of high frequency/multiple meaning words, and Tier III has subject or domain specific terms. Tier III science vocabulary terms present a major comprehension obstacle to science learners and certain literacy skills are required to unlock their meaning (Yildirim et al., 2011). The Wisconsin Department of Public Instruction stated that when addressing scientific vocabulary, teachers should properly support students in using "Tier II" terms such as evidence, analyze, explanation, prediction, infer and environment because they have unique application for science. These should be taught along with "Tier III" science vocabulary such as chlorophyll, covalent bonding, and vacuole.

Students who do not understand the concept of content specific vocabulary encounter difficulties when reading informational or expository text located in most content area textbooks and literature. For example, Yildirim, Yildiz, & Ates (2011) explored the correlation between vocabulary and comprehension relative to text type with 120 fifth grade students. Correlation and bivariate linear regression analysis led to the conclusion that there was a medium correlation between vocabulary and narrative text, but a larger correlation existed between vocabulary and expository text. Simply put, subject-specific information like science contains technical words that may be unique to that content area. By providing learners with vocabulary strategies to maximize text comprehension, learners will be more able to enhance their understanding of science concepts (Cain & Oakhill, 2011; Greenleaf et. al., 2010).

When students cannot comprehend vocabulary words in text by third grade, they may have academic difficulties in later years. Students are expected to process more content specific information in grades four through twelve which requires them to utilize their reading skills to learn (Chall & Jacob, 2003). Not acquiring reading skills by third grade has been linked to poor academic performance in middle and high school, even dropping out of school (Hernandez, 2011; Lesnick et al., 2010; Lloyd, 1978). As Kamil (2003) highlights, “There are approximately 8.7 million fourth through twelfth graders in America whose chances for academic success are dismal because they are unable to read and comprehend the material in their textbooks” (p. 1). For this reason, effective vocabulary instruction with expository text is suggested. Incorporating multiple reading opportunities with diverse genres and high interest readable text including, but not limited to trade books, magazines and internet sources, can expose students to advanced vocabularies through intentional and incidental vocabulary learning (Wyss et al., 2013).

Teaching expository reading with vocabulary is challenging for many content area teachers. One reason may be the type of literacy instruction that pre-service teachers are exposed to in their methods textbooks. Draper (2002) utilized a qualitative method to inspect nine secondary methods textbooks including science, social studies and math to identify the types of instructional activities content area teachers could use to assist their students with reading and writing in the content areas. The data revealed that while there was mention of the need to incorporate reading and writing in these materials, the examples of how to implement literacy were general such as, silent reading, oral reading and jigsaws. The science author even criticized the use of science textbooks by stating, "science course often results in students memorizing many terms, taking factually oriented paper-and-pencil tests, and remembering very little fundamental science" (p. 3)

To this point, Montelongo, Herter, Ansaldo and Hatter (2010) conducted an action research study where they created a lesson cycle to provide at-risk middle schoolers with strategic practice in reading and writing expository text. The cycle consisted of four parts: (1) vocabulary words, (2) text structure, (3) modified sentence completion, and (4) rewriting text. Students were asked to identify and define vocabulary words important to the text using context clues; to maximize learning of the term, students had to check their definition against the dictionary's and write a sentence using the term. Afterward, the students were given a sample paragraph and introduced to utilizing specific signal words, such as "because" which denotes cause-effect. The purpose was to identify various expository structures including generalization, compare/contrast, cause/effect, and problem/solution. The next stage in the lesson cycle was combining the learning of vocabulary with the introduction of text structure through a sentence completion exercise (fill-in-the blanks activity). In this activity, students were to select from 10-12 sentences those that were related in order to identify main ideas and supporting details. Once located and arranged in a logical order, they wrote or pasted them onto a graphic organizer. Lastly, the students synthesized the information in their own words demonstrating their comprehension of the text. Teaching with expository text is just one mode of delivering effective vocabulary instruction. In this detailed description of an action research study, several effective methods of introducing reading in content area classrooms by assessing vocabulary and writing were modeled for possible duplication in science and other high school subject areas.

However, teachers often do not teach content area literacy or vocabulary strategies well. For example, Ness (2016) collected data from eight middle and high school science and social studies classrooms by observing 2,400 minutes of direct classroom observations to determine (1) to what degree did the teachers incorporate reading comprehension strategies during instruction? and (2) which reading strategies did they use most? Ness found that content area teachers are not prepared to incorporate effective reading strategies in their classrooms. Out of 40 hours of instructional time, only 82 minutes or just less than 3% of the time was spent in helping students read informational text. Also, of the eight reading comprehension strategies recommended by the National Reading Panel, teachers only incorporated three strategies.

Self-Efficacy

Self-efficacy for teaching science vocabulary may impact teachers' instruction teacher's sense of efficacy is related to the quality of instruction they deliver. Holzberger, Philipp, & Kunter (2013) combined a self-report measure of teacher self-efficacy with teacher and student ratings of instructional quality (assessing cognitive activation, classroom management, and individual learning support for students), and 2-level cross-lagged structural equation analyses were conducted. It was partially confirmed that teacher self-efficacy did impact the quality of instruction delivered.

When teachers do not feel confident about their ability to deliver literacy instruction it influences the classroom environment and can impact students' academic performance. Guo et al. (2012) identified the relationship between teacher self-efficacy in delivering literacy instruction and students' academic performance when they re-analyzed longitudinal data of 1,043 fifth graders from the National Institute of Child Health and Human Development (NICHD) Study of Early Childcare and Youth Development. SEM results indicated that teachers with a higher sense of self efficacy showed more support and provided a more positive classroom environment than teachers with a lower sense of self-efficacy. Also, their students had higher literacy skills than the students of teachers with a low sense of self-efficacy. Due to the recent curriculum shift by the Common Core Literacy Standards (CCLS), all content area teachers are required to implement reading and writing skills into their classrooms. The next section will explain the theory that outlines how a teacher's perceptions may influence their behavior.

The Social Cognitive Theory (SCT) was developed by Albert Bandura in 1968 as an off shoot of the Social Learning Theory (SLT) of the 1960s. Five constructs were conceived from the Social Learning Theory: reciprocal determinism, behavioral capability, observational learning, re-enforcements and expectations. The principle supporting the SCT was that during the learning process a subject employs cognitive, social, and behavioral skills to guide decision making (Bandura, 1982). No longer was the notion accepted that learners are passive beings that were filled with information. Rather, SCT considered the social environment and past experiences in which an individual carries out a behavior because one's experiences may determine their success or efficacy in behavioral actions. For example, will a science teacher implement effective literacy strategies like vocabulary if he or she has not had positive experiences?

Self–efficacy is defined as a person's beliefs in their ability to perform behaviors necessary to produce specific outcomes. According to Bandura (1982), "self-percepts of efficacy influence thought patterns, actions and emotional arousal (p.122)". Perceived self-efficacy has played a major role in educators' attitudes and actions in the classroom. For example, with the recent integration of CCLS in the NGSS, science teachers are expected to teach reading strategies along with their science content but most science teachers do not feel that they are prepared or responsible for teaching reading strategies in their classroom. Smith (2017) utilized qualitative case study methods to examine seventh and eighth graders' content area teachers' perspectives on teaching literacy and collected interviews, observations and lesson plans from 11 English, math, science and social studies teachers. Findings indicated that teachers felt unprepared to teach reading strategies.

Teachers' Self-Efficacy in Literacy

Every subject has specialized vocabulary unique to its content area. The need for content area literacy was echoed in an on-line article entitled: "Is every teacher a literacy teacher?" (Heller, 2012). As a data facilitator, he conducted a session for all the data teams in New York City schools. During the sessions, teachers discussed who has the responsibility to teach literacy. Every content area teaching group except ELA identified their students as being weak in academic vocabulary of their discipline. This study acknowledged the need for science learners and other content area learners to get assistance in teaching vocabulary. Keys (2016) identified one reason of why ELA teachers do not consider their students to be weak in academic vocabulary. The purpose for conducting his study was to evaluate high school teachers' perceptions with self-efficacy and literacy instruction across the curriculum from teachers in Tennessee high schools who had taught math, science, social studies, career/technical education or ELA after the implementation of new literacy standards in Tennessee. Data was collected through on-line, voluntary surveys using Likert scaling and one open-ended response question. Findings suggested that ELA teachers were more confident in teaching literacy strategies than non–ELA teachers. ELA teachers tend to receive more pre-service training in their educational programs than other content areas. Therefore, it stands to reason that they have experienced more exposure to literacy strategies that possibly increased their confidence of teaching such in the classroom.

Science teachers may feel that they have not been trained properly and thus do not feel confident enough to teach literacy strategies that will maximize comprehension (Hall 2005; Ness 2016). Cantrell Burns and Callaway (2008) conducted a study about middle and high school content area teachers' beliefs about literacy teaching and learning during the initial phase of a yearlong literacy professional development project. They used teacher interviews to examine factors that contribute to and/or inhibit teachers' successful implementation of content literacy techniques. They also believed literacy instruction was important to their content area, even admitting that they themselves were literacy teachers but expressed difficulties with implementing literacy strategies during the initial phase. However, with content literacy professional development with coaching support, teacher self-efficacy was improved. Cantrell and Hughes (2008) extended this study to explore the relationship between teacher efficacy and implementation of a content literacy approach. A teacher survey was used to measure teachers' efficacy before and after participation in professional development. Classroom observations were used to measure teachers' implementation of content literacy practices. Results showed significant improvements in teachers' personal and general efficacy for literacy teaching. Those teachers who had a high sense of self-efficacy were more likely to implement the recommended content literacy strategies. Also, coaching and collaboration were key factors in improving self-efficacy with utilizing literacy strategies. With the proper professional development and coaching in literacy instruction, teachers' self-efficacy may improve resulting in an environment where struggling readers receive needed literacy interventions (Crow, 2016).

Reading ability is critical to performing on standardized science tests because standardized science tests evaluate how well students can read to select the best answer and not just science concepts knowledge (Cromley, 2009; O'Reilly & McNamara, 2011; Visone, 2009; Visone, 2010). Narrowing the specific area of reading to teach will even better help teachers prepare students to select correct responses on science tests. Therefore, my study will address the need to identify a specific area of reading (i.e., vocabulary) in order to streamline classroom literacy practices. Other studies have identified phonics, comprehension, writing and fluency as aspects of reading to learn content area information (Cromley et al., 2010; Grillo & Dieker, 2013; Beach et al., 2015; Seifert & Espin, 2012). Few have elaborated on the empirical relationship between high school science teachers' vocabulary instruction and how it impacts students' academic performance. As a result, my study addressed the gap in literature by answering three questions: (1) How much of the variability in the average ACT science reasoning sub-score can be explained by the average ACT reading sub-score for the 2009 ninth grade cohort? (2) How does science teacher's self-efficacy influence student's performance on their average ACT science reasoning sub-score and student's performance on their average ACT reading sub-score? (3) How does science teacher's emphasis (1 = no emphasis, 2 = minimal emphasis, 3 = moderate emphasis, 4 = heavy emphasis) on teaching important terms and facts influence student's average ACT science reasoning sub-score and student's average ACT reading sub-score?

CHAPTER III

METHODOLOGY

Due to the addition of literacy standards with the recent Next Generation Science Standards, the way science teachers deliver instruction has changed. Science teachers are now expected to implement literacy strategies during their delivery of the science curriculum (Next Generation Science Standards*,* 2013). However, some pre-service and in-service content area teachers feel that it is the reading teacher's responsibility to assist students with reading strategies (Hall, 2005). Even more so, content area teachers do not feel adequately trained to implement reading in their instructional practices so they may resort to only requiring rote memorization of vocabulary (Wood et al., 2009).

Albert Bandura (1992) considers the lack of confidence to perform a task as low self-efficacy. The link between how one feels about performing a task and them performing the task is the framework for Bandura's theory of self-efficacy. When teachers feel positively about helping students, the learning environment and students' academic achievement benefit (Crow, 2016). Because there is a correlation between reading ability and standardized science test performance (Cromley, 2009; Visone, 2009) it is believed that content area teachers properly trained in teaching vocabulary strategies can assist students in improving their reading skills and standardized science test scores (O'Reilly & McNamara, 2009).

The purpose of this study was to determine the relationship between ACT science performance and ACT reading performance as indicated by the 2009 ninth grade participants of the

High School Longitudinal Study transcript update results for the year 2013. Also, of importance, was how science teachers' self-reported responses to utilizing literacy instruction such as vocabulary strategies in science classrooms influence science performance. This chapter will outline the research design and procedures undertaken by this study to answer three research questions.

Research Questions

1. How much of the variability in the average ACT science reasoning sub-score can be explained by the average ACT reading sub-score for the 2009 ninth grade cohort?
2. How does science teacher's self-efficacy influence student's performance on their average ACT science reasoning sub-score and student's performance on their average ACT reading sub-score?
3. How does science teacher's emphasis (1 = no emphasis, 2 = minimal emphasis, 3 = moderate emphasis, 4 = heavy emphasis) on teaching important terms and facts influence student's average ACT science reasoning sub-score and student's average ACT reading sub-score?

Sample

The High School Longitudinal Study of 2009 (HSLS:2009) focused on how students planned and made decisions about their postsecondary course of action. As a result, the populations under investigation were 2009 ninth grade students, their parents, and their teachers, counselors, and administrators. In harmony with NCES, Lesnick et al (2010) identified ninth grade as a critical transition in determining the path of student performance and trajectory. Ingels et al. (2014) went on to explain how each sampled group contributed to the research study. Students explained their academic behavior (attendance, study habits), attitudes and beliefs (self-efficacy) about their school and home experiences. Parents informed the study by relaying how they supported their child's academic pursuits and what resources were available at home to inform the college planning and career options process. Teachers shared their professional preparation, perceptions and experiences with leadership and work-related attitudes or efficacy. Administrators outlined how they provide transitional programming and courses for 8th graders along with planning for their post-secondary options. Lastly, counselors expounded on how they provide course placement, advising and support for both struggling and excelling students.

School Participants

Before selecting the student sample, the participating schools had to be identified. The sample design occurred in two stages: base year and first year follow up. The base year consisted of collecting a baseline or initial measurements which included interviews, surveys, and mathematics assessment scores. Researchers utilized the stratified random selection method to locate a sample of schools. The population of school participants was regular public schools as well as charter schools and private schools in the 50 states and the District of Columbia who provided instruction to students in both 9th and 11th grades during the fall of 2009. Additionally, the following types of schools were excluded from the sample (Ingels et al. 2014):

- Schools that do not require students to attend daily classes at their facility (on-line schools)
- Schools that only offer testing services for home-schooled students
- Ungraded schools (no metric to define students as being in the 9th grade)
- Other schools that address disciplinary issues but do not enroll students directly
- Juvenile correction/detention facilities

- Schools without both a 9th and 11th grade
- Department of Defense schools that do not enroll students directly
- Career technical and education schools that do not enroll students directly
- Special education schools for students with disabilities
- Bureau of Indian affairs schools

As a result, a total of 944 of 1,889 eligible schools participated in the base year resulting in a 55.5 % weighted response rate (50.0 % unweighted). To retrieve the most current data, the initial base year school samples were taken from two National Center for Education Statistics (NCES) files: 2005-06 CCD for public school sampler; 2005-06 private school survey (PSS) was utilized for the private school sample. The population was divided into different subgroups or strata by allowing the interaction of the following factors: school type (public, private – Catholic, private – other), geographic region (Northeast, Midwest, South, West) and geographic location of the school (metropolitan area or locale: city, suburban, town rural) to create the 48 first stage sampling strata.

The HSLS: 2009 study was initially meant to be a representative sample of ninth grade students 2009-10 school year in schools across the United States, but the National Science Foundation requested a representative sample within certain states. Therefore, adjustments were made from a national design to a state design. A power analysis suggested that at least 40 participating public schools per state would be enough to meet the precision criteria for the national design. The national sample yielded a total of 1,973 sample schools by allowing 8/10 states to qualify additional schools. Eighty-four of these were later identified as ineligible during the initial phase of the study resulting in 1,889 eligible schools.

Students

After applying stratified systematic sampling during the base year, a sample of 26,305 students was selected from 944 participating schools. These were 1, 099 students who were ineligible yielding 25,206 students. The second stage sampling level organized the students by race (Hispanic, Asian, Black, other) by each school. Therefore, 28 ninth graders were selected from each of the 944 participating schools. A total of 21,444 students participated in the HSLS: 2009 base year. These students completed a questionnaire and mathematics ability assessment.

School Administrator

All sampled HSLS: 2009 school administrators were contacted by study recruiters to conduct the in-school data collection. Reasonably, each school administrator was sampled with the same probability that was calculated for the school.

School Counselor

The ninth-grade students' lead counselor for each of the HSLS: 2009 participating schools during the base year were asked to complete a questionnaire. Just as the school administrator, the counselor sample was the same probability as calculated for the school.

Students' Parents/Guardian

For each of the 25,206 HSLS: 2009 study eligible students, contextual information about family and home life was requested from one knowledgeable parent or guardian. Therefore, the random selection probability for the parent was identical to that of his or her student.

Students Science Teacher

Schools were asked to provide information about the science courses the student was currently attending in addition to the student and parent contact information. Then the respective science teacher for each sample student were contacted to complete a subject-specific questionnaire. Hence, teachers were randomly sampled with the same probability as the student.

Data

Academic Transcripts

Transcript information is very vital to informing the experiences of students in science. Variables such as GPA in science and the highest science course completed can be combined with the questionnaire and assessment data for analysis in order to expound on students' experiences and teacher instructional practices that contribute to science students' academic performance.

From September 2013 to June 2014, effort was made to collect transcripts from each of the 944 participating schools from the base year. Six schools were closed which resulted in 938 base year schools being contacted to provide transcripts for the 23,415 sampled students during the initial phase in fall 2009. After research applications or extension approvals for data sharing were completed for some 38 districts, each school was asked to provide basic enrollment, testing, and course taking information for each student, as well as information about the school's grading and graduation policies/requirements and students' high school completion status. The information requested included the following standardized test scores (composites variables constructed from transcript and external data sources) for the following:

- Scholastic Assessment Test (SAT; specific subject area tests that be taken individually to gauge performance in math, science, etc.)

- American College Test/Scholastic Assessment Test (ACT/SAT; combined subject areas taken together which is different from the SAT-specific subject test)
- Advanced Placement Test (AP)
- Pre-Scholastic Assessment Test (PSAT)

Science Teacher Survey

For each sampled student of the 2009 cohort, the associated science teacher was contacted to complete a subject-specific questionnaire. Science students' teachers were surveyed to capture information about teacher background and preparation. The respective science teacher survey shed light on the school climate and classroom practices that students are exposed to. The survey was given to science teachers only during the base year 2009. Science teachers' survey data was not collected in the follow-ups in 2012 and 2016. Each staff questionnaire took about 30 minutes and was available on the web or via computer-assisted telephone interview (CATI).

Instruments

ACT Test

The ACT is a standardized test first introduced in November 1959 by Everett Franklin Lindquist, a University of Iowa professor. Early on, ACT was an abbreviation for American College Testing but now the test is administered by a nonprofit organization by the same name: ACT, Inc. The purpose of the test is to give prospective colleges in the United States and Canada an indication of how well a student may perform on their curriculum; therefore, it is utilized as one component for admission. The exam originally consisted of four tests: English, Mathematics, Social Studies and Natural Sciences. However, in 1989, the Social Studies was changed into a Reading section with a social sciences subsection. The Natural Sciences component was renamed the Science Reasoning test which placed more emphasis on problem solving skills as opposed to memorizing scientific facts. An optional writing test was added in February 2005 to reflect the changes on its competitor test, the SAT. The four main sections—English, mathematics, reading and science reasoning—are scored individually on a scale of 1-36 with a composite score (the rounded whole number average of the four sections) provided as well. The writing test is optional with a score ranging from 2 -12 instead of 36 like the other subjects. The writing score does not impact the composite score. As of the September 2015 testing, the combined English/writing score was eliminated and two new scores: ELA (an average of the English, Reading, and Writing scores) and STEM (an average of Math and Science scores) are now reported.

The chart below summarizes each section and its detailed components.

Table 1

ACT Test Format

Section	Number of questions	Time (minutes)	Score Range (2018)	Average score (2018)	College Readiness Benchmark	Content
English	75	45	1-36	20.2	18	Usage/mechanics and rhetorical skills
Mathematics	60	60	1-36	20.5	22	Pre-algebra, elementary algebra, intermediate algebra, coordinate geometry, geometry, elementary trigonometry, reasoning and problem solving
Reading	40	35	1-36	21.3	22	Reading comprehension
Science	40	35	1-36	20.7	23	Interpretation, analysis, evaluation, reasoning, and problem solving
Optional Writing (not in composite)	1 essay prompt	40	1-12	6.5		Writing skills
Composite			1-36	20.8		Average (mean) of all sections except writing

ACT Science Test

ACT Science test is one of the dependent variables in the study. The ACT Science test consists of 40 questions that must be answered within the 35 minutes time limit. The test has several passages that focus on biology, chemistry, earth/space sciences and physics. The passages are presented in one of the three formats: Data Representation, Research Summaries and Conflicting Viewpoints. Although the passages and questions focus on scientific topics, they do not require students to respond about specific science facts. Students are asked to comprehend, analyze, and evaluate information included in graphs, tables, charts and graphs and diagrams that make up each passage.

ACT Reading Test

The ACT Reading test is one of the dependent variables of this study. The test consists of 40 questions within a time frame of 35 minutes. It measures reading comprehension by requiring the learner to derive meaning from the text applying referring and reasoning skills to determine main ideas, locate and interpreting significant details and understanding sequencing of events. Learners are also expected to determine the meaning of context-dependent words, phrases and statements and analyze the author's or narrator's voice and methods.

High School Longitudinal Study (HSLS:2009) Teacher Survey

Most recent literature was utilized to guide the framework to construct the survey to ensure it included factors that informed the relationship between students' home experiences, school environment with academic performance and decision making. The following procedures resulted in the structural format of the HSLS teacher survey.

1. Teachers of participating students eligible for the study were identified. They were given a questionnaire where at the beginning she or he was asked to select each of the courses they taught.
2. After the introduction, there are four sections: Section A collected background information on the respondent, including demographic characteristics, educational history, certification and teaching history.
3. Section B was only for mathematics teachers.
4. Section C—science teachers were asked to identify the course (e.g., biology, chemistry, physics). The teacher assessed the achievement level and preparedness of students in the course, and they also reported on the use of small groups in class. In this section, the science teacher was asked about his or her emphasis on various course objectives.

5. Section D, the final section consisted of numerous parts. It assessed the teachers' evaluations of the school's principal and faculty. It asked about the prevalence of various problems at the school and limitations on their teaching. Also, in section D, science teachers were asked about their beliefs about the influence of a student's home environment on their ability to be effective teachers and the beliefs about how males' and females' science abilities compare.

To provide contextual information about the school environments, science teachers linked to the students completed questionnaires concerning teacher background and preparation, school climate and subject-specific classroom practices. All teachers who had an HSLS:2009 student in their science course were eligible for the teacher questionnaire (Appendix A). Science teachers of sampled ninth grade students were asked to complete a teacher survey that covered topics such as the following:

- Teacher interaction with students.
- Teacher background and experience in teaching profession; and
- Teacher preparedness to teach subject area.

The standard version of the HSLS:2009 teacher survey took about 26 minutes to complete. Web-based teacher interviews were completed in an average of 26 minutes while telephone interviews were completed in 27 minutes. An abbreviated version of the teacher survey was offered to nonresponding teachers about 2 weeks prior to the end of the data collection. The abbreviated survey asked questions about the teacher's background and teaching experience and could be completed in 10 minutes, with online interviews averaging 10 minutes and telephone interviews averaging about 9 minutes. If allowed by their school or district, all participating teachers received a check for $25 for completing the survey.

Teachers were not asked questions about a certain student but about students in general. They began the survey with questions about their own demographic description, educational history, certification, and teaching history. Respondents were also asked to report on their beliefs about the influence of students' home environments on their ability to be effective teachers; how male and female science abilities compared and how they assessed the achievement levels and preparedness of students in their class.

Science Teacher Self-Efficacy

Science teacher self-efficacy is one of the independent variables selected from the HSLS:2009 longitudinal study science teacher survey. The self-efficacy scale was created from the result of combining the responses from several questions included in the teacher questionnaire. Cronbach's alpha is a measure of internal consistency, that is, how closely related a set of items are as a group. It ranges from 0 to 1 and is a measure of scale reliability. Higher values indicate a great internal consistency and ultimately reliability. The Cronbach's alpha for the following factors of the self-efficacy scale is 0.68 indicating a possible poor internal consistency among the items.

Participants are asked to reply 1 = strongly agree, 2 = agree, 3 = disagree and 4 = strongly disagree to questions that ask about what extent does he or she agree or disagree with statements about his or her instruction. The following areas and questions depict the science teacher self-efficacy scale: (1) the amount a student can learn is primarily related to family background (2) if students are not disciplined at home, they are not likely to accept any discipline at school (3) you are limited in what you can achieve because a student's home environment is a large influence on their achievement (4) if parents would do more for their children, you could do more for you students (5) If a student did not remember information you gave in a previous lesson, you would know how to increase their retention in the next lesson (6) when it comes right down to it, you really cannot do much because most of s student's motivation and performance depends on their home environment. As noted, the self–efficacy scale is created from areas of classroom and behavioral management including family background, discipline, student achievement, parenting, student retention of information, redirecting classroom disruption and impact of students' home environment on their academic performance. The scale does little to inform the status of how science teachers feel about implementing vocabulary strategies to teach science terms.

Teaching Students Important Terms and Facts of Science

High school science learners are presented with a higher demand of reading technical text that is loaded with domain specific words. Therefore, students must determine the meaning of key terms and domain -specific words in order to comprehend the information. Teaching students important terms is another independent variable drafted from the HSLS:2009 science teacher survey which asked how much emphasis science teachers placed on various objectives. The specific question used for this study asked "Think about the full duration of this (Fall 2009 science course). How much emphasis are you placing on teaching important terms and facts of science?" The response options were 1 = no emphasis, 2 = minimal emphasis, 3 = moderate emphasis and 4 = heavy emphasis.

Research Design

Simple linear regression was used to explain the relationship between the ACT reading and ACT Science Reasoning scores outlined in question one. Simple linear regression was chosen to explain, if present, the significant relationship between the continuous dependent variable ACT Science Reasoning score and the continuous independent variable ACT reading score.

Path Analysis, a multivariate technique derived from SEM that specifies relationships between observed (measured) variables**,** was used to answer questions two and three by identifying the relationships between ACT Science Reasoning scores, ACT Reading scores, science teachers' emphasis on important terms (vocabulary) and science teachers' self-efficacy. Path analysis was chosen for this study because all the variables identified were observed variables. SEM is a family of statistical models that seek to explain the relationships among multiple variables; it can simultaneously handle a variety of statistical analyses (Mertler & Vannatta, 2010).

SEM is a very general statistical modeling technique, which is widely used in the behavioral sciences. It can be viewed as a combination of factor analysis and regression or path analysis. SEM provides a very general and convenient framework for statistical analysis that includes several traditional multivariate procedures, for example, factor analysis, regression analysis, discriminant analysis, and canonical correlation, as special cases (Hair, Black, Babin, & Anderson, 2010). Structural equation models are often visualized by a graphical path diagram.

A path diagram consists of boxes and circles, which are connected by arrows (Gay, Mills, & Airasian, 2006). In Wright's notation, observed (measured) variables are represented by a rectangle or square box, and latent (unmeasured) variables are represented by a circle or ellipse. Single headed arrows or 'paths' are used to define causal relationships in the model, with the variable at the tail of the arrow causing the variable at the point. Double headed arrows indicate covariances or correlations, without a causal interpretation. Statistically, the single headed arrows or paths represent regression coefficients, and double-headed arrows represent covariances. Figure 1 shows the path diagram for the path model of the variables under investigation.

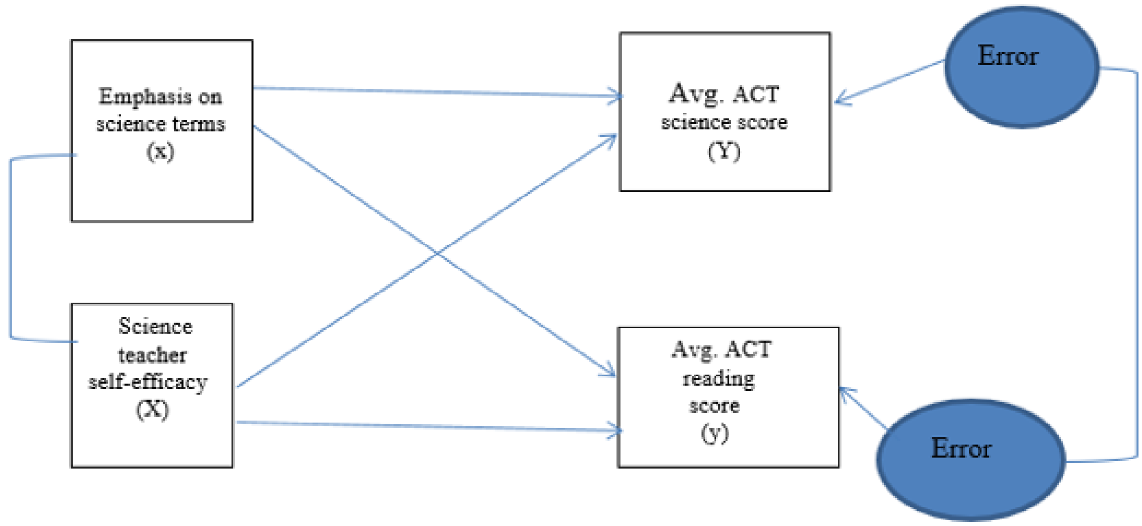


Figure 1. Path model.

CHAPTER IV

DATA ANALYSIS

This chapter discusses the data analysis and findings from the collection of science teacher survey results and science students ACT science and reading assessment performance from the HSLS: 2009 study with transcript follow-up in 2013. The chapter begins with a presentation of the demographics of the study sample. The chapter continues with the analysis of data including correlations and the path analysis. The chapter concludes with the presentation of the effects of the independent variables: science teachers' self-efficacy and science teachers' emphasis on terminology and facts on the dependent variables; average ACT reading scores and average ACT science scores.

The data collected in the science teacher's questionnaire represents the insight of science teachers into several factors that hypothetically impact their intention to create an effective learning environment for all science learners. The theory that supports this idea was conceptualized by Albert Bandura as the SLT of the 1960's which began as five constructs. The first construct is reciprocal determinism which states that an individual's actions impact and is impacted by personal factors and their social environment. Behavioral capability implies that for an individual to perform a task, he or she must have the knowledge and skills to carry it out; observational learning reiterates learning that occurs by watching other's behavior. Re-enforcement theory indicates that when an action is followed by a reward, the response is likely to occur in the future and the Expectancy theory claims that individuals are motivated by what they think will happen if they respond a certain way. As learning evolves, the idea of assessing one's beliefs about learning or performing a task appears resulting in the sixth construct, self-efficacy. Due to the addition of final construct, the SLT becomes the social cognitive theory. Self-efficacy refers to the possibility of an individual's environment or previous experiences informing how they feel about their success or efficacy in performing an action. Science teachers' self-efficacy impacts their ability to implement vocabulary strategies about key science terms.

The data analysis results of this chapter are presented in three sections that follow the three steps of the analysis. In this chapter the demographics of the sample are presented first to provide the reader the context of the data. The second section presents simple linear regression analysis of data. Thirdly, Analysis of Moment Structure (AMOS) identifies the significant constructs in the path diagram by estimating the path coefficients or the magnitude of the relationship between the independent variables, science teacher self-efficacy and emphasis on terminology and facts on the dependent variables, average ACT reading score and average ACT science score.

The sample for the present study was taken from the population of students and teachers within approximately 944 of the possible 1,889 eligible schools. This resulted in a 55.5% weighted school response rate. The types of schools varied; they included regular public, public charter and private schools in the 50 states and the District of Colombia that provided instruction to students in both the 9^{th} and 11^{th} grades as of fall 2009. There was a two-stage, stratified sampling design for selecting the participants. After the schools were selected in the first stage, students were randomly selected from the sampled schools in the second stage. Schools were contacted in fall of 2009 and informed about the study and the longitudinal nature; they were reminded that a follow-up was to be expected.

Table 2

Base-Year Weighted Response Rate by School Characteristics: 2009

School Characteristics	Sample Schools[1]	Number of base year responding schools	Base year weighted response rate[2]
Total	1970	940	55.5
School Type			
Public	1,550	770	58.8
Private (total)	430	180	46.2
Catholic	200	100	57.0
Other private	230	75	42.2
Region			
Northeast	360	150	40.9
Midwest	490	250	64.8
South	730	380	60.0
West	390	160	47.1
Locale			
City	670	270	44.1
Suburban	720	270	44.1
Town	200	1120	67.5
Rural	390	220	66.6

[1] School characteristics are taken from the NCES files used for sampling. Namely, the 2005-06 Common Core of Data (CCD) and the 2005-06 Private School Universe Survey (PSS) for the initial sample of public and private schools respectively; and the subsequent sample of schools just prior to HSLS:09 base year data collection from the 2006-07 CCD and the 2007-08 PSS.
[2] Weighted response rates were calculated with the school-level base weight as the sum of the weights for the eligible, responding schools divided by the sum of the weights for all eligible schools in the HSLS:09 sample (see American Association for Public Opinion Research (2011).
SOURCE: U.S Department of Education, Institute of Education Science, National Center for Education Statistics. High School Longitudinal Study of 2009 (HSLS:09) Base Year

A sample of 26,305 students were randomly selected from the 944 participating schools in the base year. During the base year recruitment, 1,099 students (4.2% unweighted) were classified as study ineligible and excluded from the data collection rosters, yielding 25, 206 study-eligible students.

Table 3

Base-Year Student Response Rates by Student Characteristics: 2009

		Student Participants		
Student characteristics	Eligible Students	Number	Weighted Percent	Unweighted Percent
Total	25,20	21,440	85.7	85.1
Sex				
Male	12,890	10,890	85.0	84.5
Female	12,320	10,560	86.4	85.7
Race/Ethnicity				
American Indian/Alaska Native	250	220	87.1	89.6
Asian Pacific Islander	2,570	2,140	86.2	83.2
Black or African American	3,110	2,680	86.8	88.8
Hispanic	3,960	3,5120	88.6	88.8
White	14,700	12,630	86.2	85.9
Other race, more than one race, or missing value	610	250	34.4	40.8

[1] Weighted percentages used the student base weight
NOTE: The variables used for sex and race/ethnicity are not presented on the main data file. To produce response rate calculations for all 25,206 eligible cases, information on sex and race/ethnicity relied on sampling frame variables that are not presented on the main data file.
Source: U.S. Department of Education, Institute of Education Science, National Center for Education Statistics. High School Longitudinal Study of 2009 (HSLS:09) Base Year

Demographics

Of the 944 school participants, the majority were public school students (767, 58.8%), from the south (380, 60.0%) and suburban (335, 46.4%). Of the 25,206 eligible student questionnaire participants, 21,444 responded (85.7%). Eligible science teacher questionnaire participants were 22,597 with 16,269 (70.2%) responding.

Table 4

Science Teachers Identified for the HSLS:2009 by School Type, Region and Locale

School Sampling	Average Characteristics		
	Count	Percent[1]	per school[2]
Total	4,804	100.0	5.2
School Type			
Public	4,340	90.3	5.8
Private	470	9.7	2.7
Catholic	310	6.5	3.1
Other private	150	3.2	2.1
Region			
Northeast	790	16.5	5.5
Midwest	1,210	25.1	4.9
South	1,920	40.0	5.2
West	880	18.3	5.6
Locale			
City	1,440	30.0	5.5
Suburban	1,940	40.4	5.9
Town	450	9.4	4.0
Rural	970	20.2	4.5

[1] Teacher was provided by 921 of the HSLS:2009 participating schools.
[2] Average number of teachers included in HSLS:2009 for 921 of the 944 participating schools that provided teacher information.
SOURCE: U.S Department of Education, Institute of Education Science, National Center for Education Statistics. High School Longitudinal Study of 2009 (HSLS:09) Base Year

The purpose of this study is to further examine the relationship between reading and science performance. Simple linear regression measures the relationship between ACT reading and ACT science sub-scores. Reading ability is known to impact science performance (Visone, 2009). According to O'Reilly and McNamara (2007), students who read well are more likely to score higher on standardized science tests.

Additionally, this study implements path analysis methodology to explain how science students' test scores are impacted when science teachers emphasize important science terminology because science text contains academic terms that students must understand in order to comprehend science concepts (Groves, 1995; Snow, 2010). The degree to which students seek to engage in communicating science content may be impacted by how confident science teachers feel about teaching vocabulary strategies that assist with learning word meaning because most science teachers are not prepared to teach reading strategies (Wood et al., 2009).

Simple Linear Regression

Simple Linear Regression or bivariate regression is a type of statistical analysis that allows one to summarize and study the relationship between two quantitative continuous variables which can be expressed as a straight line: There is one independent or predictor variable and there is one dependent or response variable. For this study, the predictor variable is average ACT reading score and the responding variable is average ACT science score. The bivariate regression utilizes the relationship between the independent and dependent variables to predict average ACT science scores from average ACT reading scores.

Prior to completing any analyses, the data were screened for outliers and violations to assumptions. There are three assumptions associated with linear regression: normality, linearity, and homoscedasticity. There were also univariate outliers identified graphically with the boxplot which added to the variation of the scores and did not cause severe skewness or kurtosis. As a result, outliers were included in the analysis.

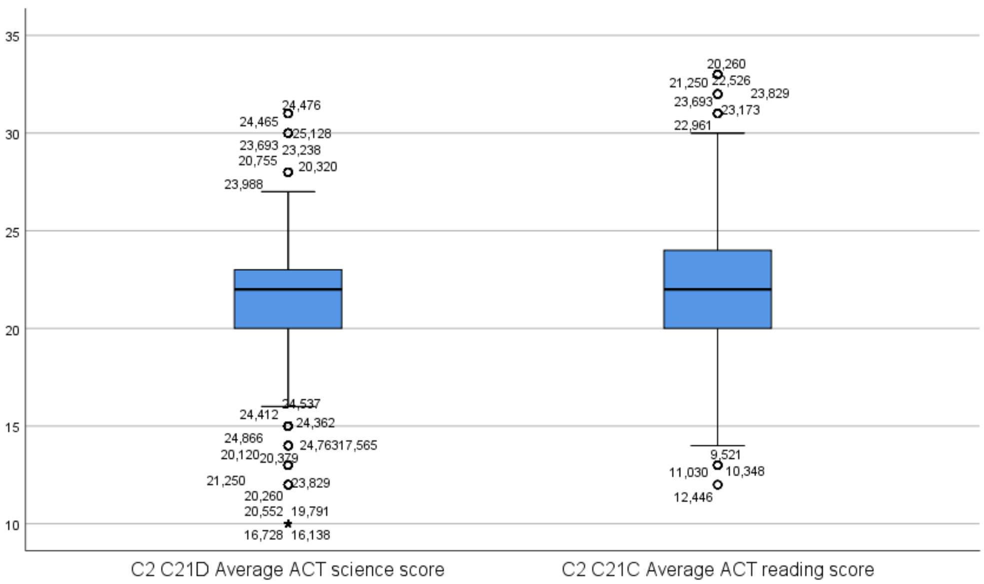


Figure 2. Boxplot displaying outliers for average ACT science scores and average ACT reading scores.

SOURCE: U.S Department of Education, Institute of Education Science, National Center for Education Statistics. High School Longitudinal Study of 2009 (HSLS:09) Base Year

Univariate Normality

If one or more of the assumptions are violated, the analysis results may be biased. Univariate normality is the extent to which all observations in the sample for a given variable are distributed normally. Univariate normality was considered for all variables including the dependent variables, average ACT science scores and the average ACT reading scores. The independent variables, science teacher's emphasis on important terms/facts and the scale of science teacher's self-efficacy. There are various methods for assessing bivariate normality of which includes graphical representation in a histogram, Q-Q plot or the normal probability plot. The histogram is considered an over simplified way of determining normality. The Q-Q plot is thought to be a more standardized way of determining whether normality has been violated; it reflects the observed variables on the x-axis and the responding variables on the y-axis, the plot should resemble a straight-line pattern (Hair et al., 2010). There are statistical methods for evaluating normality; these include skewness which is the quantitative measure of the symmetry of distribution about the mean and kurtosis which is the quantitative measure of the amount of height of the values. Figure 3 shows the results of the univariate normality check+ for each of the four variables of this study. I utilized the criteria 10 for kurtosis and 3 for skewness based on the recommendation by Tabachnick and Fidel (2013) who proports that large sample sizes results are not impacted by issues with skewness and kurtosis. Therefore, I did not transform any of the variables.

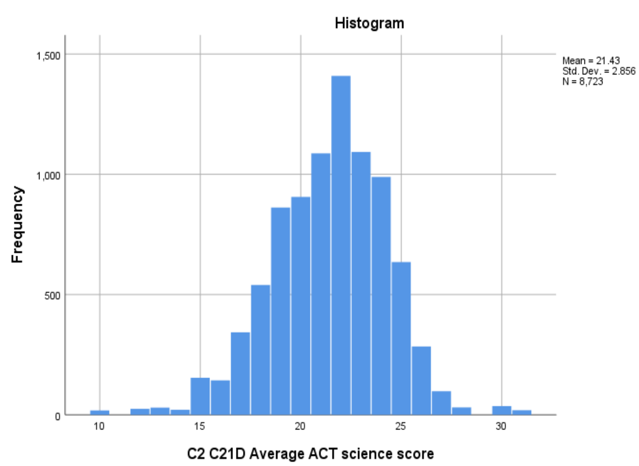


Figure 3. Normality check of average ACT science score with histogram plot.

SOURCE: U.S Department of Education, Institute of Education Science, National Center for Education Statistics. High School Longitudinal Study of 2009 (HSLS:09) Base Year

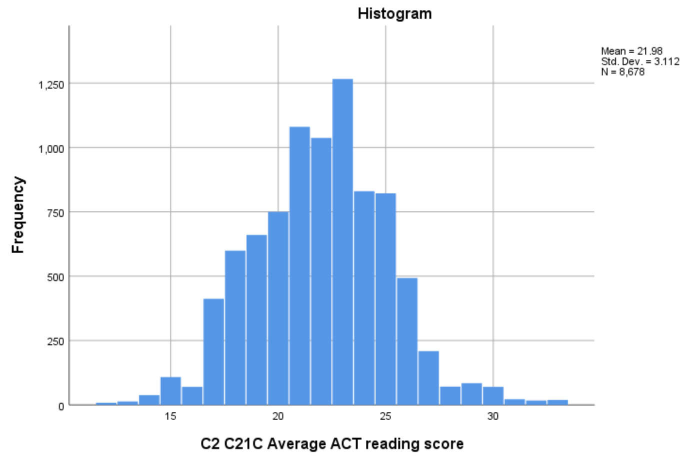


Figure 4. Normality check of average ACT reading scores with histogram plot.

SOURCE: U.S Department of Education, Institute of Education Science, National Center for Education Statistics. High School Longitudinal Study of 2009 (HSLS:09) Base Year

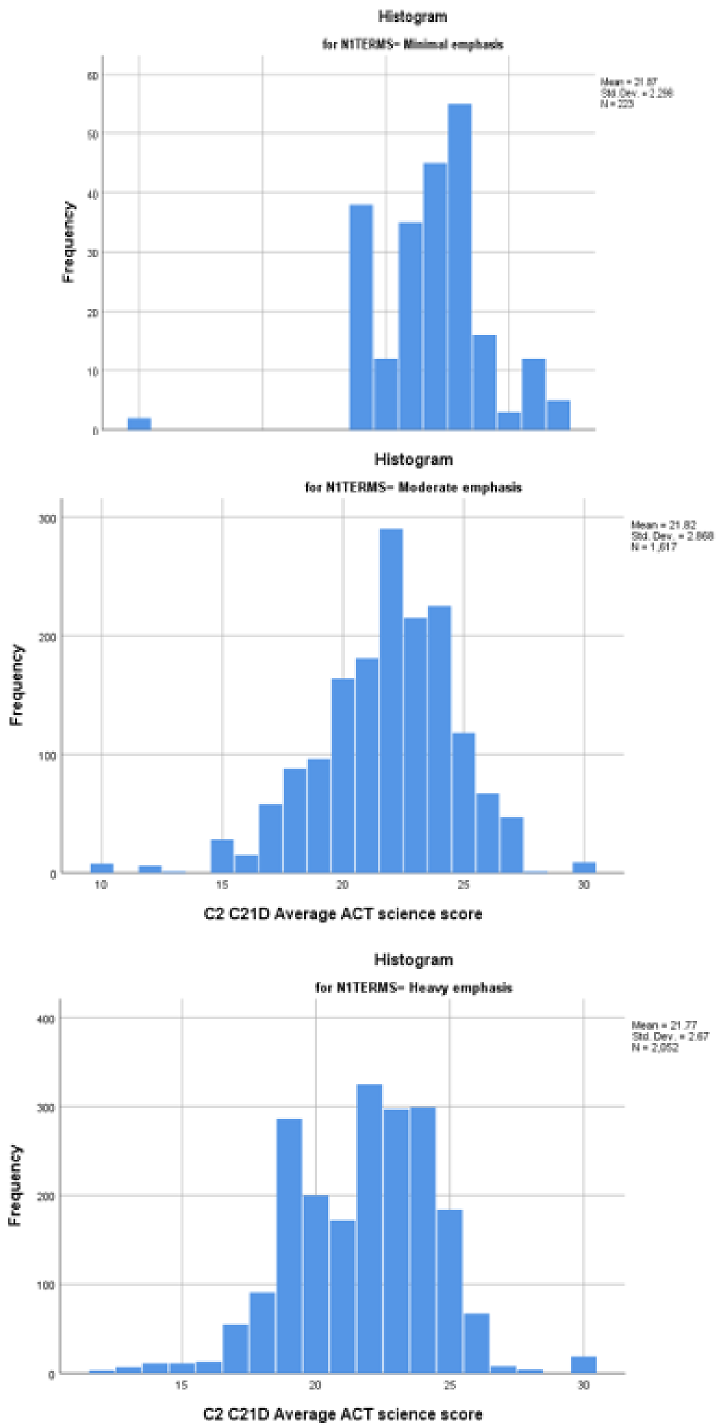


Figure 5. Normality check of emphasis of science terms variable with histogram plots for minimum, moderate and heavy emphasis.

SOURCE: U.S Department of Education, Institute of Education Science, National Center for Education Statistics. High School Longitudinal Study of 2009 (HSLS:09) Base Year

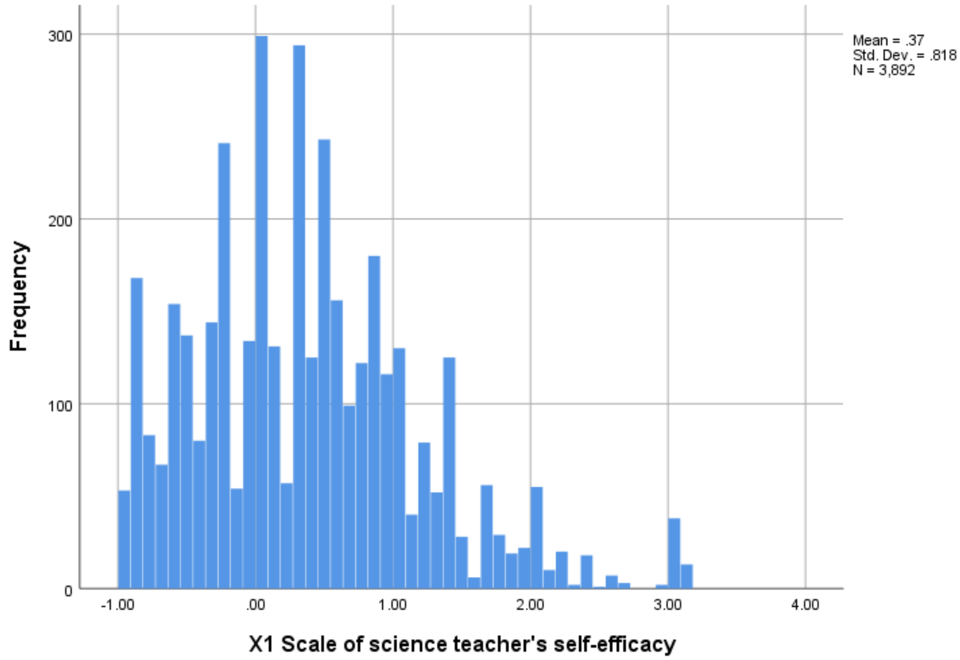


Figure 6. Normality check for science teacher's self-efficacy scale using a histogram plot.

SOURCE: U.S Department of Education, Institute of Education Science, National Center for Education Statistics. High School Longitudinal Study of 2009 (HSLS:09) Base Year

Linearity

The assumption of linearity asserts that there is a straight-line relationship between two or more variables. The variables may consist of a raw data point or can be derived from several variables to from composite variables such as teacher self-efficacy. The method used to assess nonlinearity in this study is the examination of residual plots. Residuals are considered predictor errors because they measure the difference between the obtained values and the predicted values for a variable (Mertler & Vannatta, 2010). When the standardized residuals are plotted against the predicted values, nonlinearity will be reflected by a curved pattern to the points. Simpler residuals will fall above or below the zero line for points. A relationship that is linear would be obvious by the arrangements of points gathering around the zero liner (Hair et al., 2010). Below are the linearity check results for the study's variables. Figure 7 shows the results for science teacher's emphasis on important science terms/facts (N1TERMS), scale of science teacher's self-efficacy (X1SEFF), average ACT science scores (C2AVGSCI) and average ACT reading score (C2 AVGREAD). The relationship plots between the variables seem to cluster around the zero line which indicate a liner relationship between the variables.

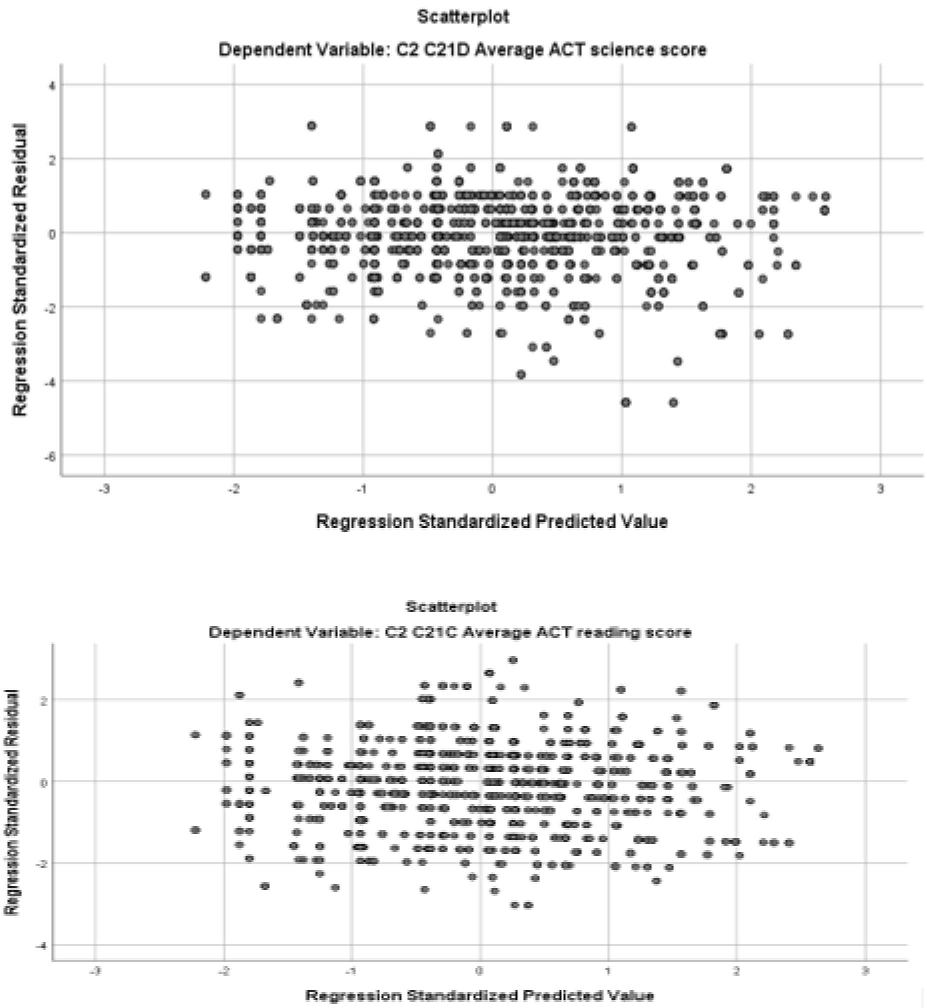


Figure 7. Linearity assumption check for (a) emphasis of science terms and science teacher's self-efficacy on average ACT science scores and (b) emphasis of science terms and science teacher's self-efficacy on average ACT reading scores.

SOURCE: U.S Department of Education, Institute of Education Science, National Center for Education Statistics. High School Longitudinal Study of 2009 (HSLS:09) Base Year

Homoscedasticity

Homoscedasticity is the assumption that the variability in scores for one variable that is continuous is about the same for another variable that is continuous. In the univariate case, it assessed statistically by the Levene's test. The statistic tests the hypothesis that the samples come from a population with the same variances. If the Levene's test is small or $p < .05$, then the null hypothesis that the variances are equal should be rejected. A rejection of the test is not fatal to the analysis. Homoscedasticity is connected to the normality assumption in that if the assumption of multivariate normality is met, the two variables must be homoscedastic. On the other hand, a lack of homoscedasticity or heteroscedasticity can be caused by non–normality, a relationship concerning the transformation of a variable or by error in measurements.

Heteroscedasticity can also be assessed by bivariate scatterplots examination. Although subjective, the points of the variables should collect about the same width across all values with some bulging toward the middle. Multivariate homoscedasticity can be assessed statistically by the Box's M test for equality of variance-covariance matrices. If the significance for the Box's M test is small, $p < .05$, the null hypothesis that the covariance matrices are equal should be rejected. A violation of this test can be corrected by transformation of variables. Like homogeneity of variance for univariate situations, a violation of the multivariate homoscedasticity will not be fatal to results.

The results for homogeneity of variance by bivariate scatterplots observations showed a violation with two variables: N1TERMS and X1SEFF. This may be due to non-normality analyses results. The results are in violation of normality and homogeneity of variance. However, this will not affect the analysis results. Multivariate homoscedasticity assumption is in violation, Box M, ($p = .000$). One should reject the null hypothesis that covariances matrices or the variability in scores for the dependent variables and independent variables are equal which could be due to non-normality. See figure 8 for details.

Box's Test of Equality of Covariance Matrices[a]

Box's M	2248.723
F	13.951
df1	153
df2	68124.502
Sig.	.000

Tests the null hypothesis that the observed covariance matrices of the dependent variables are equal across groups.

a. Design: Intercept + Terms1 + SEFF3 + Terms1 * SEFF3

Figure 8. Homoscedasticity assumption check with Box M results

SOURCE: U.S Department of Education, Institute of Education Science, National Center for Education Statistics. High School Longitudinal Study of 2009 (HSLS:09) Base Year

Question #1 Results

The first question addressed in the analysis is how much of the variability in the average ACT science reasoning score (C2ACTSCI) can be explained by the average ACT reading score (C2ACTREAD) for the 2009 ninth grade cohort? The data file was examined for any violations to assumptions. When examining univariate normality, I utilized the criteria, 10 for kurtosis and 3 for skewness based on the recommendation by Tabachnick and Fidel (2013) who state that large sample sizes results are not impacted by issues with skewness and kurtosis. Therefore, the variables were not transformed.

Simple linear regression and correlation analyses were conducted to examine the relationship between average ACT science reasoning and average ACT reading. Table 4 summarizes the descriptive statistics of the four variables: N1TERMS, X1SEFF, C2ACTSCI, and C2ACTREAD. Table 5 summarizes the regression analyses results. As shown, the C2ACTSCI scores positively and significantly correlate with the C2ACTREAD scores, $\beta = .861$, $t(8676) = 157.87$, $p < .001$. Those students who have higher average ACT science scores tend to have higher average ACT reading scores. The simple linear regression model with one predictor produced $R^2 = .742$, Adjusted $R^2 = .742$ $F(1, 8676) = 24922.37$, $p < .001$. The C2ACTREAD score has significant positive regression weight indicating for every unit change in the reading score, there is a .86 unit increase on the C2ACTSCI score.

Table 5

Descriptive Statistics and Correlations

Variable	Mean	Standard Deviation	Correlations
Science teacher's emphasis on important science teacher's terms/facts	3.47	.603	
Scale of science teacher's self-efficacy	.368	.818	
Avg. ACT science score	21.43	2.863	1.000
Avg. ACT reading score	21.98	3.112	.861

N (listwise) = 3, 982

SOURCE: U.S Department of Education, Institute of Education Science, National Center for Education Statistics. High School Longitudinal Study of 2009 (HSLS:09) Base Year

Question #2 Results

The second question addressed by this study is how does science teachers' self-efficacy influence students' performance on their average ACT science reasoning sub-score and students' performance on their average ACT reading sub-score? Path analysis was conducted to determine the hypothesized predictive linkage between the variables: X1SEFF and N1TERMS on C2ACTSCI scores and C2ACTREAD scores.

Prior to analysis, data was screened for outliers, normality, linearity and homoscedasticity. Outliers were identified but extreme values were kept as part of the data set in order to add to the diversity of students' scores and teacher responses. When examining univariate normality, 10 for kurtosis and 3 for skewness were applied based on the recommendation by Tabachnick and Fidel (2013) who proports that large sample sizes results are not impacted by issues with skewness and kurtosis. Therefore, the variables were not transformed.

The chi square value for the initial saturated (just identified) model is X^2 (0, N = 3892) = .000, p = is not producible for this model. The saturation of the initial model results from there being a direct path from each variable to each other variable. With a saturated model, the fit between data and model will be perfect. As a result, the chi square that tests the null hypothesis that the fit is perfect will have a value of zero indicating a perfect fit of model to data. However, the only model fit index is GFI = 1.000 which is greater than .9. This indicates that a portion of the variance in the sample covariance is accounted for by the model. So, the difference between error1(e1) for average ACT reading scores and error2 (e2) for average ACT science scores is accounted for by the initial model. To improve the fit of the mode, I deleted the non-significant paths between N1TERMS and C2ACTREAD scores ($p > .001$) and C2ACTSCI scores ($p > .001$). Both N1TERMS $\beta = -.058$, $t(3,886) = -.815$, $p = .415$ and $\beta = -.093$, $t(3,886) = -1.168$, $p = .243$ did not contribute to the model of explaining the variance in C2ACTSCI scores and average C2ACTREAD scores respectively.

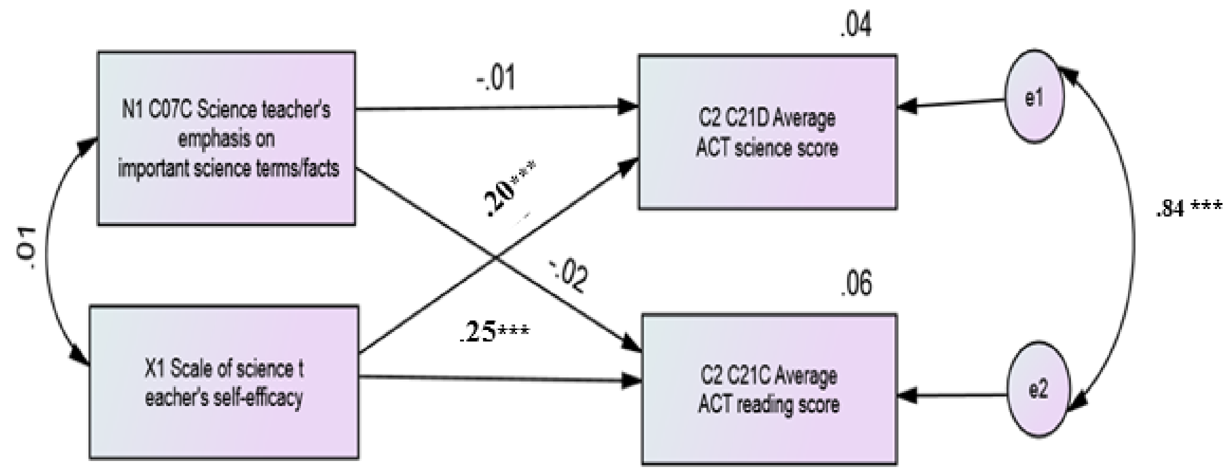
Model Fit Indices for Questions #2 and #3

After deleting the insignificant path in the initial model, the resulting reduced or over identified model produced a chi square, X^2 (2, N = 3892) = 1.461, $p = .482$. This indicates a good fit between the reduced or over identified model and the data. Other model fit indices such as CMIN = .730, which aides in determining how much of the fit of data to model is reduced by dropping one or more paths. Because the index is < 2 or 3, the model with only self- efficacy as an exogenous variable is still accounting for the variance in the endogenous variables, average ACT reading scores and average ACT science scores. GFI, the goodness of fit index tells what proportion of the variance in the sample covariance is accounted for by the model. Because the GFI = 1.00, it is > .9 and therefore, the model explains 84% of the covariance between e1 of average ACT reading scores and e2 of ACT science scores, e1 ↔ e2, B = 6.742, $t(3,886) = 40.164$, $p < .001$.

TLI is a goodness of fit model that compares this model to the independence model. TLI = 1.00 indicates that this model compared to the independent model is a good fit because the calculated index > .9. The Root Mean Square Error Approximation (RMSEA) index estimates the lack of fit of reduced model compared to the saturated model. The RMSEA = .000 which is < .05 and indicates a good fit. Lastly, the Standardized Root Mean Square (SRMS) is an index of the amount by which the reduced model's variances and covariances differ from the observed variances and covariances. The SRMS = .013 which indicates a good fit to the model and the data. The reduced model did good job of accounting for the differences in variances and covariances from the observed.

The exogenous variables, scale of X1SEFF and N1TERMS did significantly account for some of the variation in the endogenous variables, C2ACTREAD scores and C2ACTSCI scores. For C2ACTREAD scores $R^2 = .06$, $F(2, 3889) = 127.81$, $p < .001$, the model explained .06 or 6% of the variance in C2ACTREAD scores. For C2ACTSCI scores $R^2 = .04$, $F(2, 3889) = 81.48$, $p < .001$, the model explained .04 or 4% of the variance.

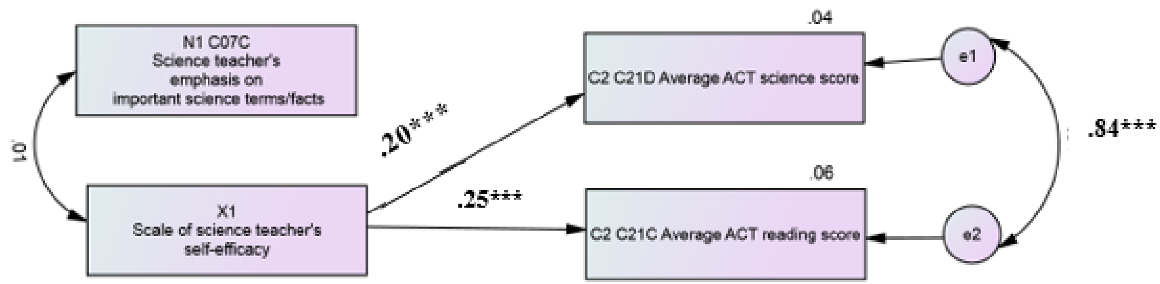
Path coefficients showed that for every standard deviation in X1SEFF $\beta = .248$, $t(3889) = 15.94$, $p < .001$, the science students' C2ACTREAD score increased by .25 standard deviation units. Also, for every standard deviation in X1SEFF $\beta = .200$, $t(3889) = 12.75$, $p < .001$, the science students' C2ACTSCI scores increased by .20 standard units. The results imply that when science teachers feel confident about their ability to teach science, there students' standardized reading and science test scores are higher. Also, the error (e1) for C2ACTREAD and the error (e2) for C2ACTSCI are strongly correlated, $r\ (3889) = .84$, $p < .001$. The error indicates that there are other variables other than self-efficacy that could explain the variation in C2ACT READ and C2ACTSCI scores.



Note. This path analysis shows association between endogenous variables (Average ACT science score, Average ACT reading score) and emphasis on important terms/facts and self-efficacy. Coefficients presented are standardized linear regression coefficients $***p < >001$.

Figure 9. The initial saturated model with all variables included: C2ACTREAD scores, C2ACTSCI scores, X1SEFF and N1TERMS.

SOURCE: U.S Department of Education, Institute of Education Science, National Center for Education Statistics. High School Longitudinal Study of 2009 (HSLS:09) Base Year



Note. The path analysis shows the deletion of the statistically insignificant path of emphasis on important terms/fact exogenous variable.

Figure 10. Reduced Model does not include the variable paths for N1TERMS because it was non-significant, p >.001.

SOURCE: U.S Department of Education, Institute of Education Science, National Center for Education Statistics. High School Longitudinal Study of 2009 (HSLS:09) Base Year

Question # 3 Results

The next question examined by path analysis is how does science teacher's emphasis (1 = no emphasis, 2 = minimal emphasis, 3 = moderate emphasis, 4 = heavy emphasis) on teaching important science terms influence student's average ACT science reasoning sub-score and student's average ACT reading sub-score? Path analysis is applied to determine the hypothesized effects of N1TERMS on students' C2ACTREAD and C2ACTSCI scores. Even though the exogenous variable science teacher's emphasis on important terms and facts is included in the initial diagram to explain variation in C2ACTREAD and C2ACTSCI scores, it is not a statistically significant path. So, N1TERMS produces a statistically nonsignificant negative relationship with C2ACTREAD and C2ACTSCI scores. Thus, for every standard deviation in N1TERMS, C2ACTREAD scores decreases by -.09 standard units, *N1TERMS* β = - .018 $t(3889) = -1.168$, $p = .243$. Additionally, for every standard deviation in N1TERMS, C2ACTSCI scores decrease by -.06 standard units, *N1TERMS* β = - .013 $t(3889)$ = - .815, $p = .415$. On the other hand, when science teachers placed moderate to heavy emphasis on teaching important science terms and facts, their students' standardized reading and science test scores decrease. Results suggest the need for quality professional development on effective reading (vocabulary) strategies for science teachers which could improve their students' standardized test scores.

CHAPTER V

CONCLUSION

Chapter 5 includes the summary and discussion of the results presented in chapter 4. Each of the research questions and the findings relevant to each question are presented. The relationships confirmed in the present study are shown in the final structural model of the path diagram. The chapter concludes with recommendations.

ACT Reading Sub-scores and ACT Science Sub-scores

This study's finding that there is a high positive and significant correlation between average ACT reading sub-scores and average ACT science sub-scores agrees with the literature that indicates that reading performance has a definite impact on science performance on standardized tests (Cromley, 2009; O'Reilly & McNamara, 2007; Visone, 2009; Visone, 2010). As confirmed by the Pearson correlation coefficient of .861, there is a strong positive linear relationship between ACT reading sub scores and ACT science sub scores. Therefore, average ACT reading sub scores have high explanatory ability based on the model which has only ACT reading sub scores. The R^2 value of 0.74 indicates that 74% of the variation in average ACT science sub scores can be explained by the model so it is reliable. It also means that only 26% variation in ACT science performance is still unexplained so adding other independent variables could improve the model.

Framing the relationship between reading and science performance in the context or school type (public, private,), region (northeast, Midwest, south, west) and locale (city, suburban, town, rural) can provide details about where sample participants across the nation and even states are experiencing the most hardship with science performance when it comes to standardized tests. Of the 944 sample schools that participated in the High School Longitudinal Study 2009:13 (HSLS: 2009:13), the test scores consisted of 46% public schools, with 60% being in the South and from rural communities.

Cromley (2009) speaks to not only the relationship between reading and science performance but highlights the direction of influence. Fifteen-year-old science learners from 72 countries' PISA reading and science scores were analyzed for three years: 2000, 2003, and 2006. Correlations revealed that the reading and science relationship was weaker for countries with the lowest reading scores: .840 for the 2000 data set, .805 for the 2003 data set and .819 for the 2006 data set. Thus, the results from this study and others support the need for reading intervention in the science classroom and quality reading professional development for science teachers (Cantrell, Burns, & Callaway, 2008; Cantrell & Hughes, 2008; Hall, 2005; Holzberger, Philip, & Kunter, 2013; Ness, 2016).

Science Teacher Self-Efficacy and its influence on the ACT Reading and Science

The demand for incorporating reading strategies into the science curriculum has developed during the career of many practicing teachers. In 2013, with a collaborative effort of the National Research Council (NRC), the NSTA, the American Association for the Advancement of Science (AAAS) and Achieve, the NGSS for grades K-12 were completed (Next Generation Science Standards, 2013*)*. The primary goal was to provide students with critical thinking and literacy skills required for college and the workforce. Unfortunately, many science teachers may not feel confident when it comes to including reading strategies with their instruction (Hall, 2005). They also have a low self-efficacy about their ability to teach literacy strategies to their students. This point was confirmed by Ness (2016) who utilized 2,400 minutes of direct classroom observation in the high school classroom to highlight that of the 40 hours of instructional time, only 3% or 82 minutes were spent on helping students to apply three reading strategies in comprehending informational text. Additionally, Smith (2017) applied qualitative case study methodology to confirm that science and other content area teachers did not feel prepared to teach reading strategies.

Self-efficacy is defined as one's belief in their ability to perform a task in order to produce a specific outcome. According to Bandura, when teachers believe in their ability to perform a task, their efficiency increases which can positively impact the learning environment (1993). This leads us to the third question of this study, how does science teacher's emphasis (1 = no emphasis, 2 = minimal emphasis, 3 = moderate emphasis, 4 = heavy emphasis) on teaching important terms and facts influence student's average ACT science reasoning sub-scores and average ACT reading sub-scores? After applying path analysis to determine the effects among the variables science teachers' self-efficacy on student's average ACT science scores and student's average ACT reading scores, the path coefficients revealed that for every standard deviation in science teacher's self-efficacy, the science student's average ACT reading score increased by .25 standard deviations. Also, for every standard deviation in science teacher's self-efficacy, the science student's average ACT science score increased by .20 standard deviation units. Both relationships were significant at the $p = .001$ level.

Overall, when teachers have a high self-confidence about their instructional practices, this has a positive result on student's standardized test performance. Assisting preservice and inservice teachers to better deliver content area material along with literacy strategies is highly supported. Holzberger, Philipp & Kunter (2013) echoed this sentiment when they conducted a structure equation analysis on a self-reported measure of teacher self-efficacy with teacher and student ratings of instructional quality. The study confirmed that self-efficacy had an impact on how instruction was delivered. Guo, Conner, Yang, Roehrig, & Morrison (2012) made this point when they examined the relationship between teacher self-efficacy in delivering literacy instruction and the influence on students' academic performance. Structural Equation Modeling (SEM) was applied to re-analyze the longitudinal data of 1,043 fifth graders from the National Institute of Child Health and Human Development (NICHD) study of Early Childcare and Youth Development. Teachers with a higher sense of self-efficacy provided a more positive classroom environment as opposed to teachers with a lower self-efficacy. Likewise, teachers with a higher sense of self-efficacy had students with higher literacy skills than those teachers with a low sense of self-efficacy.

Vocabulary Instruction and its Influence on the ACT Reading and Science

Vocabulary acquisition has been identified as one of the key components of effective reading instruction according to the National Reading Panel. It has been documented that understanding vocabulary terms in science text is instrumental in the comprehension of science text. Seifret and Espin (2012) conducted a within-subject design study to examine three different instructional approaches — text reading, vocabulary learning, and text reading plus vocabulary learning. Each student that participated was subjected to one of four conditions: three interventions (text reading, vocabulary instruction, text reading plus vocabulary instruction) and one control. The dependent variables were reading fluency and vocabulary knowledge from four 500-word text passages taken from four sections of a standard high school biology textbook: Miller & Levine 2004. Students had no previous exposure to the material, the four topics were not related to each other, and all topics came from introductory material to limit the amount of background knowledge required for comprehension. After applying a one-factor repeated-measures ANOVA, the results indicated text reading plus vocabulary learning instruction had a positive effect on reading fluency and vocabulary knowledge of science text. With vocabulary being a major factor in academic language utilized in science text, there appears to be a relationship between the degree to which vocabulary instruction is introduced in the science classroom and how this implementation may impact science performance.

The previous paragraph introduces the results of the second question answered in this study: How does science teachers' emphasis on important science terms influence the ACT reading and ACT science reasoning scores? The statistical application of path analysis concluded that for every standard deviation in science teachers' emphasis on important terms and facts, there was a -.02 standard deviation decrease in the students' average ACT reading scores and a -.01 standard deviation decrease in the students' average ACT science scores. Simply, when science teachers answered that they placed moderate (3) or heavy (4) emphasis on teaching important terms and facts of science, the effort was not reflected in the ACT reading scores nor was it shown in the ACT science scores. A valid explanation for this inverse relationship that seems contrary to previous research that documented positive effects when applying vocabulary intervention is summarized in a qualitative case study conducted by Smith (2017) which examined 7th and 8th graders content area teachers' perspectives on teaching literacy. Interviews, observations and lesson plans indicated that teachers felt unprepared to teach reading strategies. Thus, the usual instructional efforts of vocabulary learning may consist of superficial learning of definitions and rote memorization of words (Wood et al., 2009). When teachers do not feel secure about their ability to deliver effective literacy instruction, it can negatively impact the classroom environment and their students' academic performance. One explanation for the negative impact of vocabulary instruction may have been identified in a study conducted by Draper (2002). He conducted a qualitative study to examine nine secondary methods class' textbooks that were utilized by the instructor as a reference to teaching content area reading. Analysis revealed that while there were reading strategies mentioned, direction on how to implement the skills were general and often emphasized rote memorization of terms with very little application to learning the fundamentals of science.

Implications for Practice

There is an established international and national science achievement gap that has played out on the world's stage. American students' science performance on standardized tests has been mediocre and waning over the past decades (Kastberg et al., 2016; Kelly et al., 2013; Martin et al., 2016). With every moment in today's modern global society, there is an even greater need for scientific literacy to inform various aspects of human society: economic development, health care, mass communication and transportation to name a few.

One of the factors impacting science performance on standardized tests is reading ability. More so than science knowledge, standardized science tests evaluate how well students can read the academic language found in scientific text in order to select the best answer (Cromley, 2009; O'Reilly & McNamara, 2007; Seifret & Espin, 2012; Snow, 2010; Visone 2009; Visone 2010). Not only has there been a historical consensus about the relationship between reading ability and science performance, the results of this study expand the relationship to include how emphasis of science terms/ facts by science teachers with various levels of self – efficacy can influence the reading and science performance relationship

As a result of the demand for science learners to independently read and comprehend the sophisticated terminology in science text, teachers must be prepared to introduce literacy strategies including specifically vocabulary strategies in their instructional practices because vocabulary knowledge is a strong indicator of science concept comprehension (Cromley et al., 2010; Shokouhi & Maniati, 2009). When teachers feel confident about their instruction ability, they can create a learning environment where students can thrive and benefit academically (Bandura, 1993). Based on previous studies, most content area teachers including science teachers are not prepared to teach reading strategies (Wood et al., 2009). They do not feel that they have been properly prepared to carry out the task of effectively teaching literacy combined with their content knowledge (Hall, 2005). The results of this study support this very sentiment. Even though teachers may have reported that they moderately or highly emphasized science terms/facts in their instruction, the expected positive results were not reflected in the student's average ACT reading sub-scores or the average ACT science sub-scores. Rather when teachers emphasized science terms or vocabulary instruction in their classrooms, science students' reading and science sub - scores on standardized tests went down.

Bandura, the chief proponent of the SCT, stated that when one has a low self- efficacy about their ability to perform a task the approach they take and the effort that he or she puts into the performing the task for maximum outcome will be affected. In the context of science teachers, those that do not feel they have had the proper training may result to only superficially emphasizing science terms through rote memorization which limits any in depth understanding of science concepts. Thus, the science learners will not be able to transfer any critical analysis of scientific ideas into performing on a standardized test. On the other hand, when students are taught effective reading techniques through direct instruction, their self-efficacy improves which may result in better performance on science tests (Braten, Anmarkrud & Stromso, 2013; Grillo & Dieker, 2013).

In order to improve science teachers' self-efficacy about implementing literacy strategies in their instruction, quality professional development is necessary. Whether in-service or pre-service, quality professional development can prepare our new generation of teachers for the literacy demand of today's content areas. Greenleaf et al. (2010) supported this point when they conducted a study that examined the effects of a professional development program that integrated academic literacy and biology instruction on science teachers' instructional practices. They also evaluated how the professional development impacted students' science achievement and literacy. The intervention involved ten days of professional development in Reading Apprenticeship, an integration of metacognitive inquiry routines during subject area instruction. The study applied a group-randomized, experimental design and multiple measures of teacher implementation and student learning. After applying hierarchical linear modeling, teachers that participated in the literacy professional development showed an increased support for science literacy learning and the use of metacognitive inquiry routines and reading comprehension instruction. Additionally, students in the classrooms of teachers participating in the literacy professional development performed better on state standardized test in biology among other subjects.

Vocabulary Instruction

There are numerous vocabulary reading strategies that science teachers can use in their instructional practices. Even more so, when students receive effective vocabulary strategies, it improves their vocabulary knowledge, fluency, and comprehension (Seifert & Espin, 2012). To deliver high quality vocabulary instruction, teachers must select the words to teach and the instructional practices that will help students learn. To determine which words, it requires more instructional attention, Beck, McKeown, and Kucan, 2008 devised the concept of "word tiers". Tier I words are every day, basic familiar words. Tier II words are more sophisticated and are utilized more by literate language users while Tier III words are rear and belong to a specific domain. Below is an example of word Tiers.

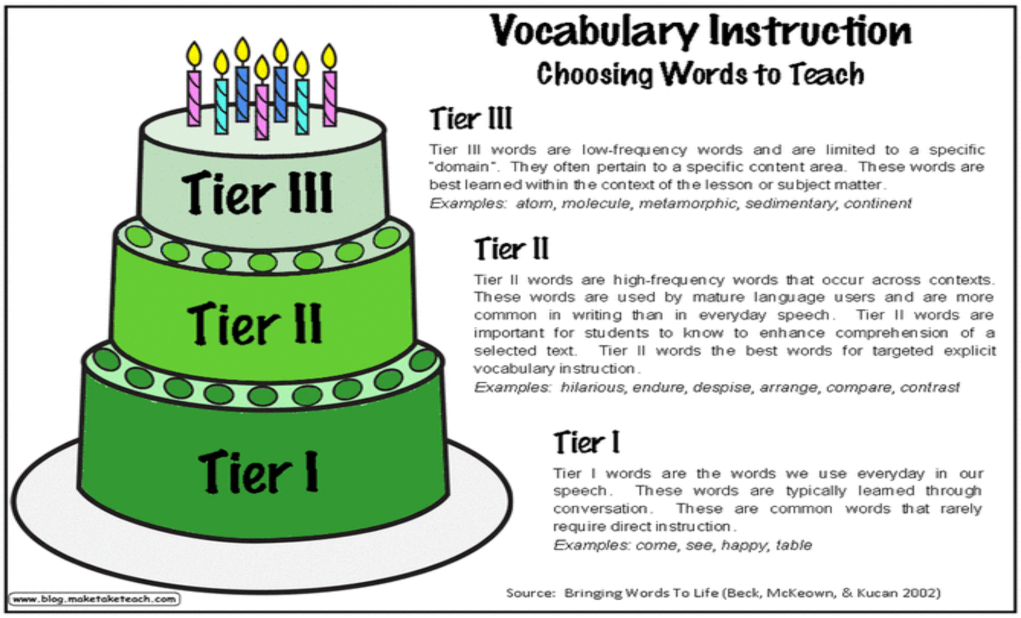


Figure 11. Vocabulary Instruction – Choosing Words to Teach

Source: Bringing Words to Life (Beck, McKeown & Kucan, 2002)

Tier II words are most important to teach because they play a critical role in literacy; they are prevalent in written text but are not common in everyday conversation. Most exposure to Tier II words come from interaction with reading books. Students have different vocabularies. Receptive or recognition vocabulary includes words that are understood in reading or listening. Productive or expressive vocabulary is what one speaks or writes. To assist learners in becoming more academically successful, they must cross the “lexical bar” which is the barrier between conversational word meaning and the more sophisticated vocabulary language in books. When teaching Tier II words, teachers want students to use them to talk about people, ideas and events in the world and build connections between new words and what they already know.

On the other hand, not all students are aware of all Tier I words or those that are in simple written materials for younger readers or words used in informal context. When this happens, more deliberate conversations to allow interactions in the classroom will engage students to use various words. Also, teachers can be more loquacious when eliciting a definition so students will be aware of the context in which new words are used.

Tier III words can be less concrete and imaginable and more abstract and complex. Therefore, many Tier III words need to be taught within the context of the content domain they represent (Palumbo, Kramer-Vida, & Hunt, 2015). For example, cytokinesis, meiosis and photo-synthesis are science terms. Just knowing definitions is not enough, adequate explanations of concepts and connection between them are critical for comprehension. See the following exam-ple below of a sample concept map for the Tier III science term, photosynthesis.

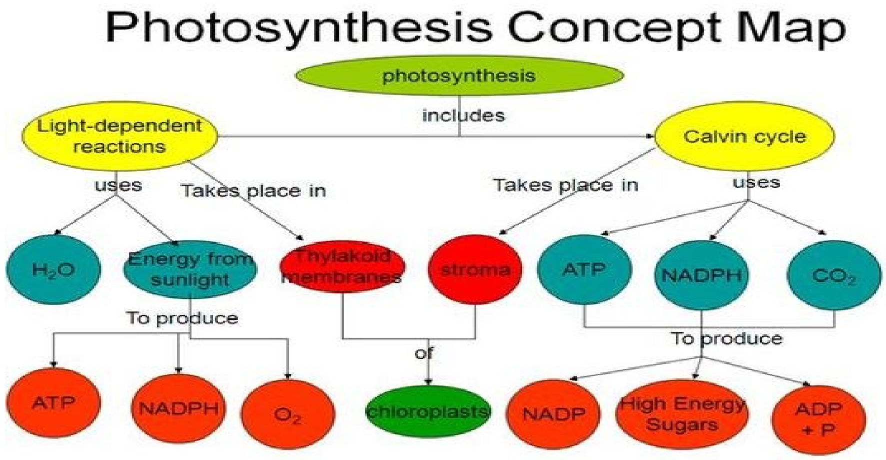


Figure 12. Photosynthesis Concept Map

Source: Ahmad, Munir, Hadzirah, & Syed (n.d)

Beck, McKewon & Kucan (2008) identified three features of effective vocabulary instruction: (1) numerous exposures to new words, (2) both definitional and contextual information and, (3) engagement of students in active or deep processing. Adolescents encounter more expository writing especially in their textbooks as they progress through middle and high school (Yildirim et al., 2011). When struggling readers are exposed to varied types of high interest-low reading level materials, such as trade books, magazines, and newspaper and media reports they are presented with vocabulary in context. Utilizing engaging vocabulary strategies will allow for high order thinking which is required in comprehending expository science text (Hoskins, 2010). In other words, students will be able to utilize vocabulary terms appropriately to relay ideas when communicating with others. These and other scientifically evaluated strategies have been recommended to combat low vocabulary in struggling readers, but many content area teachers are uncertain as to how vocabulary instruction can be included in everyday instruction other than the usual defining of terms that may occur in most classrooms (Wood et al., 2009; Julien & Barker, 2009). There are several reading strategies that can be incorporated in the science classroom as discussed in Chapter 2.

Limitations and Recommendations for Future Research

The study's aim was to investigate "self-efficacy" in the context of science teachers' attitude about implementing reading strategies into their classroom instruction. The re-analysis of the 2009 data from the base line survey collected about science teacher's self-efficacy yielded a positive correlation. As a science teacher's self-efficacy increased, the student's average ACT science sub-score and average ACT reading sub-score increased. Because I utilized a survey data previously constructed, I was limited to the survey authors' interpretation of the self-efficacy scale. The self-efficacy survey scale measured questions referencing teacher's attitudes toward classroom- and behavioral management items as opposed to feelings about reading strategies. For example, one of the questions used to create the scale asked, "If a student in your class becomes disruptive and noisy, you feel assured that you know some techniques to redirect them quickly." For this reason, findings do not describe science teacher's self-efficacy as it relates to employing vocabulary strategies in the science classroom. Research does state that science teachers who are confident about teaching science are also more confident when it comes to teaching reading strategies (Crow, 2016). To improve the validity of this study, future research should include a survey that addresses specific content questions about implementing reading strategies, particularly vocabulary strategies during instruction. Adjustments to the survey will quantitatively and descriptively provide information about vocabulary instruction and its impact on science performance.

In conclusion, standards-based curriculum and standardized testing are mainstays in education today and literacy in science is an important focus. According to the (NGSS), science learners should be able to understand science terminology in order to comprehend science concepts. Therefore, based on the established direct relationship between reading ability and science performance, this study attempted to extend understanding of the relationship by narrowing the area of reading that influences science performance. Because science is heavily saturated with technical academic language, understanding the role of vocabulary instruction on science performance is critical to improving teachers' awareness and self-efficacy about how creating an environment rich in effective literacy strategies, especially vocabulary, influences students' academic performance and prepares them for college or the work force. This study revealed that when science teachers feel confidently about teaching, students' scores on standardized tests increase.

Many teachers do not feel prepared to effectively implement evidence-based vocabulary methods into their instruction. Therefore, their idea of incorporating vocabulary techniques may be to simply ask students to define words from the dictionary for rote memorization. This idea explains the results to question three of this study. Even though teachers reported spending moderate to heavy emphasis on science terms and facts, the effort did not transfer to students' standardized test scores. As science teachers claimed to put moderate to heavy emphasis on science terms/facts, students' scores on the reading and science sub-scores of the ACT declined. These results suggest the importance of creating training opportunities for pre-service and in-service science teachers to acquire and deliver research-based literacy strategies. Training science teachers will increase their self-efficacy, in turn creating an environment for students to thrive and perform well on high stakes standardized tests which can improve high school graduation rates and escalate American students' competitiveness in a global society.

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APPENDIX A

SCIENCE TEACHER SURVEY

* Questions marked with an asterisk (*) were not asked of all respondents.

SECTION A: Teacher Background

~~~~~~ We would like to confirm your sex. Are you male or female?

Male
Female

~~~~~~ Are you of Hispanic or [Latino/Latina] origin?

No
Yes

~~~~~~

[In addition to learning about your Hispanic background, we would also like to know about your racial background.] Which of the following choices describe your race? You may choose more than one. (Check all that apply.)

White
Black/African American
Asian
Native Hawaiian or Other Pacific Islander
American Indian or Alaska Native

~~~~~~

What is the highest degree you have earned?

Associate's degree
Bachelor's degree
Master's degree
Educational Specialist diploma
Ph.D., M.D., law degree, or other high level professional degree
You do not have a degree

~~~~~~

* In what year did you receive your [highest degree earned]?

~~~~~~

* What is the name of the college or university where you earned your [highest degree earned]?

~~~~~~

* Was this [highest degree earned] awarded by [institution name]'s department of education?

No
Yes

~~~~~~

* What was your major field of study for your [highest degree earned]?
(Please type your major in the space below and click on "Search for major". Do not enter abbreviations. If you had more than one major field of study, please report the major most closely related to your current teaching position.)

~~~~~~

* In what year did you receive your Bachelor's degree?

~~~~~~

* What is the name of the college or university where you earned your Bachelor's degree?

~~~~~~

* Was this Bachelor's degree awarded by [institution name]'s department of education?

No
~~~~~~

Yes

~~~~~~

* What was your major field of study for your Bachelor's degree?
(Please type your major in the space below and click on "Search for Major". Do not enter abbreviations. If you had more than one major field of study, please report the major most closely related to your current teaching position.)

~~~~~~

* Have you started, but not completed, any work on a degree beyond [highest degree earned]? (If you have started more than one of the degrees listed below, please select the higher degree.)

No, have not started any other degree
Yes, started but not completed an Associate's degree
Yes, started but not completed a Bachelor's degree Yes,
started but not completed a Master's degree
Yes, started but not completed an Education Specialist diploma
Yes, started but not completed a Ph.D., M.D., law degree, or other high level professional degree

~~~~~~

* In which of the following branches of math have you taken one or more college-level courses? (Check all that apply.)

Algebra such as Abstract Algebra, Linear Algebra, or Groups, Rings, and Fields
Applied mathematics such as Dynamical systems, Game theory, Information theory, Mathematical modeling, or Mathematical physics
Calculus, Analysis, or Differential equations
Discrete mathematics, Combinatorics, or Graph theory Foun-
dations, Philosophy, History of mathematics, or Logic Geome-
try, Trigonometry, or Topology
Number theory Proba-
bility or Statistics None
of these

~~~~~~

* Which of the following college-level science courses have you taken?
(Check all that apply.)

Any biology or life science course
Any chemistry course
Any earth or space science course
Any physics course
Any engineering course
Any physical science course
None of the these

~~~~~~

* Which of the following college-level biology or life science courses have you taken?
(Check all that apply.)

Anatomy or physiology
Botany or plant physiology
Cell biology
Ecology
Entomology
Genetics or Evolution
~~~~~~

Microbiology
Zoology or animal behavior
None of the these
~~~~~~

* Which of the following college-level chemistry courses have you taken?
(Check all that apply.)
Analytical chemistry
Biochemistry Organic
chemistry Physical
chemistry None of
these
~~~~~~

* Which of the following college-level earth or space science courses have you taken?
(Check all that apply.)
Astronomy
Environmental science
Geology Meteorol-
ogy Oceanography
Physical Geography
None of these
~~~~~~

* Which of the following college-level physics courses have you taken?
(Check all that apply.)
Electricity and magnetism
Heat and thermodynamics
Mechanics Modern/quan-
tum physics Nuclear physics
Optics
None of these
~~~~~~

* Did you work in a job in which you used college-level math before becoming a teacher?
No
Yes
~~~~~~

* Did you work in a job in which you used college-level science before becoming a teacher?
No
Yes
~~~~~~ Did
you enter teaching through an alternative certification program?
No
Yes
~~~~~~

* Which of the following describes the math teaching certificate you currently hold in [your state]?
Regular or standard state certificate or advanced professional certificate
Certificate issued after satisfying all requirements except the completion of a probationary teaching period
~~~~~~

Certificate that requires some additional coursework or passing a test
Certificate issued to persons who must complete a certification program in order to continue teaching
You do not hold any of these certifications in this state

~~~~~~

* In which grades does this certificate allow you to teach math in [your state]?
(Check all that apply.)

Kindergarten through 5th grade (any or all grades)
6th through 8th grade (any or all grades)
9th through 12th grade (any or all grades)

~~~~~~

* Including this school year, how many years have you taught high school (grades 9-12) math at any school?

~~~~~~

* Which of the following describes the science teaching certificate you currently hold in [your state]?

Regular or standard state certificate or advanced professional certificate
Certificate issued after satisfying all requirements except the completion of a probationary teaching period
Certificate that requires some additional coursework or passing a test
Certificate issued to persons who must complete a certification program in order to continue teaching
You do not hold any of these certifications in this state

~~~~~~

* In which grades does this certificate allow you to teach science in [your state]?
(Check all that apply.)

Kindergarten through 5th grade (any or all grades)
6th through 8th grade (any or all grades)
9th through 12th grades for biology or life sciences (any or all grades)
9th through 12th grade for chemistry, physics, or physical science (any or all grades)
9th though 12th grades for earth or space sciences (any or all grades)

~~~~~~

* Including this school year, how many years have you taught high school (grades 9-12) science at any school?

~~~~~~

The next two questions are about your years teaching [math / science / math, science,] or any other subject. Including this school year, how many years have you taught...

any grade K-8 at any school?
any grade 9-12 at any school?

~~~~~~

Including this school year, how many years have you taught any subject at any grade level at [your school]?

~~~~~~

Are you currently collecting a pension from a teacher retirement system or drawing money from a school or system sponsored 401(k) or 403(b) plan which includes funds you contributed as a teacher?

No
Yes

~~~~~~
~~~~~~

SECTION B: Math Department and Instruction

~~~~~~

* Now we have some questions regarding your math instruction and the math department at [your school].

~~~~~~

* Indicate the extent to which you agree or disagree with each of the following statements about high school math teachers at your school. High school math teachers at your school...

set high standards for teaching.
Strongly agree
Agree
Disagree
Strongly disagree
set high standards for students' learning.
Strongly agree
Agree
Disagree
Strongly disagree
believe all students can do well.
Strongly agree
Agree
Disagree
Strongly disagree
make expectations for instructional goals clear to students.
Strongly agree
Agree
Disagree
Strongly disagree
have given up on some students.
Strongly agree
Agree
Disagree
Strongly disagree
care only about smart students.
Strongly agree
Agree
Disagree
Strongly disagree
expect very little from students.
Strongly agree
Agree
Disagree
Strongly disagree
work hard to make sure all students are learning.
Strongly agree
Agree
Disagree
Strongly disagree

~~~~~~
~~~~~~

* The following questions are about the [fall 2009 math course] you are teaching.
[if web interview: We would like to standardize the various course titles we receive from schools into defined categories. This course may or may not exactly match one of these categories. Regardless, please indicate which of the following best categorizes this course.]
[if phone interview: We would like to standardize the various course titles we receive from schools into defined categories. Please indicate which of the following best categorizes this course.] Pre-Algebra
Review or Remedial Math
Algebra I, part 1 or part 2
Algebra I
Algebra II Geometry
Trigonometry Analytic Geometry
Statistics or Probability
Pre-calculus Calculus Integrated
Math I
Integrated Math II or above
Other math
~~~~~~

* Which of the following best describes the achievement level of students in [fall 2009 math course] compared with the average 9th grade student in this school?
Higher achievement levels
Average achievement levels
Lower achievement levels
Widely differing achievement levels
~~~~~~

* About what percentage of the students in [fall 2009 math course] are not adequately prepared to tackle the material you cover?
25% or less
26% to 50%
51% to 75%
More than 75%
~~~~~~

* Do you have students in your [fall 2009 math course] course work in small groups?
Yes
Not currently, but you plan to at some point during this course
No
~~~~~~

* Primarily, how do you [plan to] assign students to groups in [fall 2009 math course]?
Intentionally create groups so students will be of similar ability levels
Intentionally create groups so students will be of different ability levels
Create groups without regard to ability level such as alphabetically or randomly
Groups will be chosen by the students
~~~~~~

* Think about the full duration of this [fall 2009 math course]. How much emphasis are you placing on each of the following objectives?
~~~~~~

Increasing students' interest in mathematics
No emphasis Mini-
mal Emphasis Mod-
erate Emphasis
Heavy Emphasis
Teaching students mathematical concepts
No emphasis Mini-
mal Emphasis Mod-
erate Emphasis
Heavy Emphasis
Teaching students mathematical algorithms or procedures
No emphasis Mini-
mal Emphasis Mod-
erate Emphasis
Heavy Emphasis
Developing students' computational skills
No emphasis Mini-
mal Emphasis Mod-
erate Emphasis
Heavy Emphasis
Developing students' problem solving skills
No emphasis Mini-
mal Emphasis Mod-
erate Emphasis
Heavy Emphasis
Teaching students to reason mathematically
No emphasis Mini-
mal Emphasis Mod-
erate Emphasis
Heavy Emphasis
Teaching students how mathematics ideas connect with one another
No emphasis Mini-
mal Emphasis Mod-
erate Emphasis
Heavy Emphasis
Preparing students for further study in mathematics
No emphasis Mini-
mal Emphasis Mod-
erate Emphasis
Heavy Emphasis
Teaching students the logical structure of mathematics
No emphasis Mini-
mal Emphasis Mod-
erate Emphasis
Heavy Emphasis
Teaching students about the history and nature of mathematics
No emphasis
Minimal Emphasis

Moderate Emphasis
Heavy Emphasis
Teaching students to explain ideas in mathematics effectively
No emphasis Mini-
mal Emphasis Mod-
erate Emphasis
Heavy Emphasis
Teaching students how to apply mathematics in business and industry
No emphasis Mini-
mal Emphasis Mod-
erate Emphasis
Heavy Emphasis
Teaching students to perform computations with speed and accuracy
No emphasis Mini-
mal Emphasis Mod-
erate Emphasis
Heavy Emphasis
Preparing students for standardized tests
No emphasis Mini-
mal Emphasis Mod-
erate Emphasis
Heavy Emphasis
~~~~~~

* To what extent do you agree or disagree with each of the following statements about how high school math teaching assignments are made at [your school]?
Advanced courses are assigned to teachers with the most seniority
Strongly agree
Agree
Disagree
Strongly disagree
Advanced courses are assigned to teachers with the strongest math background
Strongly agree
Agree
Disagree
Strongly disagree
All or most math teachers are assigned at least one section of advanced courses
Strongly agree
Agree
Disagree
Strongly disagree
Non-college prep courses are assigned to teachers new to the profession
Strongly agree
Agree
Disagree
Strongly disagree
Non-college prep courses are assigned to teachers whose students do not perform well on standardized tests
Strongly agree
~~~~~~

Agree
Disagree
Strongly disagree
All or most math teachers are assigned at least one section of a non-college prep course
Strongly agree
Agree
Disagree
Strongly disagree
~~~~~~

* How would you rate the following aspects of remedial help for students in [your school] who are struggling in Algebra I?
Availability of tutoring or other remedial assistance
Poor
Fair
Good
Excellent
Quality of tutoring or other remedial assistance
Poor
Fair
Good
Excellent
~~~~~~

* To what extent do you agree or disagree with each of the following statements about the math department at [your school]? Math teachers in this department...
share ideas on teaching.
Strongly agree
Agree
Disagree
Strongly disagree
discuss what was learned at a workshop or conference.
Strongly agree
Agree
Disagree
Strongly disagree
share and discuss student work.
Strongly agree
Agree
Disagree
Strongly disagree
discuss particular lessons that were not very successful.
Strongly agree
Agree
Disagree
Strongly disagree
discuss beliefs about teaching and learning.
Strongly agree
Agree
Disagree

Strongly disagree
share and discuss research on effective teaching methods.
Strongly agree
Agree
Disagree
Strongly disagree
share and discuss research on effective instructional practices for English language learners.
Strongly agree
Agree
Disagree
Strongly disagree
explore new teaching approaches for under-performing students.
Strongly agree
Agree
Disagree
Strongly disagree
make a conscious effort to coordinate the content of courses with other teachers in this school.
Strongly agree
Agree
Disagree
Strongly disagree
are effective at teaching students mathematics.
Strongly agree
Agree
Disagree
Strongly disagree
provide support to new mathematics teachers.
Strongly agree
Agree
Disagree
Strongly disagree
are supported and encouraged by the math department's chair or curricular area coordinator.
Strongly agree
Agree
Disagree
Strongly disagree
~~~~~~
~~~~~~

SECTION C: Science Department and Instruction

~~~~~~

* Now we have some questions regarding your science instruction and the science department at [your school].

~~~~~~

* Indicate the extent to which you agree or disagree with each of the following statements about high school science teachers at your school. High school teachers at your school...

set high standards for teaching.
Strongly agree
Agree
Disagree
Strongly disagree
set high standards for students' learning.
Strongly agree
Agree
Disagree
Strongly disagree
believe all students can do well.
Strongly agree
Agree
Disagree
Strongly disagree
make expectations for instructional goals clear to students.
Strongly agree
Agree
Disagree
Strongly disagree
have given up on some students.
Strongly agree
Agree
Disagree
Strongly disagree
care only about smart students.
Strongly agree
Agree
Disagree
Strongly disagree
expect very little from students.
Strongly agree
Agree
Disagree
Strongly disagree
work hard to make sure all students are learning.
Strongly agree
Agree
Disagree
Strongly disagree

~~~~~~

* The following questions are about the [fall 2009 science] course you are teaching.
[if web interview: We would like to standardize the various course titles we receive from schools into defined categories. This course may or may not exactly match one of these categories. Regardless, please indicate which of the following best categorizes this course.]
[if telephone interview: We would like to standardize the various course titles we receive from schools into defined categories. Please indicate which of the following best categorizes this course.]

General Science Life
Science Environmental
Science Earth Science
Other Earth or Environmental Science such as ecology, geology, oceanography, or meteorology
Physical Science without Earth Science
Physical Science with Earth Science
Other Physical Science such as astronomy or electronics
Principles of Technology
Anatomy or Physiology
Biology I
Advanced Biology such as Biology II, AP, or IB
Other Biological Science such as botany, marine biology, or zoology
Chemistry I
Advanced Chemistry such as Chemistry II, AP, or IB
Physics I
Advanced Physics such as Physics II, AP, or IB
Integrated Science I
Integrated Science II or above
Other science
Physical Science with Earth Science

~~~~~~

* Which of the following best describes the achievement level of students in [fall 2009 science course] compared with the average 9th grade student in this school?

Higher achievement levels
Average achievement levels
Lower achievement levels
Widely differing achievement levels

~~~~~~

* About what percentage of the students in [fall 2009 science course] are not adequately prepared to tackle the material you cover?

25% or less
26% to 50%
51% to 75%
More than 75%

~~~~~~

* Do you have students in your [fall 2009 science] course work in small groups?

Yes
Not currently, but you plan to at some point during this course
No

~~~~~~
~~~~~~

* Primarily, how do you [plan to] assign students to groups in [fall 2009 science course]?
Intentionally create groups so students will be of similar ability levels
Intentionally create groups so students will be of different ability levels
Create groups without regard to ability level such as alphabetically or randomly
Groups will be chosen by the students
~~~~~~

* Think about the full duration of this [fall 2009 science] course. How much emphasis are you placing on each of the following objectives?
Increasing students' interest in science
No emphasis
Minimal Emphasis
Moderate Emphasis
Heavy Emphasis
Teaching students basic science concepts
No emphasis
Minimal Emphasis
Moderate Emphasis
Heavy Emphasis
Teaching students important terms and facts of science
No emphasis
Minimal Emphasis
Moderate Emphasis
Heavy Emphasis
Teaching students science process or inquiry skills
No emphasis
Minimal Emphasis
Moderate Emphasis
Heavy Emphasis
Preparing students for further study in science
No emphasis
Minimal Emphasis
Moderate Emphasis
Heavy Emphasis
Teaching students to evaluate arguments based on scientific evidence
No emphasis
Minimal Emphasis
Moderate Emphasis
Heavy Emphasis
Teaching students how to communicate ideas in science effectively
No emphasis Mini-
mal Emphasis Mod-
erate Emphasis
Heavy Emphasis
Teaching students about the applications of science in business and industry
No emphasis Mini-
mal Emphasis Mod-
erate Emphasis
Heavy Emphasis
~~~~~~

Teaching students about the relationship between science, technology, and society
No emphasis Mini-
mal Emphasis Mod-
erate Emphasis
Heavy Emphasis
Teaching students about the history and nature of science
No emphasis Mini-
mal Emphasis Mod-
erate Emphasis
Heavy Emphasis
Preparing students for standardized tests
No emphasis Mini-
mal Emphasis Mod-
erate Emphasis
Heavy Emphasis
~~~~~~

* To what extent do you agree or disagree with each of the following statements about how high school science teaching assignments are made at [your school]?
Advanced courses are assigned to teachers with the most seniority
Strongly agree
Agree
Disagree
Strongly disagree
Advanced courses are assigned to teachers with the strongest science background
Strongly agree
Agree
Disagree
Strongly disagree
All or most science teachers are assigned at least one section of advanced courses
Strongly agree
Agree
Disagree
Strongly disagree
Non-college prep courses are assigned to teachers new to the profession
Strongly agree
Agree
Disagree
Strongly disagree
Non-college prep courses are assigned to teachers whose students do not perform well on standardized tests
Strongly agree
Agree
Disagree
Strongly disagree
All or most science teachers are assigned at least one section of a non-college prep course
Strongly agree
Agree
Disagree
~~~~~~

Strongly disagree

~~~~~~

* To what extent do you agree or disagree with each of the following statements about the science department at [your school]? Science teachers in this department...

share ideas on teaching.
Strongly agree
Agree
Disagree
Strongly disagree

discuss what was learned at a workshop or conference.
Strongly agree
Agree
Disagree
Strongly disagree

share and discuss student work.
Strongly agree
Agree
Disagree
Strongly disagree

discuss particular lessons that were not very successful.
Strongly agree
Agree
Disagree
Strongly disagree

discuss beliefs about teaching and learning.
Strongly agree
Agree
Disagree
Strongly disagree

share and discuss research on effective teaching methods.
Strongly agree
Agree
Disagree
Strongly disagree

share and discuss research on effective instructional practices for English language learners.
Strongly agree
Agree
Disagree
Strongly disagree

explore new teaching approaches for under-performing students.
Strongly agree
Agree
Disagree
Strongly disagree

make a conscious effort to coordinate the content of courses with other teachers in this school.
Strongly agree
Agree
Disagree
~~~~~~

Strongly disagree
are effective at teaching students in science.
Strongly agree
Agree
Disagree
Strongly disagree
provide support to new science teachers.
Strongly agree
Agree
Disagree
Strongly disagree
are supported and encouraged by the science department's chair or curricular area coordinator.
Strongly agree
Agree
Disagree
Strongly disagree
~~~~~~
~~~~~~

SECTION D: Beliefs About Teaching and Current School

~~~~~~

The questions in the final section are related to your beliefs about teaching and your opinions about [your school].

~~~~~~

In general, how would you compare males and females in each of the following subjects?

English or Language Arts Females are much better Females are somewhat better Females and males are the same Males are somewhat better Males are much better

Math

Females are much better Females are somewhat better Females and males are the same Males are somewhat better Males are much better

Science

Females are much better Females are somewhat better Females and males are the same Males are somewhat better Males are much better

~~~~~~ To what degree is each of the following matters a problem at [your school]?

Student tardiness Not a problem Minor problem Moderate problem Serious problem

Student absenteeism Not a problem Minor problem Moderate problem Serious problem

Student class cutting Not a problem Minor problem Moderate problem Serious problem

Teacher absenteeism Not a problem Minor problem Moderate problem Serious problem

Students dropping out
~~~~~~

Not a problem Minor problem Moderate problem Serious problem

Student apathy

Not a problem Minor problem Moderate problem Serious problem

Lack of parental involvement

Not a problem Minor problem Moderate problem Serious problem

Students come to school unprepared to learn

Not a problem Minor problem Moderate problem Serious problem

Poor student health

Not a problem Minor problem Moderate problem Serious problem

Lack of resources and materials for teachers

Not a problem Minor problem Moderate problem Serious problem

Student tardiness

Not a problem Minor problem Moderate problem Serious problem

Student absenteeism

Not a problem Minor problem Moderate problem Serious problem

Student class cutting

Not a problem Minor problem Moderate problem Serious problem

Teacher absenteeism Not a problem Minor problem Moderate problem

Serious problem
Students dropping out
Not a problem Mi-
nor problem Moder-
ate problem Serious
problem
Student apathy Not
a problem Minor
problem Moderate
problem Serious
problem
Lack of parental involvement
Not a problem Mi-
nor problem Moder-
ate problem Serious
problem
Students come to school unprepared to learn
Not a problem Mi-
nor problem Moder-
ate problem Serious
problem
Poor student health
Not a problem Mi-
nor problem Moder-
ate problem Serious
problem
Lack of resources and materials for teachers
Not a problem Mi-
nor problem Moder-
ate problem Serious
problem
~~~~~~

In your view, to what extent do the following limit how you teach?
Students with different academic abilities in the same class
Not applicable
Not at all
A little
Some
A lot
Students who come from a wide range of socio-economic backgrounds
Not applicable
Not at all
A little
Some
A lot
Students who come from a wide range of language backgrounds
Not applicable
Not at all
~~~~~~

A little
Some
A lot

Students with special needs such as hearing, vision, or speech impairments, physical disabilities, or mental, emotional, or psychological impairments

Not applicable
Not at all
A little
Some
A lot

Uninterested students

Not applicable
Not at all
A little
Some
A lot

Low morale among students

Not applicable
Not at all
A little
Some
A lot

Disruptive students

Not applicable
Not at all
A little
Some
A lot

Inadequate opportunities for professional learning

Not applicable
Not at all
A little
Some
A lot

Inadequate administrative support

Not applicable
Not at all
A little
Some
A lot

Students with different academic abilities in the same class

Not applicable
Not at all
A little
Some
A lot

Students who come from a wide range of socio-economic backgrounds

Not applicable

Not at all
A little
Some
A lot

Students who come from a wide range of language backgrounds
Not applicable
Not at all
A little
Some
A lot

Students with special needs such as hearing, vision, or speech impairments, physical disabilities, or mental, emotional, or psychological impairments
Not applicable
Not at all
A little
Some
A lot

Uninterested students
Not applicable
Not at all
A little
Some
A lot

Low morale among students
Not applicable
Not at all
A little
Some
A lot

Disruptive students
Not applicable
Not at all
A little
Some
A lot

Inadequate opportunities for professional learning
Not applicable
Not at all
A little
Some
A lot

Inadequate administrative support
Not applicable
Not at all
A little
Some
A lot

Shortage of computer hardware or software

- Not applicable
- Not at all
- A little
- Some
- A lot

Shortage of support for using computers
- Not applicable
- Not at all
- A little
- Some
- A lot

Shortage of textbooks for student use
- Not applicable
- Not at all
- A little
- Some
- A lot

Shortage of other instructional equipment for students' use
- Not applicable
- Not at all
- A little
- Some
- A lot

Shortage of equipment for your use in demonstrations and other exercises
- Not applicable
- Not at all
- A little
- Some
- A lot

Inadequate physical facilities
- Not applicable
- Not at all
- A little
- Some
- A lot

High student to teacher ratio
- Not applicable
- Not at all
- A little
- Some
- A lot

Lack of planning time
- Not applicable
- Not at all
- A little
- Some
- A lot

Lack of autonomy in instructional decisions

- Not applicable
- Not at all
- A little
- Some
- A lot

Lack of parent or family support
- Not applicable
- Not at all
- A little
- Some
- A lot

Shortage of computer hardware or software
- Not applicable
- Not at all
- A little
- Some
- A lot

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Lack of planning time
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A little
Some
A lot

Lack of autonomy in instructional decisions
Not applicable
Not at all
A little
Some
A lot

Lack of parent or family support
Not applicable
Not at all
A little
Some
A lot

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To what extent do you agree or disagree with each of the following statements as it applies to your instruction?

The amount a student can learn is primarily related to family background
Strongly agree
Agree
Disagree
Strongly disagree

If students are not disciplined at home, they are not likely to accept any discipline at school
Strongly agree
Agree
Disagree
Strongly disagree

You are very limited in what you can achieve because a student's home environment is a large influence on their achievement
Strongly agree
Agree
Disagree
Strongly disagree

If parents would do more for their children, you could do more for your students
Strongly agree
Agree
Disagree
Strongly disagree

If a student did not remember information you gave in a previous lesson, you would
~~~~~~

know how to increase their retention in the next lesson
Strongly agree
Agree
Disagree
Strongly disagree
If a student in your class becomes disruptive and noisy, you feel assured that you know some techniques to redirect them quickly
Strongly agree
Agree
Disagree
Strongly disagree
If you really try hard, you can get through to even the most difficult or unmotivated students
Strongly agree
Agree
Disagree
Strongly disagree
When it comes right down to it, you really cannot do much because most of a student's motivation and performance depends on their home environment
Strongly agree
Agree
Disagree
Strongly disagree
The amount a student can learn is primarily related to family background
Strongly agree
Agree
Disagree
Strongly disagree
If students are not disciplined at home, they are not likely to accept any discipline at school
Strongly agree
Agree
Disagree
Strongly disagree
You are very limited in what you can achieve because a student's home environment is a large influence on their achievement
Strongly agree
Agree
Disagree
Strongly disagree
If parents would do more for their children, you could do more for your students
Strongly agree
Agree
Disagree
Strongly disagree
If a student did not remember information you gave in a previous lesson, you would know how to increase their retention in the next lesson
Strongly agree
Agree
Disagree

Strongly disagree

If a student in your class becomes disruptive and noisy, you feel assured that you know some techniques to redirect them quickly

Strongly agree
Agree
Disagree
Strongly disagree

If you really try hard, you can get through to even the most difficult or unmotivated students

Strongly agree
Agree
Disagree
Strongly disagree

When it comes right down to it, you really can not do much because most of a student's motivation and performance depends on their home environment

Strongly agree
Agree
Disagree
Strongly disagree

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To what extent do you agree or disagree with each of the following statements about [your school]'s principal? The principal...

deals effectively with pressures from outside the school that might interfere with my teaching.

Strongly agree
Agree
Disagree
Strongly disagree

does a poor job of getting resources for this school.

Strongly agree
Agree
Disagree
Strongly disagree

sets priorities, makes plans, and sees that they are carried out.

Strongly agree
Agree
Disagree
Strongly disagree

knows what kind of school he or she wants and has communicated it to the staff.

Strongly agree
Agree
Disagree
Strongly disagree

lets staff members know what is expected of them.

Strongly agree
Agree
Disagree
Strongly disagree

is interested in innovation and new ideas.
~~~~~~

Strongly agree
Agree
Disagree
Strongly disagree
usually consults with staff members before he or she makes decisions that affect them.
Strongly agree
Agree
Disagree
Strongly disagree
deals effectively with pressures from outside the school that might interfere with my teaching.
Strongly agree
Agree
Disagree
Strongly disagree
does a poor job of getting resources for this school.
Strongly agree
Agree
Disagree
Strongly disagree
sets priorities, makes plans, and sees that they are carried out.
Strongly agree
Agree
Disagree
Strongly disagree
knows what kind of school he or she wants and has communicated it to the staff.
Strongly agree
Agree
Disagree
Strongly disagree
lets staff members know what is expected of them.
Strongly agree
Agree
Disagree
Strongly disagree
is interested in innovation and new ideas.
Strongly agree
Agree
Disagree
Strongly disagree
usually consults with staff members before he or she makes decisions that affect them.
Strongly agree
Agree
Disagree
Strongly disagree
~~~~~~

To what extent do you agree or disagree with each of the following statements about teachers at [your school]? Teachers at this school...

help maintain discipline in the entire school, not just in their classroom.
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Strongly agree
Agree
Disagree
Strongly disagree
take responsibility for improving the school.
Strongly agree
Agree
Disagree
Strongly disagree
set high standards for themselves.
Strongly agree
Agree
Disagree
Strongly disagree
feel responsible for helping students develop self-control.
Strongly agree
Agree
Disagree
Strongly disagree
feel responsible for helping each other do their best.
Strongly agree
Agree
Disagree
Strongly disagree
feel responsible that all students learn.
Strongly agree
Agree
Disagree
Strongly disagree
feel responsible when students in this school fail.
Strongly agree
Agree
Disagree
Strongly disagree
help maintain discipline in the entire school, not just in their classroom.
Strongly agree
Agree
Disagree
Strongly disagree
take responsibility for improving the school.
Strongly agree
Agree
Disagree
Strongly disagree
set high standards for themselves.
Strongly agree
Agree
Disagree

Strongly disagree
feel responsible for helping students develop self-control. Strongly agree
Agree
Disagree
Strongly disagree
feel responsible for helping each other do their best. Strongly agree
Agree
Disagree
Strongly disagree
feel responsible that all students learn. Strongly agree
Agree
Disagree
Strongly disagree
feel responsible when students in this school fail. Strongly agree
Agree
Disagree
Strongly disagree
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