PERCEIVED SELF-EFFICACY AND STUDENT-TEACHER RELATIONSHIPS AMONG DIVERSE TITLE I STUDENTS'ACHIEVEMENT IN SCIENCE

by

Triaka A. Larry

Liberty University

A Dissertation Presented in Partial Fulfillment

Of the Requirements for the Degree

Doctor of Education

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ABSTRACT

The need for more diversity in STEM-related careers and college majors is urgent. Self-efficacy and student-teacher relationships are factors that have been linked to influencing students' pursuit of subject-specific careers and academic achievement. The impact of self-efficacy and student perceptions of teacher interpersonal behaviors on student achievement have been extensively researched in the areas of Mathematics and English, however, most studies using science achievement, as a criterion variable, were conducted using non-diverse, White upper middle class to affluent participants. In order to determine the strength of relationships between perceived science self-efficacy, and student perceptions of teacher interpersonal behaviors as factors that influence science achievement (Science GPA), the Science Self-Efficacy Questionnaire (SSEQ) and Questionnaire on Teacher Interactions (QTI) were administered to twelfth grade students enrolled at a highly diverse urban Title I high school, while controlling for demographics, defined as gender, ethnicity, and minority status. Using a hierarchical multiple linear regression analysis, results demonstrated that the predictor variables (i.e., gender, ethnicity, minority status, science self-efficacy, and teacher interpersonal behaviors) accounted for 20.8% of the variance in science GPAs. Science self-efficacy made the strongest unique contribution to explaining science GPA, while minority status and gender were found to be statistically significant contributors to the full model as well. Ethnicity and teacher interpersonal behaviors did not make a statistically significant contribution to the variance in science GPA, and accounted for $\leq 1\%$ of the variance. Implications and recommendations for future research are subsequently given.

Keywords: self-efficacy, teacher interpersonal behaviors, science achievement, diverse Title I high school, STEM

Dedication

This body of work is dedicated to my Lord and Savior, Jesus Christ. He instilled in me the strength, courage, tenacity, wisdom, and alacrity to pursue one of my life long dreams of obtaining a doctoral degree. This process has shown me the depth of my inner strength and I am forever grateful. Jesus continues to show me his unconditional love and motivates me to live a purpose-driven life. Throughout this process I found peace in knowing that in Philippians 4:6-8 God stated, "Be anxious for nothing, but in everything by prayer and supplication, with thanksgiving, let your requests be made known to God; and the peace of God, which surpasses all understanding, will guard your hearts and minds through Christ Jesus."

Moreover, the enormous love I have for my three-year-old son, Jathan Josiah, has allowed me to be relentless in completing this study. My dissertation process began two months after he was born and I vowed that this body of work would be dedicated to him as well. I know at times I was mentally and emotionally absent from you throughout this process, however, I am so graciously thankful for you still loving me despite it all. My prayer is that when you get older you will understand the sacrifices I made to ensure you have a better life than mine, as well as, an exemplary role model at home first. I know that God gave me you, my perfect gift, to save me! I am thankful for this blessing.

Lastly, I cannot forget my loving, praying, supporting, and encouraging mother, Mary M. Byrd, and sisters, Ebony Jackson and Dorquisha Larry. I want you all to know that words cannot express the love and gratitude I have for you all. Thank you.

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List of Abbreviations

Adequately Yearly Progress (AYP)

American Community Survey (ACS)

College and Career Readiness Performance Index (CCRPI)

Every Student Succeeds Act (ESSA)

Grade Point Average (GPA)

Institutional Review Board (IRB)

Metacognition Awareness Inventory (MAI)

Model for Teacher Interpersonal Behaviors (MTIB)

Motivated Strategies for Learning Questionnaire (MSLQ)

Multivariate analysis of variance (MANOVA)

National Assessment of Educational Progress (NAEP)

National Center for Education Statistics (NCES)

No Child Left Behind Act (NCLB)

Questionnaire for Teacher Interactions (QTI)

Science Self-Efficacy Questionnaire (SSEQ)

Socioeconomic Status (SES)

Science, Technology, Engineering, and Mathematics (STEM)

Statistical Package for the Social Sciences (SPSS)

Student Identification Number (SIN)

Variable Inflation Factor (VIF)

CHAPTER ONE: INTRODUCTION

Overview

This chapter will provide information on the investigation of science self-efficacy and student perception of teacher interpersonal behaviors as it relates to positive learning outcomes in science achievement. Current literature will be reviewed and gaps in literature will be examined that will lead to the statement of the problem, purpose, and the significance of the study. Also, research questions and hypotheses will be stated, independent and dependent variables will be identified, and a list of definitions relevant to this study will be provided.

Background

A continuous issue in the educational system of the of the United States is the closing of achievement gaps among minorities including: Blacks, Hispanics, and other subgroups, such as students with exceptionalities and special needs, as well as the gap within gender differences and among varying levels of socioeconomic status (SES) (Kennedy, 2010). Achievement gaps are seen specifically in grade levels, end-of-course grades, and standardized assessment scores. In addition, the gaps have affected high school drop-out rates, higher level course selections, and overall college-completion rates between subgroups (Hemphill & Vanneman, 2011; Vanneman, Hamilton, Anderson, & Rahman, 2009). Despite the gaps, results from the National Assessment of Educational Progress (NAEP) show great strides being accomplished by Black Americans and Hispanics, specifically showing improvements in mathematics and reading across the nation (Hemphill & Vanneman, 2011). Minority groups are steadily improving; however they continue to lag behind, compared to other subgroups, in SAT/ACT scores, high school and college graduation rates, choosing to enroll in more rigorous courses, and majoring in STEM-related career fields (Quinn & Cooc, 2015). Recent data show small gains since the implementation of

the reform effort, No Child Left Behind Act (No Child Left Behind Act of 2001, 2002). However, academic achievement gaps between minorities and their White constituents continue to grow (Santau, Maerten-Rivera, & Huggins, 2011), especially in the areas of science, technology, engineering, and math (STEM) (Mustaq, 2012).

In recent years, there has been much attention on improving U.S. student's math and science performance. Due to math and science abilities being influential in student's interests and self-efficacy in later years, this has also influenced student's interests in careers associated with STEM (Palmer, Maramba, & Gasman, 2013; Wilson, Bates, Scott, Painter, & Shaffer, 2015). Self-efficacy can be defined as a student's level of confidence to succeed or accomplish a task (Bandura, 1997). Deficiencies in science ability among children within their early educational years can prematurely have students exclude themselves from STEM-related careers and post-secondary options based upon fear of failure, low self-efficacy beliefs, or non-interest (Palmer et al., 2013; Zayas & Mcguigan, 2006). The lack of student participation and interest in STEM courses and careers in the United States is vastly growing (MacPhee, Farro & Canetto, 2013; Palmer et al., 2013). In addition, the concern for deficiencies in academic achievement among underrepresented groups in science has caused nation to take drastic measures to increase global competitiveness and ensure leadership in science and technology (MacPhee et al., 2013). Therefore, within the NCLB educational reform policy, one goal established by President George W. Bush was to improve K-12 math and science performances, as well as instructional strategies (No Child Left Behind Act of 2001, 2002).

Across the United States, gaps in achievement and performance are continuously being addressed at the local, state, and federal level, increasing the strict accountability of schools to ensure closures in gaps, as mandated by the No Child Left Behind Act of 2001 (NCLB). NCLB

encouraged school systems that all students would "learn and excel-regardless of race, family-background, or income" (NCLB, 2003, p. 2) and be on grade level in reading and math by 2014. Specifically, the reform policy was designed to address the issue of low academic performance among the poor and minimize the achievement gaps between the wealthy and economically disadvantaged students as well as among ethnicities (Hemphill & Vanneman, 2011; Synder & Dillow, 2010; Vanneman et al., 2009). Recently, President Barack Obama signed legislation on December 10, 2015 to replace NCLB with the Every Student Succeeds Act (ESSA), which is a bipartisan measure consenting to reactivate the Elementary and Secondary Education Act (ESEA), a national educational law that was previously implemented before NCLB. ESEA has shown to be committed to equal opportunity for all students regardless of race, ethnicity, and economic status (Every Student Succeeds Act of 2015, 2015-2016). Despite new legislation, gaps in achievement are still prevalent across the country and need attention.

In an effort to narrow the achievement gap among ethnic subgroups, NCLB (No Child Left Behind Act of 2001, 2002) implemented an accountability system in order for teachers to foster academic growth and development for students through the creation of well-articulated curriculum and instruction with meaningful assessment systems (No Child Left Behind Act of 2001, 2002; Santau et al., 2011). Teacher accountability has become one of many factors believed to be influential in improving student learning outcomes, while closing achievement gaps. The accountability of teachers has ranked at the top of the priority agenda for state officials, second to school finance (DiPrete & Buchmann, 2013; Howard, 2015; Lewis, 2004). As a solution to improving low-achieving schools and close achievement gaps among various subgroups, teacher merit pay or performance pay systems were introduced as an incentive to improving student achievement through the use of measurable factors, such as standardized test

scores, student growth, or overall teacher evaluation scores (Aud et al., 2010). Due to the new accountability system, many states, such as Texas, Georgia, Colorado, and New York have implemented the use of merit pay to motivate teachers to improve student achievement (Every Student Succeeds Act of 2015, 2015-2016). In recent years, the state of Georgia implemented merit pay based on a student's academic achievement on standardized assessments, as opposed to using a teacher's years of experience and degrees held, like other surrounding states (Balch & Springer, 2015). The accountability system would require the outcome of student scores on state standardized assessments be linked to teachers' yearly evaluations in over 26 Georgia school districts beginning in 2012, which will determine salaries and bonuses (Anderson, 2012). Despite the implementation of NCLB (No Child Left Behind Act of 2001, 2002) and the recent incentives including merit pay and achievement bonuses to aid in teacher accountability, no major gains in closing the achievement gaps between these subgroups have been verified (Howard, 2015).

Due to persistent moves toward closing achievement gaps, the federal government has given flexibility to each state to design innovative strategies, promote successful accountability, and make certain that all students stay on track for graduation (NCLB, 2003). To ensure that states were improving, NCLB mandated a school and district evaluation system to measure adequate yearly progress, specifically, student achievement and growth across subgroups on state standardized assessments and other factors such as attendance, graduation rates, and advanced course enrollment (No Child Left Behind Act of 2001, 2002). Furthermore, NCLB (No Child Left Behind Act of 2001, 2002) required states to make comprehensive adequate yearly progress in raising the percentage of students proficient in the areas of reading and mathematics and in tightening the assessment-score gap between advantaged and disadvantaged students, which

specifically affected minorities from low socioeconomic areas (Santau et al., 2011). Defined by NCLB, adequate yearly progress is a measurement of students' year-to-year academic achievement and progress on state standardized assessments in every public school and school district (Every Child Succeeds Act of 2015, 2015-2016). Increased accountability among districts and teachers to ensure student success on standardized assessments and overall academic achievement and growth has created increased stress and anxiety (Jensen, 2009). Since the passing of NCLB (No Child Left Behind Act of 2001, 2002), significant flaws within the law have become apparent; therefore, in an effort to continue reforming the public education system, the passing of Every Student Succeeds Act (ESSA), under the administration of President Obama, has addressed change and accountability, by eliminating the overuse of standardized testing and a one-size-fits-all model for schools, as well as, ensuring all students are prepared for postsecondary options and have access to education at an early age (U.S. Department of Education, 2015; Every Child Succeeds Act of 2015, 2015-2016). Next, ESSA can be a change which could be encouraging to public school districts across the country; however, additional efforts will continue to be needed to close the achievement gaps among economically diverse populations, specifically in urban school districts.

Within the past 10 years, various studies have shown that NCLB may have not taken into consideration other factors that can influence a student's growth and academic achievement (Montalvo, Mansfield, & Miller, 2007; Murray & Malmgren, 2005; Pianta & Stuhlman, 2004; Wu, Hughes, & Kwok, 2010). Race and ethnic disparities, socio-cultural differences, social and mental disadvantages, and socioeconomics are all factors that can directly affect a student's ability to successfully achieve (Wu et al., 2010). Additional environmental factors, including school resources and accessibilities, school culture and climate, student self-efficacy and their

relationship with teachers, can positively or negatively impact learning outcomes (Pianta, 1999; Eccles, 2002; Wu et al., 2010). The factors above continue to plague urban school districts across the country serving low socioeconomically disadvantaged populations (Evan & Rosenbaum, 2008; Quinn & Cooc, 2015). However, this particular study will focus on current research that has linked student-teacher interpersonal relationships to a student's academic self-efficacy and achievement, specifically in STEM-education. Interpersonal relationships refers to the interactions and behaviors between persons encountered (den Brok, Levy, Brekelmans, Wubbels, 2005), and self-efficacy is the "belief in one's capabilities to organize and execute courses of action required to produce given attainments" (Bandura, 1997, p.3), specifically, a person's self-confidence. Furthermore, current scientific research is aiming to determine the root causes and factors of underperformances among various ethnic populations, and consequent professional underrepresentation of minorities in science; specifically in STEM-related career field.

Despite reform efforts, minority students, specifically African Americans and Hispanics, from low-socioeconomic backgrounds consistently score lower on state standardized assessments, compared to other ethnic groups, causing substantial academic gaps between minorities and their White constituents affecting many urban school districts (Evan & Rosenbaum, 2008; Jensen, 2009; Mustaq, 2012). Low performance on these assessments can greatly impact a school district's adequate yearly progress based upon the requirements of NCLB (No Child Left Behind Act of 2001, 2002) as well as teacher yearly evaluations. Moreover, Lipina and Colombo (2009) concluded in their studies that students from low SES backgrounds tend to exhibit lower task persistence, lack self-regulatory habits, and possess lower academic engagement as well as poor study habits, all of which are factors that can contribute to low

academic achievement and performance. Lower task persistence and lack of self-regulation refers to the ability to easily lack attention, determination, and consistency on tasks, as well as, lack the ability to control thoughts, emotions, and behaviors, respectively (Drake, Belsky, & Fearon, 2014). Low performing students often exhibit low self-efficacy, task persistence and self-regulatory habits within their weaker subjects (Evan & Rosenbaum, 2008). This has been evident in subject areas such as language arts, science, and math (Halle, Hair, Wandner, McNamara, & Bosse, 2012; Kieffer 2011). Low levels of self-efficacy can lead to lack of motivation, off-task behaviors, and the likelihood of falling behind in science related courses as they progress through school and into higher education (Drake et al., 2014; Ruby, 2006). Self-efficacy and the influence of teacher-student relationships on academic growth and performance as well as motivation and engagement have become areas of interest to assist students and help close achievement gaps among American students.

A student's perception of teacher interpersonal behaviors and their own perceived confidence levels, such as self-efficacy, on academic achievement, are two factors that have become a main focus in educational research studies in recent years. Teacher interpersonal behaviors are the personal affective behaviors that specifically relate to how teachers interact with their students. These interactive behaviors are usually described in terms of dimensions of teacher proximity to students (cooperative behaviors vs. oppositional behaviors) and their influence (dominance vs. submission) (Leary, 1957; Wubbels & Brekelmans, 2005). The relationship between students and their teachers can affect the willingness to learn and thrive, which may affect their self-efficacy beliefs (Britner & Pajares, 2006).

Some recent studies found that there is a positive correlation between school culture and teacher-peer relationships to positively impacting learning outcomes (Divoll, 2010; Palmer et al.,

2013; Sands, 2011; Wilkins, 2006). Therefore, establishing high expectations and building a strong sense of community and belonging can foster positive relationships between students and their teachers, which can positively affect school culture (Blankstein, Cole, & Houston, 2007; Divoll, 2010). In the study conducted by Blankstein et al. (2007), researchers suggested that the key to having a successful school or organization with high expectations and academic achievement is to build strong and positive relationships between students and teachers. Also, they concluded that an effective teacher demonstrates the ability to not only deliver meaningful content and curriculum but must be able to meet the needs of all students, despite their individual differences (Blankstein et al., 2007). The building of strong student-teacher relationships can motivate learning and influence positive outcomes as well as foster a sense of belonging, build self-confidence, and create an atmosphere of high expectations and accountability among students (Buyse, Verschueren, Verachtert, & Damme, 2009; Divoll, 2010; Pianta & Stuhlman, 2004; Sands, 2011). Additionally, many current studies on student perceptions of teacher interpersonal behaviors and self-efficacy are limited to specific subject areas that are used to measure student growth and a school's adequately yearly progress, such as reading and mathematics. Using only reading and mathematics as a basis to determine academic achievement limits equitable data and does not fully show a student's overall achievement in all subject area, specifically in the area of science. Further studies are warranted to address this issue as well as focus additional attention on factors that can increase minority participation and academic achievement in STEM-related courses and careers.

Problem Statement

Over the past few decades, there are many studies that have been conducted on the investigation of self-efficacy and student-teacher relationship, as these elements affect student

achievement in non-science related areas, but not many studies have been conducted in science-related or STEM subject areas. Studies that have investigated self-efficacy and student-teacher relationships within the area of science and STEM mainly used elementary students as participants (Hallinan, 2008; Jerome, Hamre, & Pianta, 2009), but little literature exists on the utilization of participants within secondary school settings, especially high school students (Jerome et al., 2009; Opdenakker, Maulana, & den Brok, 2012). Studies using high school student participants did associate positive student-teacher relationships with positive student learning and social outcomes, however, many of the studies are outdated and are not specific to science achievement (Alexander, Entwisle, & Horset, 1997; Kıran & Sungur, 2012; Klem & Connell, 2004; Miller, 2006). Also, studies that utilized high school students in their investigation were conducted mostly within non-diverse White middle class to very affluent populations, with little to no disadvantaged participants, specifically, students with exceptionalities and special needs, including non-native English speakers and students from urban, low socioeconomically disadvantaged, or highly ethnically diverse populations.

The impact of a student's self-efficacy has been found to be "a strong predictor of academic achievement, course selection, and career decisions across domains and age levels" (Pajares, 2008, p. 63). Due to increased minority underrepresentation in STEM-related careers compared to Whites in recent years (Estrada et al., 2016; Landivar, 2013; Mustaq, 2012), further investigation into a student's self-efficacy and student perceptions of teacher interpersonal behaviors, specifically in the area of science education, is warranted. Therefore, this study will examine the relationship between perceived science self-efficacy and student perceptions of teacher interpersonal behaviors. The problem examined in this study is the lack of literature that investigates the influence of students' perceived science self-efficacy and the perceptions of their

science teacher's interpersonal behaviors as factors that can impact achievement in science as well as provide additional insight into strategies to close academic achievement gaps among various subgroups. Therefore, this study will seek to determine a relationship between perceived science self-efficacy and student perceptions of teacher interpersonal behaviors as factors that can impact science achievement of 12th grade students in a highly-diverse, Title I high school.

Purpose Statement

The purpose of this non-experimental predictive correlational study will be to investigate the impact of students' perceived science self-efficacy and perceptions of teacher interpersonal behaviors as factors that influence science achievement in a diverse Title I high school, while controlling for gender, ethnicity, and minority status. Bandura's (1977, 1986) self-efficacy and social cognitive theory, Ainsworth's (1982) attachment theory, and the conceptual model of teacher interpersonal behaviors (Wubbels & Brekelmans, 2005) will form the theoretical frameworks for this study. Student perception of teacher interpersonal behaviors and perceived science self-efficacy will be predictor variables of interest, while science achievement, measured using students' overall science GPA, will be the criterion variable. Student perception of teacher interpersonal behaviors which is defined by Fouts and Poulsen (2001) as the emotional connectedness between the internal states of two people that come together and match, will be measured by Questionnaire for Teacher Interactions (QTI). Teaching is minimally an emotional activity, but involves the connection and relationship between teacher and student as well as positively influencing students' desire to learn (Fouts & Poulsen, 2001). The presence of warmth, closeness, and positivity are associated with positive student-teacher relationships (Hamre & Pianta, 2001). Specifically, the student's perception of teacher interpersonal behavior questionnaire scores, from the Questionnaire for Teacher Interaction (Wubbels, 1993), will serve

as the predictor variable. The subscales include leadership, helpful/friendly, understanding, student freedom, uncertainty, dissatisfied, admonishing and strictness.

Perceived science self-efficacy will be a predictor variable in this investigation as well. According to Bandura (1986), self-efficacy is composed of four main sources which are verbal persuasions, emotional arousal, vicarious experiences, and mastery experience. The sources of self-efficacy can influence a person's willingness to make choices and engage in activities that they believe will generate desired results (Kiran & Sungur, 2012). In this study, self-efficacy in science will be measured using Smist's (1993) Science Self-Efficacy Questionnaire (SSEQ). This questionnaire has been tested to confirm validity and reliability (Miller, 2006; Smist, 1993; Zimmerman, 1992). Validity and reliability statistics for each questionnaire used in this study will be further discussed in Chapter Three.

Science achievement is defined as "something that is accomplished or attained, particularly by great effort, superior ability, courage or special skills" in the area of science (Flanagan, Ortiz, Alfonso, & Dynda, 2006). Additionally, science achievement will be the criterion variable in this study and will be measured using the student's overall science GPA, specifically, using grades from participants' previously taken biology, physical science or physics, and chemistry courses. Previous studies have used overall GPAs and participants' subject area GPAs, for example, science GPAs, reading GPAs, and math GPAs, as a variable to measure academic achievement (Becker & Gable, 2009a; Britner & Pajares, 2006, Nugent, 2009; Smist, 1993; Taylor et al., 2014). Therefore, the findings from this study may give insight into how to purposely target strategies that can close achievement gaps among all subgroups, especially students in socioeconomically disadvantaged areas. In addition, this study can

possibly provide solutions and shed light into the significant lack of minorities entering science-related fields and majoring in STEM as postsecondary options.

Significance of the Study

The significance of this study is to add to the current body of knowledge regarding the predictive relationship between student perceived science self-efficacy and perceptions of teacher interpersonal behaviors as factors that influence science achievement, specifically a student's science GPA. Self-efficacy and perception of teacher interpersonal behaviors have been rarely studied concurrently in the area science education, compared to research conducted in the areas of mathematics and English (Hallinan, 2008; Jerome et al., 2009; Usher & Pajares, 2006; Wentzel, 1998; Wu et al., 2010). Current studies have investigated self-efficacy and student-teacher interactions independently as factors that influence academic achievement in science. A combination of factors, such as socioeconomic and ethnic background as well as motivation and self-concept, can contribute to student's learning outcomes and academic achievement as well. Students' self-efficacy can be influenced by interpersonal relationships with teachers, thus positively or negatively impacting a student's motivation to learn and perform in class (MacPhee et al., 2013). Furthermore, due to the lack of diversity within STEM professions as well as the lack of minorities pursing science-related degrees (Duran & Lopez, 2014; Estrada et al., 2016; Landivar, 2013), it is imperative that studies be conducted to investigate these factors, and give insight into this deficiency in science education (Wang, 2013; Armstrong & Jovanovic, 2015).

This study will examine the predictive relationship between students' demographics, defined as, gender, ethnicity, and minority status; students' perceptions of teacher interpersonal behaviors; perceived science self-efficacy; and science GPAs of students in an ethnically diverse

Title I high school. With the issue of global competitiveness and continuous gaps in academic achievement among ethnic subgroups throughout the nation, as well as the continued efforts for educational reform (U.S. Department of Education, 2011; Every Students Succeeds Act of 2015, 2015-2016), this study can add to the body of knowledge additional factors that can impact student growth and achievement, which can aid educators in finding innovative programs and resources to close these gaps, especially in the areas of science education and STEM. The findings from this study can also assist educators in understanding the importance of student self-efficacy and students' perceptions of teacher interpersonal behaviors, which can have a significant and lasting impact on students' academic achievement and interests in STEM or other science-related fields. Moreover, with the identification of specific factors that impact student choices, motivation, and achievement, teacher preparedness and efficacy can be evaluated to create professional development programs in the area of STEM and additional resources to ensure the success of all students at all grade levels and ensure success of all students, regardless of ethnic and socioeconomic backgrounds.

Research Question

The following research question will guide this non-experimental predictive correlational study:

RQ1: Is there a predictive relationship between student demographics, perceptions of teacher interpersonal behaviors, as measured by the Wubbels (1993) Questionnaire for Teacher Interaction, and science self-efficacy, as measured by the Smist (1993) Science Self-Efficacy Questionnaire, and science GPAs?

Definitions

1. *Attachment theory* - Attachment theory is the interpersonal relationship and bond between people, which has been stated to be a “lasting psychological connectedness between human beings" (Ainsworth, 1982, p. 4).
2. *Ethnicity* - Ethnicity is the affiliation or association with a particular group based upon ancestral, social, or cultural experience (Healey & O’Brien, 2014)
3. *Grade point average* - Grade point average is the calculation of the participants accumulated final grades in their science classes and divided by the number of grades awarded (Abbott, 2014).
4. *Mastery experience* - Mastery experience is a source of self-efficacy, in which successfully completing a task leads to greater feeling of self-efficacy (Bandura, 1977).
5. *Model of interpersonal teacher behaviors* - the model of interpersonal teacher behaviors is a conceptual model based upon the works of the Leary Model of proximity and influence, which explain human interactions, specifically, student perceptions of teacher interpersonal behaviors (Wubbels & Brekelsman, 2005).
6. *Motivation* - Motivation is “An internal state or condition (sometimes described as a need, desire, or want) that serves to activate or energize behavior and give it direction” in social science (Huitt, 2011, p. 19).
7. *Non-cognitive attributes* - Non-cognitive attributes are “the academically and occupationally relevant skills and traits that are not specifically intellectual or analytical in nature” (Rosen et al., 2010, p. 76).

8. *Physiological state* - Physiological state is a source of self-efficacy in which mood, stress, emotions and physical reaction can influence a person's level of self-efficacy (Bandura, 1977).
9. *Race* - Race is a group of people from common biological ancestry (Singleton, 2014)
10. *Questionnaire for Teacher Interaction Survey* - The questionnaire for teacher interaction survey is the measurement of teacher interpersonal interactions and behaviors (Wubbels, 1993).
11. *Science achievement* - Science achievement is "something that is accomplished or attained, particularly by great effort, superior ability, courage or special skills" in the area of science (Flanagan et al., 2006).
12. *Science Self-Efficacy Questionnaire* - The science self-efficacy questionnaire is the "measure of beliefs about competence in school science tasks" (Smist, 1993, p. 23).
13. *Self-efficacy* - Self-efficacy is the "belief in one's capabilities to organize and execute courses of action required to produce given attainments" (Bandura, 1997, p. 3).
14. *Self-regulation* - Self-regulation is the ability to influence one's own "motivation, thought processes, emotional states and patterns of behavior" (Bandura, 1997, p. 7).
15. *Social cognitive theory* – Social cognitive theory is the ideologies of Bandura in which he stated that "people learn behaviors through their interactions and observations of others through [cognitive processes], as well as their direct experience" (Bandura, 1977, p. 14).
16. *Social persuasion* – Social persuasion is the source of self-efficacy in which other people's encouragement influence your ability to believe you can complete a task (Bandura, 1977).

17. *Science, technology, engineering, and mathematics (STEM)* - STEM is the coupling of rigorous academic concepts with real-world lessons as it applies to science, technology, engineering, and mathematics in a context that makes connections between home, school, the community, and global enterprises to increase literacy and compete in the new economics (Tsupros, 2009).
18. *Student-teacher relationships* - Student-teacher relationships are attunement; an emotional connectedness in which the internal states of two people come together and match (Fouts & Poulsen, 2001), specifically in this study, between teacher and student only.
19. *Teacher interpersonal interactions/behaviors* - Teacher interpersonal interactions/behaviors are the personal, affective behaviors that specifically relate to how teachers interact with their students. These interactive behaviors are usually described in terms of dimensions of teacher proximity to students (cooperative behaviors vs. oppositional behaviors) and their influence (dominance vs. submission) (Leary, 1957; Wubbels & Brekelmans, 2005).
20. *Vicarious experience* - A vicarious experience is a source of self-efficacy in which through the observation and successful imitation of another person performance on a task, influences your self-confidence to complete the same task (Bandura, 1977).

CHAPTER TWO: REVIEW OF LITERATURE

Overview

This chapter will thoroughly examine the conceptual and theoretical frameworks as well as various research studies and published articles to further support the need for this quantitative study. The significance of a literature review is to identify new areas of inquiry by avoiding ineffective approaches, delineate the research problem, explore methodological designs, provide suggestions for future research, and may seek support for grounded theories (Gall, Gall & Borg, 2007). Therefore, from the examinations of literature, a better understanding of student-teacher relationships, self-efficacy, ethnicity, and achievement gaps will be developed to further support the purpose of this study.

The gap in academic achievement among gender and ethnicity, especially in the areas of science, technology and engineering, is steadily growing at an enormous rate (Ingels, Pratt, Herget, Burns, ... & Leinwand, 2011). There has been a decline over the years in the number of science classes high school students are willing to take, specifically advanced science courses (Amelink, 2009). Recently, the emphasis on increasing the amount of students to take higher-level science courses and promoting higher science achievement is ongoing (Atkinson, 2012). Science researchers and educators have examined a variety of factors that may influence academic choices and student performances (Britner & Pajares, 2006; Farooq et al., 2011; Mustaq, 2012; Mlambo, 2011). The most powerful influence is the confidence and belief in how a student approaches science, or their science self-efficacy (Bandura, 1997; Britner & Pajares, 2001). "Students who believe they can succeed academically tend to show greater interest in academic work, set higher goals, put forth greater effort, and show more resilience when they encounter difficulties" (Usher & Pajares, 2006, p. 126). Furthermore, motivational levels and a

student's self-efficacy beliefs have been linked to positively contributing to increased student achievement (Galyon, Blondin, Yaw, Nalls, & Williams, 2012).

There is also significant evidence suggesting that student-teacher relationships is another promising factor that positively influence academic achievement and the interest to learn (Baker, Grant & Morlock, 2008; O'Connor, Dearing, & Collins, 2011; Silver, Measelle, Armstrong, & Essex, 2005; Wubbels & Brekelmans, 2005; Zimmerman; 1992). The ability for teachers to create a positive learning environment that support student growth, motivation, and achievement, which is conducive for learning is imperative in fostering student self-efficacy and motivation (Chemers, Zurbriggen, Syed, Goza, & Bearman, 2011; Khan; 2013), as well as positively impacting learning outcomes (Khan, 2013; Mustaq, 2012; Niebuhr & Neibuhr, 1999; Pianta, 1999).

There is a gap in the literature on self-efficacy beliefs and student-teacher relationships as a cohesive factor contributing to academic achievement in science among students in culturally diverse high schools (Andrew, 1998; Durik, Vida, & Eccles, 2006; Motlagh et al., 2011; Taylor et al., 2014). Various outside influences such as low socioeconomic disadvantages, parent's educational level, reading and math deficiencies as well as social and cultural differences can affect student learning outcomes (Britner & Pajares, 2006; Mustaq & Khan, 2012; Mlambo, 2011). Also, despite previous research studies on science self-efficacy and student's perceptions of teacher interpersonal behaviors as predictors of influencing academic achievement, there has been a lack of recent studies that have been conducted using participants from more diverse populations and addressing the issues of ethnicity, specifically, the lack of minorities, among STEM occupations; therefore, this warrants the need for this study.

Furthermore, this review of literature will examine the theoretical frameworks of Bandura's (1977, 1986) self-efficacy and social cognitive theory, Ainsworth's (1982) attachment theory (1982), and the conceptual model of teacher interpersonal behaviors (Wubbels & Brekelmans, 2005), and other research studies related to student-teacher relationships and science self-efficacy as it relates to academic achievement in science.

Theoretical Framework

In this section, the theoretical frameworks for this study will be examined. Self-efficacy will be examined as it is rooted in the social cognitive theory (Bandura, 1977, 1986). The attachment theory (Ainsworth, 1982) and student-teacher relationships, specifically, in regards to teacher interpersonal behaviors (Wubbels & Brekelsman, 2005) will also be examined as they correlate to science achievement, gender and ethnic differences.

Social Cognitive Theory

The ideology that human behavior is significantly motivated and regulated by the continuing exercise of self-influence and observation is the premise of the Bandura's social cognitive theory (Bandura, 1997, 1986). Furthermore, it has been defined as "a general theory of human behavior stipulating that people are active agents in their own lives as they generate thoughts, feelings, and behaviors" (Martin & Kulinna, 2005, p. 266). This theory has three components that shapes its perspective. The environment, people, and behavior are factors that have contributed to the link between behaviorism and other cognitive theories of learning (Bandura, 1986, 2011; Arievitch & Haenen, 2005). The foundational principles of this theory focused on the idea that students learned through interactions with their teacher by observing, modeling and being motivated within a positive social environment (Bandura 1986, 2011). Bandura (1986) further stated "what people think, believe, and feel affects how they behave" (p.

25), which guided his theory. Based upon this, studies have concluded that a socially interdependent environment has proven to have a positive impact on student's ability to learn during social interactions, in turn, supporting increased learning outcomes and fostering the motivation to learn (Bandura, 1986, 1989, 2011; Pajares, 1996; Pintrich, Marx, & Boyle, 1993).

Furthermore, the social cognitive theory has five major concepts that guides its framework: observational learning, self-regulation, outcome expectation, goal setting and self-efficacy. The first is vicarious learning, or in other words observational learning, which is the ability to learn through mimicking or watching behaviors within a person's surrounding milieu. Observational learning is dependent upon the ability to be attentive, productive, motivated and retentive (Anderman & Patrick, 2012). To be able to learn through mimicry and observation, students must be attentive. Students should be able to reproduce what is expected of learning to show mastery and show growth. Retentiveness is also necessary to ensure that what students are learning through observation is stored and able to be applied in the future. To achieve all of the above, students must be motivated as well.

Self-regulation is another concept in which the social cognitive theory views as the ability of a person to be able to "monitor their behaviors and outcomes" (Anderman et al., 2009, p. 836). Students have to be able to not only be observant, but must be self-motivated and confident enough to set goals and achieve them. Bandura (1991) further stated that self-regulation is a major causative factor in a person's "purposeful actions" which is regulated by forethought. Bandura (1991) also added that

> People form beliefs about what they can do, they anticipate the likely consequences of prospective actions, they set goals for themselves, and they otherwise plan courses of action that are likely to produce desired outcomes. Through exercise of forethought,

people motivate themselves and guide their actions in an anticipatory proactive way. (p. 248).

Outcome expectations, the third concept of this theory, is the belief of what will happen if a particular behavior is performed and can determine a person's decisions and actions (Anderman et al., 2009). Through observation and past experiences, a person is able to make a cognizant decision on whether to action upon certain behaviors or suppress them in order to receive a desired response. Specifically, a person can act upon behaviors that may yield a positive or negative outcome based upon their wants or expected outcome. If students observe positive behaviors which may or may not be rewarded, most likely students will reciprocate these desired behaviors, which can influence learning outcomes (Bandura, 2011; Mustaq & Khan, 2012). With the ability to determine one's expected outcome, goal setting will be another concept that can be necessary to achieve these desires. Within the context of the social cognitive theory, one's internal expectations for a preferred outcome is a goal, which is reflected through the idea that "people not only learn, they use forethought to envision the future, identify desired outcomes, and generate plans of action" (Anderman & Patrick, 2012, p. 834). This can be directly related to what a person's expected outcome will be, or in other words, their level of self-efficacy.

Current focus on conceptual change, as an effort to reform science education, is ongoing with specific interest in the areas of science, inquiry learning, cognitive skills, and constructivism (Finn et al., 2014; U.S Department of Education, National Center for Education Statistics, 2010). Previously, researchers have criticized the cognitive basis of scientific thinking and learning through reasoning and practice as mechanism in impacting science instruction and achievement, specifically, how the practice of analogies, visual representation and experimenting are

"revolutionary" conceptual changes across the sciences (Duschl & Grandy, 2013; Lehrer & Schauble, 2015). However, continued research of motivational and contextual factors, along with social cognitive theory, will affect conceptual change in science instruction and can positively impact achievement (Carlson & Wiedl, 2013; Franco et al., 2012; Sinatra, Kienhues, & Hofer, 2014). In other words, there are various factors, such as motivation, outside environmental factors, economics, self-efficacy, epistemic climate, social interactions, expectancy and inquiry that have contributed to social and cognitive learning (Eccles & Wigfield, 2002; Rosenthal & Zimmerman, 2014). The conceptual models of Bandura's (1977, 1986) social cognitive theory and self-efficacy, which are part of the theoretical framework in this study, both contribute to current understanding of factors that can influence student achievement and improve science education.

Self-Efficacy

The social cognitive theory is able to explain the significance of interpersonal relationships as a factor in influencing learning outcomes and motivation. In addition to this theory, Bandura developed the theory of self-efficacy as an important factor in an individual's ability to learn. The construct of Bandura's (1977, 1986) self-efficacy theory is rooted in the social cognitive theory. Self-efficacy is defined as "people's judgments of their capabilities to organize and execute courses of action required to attain designated types of performances" (Bandura, 1986, p. 391). Self-efficacy beliefs impact people's thoughts and actions, as well as how much effort a person will expend and how long they will endure in the face of adversity (Bandura, 1997, Eccles & Wigfield, 2002). Bandura (1986) postulated, in social cognitive theory, that self-efficacy is one of the most important mechanisms that influence a person's ability to learn. People who lack self-confidence in their capabilities to succeed diminishes their

efforts or eventually abort all efforts (Bandura, 1977). Also, studies show that people who have high self-efficacy beliefs openly take responsibility for their actions and do not give up easily if they fail at a given task (Betz, 2004; Bandura, Barbaranelli, Caprara, & Pastorelli, 1996; Bong & Clark, 1999; Pajares, 2002, 2003; Pajares & Urdan, 2006). In other words, according to Bandura (1977), self-efficacy strongly influences a person's success on tasks.

In addition, Pajares (1996) concluded that the social cognitive theory is based on the idea that "individuals possess a self-system that enables them to exercise a measure of control over their thoughts, feelings, motivation, and actions" (p. 2). Pajares (1996) also argued that, "because self-efficacy beliefs are concerned with individuals' perceived capabilities to produce results and to attain designated types of performances, they differ from related conceptions of personal competence that form the core constructs of other theories" (p. 3). Therefore, self-efficacy and the ideologies of the social cognitive theory are interrelated. Overall, past studies have shown that students with high self-efficacy have persistently followed their educational goals and achieved them, compared to students with low self-efficacy (Betz, 2004: Betz & Hackett, 1997; Lent, Brown, & Larkin, 1986). The more students accomplish goals or tasks, the greater their self-efficacy, leading to increased learning outcomes.

Sources of Self-Efficacy

The influence of self-efficacy on academic achievement by affecting behavioral and physiological process, is continually being investigated in many academic domains such as science and mathematics, therefore, researchers have turned to examining the sources of self-efficacy beliefs (Bandura, 1986, 1997). Bandura (1997) theorized that the interpretation of four main sources forms people's self-efficacy beliefs. The most influential source of self-efficacy is based upon a person's previous performance, or *mastery experience*. In other words, students

will participate in a particular task or activity, interpret the outcome by their actions, use the interpretations to determine their ability to engage in future activities or tasks, and hold on to the belief that is created. Successful experience are seen as increasing a person's confidence level, however, unsuccessful experience will lower it. Also, success of that is a result of conquering a difficult task or activity may also increase a person's sense of resilience and raise self-efficacy, compared to tasks that are easily completed. However, Bandura (1997) also reported that mastery experience alone does not determine a person's self-efficacy level. Environmental and personal factors, such as previous self-efficacy beliefs, perception of level the of difficulty of certain tasks, determination, and help received during the completion of the task or activity, along with a person's cognitive process can also impact self-efficacy (Bandura, 1997; Britner & Pajares, 2006).

Secondly, students are able to form their own self-efficacy belief through *vicarious experiences* of observing other engage in tasks or activities. Individuals will use their interpretation of what they see to evaluate if they will be as successful on the identical or related tasks or activities. This particular source is weaker than mastery experience in influencing a person's self-efficacy beliefs, however, when students are uncertain about their capabilities, which can be due to limited prior exposure or experiences, they tend to imitate or models others (Bandura, 1989, 1997, 2011). A significant person or model in a student's life can help engross self-beliefs that can influence the direction in which they may take, for example, a teacher, coach, or classmate. Similar to having vicarious experiences that can influence a student's self-efficacy beliefs, *social persuasion* is another important information source that is significant as well.

Being exposed to verbal and nonverbal criticism by others can effect a student's self-efficacy beliefs. In other words, "Effective persuaders must cultivate students' beliefs in their capabilities while at the same time ensuring that the envisioned success is attainable. Also, just as positive persuasions may work to encourage and empower, negative persuasions can work to defeat and weaken self-efficacy beliefs" (Britner & Pajares, 2006, p. 487). It is much easier to lower a person's level of self-efficacy through negative persuasion and feedback than it is to strengthen their beliefs through positive reinforcement. Social persuasion does not work to increase self-efficacy independently, but is much more effect when used concurrently with the other sources of self-efficacy to promote self-confidence and motivation, such as, the last source of self-efficacy, the *physiological state* (Bandura, 1997; Britner & Pajares, 2006; Pajares, 2008).

Lastly, the fourth source of information that can influence a student's self-efficacy belief is their physiological states, such as a person's stress level, mood, and level of anxiety. The emotional state in which a person experiences can influence their level of confidence as they engage in a task or activity. The expectation is that when student's experience positive encouragement and stimulation during a task, they will be successful in completing it, compared to when suffering from tension, high level of stress and anxiety. This negative physical state or the interpretation as being negative, increases the likelihood that a student will not perform well on a task and inhibits successful outcomes (Bandura, 1997; Pajares, 2008). Also, the current degree of self-efficacy of an individual, the difficult of the task being performed, and previous experience in analogous situations can all affect a person's interpretation of their physiological and emotional state and impact they make to self-efficacy beliefs. Consequently, students "construct their self-efficacy beliefs through the interpretation and integration of information

from these four sources" (Britner & Pajares, 2006) of mastery experience, vicarious experience, social persuasion, and physiological state.

Britner and Pajares (2006) have completed various studies over the years using the sources of self-efficacy and its effect on academic performance in the area of science and mathematics, reporting that:

> The manner in which the multiple sources of information are weighted and combined influences the resulting self-efficacy. Some sources have a direct linear influence, as is the case with mastery experiences. Other factors may have a curvilinear relationship to self-efficacy and performance. For example, moderate levels of arousal may contribute to higher performance, but low or high levels of arousal may impede performance. It must be remembered as well that these sources operate congruently. Individuals often experience success or failure in an endeavor while at the same time observing others engaging in the same activity. It is also possible, if not likely, for an individual to receive feedback that constitutes social persuasion and to experience physiological and affective states during and after an experience that will be integrated into future self-efficacy beliefs. It is this cognitive processing and integration of information from multiple sources that determines an individual's self-efficacy beliefs. (p. 489)

Self-efficacy and Academic Achievement

With the increase in attention from educational researchers in exploring self-efficacy as a factor in determining motivation and academic achievement, it is relevant to explore this concept in much further detail. Studies (Bong & Skaalvik, 2003; Pajares, 1996; Pajares & Urdan, 2006; Pintrich & Schunk, 2002) have shown the importance of self-efficacy beliefs as intermediaries of various types of achievement, specifically: self-regulatory strategies, academic course

enrollment, and task and goal persistence. Bandura (1993) investigated how increased academic self-efficacy allowed for individuals to usually commit to task and goals set forth, show the ability of increased efforts despite failures, and view problems as simply challenges, not threats. Students who gain these types of insight and skills will more likely be more successful in educational attainment and beyond.

In previous research studies, positive correlations between academic achievement, cognitive ability, and high levels of self-efficacy were examined (Choi, 2005; Coutinho, 2008; Lane, Lane, & Kyprianou, 2004). Choi (2005) conducted a study on the relationship between several varying specificities of self-efficacy and self-concepts using college students. Within this particular study, it is noted that self-concept is multidimensional in nature, being "a composite of cognitive description of one's attributes and affective evaluation of those attributes in comparison with others" (Choi, 2005, p. 198), particularly to self-efficacy. The results of this multi-regression analysis indicated that the closer the specificity levels of both self-concept and self-efficacy, the stronger the relationship between the two constructs. It was also concluded that specific self-efficacy and academic self-concept are strongly correlated, therefore, supporting the social cognitive theory.

Furthermore, within the area of educational research, many learning variables, such as goals, self-efficacy, metacognition, and learning styles have been used as predictors of academic performance. Coutinho (2008) conducted a study on the relationship between self-efficacy, metacognition, and academic performance. Over 170 students completed two surveys, the Motivated Strategies for Learning Questionnaire (MSLQ) to determine levels of self-efficacy, and the Metacognition Awareness Inventory (MAI) for metacognition. The scores from these surveys were compared to each student's grade point average, using mediation and regression

analyses. This study found that a student's self-efficacy is a mediator between metacognition and academic performance. This suggests that students with effective levels of metacognition strategies are more likely to have stronger capabilities to complete and perform task, compared to students with lower metacognitive strategies. Many studies, with the use of self-efficacy as a predictor of influencing academic achievement and performance, have shown a strong relationship between the two constructs and increases as the student age, especially in high school students (Coutinho, 2008; Pajares, 2008). In addition to research being conducted on cognitive skills, high levels of self-efficacy, and learning styles, Lane et al. (2004) conducted a predictive multiple regression analysis on the relationship between self-efficacy and self-esteem to the impact on previous performance accomplishments and academic performance of 205 postgraduate students from a local university. The study revealed a significant relationship between self-esteem and self-efficacy, and the multiple regression analysis indicated that self-efficacy is a mediator between and predictive factors influencing academic performance and previous performance accomplishments. A student's metacognitive skills, level of self-efficacy, and self-concept, such as self-esteem, can play an influential role in their current and future academic performance.

While developing the social cognitive theory, Bandura (1977, 1986) discovered a connection between self-efficacy beliefs and self-regulated learning, which has been linked to positive behaviors outcomes and goal-oriented tasks. Self-regulated learning is an "integrated learning process, consisting of the development of a set of constructive behaviors that affect one's learning. These processes are planned and adapted to support the pursuit of personal goals in changing learning environments" (Lee, Lee, & Bong, 2014, p. 88). These sources of behaviors influence student motivation and alacrity to complete tasks and activities. In a study

conducted by Caprara et al. (2008), perceived self-efficacy for self-regulated learning was examined to see if achievement and academic attrition would be affected. This longitudinal investigation used 412 Italian students (48% males and 52% females ranging in age from 12 to 22 years) as participants. In addition to researching self-regulatory efficacy, retention, and academic achievement, gender difference and the influence of socioeconomic status (SES) were also explored. In their findings, Caprara et al. (2008) revealed that the transition from middle to high school showed the progressive decline of self-regulatory efficacy, while males demonstrated the highest decline of self-regulatory efficacy compared to females. Also, it was found that SES or ethnicity did not have a significant effect on high schools students' grades, only. In addition to the findings from this study, prior research often examined other factors that contributed to declined motivation and self-regulatory efficacy, such as social and biological adaptations, as well as, coping skills (Andrew, 1998; Pintrich et al., 1993; Zimmerman, 1990).

Non-cognitive attributes are skills and traits that may not be intellectual or analytical in nature (Rosen et al., 2010). Specifically, research has examined non-cognitive attributes such as self-efficacy, motivation, resilience, self-regulation, self-control, perseverance, and self-confidence to determine whether a relationship exist between such attributes and academic outcomes, including course grades and test scores (Rosen et al., 2010). Rosen et al. (2010) examined a sample of empirical studies of seven major non-cognitive attributes to provide general information, including challenges and different perspectives, as well as, discussions of methodologies, measurement instruments, major concepts, and current findings in academic research and the field of education to support students and teachers. Non-cognitive attributes develops early on in a person's childhood, and continues to develop through adolescents, which has shown to have a lasting and significant effect on success in life (Borghans, Meijers, & Ter

Weel, 2008; Rauber, 2007). In contrast, poor non-cognitive skills and attributes can develop and accumulate over time; poor self-regulation, skills, and habits internalized and enters into adulthood may lead to negative and less desirable educational and economic results, eventually impacting cognitive and academic behaviors (Farkas, 2003; Nagaoka et al., 2013; Rosen et al., 2010). This study will examine the non-cognitive attribute of self-efficacy and its impact on academic achievement.

Studies being conducted on self-efficacy and academic performance have examined the mediational questions from other studies or examined different constructs of self-efficacy (Choi, 2005; Coutinho; 2008; Rosen et al., 2010). However, Bandura et al.'s (1996) study, which developed a self-efficacy survey containing three types of self-efficacies: academic, social, and self-regulatory, has been referenced as one of the most "comprehensive account of the myriad ways in which academic self-efficacy works in concert with non-cognitive components to affect achievement" (Rosen et al., 2010, p. 108). Bandura et al. (1996) analyzed a multitude of psychosocial factors through which self-efficacy beliefs can affect children's academic achievement. The study was conducted using 279 middle school students between the age of 11-14 years, specifically 155 males and 124 females, with 88% parent participation. Non-cognitive attributes, such as perceived academic self-efficacy, perceived social self-efficacy, and perceived self-regulatory efficacy were three main factors explored in the study. It was found that there was a correlation between parents' academic self-efficacy and aspiration for their children, and their children's academic achievement through the children's perceived academic efficacy and ambition. Children's efficacy in self-regulatory learning and academic attainment contributed to their academic achievements, independently, and promoted high educational goals and prosocial behaviors (Bandura et al., 1996). Furthermore, academic achievement has been linked to a direct

result of self-efficacy and correlates to a positive impact on one's own self-efficacy (Buchanan & Selmon, 2008; Rosen et al., 2010; Allred, Harrison, & O'Connell, 2013). In review, the literature strongly suggests that there is a positive correlation between self-efficacy, self-regulatory efficacy and academic outcomes.

Science Self-Efficacy, STEM, and Minorities

The science, technology, engineering, and mathematic (STEM) workforce is essential to the America's ability to stay globally innovative and competitive. However, women and minorities are highly underrepresented in the STEM workforce and STEM degree holders (Langdon, McKittrick, Beede, Khan & Doms, 2011). Research on self-efficacy and science education has become of recent interest within the past few years as an approach to understanding the deficit of women and minorities pursuing careers in STEM-related fields (Miller, 2006; NCES, 2011; Langdon, McKittrick, Beede, Khan & Doms, 2011). Despite women displaying major progress in higher education, making up more than 57% of college students, this progress has not been distributed evenly over all major subject areas (Georgia Department of Education, 2013).

In addition to the lack of women and minorities pursing STEM degrees and careers, most women who do obtain undergraduate degrees in a STEM area are less likely, compared to their male counterparts, to obtain a STEM occupation (Georgia Department of Education, 2013). The issue in the lack of women in STEM careers may be due to several factors, including, gender stereotyping, lack of female role models, less flexibility, and lack of support due to gender bias (Langdon et al., 2011). Most of these women who have STEM degrees will pursue careers in healthcare and education instead of enter the STEM workforce. This can definitely attribute to the reason for the majority of science teachers in K-12 education to be women.

Stereotypes of reasons for gender differences, gaps in academic achievement among ethnic subgroups, and women's negative implicit cognitions about science, technology, engineering, and mathematics (STEM) have contributed to the lack of minority and female participation in STEM-related fields and science careers (Young, Rudman, Buettner & McLean, 2013). Implicit cognition refers to a person's unconscious influence such as memory, perceptions, and knowledge which can influence their behaviors (Baron, Schmader, Cvencek & Meltzoff, 2014). It is evident that men dominate careers in science-related and STEM careers as well as college majors, which may be another influential factor in the decline in women pursing such fields and/or having negative implicit cognitions about science related fields of study (Young et al., 2013). Moreover, the lack of diversity among participations can be linked to their level of science self-efficacy within their primary and secondary educational pursuit as well as within higher education, and their specific perceptions of interpersonal behaviors of their science teachers or professors. For example, a recent study was conducted to investigate the influence of female role models on women's implicit science cognition (Young et al., 2013). Three hundred and twenty college women enrolled in chemistry and engineering courses at a university were examined to determine the role of meaningful interactions with a female professor as opposed to a male professor on women's implicit cognitions about STEM and STEM-related careers. The findings revealed that women were mostly likely to have more positive implicit cognitions about science when they saw a female professor as a role model compared to male professors and vice versa for male students.

Recently over the past decade, women and minorities have been underrepresented in science related career fields, however, the correlation between an individual's science self-efficacy and its influence on academic achievement within the area of science can influence their

decision to pursue STEM majors in higher education as well as STEM occupations (Miller, 2006; Gungoren & Sungar, 2009). In addition, science self-efficacy is the confidence in oneself to perform science, in terms of organizing and completing the skills and knowledge needed to succeed in science content and processes (Miller, 2006). Some self-efficacy literature shows that a student's ability to accomplish science course, activities, and task is determined by their self-confidence and self-belief. Their science self-efficacy impacts their choice to pursue science related activities, as well as, determine the amount of effort they will spend on these activities and their determination to continue the task when they encounter challenges or difficulties (Bandura, 1997; Zeldin & Pajares, 2000). Students who have high levels of science self-efficacy tend to select science-related task and are more determined to succeed on these task. In contrast, students who do not believe in being successful in science are more likely to avoid science-related tasks or activities and put forth less effort on these particular tasks (Britner et al., 2006).

In fact, previous studies disclosed a meaningful relationship between self-efficacy beliefs and science achievement across grade levels, revealing that a student's self-efficacy increased as they advanced to a higher grade level (Andrew, 1998); Britner & Pajares, 2006; Larose, Bernier, & Tarabulsy, 2005). In contrast, recent studies indicated that student's self-efficacy declined as they progressed to higher grade level (Guervcin, 2008; Gungoren & Sungur, 2009). For example, Guvercin (2008) stated that sixth grade students' science self-efficacy beliefs were high than students in higher grade levels, specifically seventh and eighth grade students in the same middle school. Also, he reported that middle school females had higher science self-efficacy beliefs across all grade levels compared to males. Additionally, middle school students' motivation beliefs were examined by Gungoren and Sungar (2009), in which they reported a significant difference in students' motivation to learn science among all grade levels.

Specifically, supporting the above-mentioned study, in that sixth grade students also had higher science self-efficacy levels than the seventh and eighth grade students. Similarly, Britner and Pajares (2001) found that science self-efficacy was the only motivational variable that predicted science performance and that female students reported having higher self-efficacy beliefs in science compared to their male classmates. However, these studies were conducted using middle school student participant in suburban school districts with majority White constituents. There is very little literature on science self-efficacy across high school grades levels in low socioeconomically disadvantaged schools, nor in suburban affluent high schools. This further warrants a need for more research in the influence of science self-efficacy on student's motivation in science and academic achievement.

Using science self-efficacy as a way to determine confidence and motivation to pursue STEM related careers has only focused on predominantly male-dominated science occupations, such as engineering, computer programmers and technologist, chemists and mathematicians, in past research studies (Betz & Hackett, 1997; Zeldin et al., 2000; Zeldin, Britner, & Pajares, 2008). Zeldin and Pajares (2000) found that the primary sources of self-efficacy of females who opted to pursue STEM careers were social persuasions and vicarious experience, which are two of four main characteristics of self-efficacy. On the contrary, years later in a study conducted by Zeldin et al. (2008) using the narratives of 10 males who selected careers in STEM, reported that mastery experience was the main source of the males' self-efficacy beliefs. The study suggests that there is a significant difference between males and females interpretation of sources information that can influence their self-efficacy beliefs in male-dominated career fields. This further supports the major components of the social cognitive theory and self-efficacy theory in that a person's cognitive processes, interpretation of self-efficacy sources, such as mastery

experience, vicarious experiences, physiological state, and social persuasion, can significantly influence a person's self-confidence, strength of self-efficacy, which has been found to positively correlate to impacting science self-efficacy and academic achievement (Bandura, 1997, 2011; Britner & Pajares, 2006; Zeldin et al., 2008).

Moreover, it has been suggested that socioeconomic status, specifically the parent's level of education, occupation, income and home resources may impact a students' ability to succeed academically by affecting their level of motivational beliefs (Eccles, 2005; Tucker-Drob & Harden, 2012). In fact, children in low socioeconomic disadvantaged families tend to have lower self-efficacy beliefs before even attending formal schooling (Heckman, 2006; Magnuson, Meyers, Ruhm, & Waldfogel, 2004; Tucker-Drob, Rhemtulla, Harden, Turkheimer, & Fask, 2011). Eccles (2005) studied the effects of parental influence on academic achievement and suggested that a student's motivational beliefs, such as self-efficacy and motivation, are directly and indirectly arbitrated by parental influences., specifically characteristics, beliefs, and behaviors. Eccles (2005) concluded that parents' beliefs predicted parent behaviors, thus, parent behaviors directly impacted the youth motivational beliefs, furthermore, predicting youth behaviors. In additional to his findings, Eccles collaborated with other researchers to conduct a study using Eccles' expectancy-value model and a parent socialization model in which they theorized specific parental influences such as educational level, occupation, income, personal values, ethnicity, cultural background, and time spend with child, and emotional worth as factors that can contribute to a child's self-efficacy and motivation (Simpkins, Fredricks, & Eccles, 2012).

Simpkins et al. (2012) tested the model of Eccles (2005) with the utilization of mothers, their children, and teacher over a twelve year period. 723 participants, with 92% European, were

administered questionnaires about their beliefs in math, sports, reading and music, as part of a childhood and beyond study. Eccles' (2005) expectancy-value model postulates that there are many mechanism that explain the relationship between parents' beliefs and their children's academic-related behaviors, such as motivation and self-efficacy. Simpkins et al. (2012) reported that mothers' behaviors toward math, reading, and sports positively predicted their behaviors on year later, therefore, predicted their children's self-concept and motivational beliefs in math, reading, and sports a year later as well. Four years later, adolescence motivational beliefs' predicted the amount of time spend in playing music, reading outside of school, math courses taken and participating in organized sport activities. Gender differences were also explored, however, there were no significant differences among the relationships between variables. In conclusion, Simpkins et al. (2012) highlighted how a mother's beliefs and behaviors in a child's early years can predict and influence their motivational beliefs and activities in later years, supporting Eccles' (2005) findings.

Another similar study was conducted in later years supporting the study of Eccles (2005) and the expectancy value-model. The purpose of Senler and Sungur (2009) research study was to

> investigate the grade level (elementary and middle school) and gender effect on students' motivation in science (perceived academic science self-concept and task value) and perceived family involvement, and secondly to examine the relationship among family environmental variables (fathers' educational level, mothers' educational level, and perceived family involvement), motivation, gender and science achievement in elementary and middle schools. (p. 106)

Through the use of convenience sampling, 502 elementary and middle school students in grades four to eight were administered two questionnaires to measure their self-efficacy concepts and perceived science task values. A multivariate analysis of variance (MANOVA) showed that elementary school students had higher levels of self-efficacy concept and perceived science task values beliefs than the middle school student participants. Specifically, it was found that family involvement was perceived to be more present with elementary students, which was directly linked to their perceived task values and academic achievement. Also, at the elementary levels, the findings showed a significant relationship between fathers' educational levels, task values, science self-concept, and science achievement. Moreover, at the middle school level, bother mother and father educational levels as well as family involvement demonstrated a positive correlation to students' task values, which was shown to have a direct impact on science achievement (Senler & Sungur, 2009). Hence, the findings from the studies above further supports the claim that a parent's, specifically, mother's educational level does contribute to a student's ability to achieve, which can affect their overall self-efficacy. Consequently, socioeconomic status has proven to be a major factor that can impact the levels of education completed by parents, which contributes to a child's ability to be successful, however, factors such as ethnicity and gender can play a role as well.

Furthermore, in past studies, the factors of gender, SES, and ethnicity have been studied in order to further investigate self-efficacy and academic achievement (Bong & Skaalvik, 2003; Britner & Pajares, 2001; Hackett & Betz, 1995). One study in particular aimed to investigate science motivation beliefs of 262 students within a diverse middle school setting to determine if science self-efficacy beliefs predicted science achievement as a function of their gender or race/ethnicity (Britner & Pajares, 2001). This study revealed girls' science self-efficacy and self-

efficacy for self-regulation was stronger than the male participants, which is currently supported in their later studies. Also, the study reported that White students demonstrated stronger self-efficacy and achievement, while African American students reported stronger task goals and lower achievement (Britner & Pajares, 2001). Thus far, the self-efficacy literature does not address the relationship between science self-efficacy beliefs and achievement using diverse high school students as participants from socioeconomically disadvantaged populations. This further merits the need for this study. In additional to the importance of self-efficacy as a factor impacting academic performance outcomes, student's ability to form a sense of connectedness, bonds, attachments or positive relationship with their teacher is crucial as well. Next, the examination of Ainsworth's (1982) attachment theory and its connection to perceived self-efficacy and student perception of teacher interpersonal behaviors will be reviewed.

Attachment

Attachment is an emotional bond that is a "lasting psychological connectedness between human beings" (Ainsworth, 1982, p. 37). Showing evidence of how children form relationships with adults other than their parents, Bowlby (1969) reported attachment being a significant factor in showing positive academic and behavioral outcomes, supporting Ainsworth's (1982) theory of attachment. The foundational aspects of the Bowlby's (1969) initial attachment theory was rooted in ethology, information processing, developmental psychology, and psychoanalytic thinking, which formed the basic doctrines of the theory. A child psychiatrist and later behavioral researcher, Bowlby transformed philosophical thoughts about children's ties to their mother and the disturbance that occurs upon separation, deprivation, and grief (Bretherton, 1992). The first empirical study conducted by Bowlby was at a child guidance clinic that housed children in which he reported were affectionless, emotionless, and demonstrated lack of moral

turpitude, such as being susceptible to stealing. After extensive review of over 44 cases in the clinic, Bowlby (1969) concluded that family experience does affect a child's behavior, linking the clinical children's symptoms to a history of maternal deprivation and separation (Bretherton, 1992). The works of Bowlby, as the foundational researcher in the formulation of the attachment theory, later adopted a more constructivist view, where children learn about relationships by experience, similar to Bandura's (1977, 1986) self-efficacy theory being rooted in his social cognitive theory. The independent works of Bowlby have contributed greatly to the attachment theory; however, in later years his collaboration with Ainsworth's (1982) tenets of the same theory, has led to our current day ideologies of attachment bonds between children and adults.

Ainsworth's (1982) use of advanced ground-breaking methodologies to test empirical studies conducted by Bowlby and her previous works with the security theory (Blatz, 1940), played a crucial role in the expansion of the attachment theory and our current day understanding of it. The security theory, which went against the psychoanalytic doctrines of Sigmund Freud, emphasized the importance of infants and young children need for developing a secure dependence on parents before being introduced to unfamiliar settings (Blatz, 1940; Bretherton, 1992). Ainsworth's (1982) contribution to the theory was the concept of the attachment figure which is a secure base for where infants can explore the world around them. In addition to the concepts of the attachment figure, Ainsworth originated the concept of maternal sensitivity to infant signals and theorized its responsibility in the development of infant-mother attachment patterns (Bretherton, 1992).

The initial research study conducted by Ainsworth (1982) was completed in Uguanda, in which she recruited 26 families with children between the ages of one month to 24 months that were unweaned. She then observed the families every two weeks for two hours over a period of

approximately nine months. Ainsworth's interests was in examining the onset of proximity-promoting signals and behaviors, specifically noting the signals and behaviors that became preferentially directed toward the mother (Ainsworth, 1989, 1991; Bretherton, 1992). From the data collected, infant attachment patterns emerged: Infants who were securely attached cried less and appeared comfortable with exploring in the presence of the mother; insecurely attached infants cried repeatedly, even when held and sometime comforted by the mother, and explored little; and not-yet attached infants saw no preferential or differential behaviors the toward mother (Ainsworth, 1989; Brethernton, 1992). Ainsworth also concluded that secure attachment was highly correlated to maternal sensitivity. Moreover, infants showing highly secured attachment patterns had sensitive mothers compared to non-sensitive mothers who children were mostly classified as being insecure. With the contribution of Bowlby's foundational works, other empirical studies were conducted to further support the attachment theory, such as Hirschi's (1969) sociological control theory, which influenced Ainsworth's work on the attachment theory as well.

Hirschi (1969) developed the sociological control theory, also known as the social control theory, which explains the phenomenon of how parental attachment with children can affect their relationship with others. The theory assumes that individuals who have weakened "social bonds" to society will engage in delinquent activity or crimes. Hirschi's "social bond" is characterized by four elements of attachment, commitment, belief, and involvement (Hirschi, 1969). Attachment refers to the interdependent connection between people and society (Alston, Harley, & LenHoff, 1995). Hirschi theorized that people with stable and strong connection with people within their society, are more likely not to be deviant or violate social norms and not commit crimes, vice versa (Alston et al., 1995; Hirschi, 1969). Thus, those being closely attached to

family, friends, community, and other institution, is less likely engage in behaviors or situation that will cause stress or harm to the attachment. However, Hirschi (1969) stated that people who do suscept themselves to abusing drugs or engaging in unlawful or criminal behaviors, would more likely contemplate their actions and avoid these negative behaviors in order to not feel condemned or disappoint those valued attachments.

Furthermore, according to Hirschi (1969), commitment refers to invested time in social activities, institution or persons. Commitment is another basic element of the social control theory. Hirschi proposed that level of commitment strong correlated with propensity of being defiant or deviance. He states that those who take time, money, and energy to conform to the expectation of society or the norm, are less likely to be deviate or commit crimes (Alston et al., 1995). In addition to commitment, involvement is another element of Hirschi's (1969) theory of social bonding. He theorized that individuals who spend a lot of time being involved in activities or conventional endeavors, are much likely to not engage in deviant activities, due to limited time. Lastly, Hirschi (1969) postulated that the last element of the social control theory was belief. Society has specific norms that have been set forth for decades, for example, sexual conduct, and monogamy. Those individuals who accept and strongly believe in these norms, are less likely to engage in defiant acts. And, those who do not see these norms as acceptable and challenge them, are more likely to have a greater propensity to engage in deviant behaviors. Thus, the elements that shape the social control theory are important in understanding the factors that can contribute to predicting the level of deviance that may arise due to a persons' belief system and reactions to society's norms and expectations (Alston et al., 1995).

Surrounding the research of Ainsworth (1982) and Hirschi (1969), studies have shown that for children to be mentally healthy, they must develop nurturing and intimate relationship

with their mother and others they encounter (Bretherton, 1992). Ainsworth's (1982) theory of attachment with foundational support from Hirschi's (1969) sociological control theory, focused mainly on the relationship between child and mother, however; these concepts can certainly be applied to the relationships between student and teacher (Baker et al., 2008; O'Connor et al., 2011; Silver et al., 2005). Students can become attached to their teacher and may see them as role models, which can influence a student's interpretation of their vicarious experiences, which further can positively or negatively impact their confidence level and self-efficacy beliefs (Bandura, 1997; Butz & Usher, 2015; Marcus & Sanders-Reio, 2001). Vicarious experience is a source of self-efficacy in which through the observation and successful imitation of another person's performance on a task, influences their self-confidence to complete the same task (Bandura, 1977). Teachers who provide positive relationships with their students are more likely to enable students to feel safe and secure to learn, impact social and academic outcomes, including positively influencing social and academic skills, confidence and motivation (Baker et al., 2008; O'Connor et al., 2011). Also, attachment can affect an individual's ability to develop relationships, regulate emotions and self-esteem, and manage stress (Reio, Marcus, & Sanders-Reio, 2009).

Moreover, the foundational study of Hirschi (1969) reported youth who developed a strong attachment bond to parents, peers, and their school were less likely to have discipline problems in and out of school. When the attachment bond is weak, students have a tendency to become delinquent due to internal conflict with morals and guilt, and external conflicts with social bonds, rules, and consequences of actions (Hairston, 2013). Hairston (2013) used the attachment theory as a theoretical framework in conducting a correlational study to examine the relationships between student-teacher as a barrier affecting GED completion of adult learners

using test completion, age, gender, and returning students as variables and two constructs from the administered survey. Data was collected from over 120 adults students enrolled in a GED program using the Student-Teacher Relationship Survey, specifically investigating instructor correctedness and instructor anxiety constructs of the survey. The data analyses demonstrated a significant relationship between the participants' age and test completion with the two constructs of the survey given. In contrast, Hirschi (1969) suggested that when social bonds are very strong, students are more likely to commit to school and make plans to be successful, and vice versa. It is important that teachers show characteristics of care, attention, positive appraisal, and high expectations in order for students to be academically motivated to learn, which reduces student behavioral issues and the school dropout rate (Marcus & Sanders-Reio, 2001).

Furthermore, attachments allow children to obtain the sense of security through exploring their milieu freely and creates the foundation for socialization (Ainsworth & Bowlby, 1991). Interactions with adults allow children to mimic behaviors and values modeled by them, which is a concept originally postulated as sources of behaviors that influence a person's self-efficacy. Attachments can also be seen across all ages. Specifically, adolescents do not need physical attachments like most infants and younger children; however, availability to communicate, being aware of their needs, and timely responsiveness to help are more important for adolescents (Bergin & Bergin, 2009). This can be beneficial to the success of students in the classroom (Kennedy, 2008; LeCroy & Krysik, 2008). Existing studies state that attachment is a predictor of positive learning outcomes and academic achievement (Granot & Maysless, 2001; Stewart, 2007, 2008; Wong, Wiest, & Cusick, 2002). For example, in a recent study conducted by Drake et al. (2014), data analyzed from the National Institute of Child Health and Human Development Study of Early Childs Care and Youth Development (2005) gwas utilized to examine the

relationship between attachment and self-regulated efficacy at various age intervals (i.e. measured at 15 and 36 months; between grades one and five). The study confirmed that early attachment of children is related to later ability to self-regulate, but only for social self-control and not task persistence. Furthermore, attachment affects a child's ability to engage in learning, as observed by the researcher's direct observations. In summary, this particular mediational analyses further supports theoretical arguments and empirical evidence suggesting that attachment experiences in early childhood may certainly be important in later development of self-regulation, conscientious behavior, and academic outcomes (Drake et al., 2014).

Attachment between parent and child can be viewed similarly to the relationship between student and teacher (Baker et al., 2008; O'Connor et al., 2011). From a social context of education, Davis (2003) synthesized research on the influence of student-teacher relationships from three main broad themes: attachment perspective, motivation perspective, and sociocultural perspective. He suggested that students' relationships with their teacher can be correlated with the relationship they have with their parents and/or guardian as well as past parent-child interactions, which may be a factor in how student's level of motivation and self-efficacy are different (Davis, 2003). In addition, Wentzel (2002) piloted a study investigating whether teachers had similar qualities as good parents, using 452 students from to suburban middle schools, which different ethnic and racial diversity. One school consisted of more than 87% White American students and less than 7% of all other ethnic groups. On the contrary, the second school was comprised with over 91% African American students and only 6% of White Americans. Student motivation variables and teaching dimensions were examined using questionnaires. Mastery orientation, interest in class, and social goals were all motivation variables that were measured in the study. The outcome of the study suggested that motivational

levels of students are significantly impacted by teachers compared to the students' parents. Consequently, student-teacher relationships is thought to have a greater impact on a student's level of academic motivation, influencing their perceived self-efficacy.

Furthermore, student-teacher relationships can influence a student's level of motivation and self-efficacy to achieve and can be important in regulating classroom management, giving and obtaining expectations, and promoting academic achievement (Marzano, Marzano, & Pickering, 2003; Pianta, Hamre & Allen, 2012). Therefore, attachment bonds are important in fostering positive teacher-student relationships. In contrast, insecure attachment among high school students have been linked to feared failure, low attention spans, lower grades, difficulty with maintaining friendships, cognitive and behavior problems, various learning disabilities, and seek less help from teachers (Larose et al., 2005; Grossman & Grossman, 1991; Lyons-Ruth, Alpern, & Repacholi, 1993; Zettergren, 2003; Trzesniewski, Moffitt, Caspi, Taylor, & Maughan, 2006). Students with low attachment and insecurities allow their anxiety and inability to cope with stress to hinder their academic performance, causing failure (Perry, 1997; Wentzel, 2012). However, these insecure attachments can be restored through obtaining new meaningful relationships with peers and teachers, shaping students' behaviors and internal memories that can affect them for the rest of their lives (Wentzel, 2009, 2012; Wubbels, den Brok, van Tartwijk, & Levy, 2012). Based upon the literature examined thus far, Ainsworth's (1982) attachment theory is fundamental in understanding the importance of student-teacher relationships.

Student-Teacher Relationships

Previous research literature has provided strong evidence of the importance of positive and supportive student-teacher relationships as a mechanism which can impact students' social, emotional, and cognitive development (Birch & Ladd, 1998; Hamre & Pianta, 2001; Pianta &

Steinberg, 1992; Pianta, Steinberg, & Rollins, 1995). Furthermore, since the implementation of NCLB (No Child Left Behind Act of 2001, 2002), educational systems are increasingly being held accountable for student success and performances on state standardized tests; therefore, the social quality of student-teacher relationships is crucial to academic development and success (Gregory & Weinstein, 2004; Hamre & Pianta, 2001). The recent change in education reform, specifically, the Every Student Succeeds Act (ESSA), signed by President Barak Obama, emphasized the importance of minimizing standardized testing. With the minimizing of standardized testing, the ESSA can have a positive effect on teacher efficacy and alleviate other factors that contribute to the increase in teacher retention.

Maturity levels changes as students matriculate through school, however, the need for connectivity and positive relationships between the child and the teacher while in early grade school is just as imperative as when student mature and move on to high school (Crosnoe, Johnson, & Elder, 2004). Educators are steadily finding ways to improve social, cultural, and positive academic environments within schools and classrooms, therefore, student-teacher relationships can be a useful resource to use as a possible solution (Wentzel, 1998, 2003, 2012). Wentzel further explained the role of effective student-teacher relationships as a factor in influencing social, emotional, and academic outcomes in an excerpt from *Interpersonal Relationships in Education: An Overview of Contemporary Research (*Wubbels et al., 2012):

> There is growing consensus the nature and quality of children's relationships with their teachers play a critical and central role in motivating and engaging students to learn (Wentzel, 2009). Effective teachers are typically described as those who develop relationships with students that are emotionally close, safe, and trusting who provide access to instructional help, and who foster a more general those of community and

> caring in classrooms. These relationship qualities are believe to support the development of students' motivational orientations for social and academic outcomes, aspects of motivation related to emotional well-being and positive sense of self, and levels of engagement in positive social and academic activities. (p. 19)

Positive relationships with teachers can foster an environment that can cater to and help students that may display early academic difficulties and behavioral problems (Pianta et al., 1995). Murray and Zvoch (2011) conducted a study on student-teacher relationships among 193 low-income African American students. Surveys were given to the students and teachers that measured student-teacher interactions relating to emotional, behavioral, and school-related adjustment. The results indicated that African American youths who reported lower trust in their teachers matched teachers who rated students in lower relational closeness and increased conflict. Similarly, positive and strong student—teacher relationships have been linked to improving behaviorally at-risk students and help them learn adaptive behaviors that are not aggressive (Decker, Dona, & Christenson, 2007; Murray & Zvoch, 2011; Pianta, Hamre & Allen, 2012).

Student-teacher relationships were investigated in a study with highly aggressive at-risk African American and Hispanic students within an urban school district, in which they were assigned a college mentor over a period of three academic semesters (Faith, Fiala, Cavell, & Hughes, 2011). Pre and post mentoring changes were examined. The at-risk minority students were exposed to positive and supportive mentor relationships in which over time they showed a decline in their aggressive behaviors. Also, behaviors of openness, self-efficacy, extraversion, conscientiousness, and agreeability were observed in both the student and college mentor, which further supports the importance of student-teacher relationships.

Teachers who provide supportive characteristics such as being emotionally warm, available to communicate on a personal level with students, and foster a sense of acceptance, are able to help maintain academic interest and social pursuit by students (Baker et al., 2008; Pianta et al., 2012). This support eventually can help students achieve higher grades, improve positive peer relationships, as well as, support student self-efficacy (Hamre & Pianta, 2001; Pianta et al., 2012). Therefore, student-teacher relationships have shown strong reliability as a critical predictor of academic and social success of most students (Allen, Pianta, Gregory, Mikami, & Lun, 2011; Decker et al., 2007). Specifically, Decker et al. (2007) conducted an exploratory investigation to examine the association between the outcomes of at-risk African American middle school students who were in jeopardy in being referred to special education and the relationship with their teachers. The study included students from suburban and urban areas and was concluded using multi-rater, multi-method approach to collect and analyze data. The results showed that when the quality of teacher-student relationships increased, positive social, behavioral, and engagement outcomes of students were observed by teachers. Likewise, students reported as the quality of their relationships with their teachers increased, they were more engaged, positive behavioral characteristics were shown, and their grades increased. Also, analyses of didactic relationship patterns were examined to show that the increase in positive relationship patterns impacted students' social, behavioral, and engagement outcomes in a positive way. Despite the differences in school locations and socioeconomic status, positive correlations between student-teacher relationships and social, behavioral, and academic outcomes were seen (Decker et al., 2007).

Many of recent research studies on student-teacher relationships and academic outcomes focus on participants in preschool and elementary settings (Hamre & Pianta, 2012; Lumpe,

Czerniak, Haney, & Beltyukova, 2012; Lee & Bierman, 2015). Student-teacher relationships are just as important in adolescence, specifically in secondary education (Davis, 2003; den Brok & Levy, 2005; Wubbels & Brekelmans, 2012). Allen et al. (2011) investigated teacher quality as a recognizing problem of academic deficiencies in secondary education. With the use of a randomized control trials of a web-mediated intervention approach to increasing student-teacher interactions and relationships in class, 78 teachers and 2,237 high school students participated to determine if the program would not only increase teacher quality by increasing student-teacher interactions, but also positively impact student achievement. The results of the study indicated that the intervention strategy was successful in increasing teacher quality, consequently, increasing teacher abilities to create and maintain positive relationships with students. This was seen to show great gains in academic achievement the year following the intervention, specifically, moving average students from the 50th percentile to 59th percentile on standardized assessments. This further supports previous theoretical frameworks of the social cognitive theory, self-efficacy, and the importance of attachments.

Furthermore, the ability of teachers to support student growth, motivation, and achievement has been identified as one of the most influential factors contributing to positive student outcomes (Pianta, 1999; Pianta et al., 2012). In addition, teachers fostering a positive learning climate conducive for learning and establishing positive student-teacher relationships, is crucial in promoting student self-efficacy and motivation, as well as, influencing positive learning outcomes (Caldarella, Shatzer, Gray, Young, & Young, 2011; Reyes, Brackett, Rivers, White, & Salovey, 2012). Based upon the review of literature, there has been significant evidence suggesting that student perception and interaction with their teacher influences positive student academic achievement and an interest to learn. However, few studies have investigated

student-teacher relationships and academic achievement among diverse populations, specifically within diverse Title I high schools. This further warrants the need for the current study.

Student Perceptions and the Conceptual Model for Teacher Interpersonal Behaviors

To examine the impact of student-teacher relationships, it is imperative that student perceptions be used to measure teacher interpersonal behaviors, and how influential it may be on academic achievement. Subsequently, it is necessary to understand student-teacher relationships from the perspective of the student in order to fully assess how these interpersonal behaviors truly effect social, emotional, academic, and motivational outcomes. Teacher behaviors are important in classroom behavioral management, which is one of many factors that new and some veteran teachers struggle with (den Brok & Levy, 2005; Doyle, 1986). Secondly, previous research has shown teacher interpersonal behaviors being a major factor influencing student achievement and motivation in all subject areas (Brekelmans et al., 2002; den Brok et al., 2005) as well as positively effecting student engagement, when teacher interpersonal behaviors are healthy (Wubbels & Levy, 1993). Lastly, student perception is used to evaluate teaching, rather than the teacher self-reported behaviors or observation by others (den Brok & Levy, 2005; den Brok at el., 2005). Therefore, the use of student perception will also be a more accurate measurement of learning and levels of motivation, compared to a teacher or any other person's perception (Fraser, 2002).

Examining teacher interpersonal behaviors is essential to fostering a positive learning environment and impacting academic achievement, which influenced the creation of Wubbels and Brekelsman's (2005) Model for Teacher Interpersonal Behaviors (MITB). The conceptual model of student-teacher relationships adapted from Leary (1957) is modeled after his research on the interpersonal diagnosis of personality, which includes the theoretical model of proximity

and influence, and it application to education (Wubbels, Brekelmans, & Hooymayers, 1991). Leary (1957) developed the model as a functional theory and methodology for personality evaluation. The Leary Model has been investigated to a great extent in the field of clinical psychology and psychotherapy and has proven to be an effective model for explaining human interaction (Leary, 1957; Segall, Dasen, Berry, & Poortinga, 1990). Specifically, this study will focus on Wubbels et al (1991, 1993, 2005) development of the model of interpersonal behaviors as it supports the research and questionnaire used in this study.

Variations of instruments have been developed to measure student perceptions of their relationships with teachers. Based upon the Conceptual Model of Interpersonal Behavior (Wubbels et al., 1991; Wubbels & Levy, 1993), Wubbels and Levy (1993) developed the Questionnaire on Teacher Interaction (QTI) in an effort to successfully measure student perception of teacher interpersonal behaviors. This questionnaire was designed to examine the "students' perceptions evoked by what occurs in the classroom, what students think about their teacher, and what they learn and do" (Wubbels et al., 2005, p. 7). The QTI has eight subscales of teacher interpersonal behaviors that mirror the Wubbels (1993) model of teacher interpersonal behaviors, which is divided into eight sectors, or teacher behaviors (Wei, den Brok, & Zhou, 2009; Wubbels & Levy, 1993). These eight scales of the QTI measures the student's perception of their teacher's interpersonal behaviors in class, specifically, Leadership, Helpful/Friendly behavior, Understanding behavior, Student Freedom, Uncertain behavior, Dissatisfied behavior, Admonishing behavior and Strictness. The teacher interpersonal behaviors developed based upon the Model for Teacher Interpersonal Behaviors (MITB) (Wubbels & Brekelmans, 2005; Wubbels et al., 1991; Wubbels & Levy, 1993).

The QTI (Wubbels et al., 2005) is composed of two independent dimensions, influence (teacher dominance versus submissiveness) and proximity (teacher cooperation versus opposition). Influence refers to teacher's propensity to dominant in class interactions while proximity is the cooperative behaviors of the teacher within the class (Wubbels & Brekelsman, 1998; 2005). The two dimensions are used to subdivide eight teacher interpersonal behaviors: Leadership, Helpful/Friendly behavior, Understanding behavior, Student Freedom, Uncertain behavior, Dissatisfied behavior, Admonishing behavior and Strictness. Table 1 shows the characteristics of each teacher interpersonal behaviors that are subscales of the QTI.

Table 1

Characteristics of Teacher Interpersonal Behaviors

Dimension	**Behavior**	**Characteristic of Behaviors**
Influence (*Dominance-Submissiveness*)	Leadership	leader, set tasks, organize, holds attention
	Helpful/Friendly	assist, inspire confidence and trust, join
	Understanding	listens, accept apologies, empathy, patient
	Student Freedom	freedom, opportunity, independent work
Proximity *(Cooperation-Opposition)*	Uncertainty	keep low profile, wait and see, apologizes
	Dissatisfied	criticize, question, keep quiet, look glum
	Admonishing	get angry, express irritation and anger
	Strictness	exact norms and set rules, check, judge

Note. Retrieved from Wubbels and Levy (1993) and Wubbels and Brekelmans (2005).

The QTI has been used in the Netherlands to investigate the relationship between perception of the QTI scale and student learning outcomes (Wubbels et al., 1991). The study concluded that the more the teachers demonstrated characteristics of being strict, friendly,

helpful, and showed leadership behaviors, the higher the students' cognitive outcomes were. Conversely, student uncertain and dissatisfied, responsibility and freedom behaviors correlated to negative student achievement (Wubbels & Brekelmans, 2005). This instrument will be fully described in Chapter Three and will serve as the primary instrument to assess student perception of teacher interpersonal behaviors as a measurement tool for the criterion variable, perceived student-teacher relationships.

Related Literature

The Achievement Gap

Self-efficacy and student-teacher interactions have been rarely studied together in science education, compared to research conducted in the areas of mathematics and English (Hallinan, 2008; Jerome et al., 2009; Usher & Pajares, 2006; Wentzel, 1998; Wu et al., 2010). State standardized assessments have been utilized across the United States for years to determine if students meet the state's academic standards, which defines what students should have learned and be able to do by the end of the school year (No Child Left Behind Act of 2001, 2002). Initially, by the 2005-2006 school year, NCLB mandated all students, regardless of gender, race, ethnicity, SES, disabilities and English proficiency, would be required to take a state standardized assessment in math and English to measure levels of proficiency as well as the school district's adequately yearly progress (No Child Left Behind Act of 2001, 2002; Every Student Succeeds Act, 2015). Later, NCLB required all states to develop science standards by 2006 and a state standardized test by 2008 to be administered to students. Furthermore, NCLB only included the student's proficiency levels on state standardized test in the subjects of Mathematics and English as one of many factors to determine a district's and individual school's adequate yearly progress towards all student being proficient in math and reading by 2014 (No

Child Left Behind Act of 2001, 2002). Therefore, the majority of research on self-efficacy and teacher interpersonal behaviors has concentrated on the areas of math and English. Furthermore, current studies have investigated self-efficacy and student-teacher interactions independently, not concurrently, as factors that can influence science achievement. A combination of factors, such as socioeconomic and ethnic background or motivation and self-concept, can contribute to student's learning outcomes and academic achievement. Students' self-efficacy can be influenced by interpersonal relationships with teachers, thus positively or negatively impacting a student's motivation to learn and perform in class (MacPhee et al., 2013).

Despite research studies concentrating on factors that influence motivation, self-efficacy, and academic outcomes, a further look at achievement gaps can help with understanding the large disparity in academic performance across the nation (Synder & Dillow, 2012). Achievement gap is defined as the "observed, continuous disparity of educational performance measures between groups of students described by socioeconomic status (SES), gender, and race/ethnicity" (Synder & Diwillo, 2010). Academic achievement gaps among ethnic groups have been an ongoing issue in U.S. public school systems since its establishment and the Brown vs. the Board of Education decision to integrate all student to ensure educational equality (Mroczkowski & Sánchez, 2015).

The gaps in achievement have been the focus for research, education reform, controversy, and discussion for over 40 years, with the gap narrowing slowly (U.S. Department of Education, 2010, 2013; Hargreaves, 2014; Lee, & Orfield, 2006; Rothstein, 2013). According to the National Assessment of Educational Progress (NAEP), achievement gaps began to narrow throughout the late 1980s, mostly between African Americans and Whites, however; today, there is still a large gap that exists between economically disadvantaged students and minorities,

specifically African Americans compared to their White counterparts (Hemphill & Vanneman, 2011; U.S. Department of Education, 2013). Astonishingly, minorities' academic achievement has consistently been below-par and has been a pressing issue within education. The average African American or Hispanic high school student achievement levels are almost equal to the average White student in the lowest quartile of White achievement (Howard, 2015; Every Student Succeeds Act of 2015, 2015-2016).

In addition, statistics have shown that African Americans and Hispanics are more likely to not graduate, fall behind academically, drop out or acquire a postsecondary or advanced degree, or reach above the poverty line (DiPrete & Buchmann, 2013). The trends in data are continuing to show a staggering increase in the achievement gap among minorities and Whites, despite the continued efforts of educators and lawmakers to narrow the gap (Howard, 2015; Lee & Reeves, 2012).

The achievement gap has become a focal point among educators and lawmakers. Educational Reform efforts are still in effect to minimize the gap along with various other groups, such as the Education Trust and the Democrats for Education Reform (DeBray-Pelot & McGuinn, 2009; Shapiro, Meschede, & Osoro, 2013). The No Child Left Behind Act (No Child Left Behind Act of 2001, 2002) attempted to narrow the achievement gap by raising accountability for students and teachers, as well as, implementing a school choice option for parents. The school choice options was implemented to allow students who attended a school that did not meet Adequately Yearly Progress (AYP) in three consecutive years to enroll into higher performing schools (U.S. Department of Education, 2010). However, within urban school districts, there are minimum high performing schools compared to other districts that student can choose to attend (Cullen et al., 2013; Jennings & Rentner, 2006). Although the school-choice

option is available to students at these low achieving schools, parents usually do not utilize this option to better their children's education, hence, an assumption is the value of education may not be a top priority (Rentner & Kober, 2012). Lewis (2004) and Rentner and Kober (2012) conducted studies on the impact of socioeconomics and familial support on a child's ability to achieve academically. The results revealed how crucial the lack of parental support, lower educational and family values, and socioeconomically disadvantaged communities greatly impact the current issue of achievement gaps and need to be addressed.

These achievement disparities continue to exist, including emerging issues of achievement gaps among various ethnic groups and gender as well. There are several studies that have contributed to the body of knowledge stating that there are several factors externally and internally that affects the achievement gap (Berliner, 2009, 2013; Howard, 2015; Lee & Orfield, 2006; Vanneman et al., 2009). A student's parents' educational level, peer and social influences, lack of preschool instruction, racial/ethnic and/or economic background, school funding and resources, as well as, instructional quality are all factors that can contribute to achievement gaps (Berliner, 2013; Howard, 2015; Lee & Orfield, 2006). Borman and Dowling (2010) added to the body of knowledge by suggesting that the ever-growing achievement gap is definitely affected by other factors, particularly the home environment, community and the school as well. Berliner (2009) stated that high accountability has been placed on the individual school districts; therefore, "schools are told to fix problems that largely lie outside their zone of influence" (p.23), indicating that outside environmental factors are real culprit and if not addressed it will be impossible for schools to meet the expectations for "adequate yearly progress" (Berliner, 2013, p. 25). Furthermore, home and community influences outweigh the influence school has on students in low socioeconomically disadvantages areas, compared to students not significantly

impacted by poverty (Berliner, 2009, 2013; Hoff, 2013; Hemphill & Vanneman, 2011). Unfortunately, "despite numerous efforts to reduce educational inequality in the United States, substantial racial gaps and achievement and attainment remain" (Lleras & Rangel, 2008, p. 279). Therefore, the achievement disparities will continue to exist in the United States, especially among the economically disadvantaged and minorities (Hoff, 2013). The review of literature continues to support the variety of factors that contribute to increased achievement gaps among gender, race, ethnicity, and SES. Therefore, these factors can further be explored to understand the lack of females and minorities in science-related career fields, discussed in the following section.

Diversity, Science Achievement, and STEM

There is a lack of diversity and minority representation within STEM professions as well as the pursuit of science-related degrees (Duran & Lopez, 2014). Therefore, it is imperative that studies be conducted to investigate the issue, and give insight into the deficiency in science education (Wang & Degol, 2013; Armstrong & Jovanovic, 2015). More attention needs to be focused on why and how to increase the diversity of subgroups' participation in STEM and science-related careers, due to the decline in minorities and women pursing them. In current literature, one suggested solution is to increase the amount of minority students taking science-related courses, however, seeking to increase the number of minority students that take science courses, specifically woman, as well as, increasing their academic achievement in science, has been an ongoing issue (Gungoren & Sungar, 2009; Shapiro et al., 2013). Researchers have also suggested to thoroughly take into account internal and external factors that may contribute to the lack of specific subgroups participation in STEM-related fields, as a postsecondary option (Armstrong & Jovanovic, 2015; Britner & Pajares, 2006; Gungoren & Sungur, 2009;

Opdenakker et al., 2012; Wang & Degol, 2013). Moreover, science researchers have investigated a plethora of factors that can affect academic choice and performance, such as motivation, social environments, self-efficacy, and student-teacher interpersonal relationships (Britner & Pajares, 2006). The findings revealed that these factors can positively and negatively influence academic performance and choice and should be taken into account. However, there is limited research that examines the aforementioned factors using diverse populations, varying socioeconomic status (SES) and exploring ethnic diversity in science education (Opdenakker et al., 2012). Specifically, little research has been investigated on science self-efficacy of students at various educational levels and within diverse socioeconomic and ethnic groups, despite the literature showing the lack of Black Americans and Hispanics pursing science careers (Britner et al., 2006; Shapiro et al., 2013). The need for further research to investigate sources of science self-efficacy in schools with ethnically diverse populations has been suggested Britner & Pajares, 2006; Opdenakker et al., 2012; Quinn & Cooc, 2015). Based upon these findings, it is necessary for further research to be conducted in these areas.

Motivational factors that can impact science achievement with adolescents as participants have been recently studied; however, most studies were completed in other countries or controlled for other variables such as age, gender, subject area and demographic location (Areepattamannil, Freeman, & Klinger, 2011; Larson, Stephen, Bonitz, & Wu, 2014; Sun, Bradley, & Akers, 2012). Areepattamannil et al. (2011) examined the motivation to learn science, self-efficacy beliefs and science instructional practices as it relates to academic science achievement among 13, 985 Caucasian adolescent students at age 15 across 431 schools in Canada. A hierarchical linear modeling analysis was used to measure correlations and predictive effects. The findings indicated that motivational beliefs, such as self-efficacy and self-concept,

played a significant predictive effect on science achievement, especially students that enjoyed science. On the contrary, this study found that students who had a more generalized interest in science had a negative outcome in science achievement. In regards to instructional practices, the researchers concluded that hands-on activities versus science inquiry demonstrated a substantial positive predictive effect on science achievement. Based upon the study, self-efficacy and self-concept can be correlated to student's motivation to learn science which can positively affect achievement, therefore, further investigation into science self-efficacy should be warranted, especially in other ethnic subgroups to determine if it is a predictive factor.

Moreover, not only are these current studies being conducted in countries other than the United States, these countries are considered to be more scientifically and technologically advanced compared to the United States (Larson et al., 2014; Sun et al., 2012). Recently, statistics show the U.S. slowly progressing in the areas of math and science compared to two decades ago, but lag internationally (Hemphill & Vanneman, 2011). Based upon the average score of fifteen year old students taking the 2012 Program for International Student Assessment in math and science, the U. S. scored 481 points out of 1,000, indicating that they are still in the median for international comparisons, but are significantly behind in other industrially advanced nations, such as Japan, Singapore, and China (Hemphill & Vanneman, 2011). A longitudinal study conducted by Sun et al. (2012) investigated factors that affected 15 year old students' science and technology achievement in a Hong Kong international school. A multilevel, hierarchical regression model was used to explore factors from the student and school perspective. The results demonstrates that male students, students from high SES, student with higher self-efficacy and motivation, as well as, students with parents that have a high value for science and technology, were more likely to have higher achievement in science and pursue

STEM-related career fields. The results from this study and recent statistics further supports the need for investigation into self-efficacy among more ethnically and economically diverse populations to explore its impact on science achievement within the U.S. This can support the need for education reform improvements to ensure the U.S. increases its global competitiveness economically, educationally, and scientifically as well as continue to further its advancements in technology and engineering.

Within this study, the investigation of student perceptions of teacher interpersonal behaviors as a predictor of science achievement will also be addressed. Studies examining the effect of student-teacher relationships utilizing elementary students as participants are abundant; however, there is minimal research on secondary education, especially, in high school settings (Henry, Knight, & Thornberry, 2012; Wentzel & Miele, 2016). Many studies have supported the framework of teaching through interactions, which is the idea that student-teacher relationships are central forces behind student learning from preschool to elementary, with the principles of the social cognitive theory embedded in its foundation (Hamre et al., 2013; Knoell, 2012). With the use of the social cognitive theory among others, Hamre et al. (2013) provided evidence in validating this framework. They found that teacher-student interactions strongly predict student performances by analyzing various large-scale observational research studies conducted from 1998 to 2009, which included over 4,341 preschool and elementary classrooms across the United States. The study concluded that teacher efforts in providing emotional support, organization and management, and instructional support for preschool and elementary students significantly impact student performance and learning as well as developmental gains. Therefore, these findings show promise and warrant investigations among older students, specifically high school students, despite the majority of these studies being conducted utilizing primary-aged students

and focusing on student-teacher relationships and achievements in math, language arts, and reading rather than science or STEM (Hamre et al., 2013; Knoell, 2012).

Furthermore, studies that have been conducted using middle schools student's perceptions of teacher interpersonal behaviors as a factor influencing student learning outcomes were not conducted in diverse settings (Baker et al., 2008; Guay et al., 2010; Niebuhr & Niebuhr, 1999; Smart, 2014). Despite the lack of diversity, the examination of student-teacher interpersonal behaviors among middle school students and its impact on their motivation to learn science, specifically, factors such as their science self-efficacy, task value, reciprocal empathy, mastery orientations, and goal orientation showed promising conclusion to further the need for support in researching the importance of student relationships with their teachers in science classrooms (Rector, 2015; Smart, 2014). Smart (2014) conducted a mixed method study using a sequential explanatory model and found that student perceptions of teacher interpersonal behaviors is predictive in determining student motivation and efficacy for learning science. Students begin to identify their specific interest in careers and subject areas during the elementary years (Potvin & Hasni, 2014). Their career of interest is further fostered in middle school where students begin to explore specific academic subject areas that relates to their career interest which follows them to high school. A study conducted by Wang (2013), revealed that a high school student's intent to major in STEM is directly related to their exposure to mathematics and science courses, mathematic achievements, and their self-efficacy beliefs in science and math (Wang, 2013). Furthermore, the above study concluded that White students' who obtained positive experience from STEM course exposure were more likely to pursue a major in STEM, compared to the underrepresented minority students. The need for more research into building student self-efficacy, fostering positive student-teacher interactions, and

promoting an environment of high expectations for motivation and success, can increase academic performance, including within the area of science for future high school students (Pianta, Hamre, Allen, 2012; Rector; 2015; Smart, 2014). Therefore, the study further supports the need for investigations into the effects of student-teacher relationships and self-efficacy as predictors of science achievement in high school students.

High school years are when students determine their areas of interest, as well as, decide on their postsecondary options. Empirical evidence has also shown the importance of positive student-teacher relationships in high school students during these adolescent years (Alexander et al., 1997; Cataldi & KewalRamani, 2009; Dika & Singh, 2002; Hughes & Kwok, 2007; Ryan, Stiller, & Lynch, 1994; Wentzel, 2003, 2016). Unfortunately, research in this area is not up-to-date and does not specifically contain findings in the area of science education and science achievement. Similarly, little research has been conducted on the effects of student-teacher relationship in low-income and diverse populations, especially minority students. Also, positive relationships between student and teacher has proven to show a positive correlation to student achievement on standardized tests and student's grade point averages (Murray & Malmgren, 2005; Smist, 1993; Nugent, 2009). Therefore, this particular study will be one of the first to investigate student perceptions of teacher interpersonal behaviors and a student's science self-efficacy as predictors of academic achievement in science within a diverse Title I high school, using science grade point averages (GPA) as an indicator for achievement.

Teachers' attitude toward teaching specific subject areas, their interpersonal behaviors, and teaching self-efficacy has shown to have a direct impact on students' academic performance (Abudu & Gbadamosi, 2014; Hartman, 2014; Lumpe et al., 2012). At an early age, these particular factors can influence students' choice to engage in specific subject areas, such as

science, as well as, affect their decisions to pursue careers in STEM-related fields. Research done by Zeldin & Pajares (2000), Hill, Corbett, & St Rose (2010), and Mosatche, Matloff-Nieves, Kekelis, & Lawner (2013) concluded that the lack of students entering STEM-related careers was due to lack of confidence in STEM success, lack of interest in STEM topics, and science teacher or mentor influence. Furthermore, teacher influence has been a major factor in determining student interests and pursuit of certain career fields. Hall, Dickerson, Batts, Kauffmann, and Bosse (2011) sought to determine what specific factors influence a student's decision to pursue a career or interest in STEM-related fields. Teacher confidence and knowledge of science and STEM career options as well as teacher encouragement rated the highest in determining if students became interested and pursued STEM careers. Teacher confidence, motivation, and self-efficacy, which can affect classroom learning environments, student-teacher relationships and a student's self-confidence, are timeless factors that influence student learning, interests, and career choices. Also, there is a positive correlation between elementary teachers who participated in intense STEM professional development programs to increased teacher self-efficacy and beliefs, which positively affects student learning outcomes (Lumpe, 2012). Further research of these factors is imperative to aid in constructive resolutions to encouraging more minorities and women to pursue STEM-related career fields.

Gender Gaps, Academic Achievement, and STEM

Gender gaps in the areas of math and science achievement, types of courses taken, and career paths have been of great interest for the past 40 years. The lack of gender equity and the underrepresentation of minorities in science-related fields have been an ongoing discussion among educators, scholars, law and policymakers, and the general public (Crump, Ned, & Winkleby, 2015; Sherman & Fennema, 1977; Jacobs, 2005). Reports of gender gaps between

males and females, in the area of science, have steadily increased as students progressed from middle to high school (Jones, Mullis, Raizen, Weiss, & Weston, 1992; Miyake et al., 2011; Xie, Fang & Shauman, 2015). Over the past thirteen years, there has been no improvement in the amount of women pursuing careers in STEM (Hemphill & Vanneman, 2011; Georgia Department of Education, 2013; Wong, 2015). According to the Census Bureau's 2009 American Community Survey (ACS), women represented only 24% percent of STEM jobs, but compromises more than 48% of the total U.S. workforce (U.S. Department of Education, 2010). Although gender gaps exists, this study will add to the body of knowledge by examining the impact of students' perceived science self-efficacy; perception of teacher interpersonal behaviors as factors that can influence science GPA, while controlling for demographics, defined as, gender, ethnicity, and minority status of twelfth grade students in a highly diverse urban Title I high school.

Britner and Pajares (2006) previously suggested that science self-efficacy was the only variable in motivating middle school student's science achievement, and girls were found to have higher level of self-efficacy in science than the boys across all grade levels, specifically, grades six to eight. Conversely, Hong and Lin (2013) investigated the self- efficacy of 11th grade male and female high school students in relation to its impact on academic achievement. He found that male students displayed higher perceived self-efficacy than females in a high school chemistry course (Hong & Lin, 2013). The lack of research on gender gaps, as it relates to self-efficacy toward science achievement, as well as, minimum studies being conducted in high school settings, specifically, diverse Title I high schools, further warrants the need for this study.

In recent years, efforts have been made to close gender gaps through educational reform and changes among policymakers, however; studies have shown mixed results in regards to

gender gaps within science achievement (Bohrnstedt, 2013; Hong & Lin, 2013; U.S. Department of Education, 2010). According to the National Research Council (2012), in a standardized science test measuring academic growth, there were differences between males and female science achievement scores as they progressed from kindergarten through high school. Females performed on or above grade-level on science coursework compared to their male peers, however, on standardized tests measuring for mastery of the science content, they were being out performed by males (Ingels & Dalton, 2008). Despite some studies showing the decline in gender differences in science performance (Bohrnstedt, 2013; Hong & Lin, 2013; Ingels & Dalton, 2008), the underrepresentation of females in many science-related fields is still apparent (Jacob, 2005; Wong, 2015). A factor that attributes to the lack of females pursuing degrees and careers in science, technology, engineering, and mathematics (STEM) fields is partly due to the differences in science-related course success at all grade levels within secondary education and at the collegiate level, consequently affecting science self-efficacy and confidence (Hazari, Tai, & Saddler, 2007; Wong, 2015). Moreover, there are additional factors that can contribute to differences in course performance between male and female high school students within science courses.

Gender gaps in science-related courses were found to grow as students matured and moved on to high school, with females experiencing larger disadvantages (Bacharach, Baumeister, & Furr, 2003; Young & Fraser, 1994; Wong, 2015; Xie et al., 2015). A recent study by Larson et al. (2014) investigated the self-reported efforts of male and female students in two Asian Indian high school populations in predicting chemistry and physics achievement. The researcher examined the students' self-report efforts after controlling for the following: for gender, prior achievement, math and science self-efficacy and interest. Female students' level of

interest did not show any correlation to their academic achievement, compared to males whose high levels of interests in physics and chemistry did correlate to higher achievement scores. The findings in this study can further help researchers determine internal and external factors that can contribute to the underrepresentation of females in science-related majors and careers.

Gender gaps in science performance can be attributed to many other factors that may hinder academic success in science, or the decision to pursue science-related fields, such as emotions, confidence, motivation, self-value, and self-efficacy. Emotional factors can have an underling effect on student perceptions and choice educationally, vocationally, and personally (Skinner & Belmont, 1993; Pekrun, Goetz, Titz & Perry, 2002; Reeve, 2013). Eccles et al. (1993) developed the expectancy value model, which revealed that an individual's choice is strongly effected by their values and self-efficacy, or self-concepts of ability. A study conducted by Simpkins, Davis-Kean and Eccles (2006) indicated that males had higher self-concept of science ability and value compared to females, and score almost equally on standardized assessments. Moreover, these males tend to select more difficult math courses later in their academic careers. Therefore, it is imperative that gender gaps in science be closely examined to further investigate the myriad of factors that can contribute to the attrition of females in STEM careers.

Negative attitudes and the lack of confidence in science abilities impacted, by gender-biased stereotypes, maybe another factor that has influenced the amount of females who pursue degrees in STEM fields (Gunderson, Ramirez, Levine & Beilock, 2012; Xie et al., 2015). Additionally, teachers may unintentionally cause females to feel they are incapable of performing well in science, by giving more attention to male students in class; this was examined by researchers conducting a randomized double-blinded study of science faculty members at a

well-known research university (Moss-Racusin, Dovidio, Brescoll, Graham, & Handelsman, 2012). These gender-biased classroom practices have shown to negatively impact female learning outcomes in science (Gunderson et al., 2012), and their pursuit of STEM-related majors and careers (Moss-Racusin et al., 2012). In addition, females that do enter into STEM-related career fields are minorities, and find themselves isolated around a male dominated environment (Pollack, 2013).

Females that do enter science majors are likely to exhibit high self-confidence and expectations of themselves, have a strong network of family and friends, and are prepared academically for the rigor (Hemphill & Vanneman, 2011; Every Student Succeeds Act of 2015, 2015-2016). Despite the high expectation and self-confidence exuded by females with science majors in college, a plethora of environmental factors can work to lower their self-efficacy toward science and impact science achievement negatively (Society of Women Engineers, 2008; Wang & Degol, 2013). These factors can cause female undergraduates to lose interest, diminish their science self-efficacy, lower expectations for success, compared to their male counterparts, ultimately impacting perseverance to obtain the degree (Simpkins, Davis-Kean, & Eccles, 2006; Xie et al., 2015; Xie, Shauman, & Shauman, 2003;). These negative factors are crucial to the success of females in scientific-related fields and can continue to widen the gender gap.

Furthermore, a solution to narrowing the gender gaps in science achievement will be by increasing females' science efficacy, performance, and interest in science (Xu, 2008) as well as increasing the emphasis on hands-on science instruction in schools, according to major reform advocates (Lee & Burkam, 1996). In a study that examined female students enrolled in science and math advanced placement courses, Tyson, Lee, Borman, & Hanson (2007) suggested that to encourage female participation and interest, cooperative learning rather than competitive

motivation techniques should be implemented. Overall, there are many factors that contribute to gender gaps in science achievement and science-related career fields, specially STEM, however, with continued research and the change in focus of educational reform, narrowing the gap is promising in the near future.

Summary

Research examining the impact of perceived science self-efficacy and student perception of teacher interpersonal behaviors in understanding student-teacher relationships, as factors that contribute to science achievement, is extensive. However, achievement and gender gaps are still prevalent, especially among minorities and low socioeconomic disadvantaged individuals, despite many efforts to alleviate the problem. NCLB (No Child Left Behind Act of 2001, 2002) increased accountability of students, teachers and school districts to ensure that every child may have a quality education, and took action on closing the achievement gaps among gender, race, ethnicity, and SES. However, the legislation did not take into account the variety of outside factors that affect academic achievement, such as social, cultural, emotional, behavioral and cognitive factors. Furthermore, the underrepresentation of females and minority students participation in science-related majors and STEM careers, continue to rise despite reform efforts (Shapiro et al., 2013; Wang, 2013; Xu, 2008). It is anticipated that the results and findings from this particular study can add knowledge to the growing body of literature on the impact of science self-efficacy and student perception of teacher interpersonal behaviors on science achievement among more diverse populations. Additionally, there is little research information about how student perceptions of teacher interpersonal behaviors are predictors of perceived self-efficacy and science achievement among highly diverse urban Title I high school students; therefore, findings from this study can provide a distinctive perspective to recent philosophy.

CHAPTER THREE: METHODOLOGY

Overview

The purpose of this predictive correlational study will be to test the strength of relationships between two variables: self-efficacy and teacher interpersonal behaviors, which will be measured by Smist's (1993) Science Self-Efficacy Questionnaire and Wubbels' (1993) Questionnaire for Teacher Interaction, respectively, as influential factors in science achievement among diverse Title I high school students, while controlling for age, grade level, and science courses taken. Twelfth grade students enrolled at a diverse Title I high school within an urban school district in a large southeastern city will be surveyed to measure the relationship of the of predictor variables, science self-efficacy and student perceptions of teacher interpersonal behaviors, upon student academic achievement in science, which will be the criterion variable. A non-experimental hierarchical multiple linear regression analysis, with a convenience sample of high school seniors at an urban diverse Title I school, will be used to determine the relationship between the predictor variables and the criterion variable. This chapter will present the research questions and hypotheses, experimental design, participants, setting in which the study will take place as well as include information on instrumentation, experimental procedures, and data analyses.

Design

A non-experimental, predictive correlational research design, will be utilized in this quantitative study to examine if a predictive relationship exists between the variables of student perceptions of teacher interpersonal behaviors and perceived science self-efficacy, as it relates to science achievement, while controlling for demographics, which is defined as gender, age, and ethnicity. Because this non-experimental design will be used, it allows for limited bias and

ethical issues as well as evaluating theoretical differences and relationships to foster theory and practice (Gall et al., 2007). Furthermore, a predictive correlational research design will be chosen because it will allow for any relationships that may exist between variables be identified and can provide information concerning the degree of the relationship between variables being studied (Gall et al., 2007; Warner, 2013). Also, statistical significance within this design cannot imply cause-and-effect relationships (Gall et al., 2007). Therefore, a correlational coefficient will be used to determine the strength of relationships among variables within this study. Similar studies have used this research design to investigate strength of relationships between variables (Andrew, 1998; Britner & Pajares, 2006; Wentzel, 2012; Zhang, Solmon, & Gu, 2012; Larson et al., 2014).

Research Question

A non-experimental, predictive correlational design will be utilized to "analyze the relationship among a large number of variables in a single study" (Gall et al., 2007, p. 336). Specifically, a hierarchical multiple linear regression analyses will be used, due to having two predictive variables with sublevels, one being categorical and the other continuous, as well as, having only one criterion variable, science achievement, which is a continuous variable. The research question for this study is as follows:

RQ1: Is there a predictive relationship between student demographics, perceptions of teacher interpersonal behaviors, as measured by the Wubbels (1993) Questionnaire for Teacher Interaction, and science self-efficacy, as measured by the Smist (1993) Science Self-Efficacy Questionnaire, and science GPAs?

Null Hypotheses

The following are the null hypotheses for this study:

H_o1: There is no statistically significant predictive relationship between students' demographics, defined as gender, ethnicity, and minority status; and students' science GPAs.

H_o2: There is no statistically significant predictive relationship between students' perceptions of teacher interpersonal behaviors and students' science GPAs, while controlling students' demographics, defined as gender, ethnicity, and minority status.

H_o3: There is no statistically significant predictive relationship between students' demographics, defined as gender, ethnicity, and minority status; students' perceptions of teacher interpersonal behaviors and students' science self-efficacy and students' science GPAs.

Participants and Settings

The participants in this study were twelfth grade students from a diverse Title I public high school in a large southeastern metropolitan city. Convenience sampling was used to obtain participants from a population of 388 twelfth grade students enrolled in a science course during the 2016-2017 school year. The range of ages of the participants were between 17-18 years old, which is the common age range for twelfth grade high school students in the United States.

The high school in which this study took place is located within an urban inner city school district. More than 71% of the high schools in the county in which this school districted is located are Title I and within the urban area of Atlanta more than 84% of the schools are considered Title I, indicating that more than 60% of the students are eligible for free or reduced lunch (U.S. Department of Education, 2010). This research study was conducted within a Title I high school which received an achievement score of 79.8 out of 100 on the College and Career Readiness Performance Index (CCRPI) (Georgia Department of Education, 2015), and serves

approximately 1,821 students from diverse backgrounds in grades nine through 12. More than 60% of the students within this school receives free or reduced price lunch. The student population consists of 41% African Americans, 32% Whites, 20% Hispanic/Latino, 3% Two or more races, 2% Asian, and <1% American Indian/Alaska Native or Native Hawaiian or other Pacific Islanders. Because the school has been identified as Title I, it receives additional government funding and resources to supplement the need of the students and the school. By selecting this school, one can see the impact of a students' perception of teacher interpersonal behaviors and self-efficacy among a high ethnically diverse population, and determine its impact on positively promoting self-efficacy towards learning and increasing student achievement in science. Descriptive data for this sample population is presented in the following tables:

Table 2

Frequency and Percent of Diverse Title I High School Population (N = 1821)

Characteristic	Category	*N*	*%*
Gender	Male	902	49.5
	Female	919	50.5
Ethnicity	White/Caucasian	595	33
	Black/African American	735	40
	Hispanic/Latino	386	21
	American Indian/Alaska Native	0	0
	Asian/Asian American	42	2
	Native Hawaiian/Other Pacific Islander	2	<1
	Two or more races	61	3
Grade	09	532	29
	10	485	27
	11	416	23
	12	388	21
Eligibility for	Free/Reduced Lunch	970	59
Title I	n/a	746	41

Table 3

Frequency and Percent for Twelfth Grade Sample Population (N = 388)

Characteristic	Category	*N*	%
Gender	Male	183	47
	Female	205	53
Ethnicity	White	151	39
	Black/African American	159	41
	Hispanic/Latino	59	15
	American Indian/Alaska Native	0	0
	Asian/Asian American	9	2
	Native Hawaiian/Other Pacific Islander	0	0
	Two or more races	10	3
Eligibility for Title I	Free/Reduced Lunch	233	60

Instrumentation

Two instruments were used to measure the predictor variables, student perceived science self-efficacy and student perception of teacher interpersonal behaviors. In this study, the predictor variables will be science self-efficacy and student perception of teacher interpersonal behaviors. The criterion variable will be the participants' science GPAs. The Questionnaire for Teacher Interaction (Wubbels, 1993) and the Science Self-Efficacy Questionnaire (Smist, 1993) were administered to students in this study. The accepted Cronbach's alpha threshold range is between .70 to .95; therefore, to determine the reliability for each subscale used in this study, a Cronbach's alpha threshold of .70 was utilized (Gall et al., 2007; Tavakol & Dennick, 2011).

Predictor Variable

Questionnaire on Teacher-Student Interaction. To measure the predictor variables, the Questionnaire on Teacher-Student Interaction (QTI) was utilized. The survey is designed to measure teacher behaviors inside the classroom and their interactions with students. The questionnaire can be administered to students or teachers to assess perceived student-teacher interactions. Wubbels et al. (1991) collaboratively developed the Model for Interpersonal Teacher Behaviors (MITB), which eventually evolved into the QTI (Wubbels, 1993). The Questionnaire for Teacher Interaction (QTI) was initially developed in the Netherlands; however, later a 64-item American version was constructed in 1988 and further revised in 1991 (Wubbels & Levy, 1991; Wubbels, 1993). The American version of this survey was used in this study. Permission to use this instrument was requested and granted (see Appendix B).

The American-QTI is a five-point Likert scale composed of 64 items (1-Never to 5-Always). The 64-item questionnaire consisted of eight subscales with each containing 8 items: leadership, help/friendly, understanding, student responsibility/freedom, uncertain, dissatisfied, admonishing, and strict. According to the Model of Interpersonal Teacher Behaviors (Wubbels, 1985), teacher behaviors are grouped in two dimensions: Proximity, which measures cooperation versus opposition and the Influence dimension, which measures dominance versus submission. The four domains addressed by Wubbels' (1993) QTI are dominance, submission, opposition, and cooperation. The domains are further divided into eight subscales: which are measured in the QTI: leadership, helping/friendly, understanding, student responsibility or freedom, uncertain, dissatisfied, admonishing and strict (Lourdusamy & Swe Khine, 2001; Wubbels, 1993).

The eight subscales of the QTI each contains eight questions. Total scores in this survey can range from 64 to 320, with each subscale scores ranging from eight to 40. The scores

obtained within each subscale will indicate the strength of the behaviors observed by each student with higher scores indicating the student perceives the teacher to display the behavior often or always, while lower scores indicate the teacher seldom or never displays the behavior. The homogeneity of each of the eight subscales for the American version of the QTI returned an internal consistency (Cronbach's alpha) that ranged from 0.76 to 0.88 (Wubbels & Levy, 1991). Furthermore, several studies have been conducted on the reliability and validity of the QTI. The reliability and validity in each study was found to be satisfactory with a Cronbach's alpha above 0.70 for each subscale (Wubbels, 1993; Wubbels, Brekelmans, den Brok, & Tartwijk, 2006; Wubbels & Levy, 1991).

Science Self-Efficacy Questionnaire. To measure student's perceived science self-efficacy, specifically, their confidence in performing science tasks, the students' total composite scores on the SSEQ (Smist, 1993) were used. The Science Self-Efficacy Questionnaire (SSEQ) was originally developed by Smist (1993) to assess high school students' self-efficacy in science. The SSEQ is a five-point Likert scale composed of 27 items (1- Never to 5- Always), which consist of four domains: biology self-efficacy, physics self-efficacy, chemistry self-efficacy and laboratory self-efficacy. Each of these domains consist of statements that measures the level of confidence in each specific subject area, such as biology self-efficacy (i.e. "understanding concepts in a biology textbook"). A response of one (1) will indicate "very little" and a response of five (5) will indicate "quite a lot." The SSEQ composite score can range from 27-135, in which, a higher score will indicate a higher level of confidence and a lower score will indicate a lower level of confidence (Smist, 1993). Within each subscale, each specific science subject level has varying ranges of scores depending on the number of items. The biology self-efficacy subscale has a score range of 8-40 (eight items); the physics self-efficacy subscale has a score

range of 5-25 (five items); the chemistry self-efficacy has a score range of 7-35 (seven items); and laboratory self-efficacy having a score range of 6-30 (six items).

The validity and reliability of the SSEQ were examined in a previous study (Smist, 1993). A pilot study of 826 high school participants was conducted in June of 1992 to investigate the reliability and validity of the instrument. An exploratory principal factor analysis with both oblique and orthogonal rotations was used to validate this instrument, and "four factors were extracted, explaining 89% of the item covariance; the oblique rotation gave the most satisfactory interpretation" (Smist, 1993, p. 5). In addition, Cronbach's alpha estimates for the four scale scores were determined to be satisfactory: biology self-efficacy (eight items), 0.87; physics self-efficacy (five items), 0.93; chemistry self-efficacy (seven items), 0.85; and laboratory self-efficacy (six items), 0.90 (Smist 1993; Smist & Owen, 1994; Smist, Archambault & Owen, 1997).

The science self-efficacy scale (1993) has been also cross-validated with studies using different grade levels, ethnicities, across various countries, and sample sizes (Miller, 2006; Sahranavard & Hassan, 2012; Smist, 1994). Sample populations used in some studies were different from the original field test. Therefore, by conducting the same factor analysis as done by Smist in 1993, verification of reliability of the SSEQ instrument for use with more diverse populations was presented, "especially when used with a sample *N* of one hundred students or more" (Smist, 1996). This further verifies the reliability of this test for the diverse sample populations presented in this study. Table 5 describes the description of both instruments. The SSEQ can be found in Appendix F.

Criterion Variables

Science achievement. Students' academic achievement in science is the criterion variable in this study. Specifically, science achievement was measured using the participants' science Grade Point Averages (GPA) calculated based upon their previously taken science courses in biology, chemistry, and physical science or physics. Biology is taken in the ninth grade, chemistry is taken in the tenth, and students have the choice to take physics or physical science in the eleventh grade. Once students reach the twelfth grade, they are able to take any science course not previously taken to fulfill the fourth science course requirement for graduation (Georgia Department of Education, 2015). The science grade point averages range from zero to four, in which A-4, B-3, C-2, D-1, and F-0 was used to determine the numerical points earned for each science course taken. The grade of A or B will be equivalent to a numerical score of four or three, respectively. Then an average of all science courses completed by each twelfth grade student will be calculated to determine their science grade point averages. Previous researchers have conducted studies using GPAs of participants as a variable for measuring student achievement (Becker and Gable, 2009a; Britner & Pajares, 2006; Nugent, 2009; Taylor et al., 2014) and, thus, the use of GPAs for measuring achievement has been deemed acceptable within educational research literature. Below is an overview of the measurement instruments used in this study.

Table 4

Description of Measurement Instruments

	Construct Measure	Format	Validity	Score Range	Scale
QTI	Teacher interpersonal behaviors	Survey, 5-point Likert-scale	Cronbach's α = 0.76-0.88	64-320	64-item (8 subscales)
SSEQ	Self-Efficacy	Survey, 5-point Likert-scale	Cronbach's α = 0.85-0.93	27-135	27-item (4 subscales)
Science Achievement	Academic performance	GPAs		0-4.0	3 science subject areas

Procedures

Approval to conduct this study was obtained from the principal of the participating school and the superintendent of the school district. Also, approval from Liberty University's Institutional Review Board (IRB) was obtained before data the collection process. Consent forms to all participants that were under the age of eighteen were dispersed to be signed by both parent and participant. Participants had one week to return parent consent forms to the researcher. Surveys were then administered by the researcher during the first semester of the school year to participants in their science classes. This study was conducted during the 2016-2017 academic school year and examines students' perceived science self-efficacy, perception of teacher interpersonal behaviors, and science grades from previous years, as described below.

Because this sample population was conveniently accessible and in close proximity to the researcher, convenience sampling was used (Gall et al., 2007). A sample of 157 students were taken from a population of 388 twelfth grade seniors enrolled in a diverse Title I public high school composed of 1,821 students overall in grades nine through 12. There was a participant

response rate of approximately 44%, however, due to incomplete and missing item responses on sections of the questionnaires, some responses were excluded from the study. Most participants in this sample population will have completed all three science courses, biology, chemistry, and physics or physical science before entering the twelfth grade. Students will indicate on the questionnaire what course they have previously taken. To ensure participants have completed all required science courses for this study, verification was obtained from the twelfth grade counselor. Also, this will allow for the collection of accurate data in this study. Students who do not meet the course requirements was not utilized in the study.

Consent forms was given to all participants by the researcher to be signed and dated by their parent or guardian and themselves. Participants had one week from when the consent forms were distributed to be returned. Once signed forms were returned, the study continued. A list of students who will not participate in the study was kept to ensure that any of their data is not used in the study. For identification purposes, students included their Student Identification Number (SIN), which is assigned to each student entering the school district, on their surveys and the parent/participant consent forms. This identification number linked to the student's name for data collection purposes only and to ensure the collection of the correct science GPAs and previous courses taken. Research bias will be limited and the need to maintain confidentiality was upheld. The researcher does not know any of the participants in the study and all questionnaires, consent forms, and data was securely stored in sealed folders and locked in a storage space at the researcher's residence. Once the surveys are completed the SIN numbers was used to verify and compare participants' demographics, science grades, and previously taken science courses provided on their questionnaires. This step of the data collection process was critical, due to the fact that linking the SIN numbers to the surveys identified the participants'

gender, official grade level, and survey results as well as their previously taken science courses and grades. This allowed for the researcher to calculate each student's science GPA. Spread sheets was used to organize the data collected using Excel and all data was kept on a password-secured computer. Participants' previously enrolled science courses and grades were collected from the school's guidance counselors. All forms that included student names was immediately placed in a sealed folder and stored away in a locked storage place in the researcher's resident until the completion of the research. Once all information was organized in Excel and the data collection process was fully complete, the sealed folders containing the student information was shredded and destroyed. All participants are now identified by a new participant number, which were assigned by the researcher, to limit bias and maintain confidentiality.

Participants took two questionnaires using paper and pencil within their science class. The two individual questionnaires, specifically, the QTI and SSEQ were administered and consisted of a demographic section, which asked the participants to provide their age, gender, ethnicity, and previous science courses taken. Each class period is 90 minutes, in which 15-20 minutes was utilized to administer surveys. To increase the level of accuracy and truthfulness of student responses, the science teacher was not present in the class during the administration of the questionnaires to minimize possible distractions and influences (Kays, Gathercoal, & Buhrow, 2012). Upon completion of the questionnaires, the researcher transcribe all responses into an Excel spreadsheet to increase efficiency for statistical analysis and all data was kept on a password-secured computer to ensure confidentiality.

Statistical Package for the Social Sciences (SPSS) was utilized to examine the predictive relationship between a student's perception of teacher interpersonal behaviors and perceived science self-efficacy as factors that can influence science achievement, as well as, demographics

defined as, gender, ethnicity, and minority status. Age, grade level, and previous science course taken were control variables in this study. Data was then inputted into the SPSS. This software was used to help the researcher analyze data, create charts, and construct diagrams for this study. Furthermore, the students that did not participate in this study were not penalized and were allowed to participate in other activities during survey administration.

Data Analysis

The SSEQ (Smist, 1993) and QTI (Wubbels, 1993) survey data, science GPA, and demographics was analyzed using a non-experimental predictive correlational design, specifically a hierarchical multiple linear regression analysis. In order to establish relationships between predictor variables of perceived science self-efficacy and student perception of teacher interpersonal behaviors with a criterion variable of science achievement when controlling demographics, defined as gender, ethnicity, and minority status; the predictive correlational study format was the most appropriate (Gall et al., 2007). Because no treatments were applied to any of the participants; instead, existing conditions were investigated in order to explain relationships that may exist amongst the above variables, a correlational design is appropriate (Warner, 2013). Specifically, a hierarchical multiple linear regression analysis will be chosen to analyze this study because it allows for a researcher to predict one criterion variable from one or more predictor variables in which each variable or variables are added to the regression model in a specific order based upon the purpose and logic of the research (Gall et al., 2007; LoBiondo-Wood & Haber, 2010; Nieswiadomy, 2012; Tabachnick & Fidell, 2008).

According to Gall et al. (2007), “Correlational studies attempt to understand patterns of relationships among variables and compute a correlation coefficient” (p. 101). To have reliable and valid data for statistical power with medium effect size, an estimation of the samples size

will be calculated. Using the equation $N \geq 104 + k$ (N is the minimum sample size and k is the number of predictor variables in study), a minimum sample size of 106 participants will be needed for the design used in this study (Warner, 2013). However, based upon previous studies using the aforementioned questionnaires, the SSEQ requires a minimum sample size of 112 to increase statistical power. To ensure reliability, the QTI requires a minimum sample size of 106 based upon the equation used above.

The data was disaggregated and analyzed using the Statistical Package for Social Scientists Version 24 (SPSS) to answer the research question as well as reject or fail to reject the hypotheses in this study. All statistical tests were conducted at an alpha level of significance of $p < .05$ and were used be reject the H_o for all analyses in this study. Descriptive statistics were determined for all research variables as well. Mean scores, standard deviations, frequencies, and percentages were calculated for all nominal, ordinal, and continuous variables. Furthermore, total composite scores for the QTI and SSEQ were analyzed in this study to address the research question. The following is a review of the data analysis procedures, which were utilized to assess the research questions.

A hierarchical multiple linear regression was conducted to assess if the predictor variables influence the criterion variable within this study. The standard method enters all predictor variables simultaneously into the model with five blocks. The independent variables included the total composite scores of the SSEQ, which measures perceived self-efficacy and the total composite scores of the QTI, which measures students' perception of teacher interpersonal behaviors. The dependent variable is science GPAs. Also, demographics, defined as, gender, ethnicity, and minority status will be controlled for and entered into the analysis as well. Variables in this analysis was evaluated by what they added to the prediction of the criterion

variable which is different from the predictability afforded by the other predictors in the model. The *F*-test was used to assess whether the set of independent variables collectively predicts the dependent variable. *R*-squared, the multiple correlation coefficient of determination, was reported and used to determine how much variance in the dependent variable can be accounted for by the set of independent variables (Nathans, Oswald, & Nimon, 2012).

In addition, assumptions were investigated prior to the analysis of data to examine the levels of homoscedasticity, linearity, singularity, normality, multicollinearity, and outliers. A bivariate scatterplots were used to evaluate linearity and homoscedasticity, specifically to ensure a linear relationship exists between variables in this study (Field, 2009; Harlow, 2014). A scatterplot of residuals was also used to assess normality, outliers, and homoscedasticity (Field, 2009; Harlow, 2014). Normality was tested by the creation of histograms from collected data in order to assess the overall distribution of data to account for random error (Rovai, Baker, & Ponton, 2013). To check for multivariate outliers, a measure of influence was tested using a Cook's distance greater than 1 and Mahalanobis distance (Field, 2009). Values with a Cook's Distance >1.0 and a Mahalanobis distance above the critical chi-square value are causes for concern and were removed prior to analysis (Field, 2009; Rovai et al., 2013; Tabachnick & Fidell, 2008). To check for high correlations among predictors variables, which can lead to unreliable and unstable estimates of regression coefficients, a Variable Inflation Factor (VIF) was calculated and examined to determine multicollinearity (Field, 2009; Harlow; 2014; Rovai et al., 2013). Individual VIFs that are less than 10 is highly preferred to consider the assumption tenable, and average VIF should be close to 1.0 (Harlow, 2014; Warner, 2013). Higher levels of VIF indicates high multicollinearity which can have an adverse effect on the results.

In this study, the probability of rejecting the null hypothesis when it is true was set at $p < 0.05$. This will ensure a 95% certainty that the differences between groups did not occur by chance. If significant relationships between variables within this study are found, educators can use this invaluable information to assist them in identifying strategies and obtaining resources that can increase student-teacher interactions and students' science self-efficacy which can positively influence science achievement. An overview of the test of statistical analysis is displayed in Table 5 below.

Table 5

Organization of Statistical Analysis of Data

Statistical Test	Purpose
Hierarchical Multiple Regression	Analysis of hypotheses for research question
Bivariate Scatterplot and correlation coefficient	Linearity, singularity, homoscedasticity, multicollinearity, and correlation
Histogram	Normality
P-P scatterplot	Normality and outliers
VIF	Multicollinearity
Mahalanobis and Cook's Distance	Extreme outliers
Cronbach's alpha coefficient	Reliability of measurement instrument

Summary

A non-experimental predictive correlational analysis was used to investigate the research question in this study. High school students in a highly diverse Title I school from an in urban school district, located within a large southeastern metropolitan city, were participants in this study. The twelfth grade participants were administered two questionnaires: the 27-item SSEQ (Smist, 1993) and the 64-item American version of the QTI (Wubbels, 1993). The

questionnaires measured the participants' perceived science self-efficacy and perceptions of teacher interpersonal behaviors, respectively. The total composite scores for the SSEQ and QTI were used as predictor variables. The criterion variable was science achievement, in which participants' science GPAs were utilized for measurement.

In Chapter Four, the finding of this study is presented. The researcher includes descriptive statistics for each statistical analysis, including the number of participants, gender, age, ethnicity, and minority status. For the research question presented, statistical tests are explained with results. The researcher will also explain whether the null hypothesis was accepted or fail to be accepted.

CHAPTER FOUR: FINDINGS

Overview

The aim of this non-experimental predictive correlational study is to determine if students' perceived science self-efficacy and perception of teacher interpersonal behaviors factors that influence science achievement in a diverse Title I high school, while controlling for gender, ethnicity, and minority status. Due to the current push to increase minority participation in STEM-related careers and fields of study (Estrada et al., 2016; Landivar, 2013; Mustaq, 2012; Shirley, Corkin, & Martin, 2016), this study was timely. In addition, this study provides relevant literature and adds to the body of knowledge valuable information on the influence of student-teacher interactions and students' science confidence as collaborative factors that can impact science achievement among participants within a highly diverse urban high school setting. This chapter will restate the research questions and null hypotheses, and report descriptive statistics, assumptions of analyses, and results of the findings in order to reject or fail to reject the null hypotheses.

Research Questions

The following research question was investigated in this non-experimental predictive correlational study:

RQ1: Is there a predictive relationship between student demographics, perceptions of teacher interpersonal behaviors, as measured by the Wubbels (1993) Questionnaire for Teacher Interaction, and science self-efficacy, as measured by the Smist (1993) Science Self-Efficacy Questionnaire, and science GPAs?

Null Hypotheses

The null hypotheses for this study is as follow:

H_o1: There is no statistically significant predictive relationship between students' demographics, defined as gender, ethnicity, and minority status; and students' science GPAs.

H_o2: There is no statistically significant predictive relationship between students' perceptions of teacher interpersonal behaviors and students' science GPAs, while controlling students' demographics, defined as gender, ethnicity, and minority status.

H_o3: There is no statistically significant predictive relationship between students' demographics, defined as gender, ethnicity, and minority status; students' perceptions of teacher interpersonal behaviors; students' science self-efficacy; and students' science GPAs.

Descriptive Statistics

The participants for this study were drawn from a sample population of 388 twelfth grade students enrolled in a high ethnically diverse Title I high school located in a southeastern metropolitan urban school district during the 2016-2017 school year. Prior to analyses, all categorical data was entered into SPSS Version 24 and coded as either 0 or 1, such as male and female, respectively. Of the 388 twelfth grade students, 157 students participated in the study. Of the 157 participants in the study, there were more females than male, 59 (38%) identified themselves as male and 98 (62%) identified their gender as female. The ethnicity of the participants was 27 (17%) White, 77 (49%) Black/African American, 39 (25%) Hispanic/Latino, 14 (9%) Other. Additionally, 130 (83%) were categorized as minorities, and 27 (17%) were non-minorities, with minorities being defined as participants identifying themselves as Black/African American, Hispanic/Latino, and/or Other. All participants in this study were in the twelfth grade, and most were between the ages of 17 (56%) and 18 (39%), with 4% being 16 and one

participant being 19 years old. The descriptive statistics for student participant demographics are listed in Table 6 below.

Table 6

Descriptive Statistics for Twelfth Grade Student Participants (N = 157)

Variable	*n*	%
Gender		
Female	98	62
Male	59	38
Ethnicity		
Black	77	49
Hispanic	39	25
Other	14	9
White	27	17
Group		
Minority	130	83
Non-Minority	27	17

The participants' responses to the Science Self-Efficacy Questionnaire (SSEQ) and Questionnaire on Teacher Interactions (QTI) were also analyzed. The five-point Likert scale scores for the SSEQ and QTI were tallied to determine each participants' composite scores, respectively. SSEQ and the QTI were criterion variables in this study. The SSEQ composite scores yielded a mean score of 91.65 (*SD* = 20.62) with a minimum score of 27, maximum score of 135, and range of 108. This particular instrument has a composite score ranging from 27 to 135, where high scores suggest the participant has high self-efficacy and confidence in science. The QTI composite scores yielded a mean score of 178.92 (*SD* = 18.44) with a minimum score of 113, maximum score of 278, and range of 165. This instrument has a composite score ranging from 64 to 320 with higher scores suggesting more perceived student-teacher interaction and favorable teacher interpersonal behaviors. The criterion variable, science achievement, was

measured using participants' science GPAs from three previous science courses taken. Science GPA yielded a mean score of 2.69 (*SD* = 0.55) with a minimum score of 1.33, maximum score of 4.00, and range of 2.67. Table 7 displays the descriptive statistics based on minority status for the predictor and criterion variables.

Table 7

Summary of Means and Standard Deviation for Minority and Non-Minority Groups (N = 157)

	Minority			Non-Minority		
Variable	*M*	*SD*	*n*	*M*	*SD*	*n*
SSEQ Composite Scores	90.33	20.39	130	97.48	20.46	27
QTI Composite Scores	180.45	22.90	130	178.74	11.93	27
Science GPA	2.63	0.53	130	2.95	0.56	27

Assumption Testing

A hierarchical multiple linear regression analysis was conducted to assess whether a statistically significant predictive relationship exists between students' demographics, defined as gender, ethnicity, and minority status; students' perceptions of teacher interpersonal behaviors, as measured by the Wubbels (1993) Questionnaire for Teacher Interaction; and students' science self-efficacy, as measured by the Smist (1993) Science Self-Efficacy Questionnaire; and students' science GPAs. In an effort to determine whether the assumptions for conducting a hierarchical linear regression analysis were met, assumption testing for normality, homoscedasticity, singularity, linearity, multicollinearity, and extreme outliers were conducted using SPSS Version 24 prior to evaluating the relationships between the criterion variable (science GPA) and predictor variables (science self-efficacy and teacher interpersonal behaviors) while controlling for gender, ethnicity and minority status. Additionally, Cronbach's alpha coefficients were calculated for each scale used in the study in order to determine internal

reliability for each. A sample size of 157 was deemed adequate given more than two predictor variables to be included in the analysis (Tabachnick & Fidell, 2008).

Normality

The assumption of normality was assessed using a P-P plot (DeCarlo, 1997). For the assumption of normality to be met, the data points must follow a relatively straight line. Data points that are far from the diagonal suggest that normality should not be assumed. Visual inspection of the P-P scatterplot revealed a normal distribution of the residuals, suggesting the assumption of normality was tenable. Also, the inspection of the histograms for each predictor and criterion variable revealed normal bell curve, which also confirms that the assumption of normality was tenable. Figure 1 presents a P-P scatterplot of the model residuals. The histogram of the criterion variable and predictor variables are shown in Figure 2, 3 and 4, respectively.

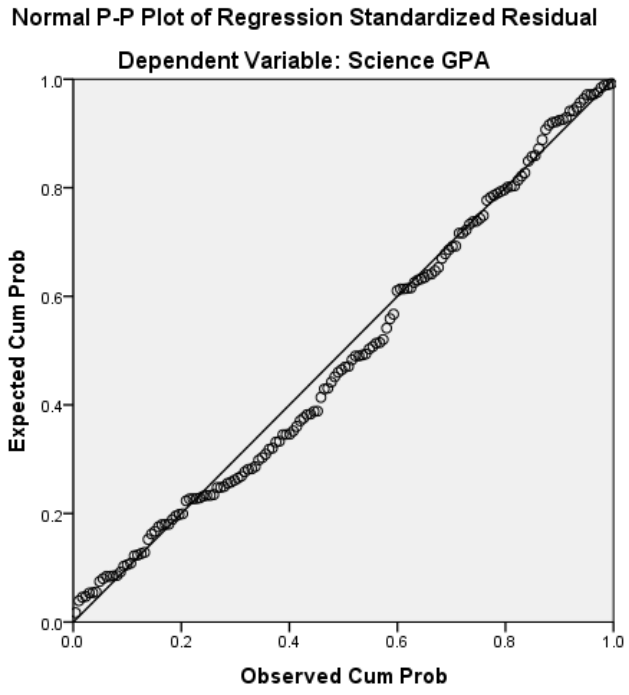

Figure 1. Normal P-P Plot of Regression of Standardized

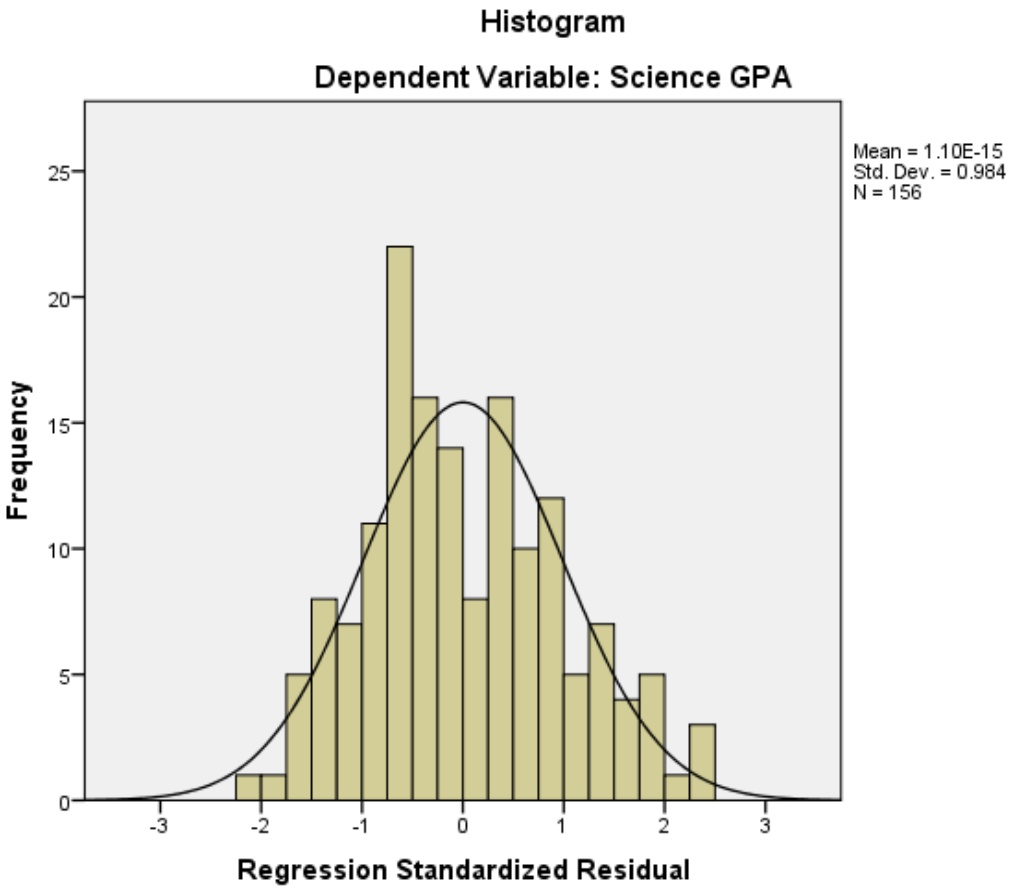

Figure 2. Histogram of Standardized Residual of Science GPA

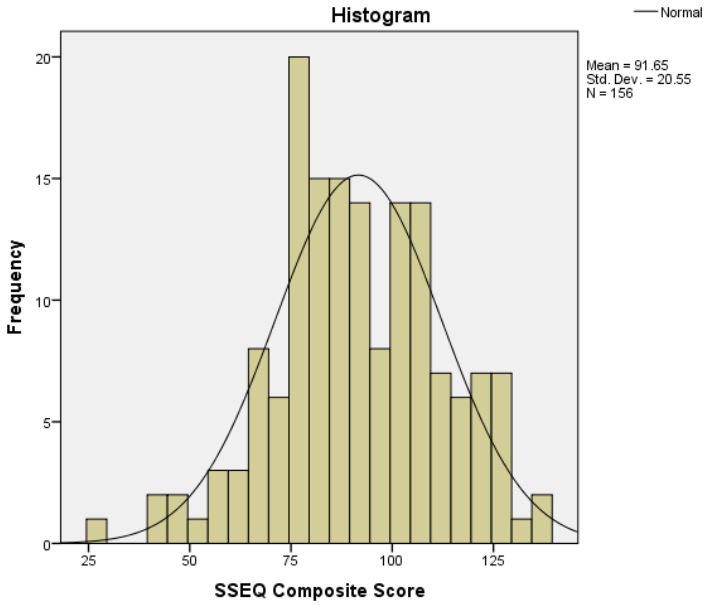

Figure 3. Histogram of Predictor Variable, Perceived Science Self-Efficacy

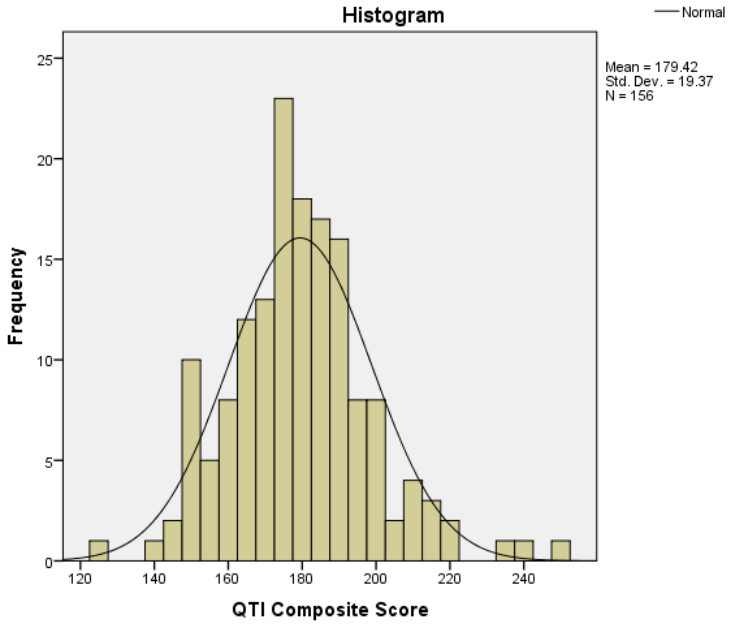

Figure 4. Histogram of Predictor Variable, Perception of Teacher Interpersonal Behaviors

Homoscedasticity and Linearity

The assumption of homoscedasticity was assessed by plotting the model residuals against the predicted model values using a bivariate scatterplot (Osborne & Walters, 2002). The assumption is met if the points appear randomly distributed and no apparent curvature (Warner, 2013). Figure 3 presents a scatterplot of predicted values and model residuals. Similar variances along the regression line with randomization was observed in the scatterplot and no curvatures were apparent, therefore the assumption of homoscedasticity and linearity was tenable. Figure 5 shows the scatterplot of the criterion variable.

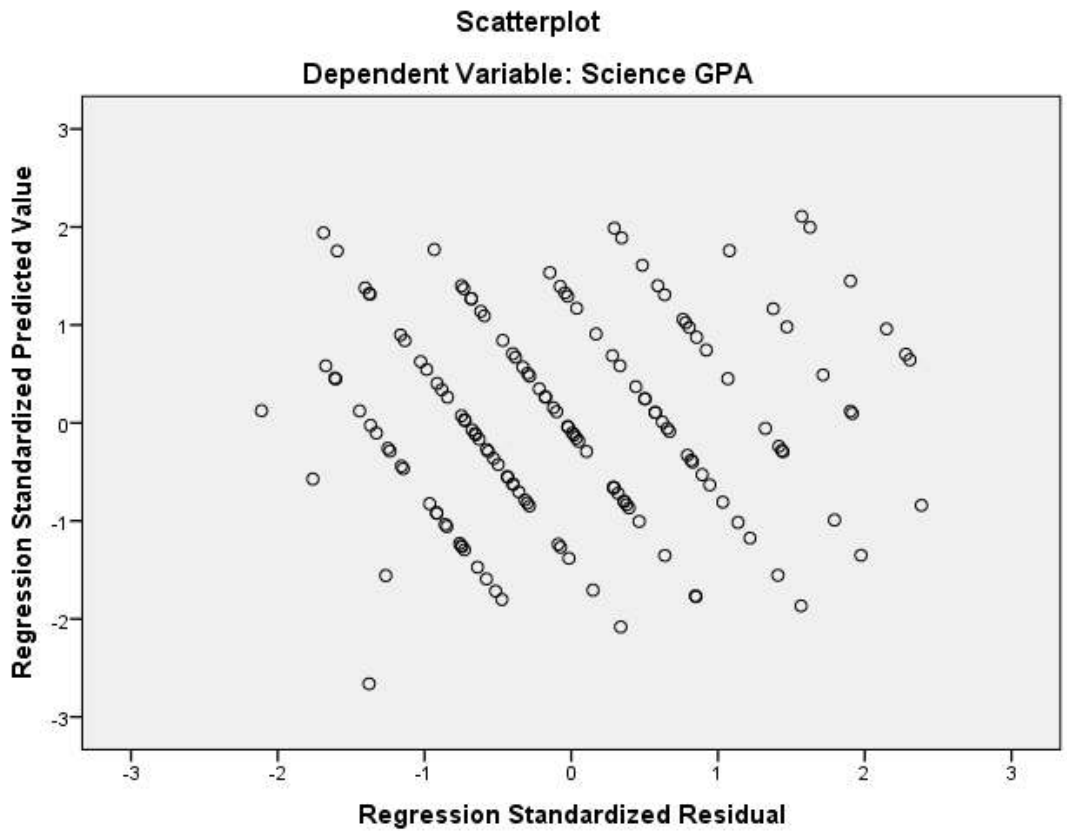

Figure 5. Bivariate Scatterplot of Criterion Variable, Science GPA

Multicollinearity

Variance Inflation Factors (VIFs) were calculated to detect the presence of multicollinearity between predictors. High VIFs indicate increased effects of multicollinearity in the model. Variance Inflation Factors greater than 5 are cause for concern, whereas VIFs of 10 should be considered the maximum upper limit (Menard, 2009). The VIF values for all of the variables were significantly below 10, and the tolerance values were all significantly greater than .10, thus the assumption of no multicollinearity was tenable (Warner, 2013). The table below displays the tolerance and VIF for each predictor variable and the control variables.

Table 8

Inter-Collinearity Statistics for Predictor Variables and Control Variables

Variable	Tolerance	VIF
Gender	.915	1.09
Ethnicity	.533	1.88
Minority Status	.521	1.92
SSEQ	.916	1.09
QTI	.975	1.03

Outliers

The potential presence of outliers were assessed using Cook's and Mahalanobias distance. Evaluation of the data set did not indicate a Cook's distance >1.0. Cook's distance of >1.0 would indicate concern (Field, 2009); therefore, no outliers were ascertained. A maximum Cook's distance of .067 was found and implies no significant problems with multivariate outliers within the data set. Likewise, the presence of outliers affecting the data within the three models was determined based on the Mahalanobis distance, which should not exceed the critical chi-square value of 20.52 for five variables (Tabachnick & Fidell, 2008). There was one case found that exceeded the critical chi-square value and removed from the data set.

Reliability

Cronbach's alpha coefficients of reliability were calculated for each of the full scales in order to determine the appropriateness of using each of the scales in the hierarchical multiple regression analyses. High internal reliability was present in each of the scales with Cronbach alpha coefficients ranging from .817 to .942. Cronbach's alpha coefficient for the Science Self-Efficacy Questionnaire was .942 and the Questionnaire on Teacher Interactions was .817. Due to the moderately high reliabilities for each of the full scales, these instruments and corresponding data were appropriate to use in the analyses (Tavakol & Dennick, 2011).

Table 9

Reliability Statistics for Measurement Instruments

Measure	Cronbach's Alpha	Number of Items
Science Self-Efficacy Questionnaire	.942	27
Questionnaire on Teacher Interactions	.817	64

Results

For this study, a five-block hierarchical multiple regression analysis was performed to test the hypotheses. The research question for this study examines the predictive relationship between students' demographics, defined as gender, ethnicity, and minority status; students' perceptions of teacher interpersonal behaviors, as measured by Wubbels' (1993) Questionnaire for Teacher Interaction; and students' science self-efficacy, as measured by the Smist (1993) Science Self-Efficacy Questionnaire; and students' science GPAs. The variables were placed into five separate blocks that resulted in five different models as displayed in Table 10 below.

Table 10

Hierarchical Data Blocks

Model	Hierarchical Regression Blocks	Variables
1	Block 1	Gender
2	Block 2	Ethnicity
3	Block 3	Minority Status
4	Block 4	Teacher Interpersonal Behaviors (QTI)
5	Block 5	Science Self-efficacy (SSEQ)

The following sections highlights the significant findings from the five-block hierarchical multiple regression analysis for each of the five models in regard to the research question and the related null hypotheses.

Null Hypothesis One

Null Hypotheses One states there is no statistically significant predictive relationship between students' demographics, defined as gender, ethnicity, and minority status; and students' science GPAs. Model 1, 2 and 3 examined how the variables of demographics were added to the regression model for the prediction of science GPA. Gender, ethnicity, and minority status are categorical variables and were numerically coded prior to the multiple regression analysis as follows: Male (1), Female (2); White/Caucasian (1), Black/African American (2), Hispanic/Latino (3), and Other (4); Minority (1) and Non-minority (2). As a result of Block 1 gender was statistically significant, with $F(1, 154) = 4.85$, $p = .03$. Thus, gender explains 3.1% of the total variance in science GPA, with $R^2 = .031$. In Block 2, the addition of ethnicity was evaluated and did reach statistical significance, $F(2, 153) = 3.27$, $p = .04$, $R^2 = 0.041$. However, the R^2 change was not statistically significant ($\Delta R^2 = .010$), with $F(2, 153) = 1.67$, $p = .199$. Thus, the addition of ethnicity did not result in a statistically significant change in the explanation of the variance and explains 1% of the variance in science GPA. In Block 3,

minority status was evaluated and did reach statistical significance explaining for 5.7% of the variance in science GPA, $F(3, 152) = 5.50$, $p = .00$, $R^2 = .057$. Overall, Model 3 explains 9.8% of the total variance in science GPA with $R^2 = .098$. Gender and minority status individually explaining 5.7% and 3.1% of the variance in science GPA, respectively, and ethnicity contributing only 1% of the variance.

Gender and minority status were found to be significant individual contributors to the model ($\beta = .18$, $p = .029$) and ($\beta = .33$, $p = .002$), respectively (see Table 14). Ethnicity ($\beta = -.102$, $p = .199$) did not individually contribute to the overall model significantly. Thus, gender and minority status were shown have a statistically significant association and influence on science GPA.

Null Hypothesis Two

Model 4 introduced teacher interpersonal behaviors (QTI) as a predictor variable to the regression model for the prediction of science GPA. Null hypothesis two predicted there would be no statistically significant predictive relationship between students' perception of teacher interpersonal behaviors, as measured by the Wubbels (1993) Questionnaire for Teacher Interaction; and students' science GPAs, while controlling students' demographics, defined as gender, ethnicity, and minority status. In Block 4, teacher interpersonal behaviors was introduced as a predictor variable and did reach statistical significance, $F(4, 151) = 4.40$, $p = .00$. While the overall model in Block 4 was significant, the R^2 change was not statistically significant ($\Delta R^2 = .006$) with $F(4, 151) = 1.09$, $p = .299$. Thus, the addition of interpersonal behaviors did not result in a statistically significant change in the explanation of the variance in science GPA, and accounted for less than 1% change in the variance of the full model, from model 3 to model 4. Therefore, the null hypothesis was rejected. However, gender ($\beta = .22$, $p = .005$), and

minority status (β = .33, p = .002) were found to be significant individual contributors to science GPA within this model (see Table 11).

Null Hypotheses Three

The fifth model introduced the science self-efficacy predictor variable to the regression model. Null Hypotheses three states there is no statistically significant predictive relationship between students' demographics, defined as gender, ethnicity and minority status; students' perceptions of teacher interpersonal behaviors, as measured by the Wubbels (1993) Questionnaire for Teacher Interaction; and students' science self-efficacy, as measured by the Smist (1993) Science Self-Efficacy Questionnaire; and students' science GPAs. In Block 5, science self-efficacy was introduced as a predictor variable and did reach statistical significance, $F(5, 150) = 7.86$, p = .00, R^2 = .208. The R^2 change was statistically significant (ΔR^2 = .103) with $F(5, 150) = .499$, p = .00. The overall model in Block 5 was significant and explained 20.8% of the variance in science GPAs, with science self-efficacy individually explaining for 10.3% of the variance, which supports the rejection of the null hypothesis.

Per Model 5, gender, minority status, and science self-efficacy were found to be significant individual contributors within this block (β = .30, p = .000), (β = .30, p = .004), and (β = .34, p = .000), respectively. Thus, science self-efficacy (ΔR^2 = .103, p = .000) makes the strongest unique contribution to explaining science GPA, while minority status (ΔR^2 = .057, p = .002) and gender (ΔR^2 = .031, p = .029) were found to be statistically significant contributors to the full model as well. Ethnicity and teacher interpersonal behaviors do not make a statistically significant contribution to the variance in science GPA, and account for ≤ 1% of the variance. A summary of the hierarchical multiple regression analysis for the entire model is displayed in

Table 11. Furthermore, the results of the statistical analyses per hypothesis and model are displayed in Table 12.

Table 11

Summary of Hierarchical Multiple Linear Regression for Variables Predicting Science GPA

	Variables	B	SE	β	R	R^2
Model 1					.175*	0.31*
	Gender	.198	.090	0.18*		
Model 2					.202	.041
	Gender	.200	.090	.177*		
	Ethnicity	-.066	.051	-.102		
Model 3					.313**	.098**
	Gender	.245	.088	.216*		
	Ethnicity	.078	.068	.121		
	Minority Status	.478	.154	.329*		
Model 4					.323	.104
	Gender	.254	.089	.224*		
	Ethnicity	.076	.068	.118		
	Minority Status	.479	.154	.330*		
	Teacher Interpersonal Behaviors	.002	.002	.081		
Model 5					.456**	.208**
	Gender	.339	.086	.30**		
	Ethnicity	.078	.065	.120		
	Minority Status	.431	.146	.297*		
	QTI	.001	.002	.043		
	Science Self-Efficacy	.009	.002	.34**		

Note. *p < .05, **p ≤ .001

Table 12

Results of Statistical Analyses per Hypothesis

Hypothesis	Statement	Overall Model/R^2	Added Variance/ΔR^2	Results
H_o1	There is no statistically significant predictive relationship between students' demographics, defined as gender, ethnicity, and minority status; and students' science GPAs.*	17%	9.8%	Rejected
H_o2	There is no statistically significant predictive relationship between students' perceptions of teacher interpersonal behaviors and students' science GPAs, while controlling students' demographics, defined as gender, ethnicity, and minority status.	10.4%	<1%	Failed to reject
H_o3	There is no statistically significant predictive relationship between students' demographics, defined as gender, ethnicity, and minority status; students' perceptions of teacher interpersonal behaviors; students' science self-efficacy; and students' science GPAs.	20.8%	10.3%	Rejected

Note. *Ethnicity was not a statistically significant contributor to the model individually.

CHAPTER FIVE: CONCLUSIONS

Overview

Given the current emphasis on STEM education and the push to increase minorities and women to pursue careers in science and mathematics (Duran & Lopez, 2014; Estrada et al., 2016; Landivar, 2013), this particular study was opportune and warranted. Moreover, with the issue of global competitiveness and continuous gaps in academic achievement among ethnic subgroups throughout the nation, as well as the continued efforts for educational reform (Every Student Succeeds Act of 2015, 2015-2016; Hemphill & Vanneman, 2011; No Child Left Behind Act of 2001, 2002), this study can add to the body of knowledge additional factors that can impact student growth and achievement, specifically within the area of science education. This study can aide educators in finding innovative programs and resources to close academic achievement gaps across the nation, especially in the many areas of STEM, specifically science. In the hope of addressing the issue, this quantitative study investigated the predictive relationships between students' perception of teacher interpersonal behaviors; perceived science self-efficacy; and science GPA, while controlling for gender, ethnicity, and minority status. Twelfth grade students from an ethnically diverse Title I high school, located within a large metropolitan city, completed the Questionnaire on Teacher Interactions (QTI) and Science Self-Efficacy Questionnaire (SSEQ) to measure perceptions of teacher interpersonal behaviors and perceived science self-efficacy, respectively. This chapter will present discussion of the findings, implications, limitations to the study, and recommendations for future research.

Discussion

The purpose of this non-experimental predictive correlational study was to investigate the impact of students' perceived science self-efficacy and perceptions of teacher interpersonal

behaviors as factors that influence science achievement in a diverse Title I high school, while controlling for gender, ethnicity, and minority status. Bandura's (1977, 1986) self-efficacy and social cognitive theory, and the conceptual model of teacher interpersonal behaviors (Wubbels & Brekelmans, 2005) formed the theoretical frameworks for this study. The study determined that there was a statistically significant relationship between gender, minority status, science self-efficacy, and science GPA; however, ethnicity and teacher interpersonal behaviors did not show a statistically significant contribution to the overall model. Ethnicity and teacher interpersonal behaviors did show individual statistical significance. A five-block hierarchical multiple regression analysis was conducted to address the following research question:

The research question in this study asked, is there a predictive relationship between students' demographics, defined as gender, ethnicity, and minority status; students' perceptions of teacher interpersonal behaviors, as measured by the Wubbels (1993) Questionnaire for Teacher Interaction and students' science self-efficacy, as measured by the Smist (1993) Science Self-Efficacy Questionnaire; and students' science GPAs?

In order to establish relationships between predictor variables of perceived science self-efficacy and student perception of teacher interpersonal behaviors with a criterion variable of science achievement when controlling demographics, defined as gender, ethnicity, and minority status; a non-experimental predictive correlational design, such as the hierarchical multiple regression analysis, was the most appropriate (Gall et al., 2007; Warner, 2013). Variables were entered into blocks based on temporal order, research, and theory. Blocks 1, 2, and 3 contained the demographic variables of gender, ethnicity, and minority status, respectively, followed by teacher interpersonal behaviors (QTI) in Block 4 and science self-efficacy (SSEQ) in the last block.

Null Hypothesis One

Null hypothesis one states there is no statistically significant predictive relationship between students' demographics, defined as gender, ethnicity, and minority status; and students' science GPAs. Gender and minority status were found to have a statistically significant relationship to science GPA, however, ethnicity did not show to be statistically significant. First, gender was entered into the hierarchical multiple regression model to determine its statistically significant relationship to science GPA. Gender was found to be significant and explains 3.1% of the variance in science GPA. The findings suggest that males had higher science GPAs than females in this study, which can possibly support other studies showing the dominance of males pursing STEM-related career fields and courses may be contributed to their higher achievement in science compared to women (Duran & Lopez, 2014; Estrada et al., 2016). Based upon the results of Model 2, there was no statistically significant relationship between ethnicity and science GPA, suggesting that no specific individual ethnic group contributed more or less to the overall model in this study. Ethnicity explains less than 1% of the variance in science GPA and did not contribute significantly to the overall regression model. However, minority status, defined as, minority and non-minority groups, was found to be a statistically significant contributor to the model and explains for 5.7% of the variance in science GPA. This finding suggest that non-minorities students' science GPAs were higher than minority students in this study.

These findings indicate the statistically significant contributions of gender and minority status to the model with an overall variance of 8.8% in science GPA, despite the inability of the results being able to identify a specific ethnic group as being statistically significant. The results

of this study support other research findings that have shown a statistically significant relationship between gender, minority status, and science achievement (Crump et al., 2015; Kost-Smith, 2011; Xie et al., 2015). The lack of gender equity and the underrepresentation of minorities in science-related fields have been an ongoing discussion among educators, scholars, law and policymakers, and the general public for many years (Crump et al., 2015; Jacobs, 2005; Sherman & Fennema, 1977). Despite continuous reports of gender gaps between males and females, in the area of science, there is a steady increase as students' progress from middle to high school (Jones et al., 1992; Miyake et al., 2010; Xie et al., 2015). Creating robust middle school transition programs, can aide middle school students in better adapting to high school life, thus alleviating possible stress and anxiety and possibly build relationships between teacher and student before entering high school. This may positively impact learning outcomes and increase students' self-efficacy. Understanding the influence of gender equity and minority participation in STEM can aide researchers, specifically educators, in finding successful resources and programs that can possibly recruit, encourage, and advocate for more participation of these underrepresented groups.

A factor that attributes to the lack of females and minorities pursing STEM-related career fields is their success in science-related coursework in high school and at the collegiate level, consequently affecting science self-efficacy and interest (Hazari et al., 2007; Wong, 2015; Xie et al., 2015). The findings in the study suggests that overall non-minority and male students' science GPAs were higher than minority and female students. Gender gaps in science-related courses were found to grow as students matured and moved on to high school, with females experiencing larger disadvantages (Bacharach et al., 2003; Wong, 2015; Xie et al., 2015). Larson et al. (2014) investigated the self-reported efforts of male and female students in two

highly diverse high schools in predicting chemistry and physics achievement, while controlling for gender, prior achievement, math and science self-efficacy and interest. No correlation was shown between female students' level of interest and their academic achievement, compared to males whose high levels of interests in physics and chemistry did correlate to higher achievement scores. As it is imperative to give insight into factors that may influence gender and minority gaps in academic achievement, the findings in this study can further help researchers determine internal and external factors that can contribute to the underrepresentation of females and minorities in science-related majors and careers (Wang & Degol, 2013; Armstrong & Jovanovic, 2015), thus finding solutions to address these factors.

Null Hypothesis Two

Null hypothesis two states there is no statistically significant predictive relationship between students' perceptions of teacher interpersonal behaviors and students' science GPAs, while controlling students' demographics, defined as gender, ethnicity, and minority status. The findings in this study concluded that there was a statistically significant relationship between students' perception of teacher interpersonal behaviors as measured by the QTI and science GPA, while controlling for gender, ethnicity, and minority status; however, the addition of interpersonal behaviors to the overall model did not result in a statistically significant change in the explanation of the variance in science GPA. The addition of ethnicity to the overall regression model resulted in less than 1% variance change in science GPA. Despite these findings, previous research literature has provided strong evidence of the importance of positive and supportive student-teacher relationships as a mechanism which can impact students' social, emotional, and cognitive development (Drake et al., 2014; Duffin, Starling, Day & Cribbs, 2016).

Significant evidence was found to suggest that student-teacher interactions can positively influence student academic achievement, increase confidence and student engagement, specifically in the areas of math and science when teacher interpersonal behaviors are healthy and teachers foster a positive classroom environment conducive for learning (Wubbels et al., 1991; Caldarella et al., 2011; den Brok & Levy, 2005; Reyes et al., 2012; Wubbels & Levy, 1993). Wubbels (1993) developed the questionnaire used in this study. The Questionnaire on Teacher Interactions (QTI) is used to measure student perception of teacher interpersonal behaviors in an effort to support the Conceptual Model for Teacher Interpersonal Behaviors (Wubbels & Brekelmans, 2005) by examining the "students' perceptions evoked by what occurs in the classroom, what students think about their teacher, and what they learn and do" (Wubbels & Brekelmans, 2005, p. 7). The conceptual model of student-teacher relationships adapted from Leary (1957) is modeled after his research on the interpersonal diagnosis of personality, which includes the theoretical model of proximity and influence, and its application to education. Many studies continue to use the QTI and similar instruments to measure student-teacher interactions and its possible impact on student achievement in various subject areas (Alexander et al., 1997; Cataldi & KewalRamani, 2009; Dika & Singh, 2002; Faith et al., 2011; Murray & Malmgren, 2005; Ryan et al., 1994; Wentzel, 203; Wentzel & Brophy, 2014).

Furthermore, empirical evidence has also shown the importance of positive student-teacher relationships in secondary education, specifically, high school students (Cataldi & KewalRamani, 2009; Faith et al., 2011; Murray & Malmgren, 2005; Wentzel, 2003; Wentzel & Miele, 2016). Research in this area is minimal and does not specifically contain findings addressing its influence in STEM, specifically within the area of secondary science education; or in low-income and diverse populations, especially among minority students. This study will add

to the body of knowledge. Positive relationships between student and teacher has proven to show a positive correlation to student achievement on standardized tests and student's grade point averages (Hargrave, Tyler, Thompson, & Danner, 2016; Rice, Barth, Guadagno, Smith, & McCallum, 2013; Sointu, Savolainen, Lappalainen & Lambert, 2016; Suldo, McMahan, Chappel, & Bateman, 2014). Thus, supporting the use of science GPAs in this study and further suggesting the need for continued research to address the aforementioned.

Null Hypothesis Three

Students' perceived science self-efficacy was found to be a statistically significant predictor variable in the overall regression model and explains 10.3% of the variance in science GPA, however, when combined with gender and minority status in Model 5, these predictor variables account for 20.8% of the variance in GPA. These findings supports the rejection of null hypothesis three. Null Hypothesis Three states there is no statistically significant predictive relationship between students' demographics, defined as gender, ethnicity, and minority status; students' perceptions of teacher interpersonal behaviors, as measured by the Wubbels (1993) Questionnaire for Teacher Interaction; and students' science self-efficacy, as measured by the Smist (1993) Science Self-Efficacy Questionnaire; and students' science GPAs. This particular investigation is one of the first to use a hierarchical regression model to include student perception of teacher interpersonal behaviors and perceived science self-efficacy as predictors of academic achievement in science, using science GPAs as the criterion variable, and conducting the study within a high ethnically diverse Title I high school. The findings in this study further support previous and current research that the correlation between an individual's science self-efficacy and its influence on science achievement may influence women and minorities' decision to pursue STEM majors in higher education as well as STEM occupations (DiBenedetto &

Bembenutty, 2013; Lee et al., 2014; Miller, 2006; Gungoren & Sungur, 2009; Larson et al., 2014).

Self-efficacy is the confidence in oneself to perform science, in terms of organizing and completing the skills and knowledge needed to succeed in science content and processes (Miller, 2006). Research on self-efficacy and science education has become of recent interest within the past few years as an approach to understanding the deficit of women and minorities pursuing careers in STEM-related fields (Miller, 2006; Langdon et al., 2011). This study found a positive correlation between self-efficacy and science GPA with no statistically significant differences among gender and minority status. Some self-efficacy literature shows that any student's ability to accomplish science course, activities, and task is determined by their self-confidence and self-belief (Chen & Usher, 2013; Han & Buchmann, 2016; Huff, Stripling, Boyer, & Stephens, 2016; Mason, Boscolo, Tornatora, & Ronconi, 2013). Their science self-efficacy impacts their choice to pursue science related activities, as well as, determine the amount of effort they will spend on these activities and their determination to continue the task when they encounter challenges or difficulties (Bandura, 1997; Han & Buchmann, 2016; Mason et al., 2013; Zeldin & Pajares, 2000). Students who have high levels of science self-efficacy tend to select science-related task and are more determined to succeed on these task. In contrast, students who do not believe in being successful in science are more likely to avoid science-related tasks or activities and put forth less effort on these particular tasks (Britner & Pajares, 2006; Mason et al., 2013). Past research and literature further supports the findings and rejects null hypothesis three.

Implications

The results of this study support Bandura's (1977) self-efficacy theory. Bandura developed the theory of self-efficacy as an important factor in an individual's ability to learn. The construct of Bandura's (1977, 1986) self-efficacy theory is rooted in the social cognitive theory, which also frames this study. Self-efficacy is defined as "people's judgments of their capabilities to organize and execute courses of action required to attain designated types of performances" (Bandura, 1986, p. 391). Self-efficacy beliefs impact people's thoughts and actions, as well as how much effort a person will expend and how long they will endure in the face of adversity (Bandura, 1993, 1997; Eccles & Wigfield, 2002). The social cognitive theory postulates that self-efficacy is one of the most important mechanisms that influence a person's ability to learn (Bandura, 1986). Given students' perceived science self-efficacy, gender, and minority status having a statistically significant influence on science GPA in this study, this upholds the tenets of Bandura's theory of self-efficacy being rooted in the social cognitive theory. Thus, theory of self-efficacy supports the findings of a positive association between self-efficacy and science GPA, while controlling for gender, ethnicity, and minority status.

The ideology that human behavior is significantly motivated and regulated by the continuing exercise of self-influence and observation is the premise of the Bandura's social cognitive theory (Bandura, 1997, 1986). The social cognitive theory is able to explain the significance of interpersonal relationships as a factor in influencing learning outcomes and motivation. Despite the finding of this study showing the addition of teacher interpersonal behaviors did not result in a statistically significant change in the explanation of the variance in science GPA, many empirical studies support student-teacher interaction as a positive factor that influence academic achievement, self-confidence, student engagement, and the motivation to

learn (Birch & Ladd, 1998; Decker et al., 2007; Gregory & Weinstein, 2004; Hamre & Pianta, 2001; Hamre et al., 2013; Murray & Zvoch, 2011; Pianta et al., 2012). However, this study does show a statistically significant relationship between teacher interpersonal behaviors and science GPA within the individual model, which is promising and further upholds the tenets of the social cognitive theory (Bandura, 1986) and the conceptual model of teacher interpersonal behaviors (Wubbels & Brekelmans, 2005). Teacher interpersonal behaviors may not be a significant overall contributor to the change in variance of science GPA, but can imply to participants within the sample population and the setting utilized in this particular study.

Findings from this study can also provide practical implications for science education. The results of the study can assist educators in understanding the importance of student perceived science self-efficacy and students' perceptions of teacher interpersonal behaviors, which can have a significant and lasting impact on students' academic achievement and interests in STEM or other science-related fields, particularly students in socioeconomically disadvantaged areas. Professional development opportunities for all educators, such as diversity and awareness training, could be implemented during the school year to provide support and resources to assist teachers with strategies to promote student self-efficacy, and build meaningful relationships with students. Also, the development of effective collaborative planning programs or communities that would help teachers plan strategies to differentiate instruction, and provide resources to create gender and culturally relevant lessons may be imperative to support teachers. Research states positive student-teacher interaction increase student motivation; therefore, promoting positive student self-efficacy and increase student achievement. Furthermore, this study can possibly shed light into reasons for the significant lack of minorities pursuing STEM

careers as a postsecondary option as well as provide possible solutions to alleviate the concern and increase minority student participation.

Lastly, the results of this study indicated a statistically significant relationship existed between gender, minority status, science self-efficacy, and science GPA. The addition of ethnicity and student perception of teacher interpersonal behaviors did not contribute significantly to the overall regression model and explained for less than 1% of the variance in science GPA. However, each variable did individually have a significant contribution to the model. This further supports the need for more research studies to bridge the gap between science self-efficacy, teacher interpersonal behaviors, and its influences on science GPA, while controlling for demographics.

Limitations

The findings and implications from this study can be utilized to provide recommendations for future research, despite several limitations that may have influenced the results of the study. A non-experimental predictive correlational design was used to determine the relationships and predictions; however, the results cannot indicate a cause and effect relationship between variables (Tabachnick & Fidell, 2008; Warner, 2013). Thus, while this study found a statistically significant relationship between gender, minority status, science self-efficacy, and science GPA, it is not possible to conclude that gender, minority status, and self-efficacy cause students to have a specific science GPA. Furthermore, this study cannot imply a cause and effect relationship between students' perception of teacher interpersonal behaviors and ethnicity as factor that do not influence science GPA, based upon the non-experimental correlation design used in this study. This limitation can be addressed by the implementation of

an experimental research design in future studies, which could compare a control group to an experimental group or the use of a qualitative design, with student interviews included.

Convenience sampling was used to obtain a sample population from 388 twelfth grade students, which can be a threat to internal stability in this study. The use of a single site in this study limits generalizability and may impact the lack of randomization in the results. The participants in this study were students from a diverse Title I public high school in a large southeastern metropolitan city. Of the 388 students, only 157 students participated in the study. Great care should be taken when attempting to generalize the findings from this study to the total population of twelfth grade student in all diverse Title I public high schools within large metropolitan cities (Rovai et al., 2013; Tabachnick & Fidell, 2008). Also, most of the participants in the study were female and minority students. This further limits the study's generalizability to White students and males in high ethnically diverse high school settings, thus can lead to external threats of validity. Further studies, including possible longitudinal studies, need to be conducted to determine generalizability.

To have reliable and valid data for statistical power with a medium effect size, an estimation of the samples size was calculated using the equation $N \geq 104 + k$ with a minimum sample size of 106, however, there is a level of non-ignorable nonresponses that must be considered (Wu, Liu, & Liu, 2009). More than half of the students within the twelfth grade student population did not participate in the study. Several of the participants did not complete the questionnaires in its entirety, provide correct student ID numbers, or had missing information in the demographic section of the questionnaires, which caused the researcher to not include their responses and were not reflected in the study. Only fully completed questionnaires from students who returned signed consent forms were reflected in the results. Despite these

limitation, extended time for questionnaire completion and the return of parent/student consent forms, allowed for a larger sample size and increased student participation.

Self-reported questionnaire data were utilized and could be a limitation in this study. Participant responses could be biased or untruthful resulting in skewed data and potentially impacting internal validity and reliability (Johnson & Wislar, 2012). Participants were instructed to be honest in their response to the questionnaires. Furthermore, demographic information, student ID numbers, previous science courses taken, and science GPAs were verified by school personnel. Self-report bias still remains a limitation. The self-reported questionnaire were completed using the paper and pencil method, which may impact participant response. With an increase in the use of technology, such as smartphones, tablets, and computers in today's society, a web-based survey may have yielded more fully completed surveys and a higher response rate (Hohwü et al., 2013). The use of other measurement instruments or the utilization of technology, such as online surveys or mobile phone applications, can minimize outside influences of self-reported instruments (Kays, Gathercoal, & Buhrow, 2012).

Recommendations for Future Research

Based upon the findings in this study and the associated literature review, further research is recommended to assess the predictive relationship of student perception of teacher interpersonal behaviors and perceived science self-efficacy on science GPA, controlling for gender, ethnicity, and minority status. The students who participated in this study were majority African Americans, female, in the same grade level, and were from an urban public high school; therefore, future research should focus on the replication of the current study as well as exploring the generalizability of this study by increasing the number of participation sites, and including a larger, more diverse population. Additional studies may examine if utilizing different grade

levels, equity across ethnicities and between genders, rural or suburban areas, public and private schools, would yield similar results as this study. A replication of this study can also focus on using different subject areas within STEM, the computation of overall GPA, or the use of a state standardized assessment, rather than students' science GPA.

A future study should be conducted to build a more robust regression model which could include the subscales of each questionnaire used in this study. Wubbels' (1993) Questionnaire on Teacher Interaction (QTI) and Smist's (1993) Science Self-Efficacy Questionnaire (SSEQ) were utilized in this study. The QTI is a 64-item questionnaire consisted of eight subscales with each containing 8 items: leadership, help/friendly, understanding, student responsibility/freedom, uncertain, dissatisfied, admonishing, and strict. These teacher behaviors are further grouped into four domains: dominance, submission, opposition, and cooperation (Wubbels, 1993; Wubbels & Levy, 1991). Additionally, the SSEQ is a five-point Likert scale composed of 27 items used to assess high school students' self-efficacy in science, which consist of four domains: biology self-efficacy, physics self-efficacy, chemistry self-efficacy and laboratory self-efficacy (Smist, 1993). With studies using the subscales of these measurement instruments, it can shed additional light into more specific variables that can address the issue of achievement gaps, lack of minority participation, and gender differences within the area of STEM-related courses and career fields.

REFERENCES

Abbott, S. (Ed.). (2014). *The glossary of education reform*. Retrieved from http://edglossary.org/hidden-curriculum

Abudu, K. A., & Gbadamosi, M. R. (2014). Relationship between teacher's attitude and student's academic achievemnt in senior secondary school chemistry. A case study of Ijebu-Ode and Odogbolu Local Government Area of Ogun state. *Wudpecker Journal of Educational Research*, *3*(3), 035-043.

Ainsworth, M. D. S. (1982). Attachment: Retrospect and prospect. In C.M. Parkes & J. Stevenson-Hinde (Eds.), *The place of attachment in human behavior*, (pp. 3-30). New York: Basic Books.

Ainsworth, M. S. (1989). Attachments beyond infancy. *American Psychologist*, *44*(4), 709.

Ainsworth, M. D. S., & Bowlby, J. (1991). An ethological approach to personality development. *American Psychologist, 46,* 331-341.

Alexander, K. L., Entwisle, D. R., & Horsey, C. S. (1997). From first grade forward: Early foundations of high school dropout. *Sociology of Education*, *70*(2), 87-107.

Allen, J. P., Pianta, R. C., Gregory, A., Mikami, A. Y., & Lun, J. (2011). An interaction-based approach to enhancing secondary school instruction and student achievement. *Science*, *333*(6045), 1034-1037.

Allred, S. L., Harrison, L. D., & O'Connell, D. J. (2013). Self-efficacy: An important aspect of prison-based learning. *The Prison Journal*, *93*(2), 211-233.

Alston, R. J., Harley, D., & Lenhoff, K. (1995). Hirschi's social control theory: a sociological perspective on drug abuse among persons with disabilities. *Journal of Rehabilitation*, *61*(4), 31.

Amelink, C. (2009). Literature overview: Gender differences in science achievement. *SWE-AWE CASEE Overviews.* Retrieved from https://www.engr.psu.edu/awe/misc/ARPs/ARP_GenderDifferencesScience_Overview.pdf

Anderman, E. M., & Anderman, L. H. (2009). Motivating children and adolescents in schools. *Columbus, Ohio: Merrill*.

Anderman, E. M., & Patrick, H. (2012). Achievement goal theory, conceptualization of ability/intelligence, and classroom climate. In *Handbook of research on student engagement* (pp. 173-191). Springer US.

Anderson, K. J. (2012). Science education and testbased accountability: Reviewing their relationship and exploring implications for future policy. *Science Education*, *96*(1), 104-129.

Andrew, S. (1998). Selfefficacy as a predictor of academic performance in science. *Journal of Advanced Nursing*, *27*(3), 596-603.

Areepattamannil, S., Freeman, J. G., & Klinger, D. A. (2011). Influence of motivation, self-beliefs, and instructional practices on science achievement of adolescents in Canada. *Social Psychology of Education*, *14*(2), 233-259.

Arievitch, I. M., & Haenen, J. P. (2005). Connecting sociocultural theory and educational practices: Galperin's approach. *Educational Psychologist*, *40*(3), 155-165.

Armstrong, M. A., & Jovanovic, J. (2015). Starting at the crossroads: Intersectional approaches to institutionally supporting underrepresented minority women STEM faculty. *Journal of Women and Minorities in Science and Engineering*, *21*(2), 141-157.

Atkinson, R. D. (2012). Why the current education reform strategy won't work. *Issues in Science*

and Technology, 28(3), 29-36.

Aud, S., Hussar, W., Planty, M., Snyder, T., Bianco, K., Fox, M., & Drake, L. (2010). The condition of education 2010 (NCES 2010-028). Washington, DC: National Center for Education Statistics, Institute of Education Sciences, US Department of Education.

Bacharach, V. R., Baumeister, A. A., & Furr, R. M. (2003). Racial and gender science achievement gaps in secondary education. *The Journal of Genetic Psychology*, *164*(1), 115-126.

Baker, J. A., Grant, S., & Morlock, L. (2008). The teacher-student relationship as a developmental context for children with internalizing or externalizing behavior problems. *School Psychology Quarterly*, *23*(1), 3.

Balch, R., & Springer, M. G. (2015). Performance pay, test scores, and student learning objectives. *Economics of Education Review*, *44*, 114-125.

Bandura, A. (1977). Self-efficacy: toward a unifying theory of behavioral change. *Psychological review*, *84*(2), 191.

Bandura, A., (1986). *Social foundations of thought and action*. Englewood Cliffs, NJ: Prentice-Hall.

Bandura, A. (1989). Social cognitive theory. In R. Vasta (Ed.), *Annals of child development. Vol. 6. Six theories of child development* (pp. 1-60). Greenwich, CT: JAI Press.

Bandura, A. (1991). Social cognitive theory of self-regulation. *Organizational behavior and human decision processes*, *50*(2), 248-287.

Bandura, A. (1993). Perceived self-efficacy in cognitive development and functioning. *Educational psychologist*, *28*(2), 117-148.

Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York: Freeman.

Bandura, A. (2011). Social cognitive theory. In P. A. M. van Lange, A. W. Kruglanski, & E. T. Higgins (Eds.). *Handbook of social psychological theories* (pp. 349-373). London: Sage.

Bandura, A., Barbaranelli, C., Caprara, G. V., & Pastorelli, C. (1996). Multifaceted impact of self- efficacy beliefs on academic functioning. *Child development*, *67*(3), 1206-1222.

Baron, A. S., Schmader, T., Cvencek, D., & Meltzoff, A. N. (2014). The gendered self-concept: How implicit gender stereotypes and attitudes shape self-definition. *Gender and Development*, 109-132.

Becker, S. P., & Gable, R. K. (2009a). Self-efficacy and post-secondary first-term student achievement. Retrieved from Http://scholarsarchive.jwu.edu

Becker, S. P., & Gable, R. K. (2009b). The relationship of self-efficacy with GPA, attendance, and college student retention. Retrieved from Http://scholarsarchive.jwu.edu

Bergin, C., & Bergin, D. (2009). Attachment in the classroom. *Educational Psychology Review*, *21*(2), 141-170.

Berliner, D.C. (2009*). Poverty and potential: out-of-school factors and school success*. Boulder, CO and Tempe, AZ: Education and the Public Interest Center, University of Colorado/Education Policy Research, Arizona State University. Retrieved from http://epicpolicy.org/publication/poverty-and-potential

Berliner, D. (2013). Effects of inequality and poverty vs. teachers and schooling on America's youth. *Teachers College Record*, *115*(12), 1-26.

Betz, N. E., & Hackett, G. (1997). Applications of self-efficacy theory to the career assessment of women. *Journal of Career Assessment, 5*(4), 383-402.

Betz, N. E. (2004). Contributions of self-efficacy theory to career counseling: A personal perspective. *The Career Development Quarterly*, *52*(4), 340-353.

Birch, S. H., & Ladd, G. W. (1998). Children's interpersonal behaviors and the teacher–child relationship. *Developmental Psychology*, *34*(5), 934–946.

Blankstein, A., Cole, R., & Houston, P. (2007). *Engaging every learner* (Vol 1). Thousand Oaks, CA: Corwin Press.

Blatz, W. E. (1940). Hostages to peace: parents and the children of democracy. W. Morrow.

Bohrnstedt, G. (2013). Gains and gaps: Education performance after a nation at risk. *American Institutes for Research*. In *No Child Left Behind and the reduction of the achievement gap: Sociological perspectives on federal educational policy*. Routledge.

Bong, M., & Clark, R. E. (1999). Comparison between self-concept and self-efficacy in academic motivation research. *Educational Psychologist*, *34*(3), 139-153.

Bong, M., & Skaalvik, E. M. (2003). Academic self-concept and self-efficacy: How different are they really? *Educational Psychology Review*, *15*(1), 1-40.

Borghans, L., Meijers, H., & Ter Weel, B. (2008). The role of noncognitive skills in explaining cognitive test scores. *Economic Inquiry*, *46*(1), 2-12.

Borman, G.D., & Dowling, N.M. (2010). Schools and inequality: A multilevel analysis of Coleman's Equality of Educational Opportunity data. *Teachers College Record, 112*(5), 1201-1246.

Bowlby, J. (1969). *Attachment and loss, Vol. 1: Attachment*. New York: Basic Books.

Brekelmans, M., Wubbels, T., & den Brok, P. (2002). Teacher experience and the teacher-student relationship in the classroom environment. *Studies in educational learning environments: An international perspective*, 73-100.

Bretherton, I. (1992). The origin of attachment theory: John Bowlby and Mary Ainsworth. *Developmental Psychology*, *28*(5)759-775.

Britner, S.L., & Pajares, F. (2001). Self-efficacy beliefs, motivation, race, and gender in middle school science. *Journal of Women and Minorities in Science and Engineering*, *7*(4), 271-285.

Britner, S.L., & Pajares, F. (2006). Sources of science self-efficacy beliefs of middle school students. *Journal of Research in Science Teaching*, *43*(5), 485-499.

Buchanan, T., & Selmon, N. (2008). Race and gender differences in self-efficacy: Assessing the role of gender role attitudes and family background. *Sex Roles*, *58*(11-12), 822-836.

Butz, A. R., & Usher, E. L. (2015). Salient sources of early adolescents' self-efficacy in two domains. *Contemporary Educational Psychology*, *42*(1), 49-61.

Buyse, E., Verschueren, K., Verachtert, P., & Damme, J. V. (2009). Predicting school adjustment in early elementary school: Impact of teacher-child relationship quality and relational classroom climate. *The Elementary School Journal*, *110*(2), 119-141.

Caldarella, P., Shatzer, R. H., Gray, K. M., Young, K. R., & Young, E. L. (2011). The effects of school-wide positive behavior support on middle school climate and student outcomes. *RMLE Online*, *35*(4), 1-14.

Caprara, G., Fida, R., Vecchione, M., Del Bove, G., Vecchio, G., Barbaranelli, C., & Bandura, A. (2008). Longitudinal analysis of the role of perceived self-efficacy for self-regulated learning in academic continuance and achievement. *Journal of Educational Psychology*, *100*(3), 525-534.

Carlson, J. S., & Wiedl, K. H. (2013). Cognitive education: Constructivist perspectives on schooling, assessment, and clinical applications. *Journal of Cognitive Education and Psychology*, *12*(1), 6-25.

Cataldi, E. F., & KewalRamani, A. (2009). High School Dropout and Completion Rates in the United States: 2007 Compendium Report (NCES 2009-064). Washington, D.C.: National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education.

Chemers, M. M., Zurbriggen, E. L., Syed, M., Goza, B. K., & Bearman, S. (2011). The role of efficacy and identity in science career commitment among underrepresented minority students. *Journal of Social Issues*, *67*(3), 469-491.

Chen, J. A., & Usher, E. L. (2013). Profiles of the sources of science self-efficacy. *Learning and Individual Differences*, *24*, 11-21.

Choi, N. (2005). Self-efficacy and self-concept as predictors of college students' academic performance. *Psychology in the Schools*, *42*(2), 197-205.

Coutinho, S. (2008). Self-efficacy, metacognition, and performance. *North American Journal of Psychology*, *10*(1), 165.

Crosnoe, R., Johnson, M. K., & Elder, G. H. (2004). Intergenerational bonding in school: the behavioral and contextual correlates of student-teacher relationships. *Sociology of Education*, *77*(1), 60–81.

Crump, C., Ned, J., & Winkleby, M. A. (2015). The Stanford Medical Youth Science Program: educational and science-related outcomes. *Advances in Health Sciences Education*, *20*(2), 457-466.

Cullen, J. B., Levitt, S. D., Robertson, E., & Sadoff, S. (2013). What can be done to improve struggling high schools? *The Journal of Economic Perspectives*, *27*(2), 133-152.

Davis, H. A. (2003). Conceptualizing the role and influence of student-teacher relationships on children’s social and cognitive development. *Educational Psychologist*, *38*(4), 207-234.

DeBray-Pelot, E., & McGuinn, P. (2009). The new politics of education: Analyzing the federal education policy landscape in the post-NCLB era. *Educational Policy*, *23*(1), 15-42.

DeCarlo, L. T. (1997). On the meaning and use of kurtosis. *Psychological methods,* 2(3), 292-307.

Decker, D. M., Dona, D. P., & Christenson, S. L. (2007). Behaviorally at-risk African American students: The importance of student–teacher relationships for student outcomes. *Journal of School Psychology*, *45*(1), 83-109.

den Brok, P., & Levy, J. (2005). Teacher-student relationships in multicultural classes: Reviewing the past, preparing the future. *International Journal of Educational Research*, *43*(1), 72-88.

den Brok, P., Levy, J., Brekelmans, M., & Wubbels, T. (2005). The effect of teacher interpersonal behaviour on students' subject-specific motivation. *The Journal of Classroom Interaction*, 1(3), 20-33.

DiBenedetto, M. K., & Bembenutty, H. (2013). Within the pipeline: Self-regulated learning, self-efficacy, and socialization among college students in science courses. *Learning and Individual Differences*, *23*, 218-224.

Dika, S. L., & Singh, K. (2002). Applications of social capital in educational literature: A critical synthesis. *Review of Educational Research*, *72*(1), 31-60.

Divoll, K. A. (2010). Creating classroom relationships that allow students to fell known (Unpublished doctoral dissertation). Amherst, MA: University of Massachusetts. Retrieved from http://scholarworks.umass.edu/open_access_dissertations/275

DiPrete, T. A., & Buchmann, C. (2013). *The rise of women: The growing gender gap in education and what it means for American schools.* Russell Sage Foundation.

Doyle, W. (1986). Classroom organization and management. *Handbook of Research on Teaching*, *3*, 392-431.

Drake, K., Belsky, J., & Fearon, R. M. (2014). From early attachment to engagement with learning in school: The role of self-regulation and persistence. *Developmental psychology*, *50*(5), 1350.

Duffin, L. C., Starling, M. P., Day, M. M., & Cribbs, J. D. (2016). The effects of a consumer chemistry intervention on urban at-risk high school students' performance, utility value, and intentions to pursue STEM. *School Science and Mathematics*, *116*(7), 356-365.

Duran, A., & Lopez, D. (2014). Women from diverse backgrounds in the science, technology, engineering, and math (STEM) professions: Retention and career development. *Impact of Diversity on Organization and Career Development*, 214-242.

Durik, A. M., Vida, M., & Eccles, J. S. (2006). Task values and ability beliefs as predictors of high school literacy choices: A developmental analysis. *Journal of Educational Psychology*, *98*(2), 382.

Duschl, R. A., & Grandy, R. (2013). Two views about explicitly teaching nature of science. *Science & Education*, *22*(9), 2109-2139.

Eccles, J. S., Midgley, D., Wigfiedl, A., Buchanan, C. M., Reuman, D., Flanagan, D., & Mac Iver, D. (1993). Development during adolescence: The impact of stage environment fit on young adolescents' experiences in schools and families. *American Psychologist, 48*(2), 90-101.

Eccles, J. S., & Wigfield, A. (2002). Motivational beliefs, values, and goals. *Annual Review of Psychology, 53*(1)*,* 109-132.

Eccles, J.S. (2005). Influences of parents' education on their children's educational attainments:

the role of parent and child perceptions. *London Review of Education, 3*(3), 191-204.

Estrada, M., Burnett, M., Campbell, A. G., Campbell, P. B., Denetclaw, W. F., Gutiérrez, C.G., & Okpodu, C. M. (2016). Improving underrepresented minority student persistence in STEM. *CBE Life Science Education*, *15*(3), es5.

Evans, G. W., & Rosenbaum, J. (2008). Self-regulation and the income-achievement gap. *Early Childhood Research Quarterly*, *23*(4), 504-514.

Every Student Succeeds Act of 2015, Pub. L. No. 114-95 § 114 Stat. 1177 (2015-2016).

Faith, M. A., Fiala, S. E., Cavell, T. A., & Hughes, J. N. (2011). Mentoring highly aggressive children: Pre–post changes in mentors' attitudes, personality, and attachment tendencies. *The Journal of Primary Prevention*, *32*(5-6), 253-270.

Farkas, G. (2003). Racial disparities and discrimination in education: What do we know, how do we know it, and what do we need to know?. *Teachers College Record*, *105*(6), 1119-1146.

Farooq, M. S., Chaudhry, A. H., Shafiq, M., & Berhanu, G. (2011). Factors affecting students' quality of academic performance: a case of secondary school level. *Journal of quality and technology management*, *7*(2), 1-14.

Field, A. (2009). *Discovering statistics using SPSS*. Sage Publications.

Flanagan, D. P., Ortiz, S. O., Alfonso, V. C., & Dynda, A. M. (2006). Integration of response to intervention and norm-referenced tests in learning disability identification: Learning from the Tower of Babel. *Psychology in the Schools*, *43*(7), 807-825.

Fouts, G., & Poulsen, J. (2001). Attunement in the classroom: Emotional connection may be the key to student stress. *ATA Magazine, 81*(3) , 14-15.

Franco, G. M., Muis, K. R., Kendeou, P., Ranellucci, J., Sampasivam, L., & Wang, X. (2012). Examining the influences of epistemic beliefs and knowledge representations on cognitive processing and conceptual change when learning physics. *Learning and Instruction*, *22*(1), 62-77.

Fraser, B. J. (2002). Learning environments research: Yesterday, today and tomorrow. In *Studies in educational learning environments: An international perspective* (pp. 1-25).

Gall, M., Gall, J.P., & Borg, W. (2007). *Educational research: An introducti*on (8th ed.). Boston, MA: Pearson.

Galyon, C. E., Blondin, C. A., Yaw, J. S., Nalls, M. L., & Williams, R. L. (2012). The relationship of academic self-efficacy to class participation and exam performance. *Social Psychology of Education*, *15*(2), 233-249.

Georgia Department of Education. (2013). *Testing and performance*. Retrieved from http: //www.doe.k12.ga.us

Granot, D., & Mayseless, O. (2001). Attachment security and adjustment to school in middle school. *International Journal of Behavioral Development*, *25*(*6*), 530-541.

Gregory, A., & Weinstein, R. S. (2004). Connection and regulation at home and in school: Predicting growth in achievement for adolescents. *Journal of Adolescent Research*, *19*(4), 405-427.

Grossmann, K.E., & Grossmann, K. (1991). Attachment quality as an organizer of emotional and behavioral responses. In C.M. Parkes , J. Stevenson-Hinde , & Parkes, J. Stevenson-Hinde & P. Marris (Eds.), *Attachment across the life cycle* (pp. 93-114). Routledge.

Gunderson, E. A., Ramirez, G., Levine, S. C., & Beilock, S. L. (2012). The role of parents and teachers in the development of gender-related math attitudes. *Sex Roles*, *66*(3-4), 153-166.

Gungoren, S., & Sungur, S. (2009). The effect of grade level on elementary school students' motivational beliefs in Science. *The International Journal of Learning, 16*, 496-506.

Guvercin, Ö. (2008). Investigating elementary students' motivation towards science learning: A cross age study (Unpublished master's thesis). Ankara, Turkey: Middle East Technical University.

Guay, F., Chanal, J., Ratelle, C. F., Marsh, H. W., Larose, S., & Boivin, M. (2010). Intrinsic, identified, and controlled types of motivation for school subjects in young elementary school children. *British Journal of Educational Psychology, 80*(4), 711-735.

Hackett, G., & Betz, N. E. (1995). Self-efficacy and career choice and development. In *Self-efficacy, adaptation, and adjustment* (pp. 249-280). Springer US.

Hairston, M. T. (2013). *Perceptions of student-teacher relationships and GED completion: A correlational study* (Unpublished doctoral dissertation). Lynchburg, VA: Liberty University.

Hall, C., Dickerson, J., Batts, D., Kauffmann, P., & Bosse, M. (2011). Are we missing opportunities to encourage interest in STEM fields? *Journal of Technology Education*, *23*(1), 1-8.

Halle, T., Hair, E., Wandner, L., McNamara, M., & Chien, N. (2012). Predictors and outcomes of early versus later English language proficiency among English language learners. *Early Childhood Research Quarterly*, *27*(1), 1-20.

Hallinan, M. T. (2008). Teacher influences on students' attachment to school. *Sociology of*

Education, 81(3), 271-283.

Hamre, B., & Pianta, R. (2001). Early teacher–child relationships and the trajectory of children's school outcomes through eighth grade. *Child Development*, *72*(2), 625-638.

Hamre, B. K., Pianta, R. C., Downer, J. T., DeCoster, J., Mashburn, A. J., Jones, S. M., ... & Hamagami, A. (2013). Teaching through interactions. *The Elementary School Journal*, *113*(4), 461-487.

Han, S., & Buchmann, C. (2016). Aligning science achievement and STEM expectations for college success: A Comparative study of curricular standardization. *RSF: The Russell Sage Foundation Journal of the Social Sciences*, *2*(1), 192-211.

Hargrave, L. D., Tyler, K. M., Thompson, F., & Danner, F. (2016). An examination of the association between student-teacher interactions and academic self-concept among african male high school students. *Journal of African American Males in Education, 7*(2), 33-49.

Hargreaves, D. H. (2014). A self-improving school system and its potential for reducing inequality. *Oxford Review of Education*, *40*(6), 696-714.

Harlow, L. L. (2014). *The essence of multivariate thinking: Basic themes and methods*. New York, NY: Routledge.

Hartman, C. (2014). *Teacher influence on elementary school students to participate in science, technology, engineering, and mathematics.* Paper presentated at the Georgia Undergraduate Research Conference, Statesboro, GA. Retrieved from http://digitalcommons.georgiasouthern.edu/gurc/2014/2014/65

Hazari, A., Tai, R.H., & Sadler, P.M. (2007). Gender differences in introductory university physics performance: The influence of high school physics preparation and affective factors. *Science Education, 91*(6), 847–877.

Healey, J. F., & O'Brien, E. (2014). *Race, ethnicity, gender, and class: The sociology of group conflict and change*. Thousand Oaks, CA: Sage Publications.

Heckman, J. J. (2006). Skill formation and the economics of investing in disadvantaged children. *Science*, *312*(5782), 1900-1902.

Hemphill, F. C., & Vanneman, A. (2011). Achievement Gaps: How Hispanic and White Students in Public Schools Perform in Mathematics and Reading on the National Assessment of Educational Progress. Statistical Analysis Report (NCES 2011-459). Washington, D.C.: National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education.

Henry, K. L., Knight, K. E., & Thornberry, T. P. (2012). School disengagement as a predictor of dropout, delinquency, and problem substance use during adolescence and early adulthood. *Journal of Youth and Adolescence*, *41*(2), 156-166.

Hill, C., Corbett, C., & St Rose, A. (2010). *Why so few? Women in science, technology, engineering, and mathematics*. Washington, D.C.: American Association of University Women.

Hirschi, T. (1969). *Causes of delinquency*. Berkeley: University of California Press.

Hoff, E. (2013). Interpreting the early language trajectories of children from low-SES and language minority homes: Implications for closing achievement gaps. *Developmental Psychology*, *49*(1), 4.

Hohwü, L., Lyshol, H., Gissler, M., Jonsson, S. H., Petzold, M., & Obel, C. (2013). Web-based versus traditional paper questionnaires: A mixed-mode survey with a Nordic perspective. *Journal of Medical Internet Research*, *15*(8), e173.

Hong, Z. R., & Lin, H. S. (2013). Boys' and girls' involvement in science learning and their self-efficacy in Taiwan. *International Journal of Psychology*, *48*(3), 272-284.

Howard, T. C. (2015). *Why race and culture matter in schools: Closing the achievement gap in America's classrooms*. New York, NY: Teachers College Press.

Huff, S. M., Stripling, C. T., Boyer, C., & Stephens, C. A. (2016). Investigating factors that influence achievement goal orientation and educational practices in undergraduate agricultural sciences and natural resource students. *NACTA Journal*, *60*(4), 423.

Hughes, J., & Kwok, O. M. (2007). Influence of student-teacher and parent-teacher relationships on lower achieving readers' engagement and achievement in the primary grades. *Journal of educational psychology*, *99*(1), 39.

Huitt, W. (2011). Motivation to learn: An overview. *Educational Psychology Interactive*. Valdosta, GA: Valdosta State University. Retrieved from http://www.edpsycinteractive.org/topics/motivation/motivate.html

Ingels, S. J., & Dalton, B. W. (2008). *Trends among high school seniors, 1972-2004* (NCES 2008-320). Washington, DC: National Center for Education Statistics, Institute for Education Sciences, U.S. Department of Education.

Ingels, S. J., Pratt, D. J., Herget, D. R., Burns, L. J., Dever, J. A., Ottem, R., ... & Leinwand, S. (2011). High School Longitudinal Study of 2009 (HSLS: 09): Base-Year Data File Documentation. NCES 2011-328. *National Center for Education Statistics*.

Jacobs, J. E. (2005). Twenty- five years of research on gender and ethnic differences in math and science career choices: What have we learned?. *New Directions For Child And Adolescent Development*, *2005*(110), 85-94.

Jennings, J., & Rentner, D. S. (2006). How public schools are impacted by" No Child Left Behind". *The Education Digest*, *72*(4), 4.

Jensen, E. (2009). *Teaching with poverty in mind: What being poor does to kids' brains and what schools can do about it*. Alexandria, VA: Association for Supervision and Curriculum Development.

Jerome, E. M., Hamre, B. K., & Pianta, R. C. (2009). Teacher-child relationships from kindergarten to sixth grade: Early childhood predictors of teacher-perceived conflict and closeness. *Social Development, 18*(4), 915-945.

Johnson, T. P., & Wislar, J. S. (2012). Response rates and nonresponse errors in surveys. *Jama*, *307*(17), 1805-1806.

Jones, L. R., Mullis, I. V. S., Raizen, S. A., Weiss, I. R., & Weston, E. A. (1992). *The 1990 science report card*. Washington, D.C.: Educational Testing Service.

Kays, K., Gathercoal, K., & Buhrow, W. (2012). Does survey format influence self-disclosure on sensitive question items? *Computers in Human Behavior, 28*(1), 251-256.

Kennedy, B. L. (2008). Educating students with insecure attachment histories: Toward an interdisciplinary theoretical framework. *Pastoral Care in Education*, *26*(4), 211-230.

Khan, M. (2013). Academic self-efficacy, coping, and academic performance in college. *International Journal of Undergraduate Research and Creative Activities*, *5*(1), 4.

Kieffer, M. (2011). Converging trajectories: Reading growth in language minority learners and their classmates, kindergarten to grade 8. *American Educational Research Journal, 48*(5), 1187-1225.

Kıran, D., & Sungur, S. (2012). Middle school students' science self-efficacy and its sources: Examination of gender difference. *Journal of Science Education and Technology, 21*(5), 619-630.

Kleinginna, P., Jr., & Kleinginna A. (1981a). A categorized list of motivation definitions, with suggestions for a consensual definition. *Motivation and Emotion, 5*(4), 263-291.

Klem, A. M., & Connell, J. P. (2004). Relationships matter: Linking teacher support to student engagement and achievement. *Journal of School Health, 74*(7), 262-273.

Knoell, C. M. (2012). The role of the student-teacher relationship in the lives of fifth graders: a mixed methods analysis. Retrieved from Http://digitalcommons.unl.edu

Kost-Smith, L. E. (2011). Characterizing, modeling, and addressing gender disparities in introductory college physics. Retrieved from Http://adsabs.harvard.edu

Landivar, L. C. (2013). Disparities in STEM employment by sex, race, and Hispanic origin. *Education Review*, *29*(6), 911-922.

Langdon, D., McKittrick, G., Beede, D., Khan, B., & Doms, M. (2011). *STEM: Good jobs now and for the future*. Washington, D.C.: US Department of Commerce. Retrieved from http://www.esa.doc.gov/sites/default/files/stemfinalyjuly14_1.pdf

Lane, J., Lane, A. M., & Kyprianou, A. (2004). Self-efficacy, self-esteem and their impact on academic performance. *Social Behavior and Personality: An International Journal*, *32*(3), 247-256.

Larose S., Bernier A., & Tarabulsy, G.M. (2005). Attachment state of mind, learning dispositions and academic performance during the college transition. *Development and Psychopathology*, *41*(1), 281-289.

Larson, L. M., Stephen, A., Bonitz, V. S., & Wu, T. F. (2014). Predicting science achievement in India: Role of gender, self-efficacy, interests, and effort. *Journal of Career Assessment*, *22*(1), 89-101.

Leary, T. (1957). *Interpersonal diagnosis of personality: A functional theory and methodology for personality evaluation*. New York: Ronald Press.

LeCroy, C. W., & Krysik, J. (2008). Predictors of academic achievement and school attachment among Hispanic adolescents. *Children & Schools*, *30*(4), 197-209.

Lee, W., Lee, M. J., & Bong, M. (2014). Testing interest and self-efficacy as predictors of academic self-regulation and achievement. *Contemporary Educational Psychology*, *39*(2), 86-99.

Lee, J., & Orfield, G. (2006). *Tracking achievement gaps and assessing the impact of NCLB on the gaps: An in-depth look into national and state reading and math outcome trends.* Cambridge, MA: The Civil Rights Project at Harvard University.

Lee, P., & Bierman, K. L. (2015). Classroom and teacher support in kindergarten: Associations with the behavioral and academic adjustment of low-income students. *Merrill-Palmer Quarterly*, *61*(3), 383-411.

Lee, V., & Burkam, D. (1996). Gender differences in middle grade science achievement: Subject domain, ability level and course emphasis. *Science Education, 80*(6), 613-650.

Lee, J., & Reeves, T. (2012). Revisiting the impact of NCLB high-stakes school accountability, capacity, and resources: State NAEP 1990-2009 reading and math achievement gaps and trends. *Educational Evaluation and Policy Analysis*, *34*(2), 209-231.

Lehrer, R., & Schauble, L. (2015). Learning progressions: The whole world is NOT a stage. *Science Education*, *99*(3), 432-437.

Lent, R. W., Brown, S. D., & Larkin, K. C. (1986). Self-efficacy in the prediction of academic performance and perceived career options. *Journal of Counseling Psychology*, *33*(3), 265.

Lewis, A. C. (2004). Failing NCLB. *The Education Digest, 69*(7), 65-67.

Lipina, S. J., & Colombo, J. A. (2009). *Poverty and brain development during childhood: An approach from cognitive psychology and neuroscience*. American Psychological Association.

Lleras, C., & Rangel, C. (2008). Ability grouping practices in elementary school and African American/Hispanic achievement. *American Journal of Education*, *115*(2), 279-304.

LoBiondo-Wood, G., & Haber, J. (Eds.) (2010) *Nursing research: methods and critical appraisal for evidence-based practice.* St. Louis, MO.: Mosby/Elsevier.

Lourdusamy, A., & Khine, M. S. (2001). *Self-evaluation of interpersonal behavior and classroom interaction by teacher trainees.* Fremantle, Australia: Annual Meeting of the Australian Association for Research in Education. Retrieved from https://eric.ed.gov

Lumpe, A., Czerniak, C., Haney, J., & Beltyukova, S. (2012). Beliefs about teaching science: The relationship between elementary teachers' participation in professional development and student achievement. *International Journal of Science Education*, *34*(2), 153-166.

Lyons-Ruth, K., Alpern, L., & Repacholi, B. (1993). Disorganized infant attachment classification and maternal psychosocial problems as predictors of hostile-aggressive behavior in the preschool classroom. *Child Development*, *64*(2), 572-585.

MacPhee, D., Farro, S., & Canetto, S. S. (2013). Academic self-efficacy and performance of underrepresented STEM majors: Gender, ethnic, and social class patterns. *Analyses of Social Issues and Public Policy*, *13*(1), 347-369

Magnuson, K. A., Meyers, M. K., Ruhm, C. J., & Waldfogel, J. (2004). Inequality in preschool education and school readiness. *American Educational Research Journal*, *41*(1), 115-157.

Marcus, R. F., & Sanders-Reio, J. (2001). The influence of attachment on school completion. *School Psychology Quarterly*, *16*(4), 427.

Martin, J. J., & Kulinna, P. H. (2005). A social cognitive perspective of physical activity related behavior in physical education. *Journal of Teaching in Physical Education*, *24*(3), 265-281.

Marzano, R. J., Marzano, J. S., & Pickering, D. (2003). *Classroom management that works: Research-based strategies for every teacher*. ASCD.

Mason, L., Boscolo, P., Tornatora, M. C., & Ronconi, L. (2013). Besides knowledge: A cross-sectional study on the relations between epistemic beliefs, achievement goals, self-beliefs, and achievement in science. *Instructional Science*, *41*(1), 49-79.

Menard, S. (2009). *Logistic regression: From introductory to advanced concepts and applications.* Thousand Oaks, CA: Sage Publications.

Miyake, A., Kost-Smith, L. E., Finkelstein, N. D., Pollock, S. J., Cohen, G. L., & Ito, T. A. (2010). Reducing the gender achievement gap in college science: A classroom study of values affirmation. *Science*, *330*(6008), 1234-1237.

Miller, M. D. (2006). *Science self-efficacy in tenth grade Hispanic female high school students.* Orlando, FL: University of Central Florida.

Mlambo, V. (2011). An analysis of some factors affecting student academic performance in an introductory biochemistry course at the University of the West Indies. *Caribbean Teaching Scholar*, *1*(2), 79-92.

Montalvo, G. P., Mansfield, E. A., & Miller, R. B. (2007). Liking or disliking the teacher: Student motivation, engagement and achievement. *Evaluation & Research in Education*, *20*(3), 144-158.

Mosatche, H. S., Matloff-Nieves, S., Kekelis, L., & Lawner, E. K. (2013). Effective STEM programs for adolescent girls: Three approaches and many lessons learned. *Afterschool matters*, *17*, 17-25.

Moss-Racusin, C. A., Dovidio, J. F., Brescoll, V. L., Graham, M. J., & Handelsman, J. (2012). Science faculty's subtle gender biases favor male students. *Proceedings of the National Academy of Sciences*, *109*(41), 16474-16479.

Motlagh, S. E., Amrai, K., Yazdani, M. J., Altaib Abderahim, H., & Souri, H. (2011). The relationship between self-efficacy and academic achievement in high school students. *Procedia-Social and Behavioral Sciences*, *15*, 765-768.

Mroczkowski, A. L., & Sánchez, B. (2015). The role of racial discrimination in the economic value of education among urban, low-income Latina/o youth: ethnic identity and gender as moderators. *American Journal of Community Psychology*, *56*(1-2), 1-11.

Murray, C., & Malmgren, K. (2005). Implementing a teacher-student relationship program in a high-poverty urban school: Effects on social, emotional, and academic adjustment and lessons learned. *Journal of School Psychology*, *43*(2), 137-152.

Murray, C., & Zvoch, K. (2011). Teacher—student relationships among behaviorally at-risk African American youth from low-income backgrounds: student perceptions, teacher perceptions, and socioemotional adjustment correlates. *Journal of Emotional and Behavioral Disorders*, *19*(1), 41-54.

Mushtaq, S. N. K. (2012). Factors affecting students' academic performance. *Global Journal of Management and Business Research, 12(9).*

Nagaoka, J., Farrington, C. A., Roderick, M., Allensworth, E., Keyes, T. S., Johnson, D. W., & Beechum, N. O. (2013). Readiness for college: The role of noncognitive factors and context. *Voices in Urban Education*, *38*, 45-52.

Nathans, L. L., Oswald, F. L., & Nimon, K. (2012). Interpreting multiple linear regression: A guidebook of variable importance. *Practical Assessment, Research & Evaluation*, *17*(9).

National Research Council. (2012). *A framework for K-12 science education: Practices, crosscutting concepts, and core ideas.* National Academies Press.

NICHD Early Child Care Research Network (Ed.). (2005). *Child care and child development: Results from the NICHD study of early child care and youth development. Guilford Press.*

No Child Left Behind Act of 2001, P.L. 107-110, 20 U.S.C. § 6319 (2002).

NCLB. (2003). Retrieved June 12, 2014, from the World Wide Web: http://www.nclb.org

Niebuhr, K., & Neibuhr, R. (1999). An empirical study of student relationships and academic achievement. *Education*, *119*(4), 679.

Nieswiadomy, R. M. (2012). *Foundations of nursing research* (6th ed.). Boston: Pearson.

Nugent, T. T. (2009). *The impact of teacher-student interaction on student motivation and achievement* (Unpublished doctoral dissertation). Orlando, FL: University of Central Florida.

O'Connor, E. E., Dearing, E., & Collins, B. A. (2011). Teacher-child relationship and behavior problem trajectories in elementary school. *American Educational Research Journal, 48*(1), 120-162.

Opdenakker, M. C., Maulana, R., & den Brok, P. (2012). Teacher-student interpersonal relationships and academic motivation within one school year: Developmental changes and linkage. *School Effectiveness and School Improvement*, *23*(1), 95-119.

Osborne, J., & Waters, E. (2002). Four assumptions of multiple regression that researchers should always test. *Practical Assessment, Research & Evaluation, 8*(2), 1-9.

Pajares, F. (1996). Self-efficacy beliefs in academic settings. *Review of Educational Research, 66*(4), 543-578.

Pajares, F. (2002). Gender and perceived self-efficacy in self-regulated learning. *Theory into Practice*, *41*(2), 116-125.

Pajares, F. (2003). Self-efficacy beliefs, motivation, and achievement in writing: A review of the literature. *Reading &Writing Quarterly*, *19*(2), 139-158.

Pajares, F. (2008). Motivational role of self-efficacy beliefs in self-regulated learning. *Motivation and Self-Regulated Learning: Theory, Research, and Applications*. New York, NY: Routledge, p. 111-139.

Pajares, F., & Urdan, T. C. (2006). *Self-efficacy beliefs of adolescents*. New York, NY: IAP.

Palmer, R. T., Maramba, D. C., & Gasman, M. (Eds.). (2013). *Fostering success of ethnic and racial minorities in STEM. Routledge.*

Pekrun, R., Goetz, T., Titz, W., & Perry, R. P. (2002). Academic emotions in students' self-regulated learning and achievement: A program of qualitative and quantitative research. *Educational Psychologist*, *37*(2), 91-105.

Perry, B. D. (1997). Incubated in terror: Neurodevelopmental factors in the "cycle of violence." *Children in a Violent Society*, 124-149.

Pianta, R. C. (1999). *Enhancing relationships between children and teachers*. Washington, DC: American Psychological Association.

Pianta, R. C., & Steinberg, M. (1992). Teacher-child relationships and the process of adjusting to school. *New Directions for Child and Adolescent Development*, *1992*(57), 61-80.

Pianta, R. C., & Stuhlman, M. W. (2004). Teacher-child relationships and children's success in the first years of school. *School Psychology Review, 33*(3) Retrieved from http://www.nasponline.org

Pianta, R. C., Steinberg, M. S., & Rollins, K. B. (1995). The first two years of school: Teacher–child relationships and deflections in children's classroom adjustment. *Development and Psychopathology*, *7*(2), 295-312.

Pianta, R. C., Hamre, B. K., & Allen, J. P. (2012). Teacher-student relationships and engagement: Conceptualizing, measuring, and improving the capacity of classroom interactions. In *Handbook of research on student engagement* (pp. 365-386). New York, NY: Springer .

Pintrich, P. R., Marx, R.W., & Boyle, R. A. (1993). Beyond cold conceptual change: The role of motivational beliefs and classroom contextual factors in the process of conceptual change. *Review of Educational Research, 63*(2), 167-199.

Pintrich, P. R., & Schunk, D. H. (2002). *Motivation in education: Theory, research, and applications* (2nd ed.). Columbus, OH: Merrill Prentice Hall.

Pollack, T. M. (2013). Unpacking everyday "teacher talk" about students and families of color: Implications for teacher and school leader development. *Urban Education*, *48*(6), 863-894.

Potvin, P., & Hasni, A. (2014). Interest, motivation and attitude towards science and technology at K-12 levels: a systematic review of 12 years of educational research. *Studies in Science Education, 50*(1), 85-129.

Quinn, D. M., & Cooc, N. (2015). Science achievement gaps by gender and race/ethnicity in elementary and middle school: Trends and predictors. *Educational Researcher*, *44*(6), 336-346.

Rauber, M. (2007). *Noncognitive skills and success in life: the importance of motivation and self-regulation*. Institutional Repository of the University of Konstanz. Retrieved from http://nbn-resolving.de/urn:nbn:de:bsz:352-opus-37896

Rector, R. (2015, February). Reciprocal empathy: A study of student-teacher interaction. In *Proceedings of the Oklahoma Academy of Science* (Vol. 34, pp. 175-177).

Reeve, J. (2013). How students create motivationally supportive learning environments for themselves: The concept of agentic engagement. *Journal of Educational Psychology*, *105*(3), 579.

Reio, T., Marcus, R., & Sanders-Reio, J. (2009). Contribution of student and instructor

relationships and attachment style to school completion. *The Journal of Genetic Psychology*, *170*(1), 53-71.

Rentner, D. S., & Kober, N. (2012). After the stimulus money ends: The status of state k-12 education funding and reforms. *Center on Education Policy*. Washington, DC.

Reyes, M. R., Brackett, M. A., Rivers, S. E., White, M., & Salovey, P. (2012). Classroom emotional climate, student engagement, and academic achievement. *Journal of Educational Psychology*, *104*(3), 700.

Rice, L., Barth, J. M., Guadagno, R. E., Smith, G. P., & McCallum, D. M. (2013). The role of social support in students' perceived abilities and attitudes toward math and science. *Journal of Youth and Adolescence*, *42*(7), 1028-1040.

Rosen, J. A., Glennie, E. J., Dalton, B. W., Lennon, J. M., & Bozick, R. N. (2010). *Noncognitive Skills in the Classroom: New Perspectives on Educational Research*. RTI International. PO Box 12194, Research Triangle Park, NC 27709-2194.

Rosenthal, T. L., & Zimmerman, B. J. (2014). *Social learning and cognition*. New York, NY: Academic Press.

Rothstein, R. (2013). For public schools, segregation then, segregation since. *Economic Policy Institute.* Retrieved from http://gato-docs.its.txstate.edu

Rovai, A. P., Baker, J. S., & Ponton, M. K. (2013). *Social science research design and statistics: A practitioner's guide to research methods and SPSS analysis.* Chesapeake, VA: Watertree Press.

Ruby, A. (2006). Improving science achievement at high-poverty urban middle schools. *Science Education, 90*(6), 1005-1027.

Ryan, R. M., Stiller, J. D., & Lynch, J. H. (1994). Representations of relationships to teachers, parents, and friends as predictors of academic motivation and self-esteem. *The Journal of Early Adolescence*, *14*(2), 226-249.

Sahranavard, M., & Hassan, S. A. (2012). The Relationship Betweenself-Concept, Self-Efficacy, Self-Esteem, Anxietyand Science Performance Among Iranian Students. *Middle-East Journal of Scientific Research*, *12*(9), 1190-1196.

Sands, T. D. (2011). *The relationship factor: Understanding the role and development of teacher-student relationships in middle school* (Unpublished doctoral dissertation). Lynchburg, VA: Liberty University.

Santau, A. O., Maerten- Rivera, J. L., & Huggins, A. C. (2011). Science achievement of English language learners in urban elementary schools: Fourth-grade student achievement results from a professional development intervention. *Science Education*, *95*(5), 771-793.

Segall, M. H., Dasen, P. R., Berry, J. W., & Poortinga, Y. H. (Eds.). (1990). *Human behavior in global perspective: An introduction to cross-cultural psychology*. New York: Pergamon.

Senler, B., & Sungur, S. (2009). Parental influences on students' self-concept, task value beliefs, and achievement in science. *Spanish Journal of Psychology, 12*(1), 106-117.

Shapiro, T., Meschede, T., & Osoro, S. (2013). The roots of the widening racial wealth gap: Explaining the black-white economic divide. *Institute on Assets and Social Policy*. Waltham, MA: Brandeis University.

Sherman, J., & Fennema, E. (1977). The study of mathematics by high school girls and boys: Related variables. *American Educational Research Journal*, *14*(2), 159-168.

Shirley, L. Y., Corkin, D. M., & Martin, J. P. (2016). STEM motivation and persistence among underrepresented minority students. *Race and Ethnicity in the Study of Motivation in Education*, 67.

Silver, R. B., Measelle, J. R., Armstrong, J. M., & Essex, M. J. (2005). Trajectories of classroom externalizing behavior: Contributions of child characteristics, family characteristics, and the teacher–child relationship during the school transition. *Journal of School Psychology, 43*(1), 39-60.

Simpkins, S. D., Davis-Kean, P. E., & Eccles, J. S. (2006). Math and science motivation: A longitudinal examination of the links between choices and belief. *Developmental Psychology, 42*(1), 70-83.

Simpkins, S. D., Fredricks, J. A., & Eccles, J. S. (2012). Charting the Eccles' expectancy-value model from mothers' beliefs in childhood to youths' activities in adolescence. *Developmental Psychology*, *48*(4), 1019.

Sinatra, G. M., Kienhues, D., & Hofer, B. K. (2014). Addressing challenges to public understanding of science: Epistemic cognition, motivated reasoning, and conceptual change. *Educational Psychologist*, *49*(2), 123-138.

Singleton, G. E. (2014). *Courageous conversations about race: A field guide for achieving equity in schools*. Thousand Oaks, CA: Corwin Press.

Skinner, E. A., & Belmont, M. J. (1993). Motivation in the classroom: Reciprocal effects of teacher behavior and student engagement across the school year. *Journal of Educational Psychology*, *85*(4), 571.

Smart, J. B. (2014). A mixed methods study of the relationship between student perceptions of teacher-student interactions and motivation in middle level science. *RMLE Online*, *38*(4), 1-19.

Smist, J. M. (1993). *General chemistry and self-efficacy*. Chicago, IL: National Meeting of the American Chemical Society.

Smist, J. M., & Owen, S. V. (1994). *Explaining Science Self-Efficacy*. Presented at Annual Meeting of the American Educational Research Association. New Orleans, LA. Retrieved from http://eric.ed.gov

Smist, J. M., Archambault, F. X., & Owen, S. V. (1997). *Gender and ethnic differences in attitude toward science and science self-efficacy among high school students*. Paper presentated at the annual meeting of the American Educational Research Association, San Francisco, CA.

Snyder, T. D., & Dillow, S. A. (2010). Digest of Education Statistics 2009 (NCES 2010-013) National Center for Education Statistics. *Institute for Education Sciences, US Department of Education. Washington, DC*.

Snyder, T. D., & Dillow, S. A. (2012). *Digest of education statistics 2011*. National Center for Education Statistics.

Society of Women Engineers. (2001). *Society of Women Engineers Patches for Peace quilt block* [quilt block]. Digital Collections and Archives, Tufts University.

Sointu, E. T., Savolainen, H., Lappalainen, K., & Lambert, M. C. (2016). Longitudinal associations of student-teacher relationships and behavioural and emotional strengths on academic achievement. *Educational Psychology*, *37*(4), p. 1-11.

Stewart, E. B. (2007). Individual and school structural effects on African American high school students' academic achievement. *The High School Journal*, *91*(2), 16-34.

Stewart, E. B. (2008). School structural characteristics, student effort, peer associations, and parental involvement the influence of school-and individual-level factors on academic achievement. *Education and Urban Society*, *40*(2), 179-204.

Suldo, S. M., McMahan, M. M., Chappel, A. M., & Bateman, L. P. (2014). Evaluation of the teacher–student relationship inventory in American high school students. *Journal of Psychoeducational Assessment*, *32*(1), 3-14.

Sun, L., Bradley, K. D., & Akers, K. (2012). A multilevel modelling approach to investigating factors impacting science achievement for secondary school students: PISA Hong Kong sample. *International Journal of Science Education*, *34*(14), 2107-2125.

Tabachnick, B. G., & Fidell, L. S. (2008). Using Multivariate Statistics. Boston, MA: Pearson.

Tavakol, M., & Dennick, T. (2011). Making sense of Cronbach's alpha. International Journal of Medical Education, *2*, 53-55.

Taylor, G., Jungert, T., Mageau, G. A., Schattke, K., Dedic, H., Rosenfield, S., & Koestner, R. (2014). A self-determination theory approach to predicting school achievement over time: The unique role of intrinsic motivation. *Contemporary Educational Psychology*, *39*(4), 342-358.

Trzesniewski, K., Moffitt, T., Caspi, A., Taylor, A., & Maughan, B. (2006). Revisiting the association between reading achievement and antisocial behavior: New evidence of an environmental explanation from a twin study. *Child Development*, *77*(1), 72-88.

Tsupros, S. I. (2009). *Challenges in science, technology and mathematics in United States.* Hays blaine Lanzta Sr Ed. *D p. 3*. Retrieved from http://globalacademicgroup.com

Tucker-Drob, E. M., & Harden, K. P. (2012). Intellectual interest mediates Gene× Socioeconomic Status interaction on adolescent academic achievement. *Child Development*, *83*(2), 743-757.

Tucker-Drob, E. M., Rhemtulla, M., Harden, K. P., Turkheimer, E., & Fask, D. (2011). Emergence of a gene× socioeconomic status interaction on infant mental ability between 10 months and 2 years. *Psychological Science*, *22*(1), 125-133.

Tyson, W., Lee, R., Borman, K. M., & Hanson, M. A. (2007). Science, technology, engineering, and mathematics (STEM) pathways: High school science and math coursework and postsecondary degree attainment. *Journal of Education for Students Placed at Risk*, *12*(3), 243-270.

U.S. Department of Education, National Center for Education Statistics. (2010). *The Condition of Education 2010* (NCES 2010-028). Washington, DC: U.S. Government Printing Office.

U.S. Department of Education, National Center for Education Statistics. (2013). *The Condition of Education 2013* (NCES 2010-037). Washington, DC: U.S. Government Printing Office.

Usher, E. L., & Pajares, F. (2006). Sources of academic and self-regulatory efficacy beliefs of entering middle school students. *Contemporary Educational Psychology*, *31*(2), 125-141.

Vanneman, A., Hamilton, L., Anderson, J. B., & Rahman, T. (2009). Achievement gaps: How black and white students in public schools perform in mathematics and reading on the national assessment of educational progress. Statistical Analysis Report (NCES 2009-455). Washington, D.C.: National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education.

Wang, M. T., & Degol, J. (2013). Motivational pathways to STEM career choices: Using expectancy–value perspective to understand individual and gender differences in STEM fields. *Developmental Review*, *33*(4), 304-340.

Wang, X. (2013). Why students choose stem majors motivation, high school learning, and postsecondary context of support. *American Educational Research Journal*, *50*(5), 1081-1121.

Warner, R. M. (2013). *Applied statistics: From bivariate through multivariate techniques* (2nd ed.). Thousand Oaks: Sage Publications, Inc.

Wei, M., Den Brok, P., & Zhou, Y. (2009). Teacher interpersonal behaviour and student achievement in English as a foreign language classrooms in China. *Learning Environments Research*, *12*(3), 157-174.

Wentzel, K. (1998). Social relationships and motivation in middle school: The role of parents, teachers, and peers. *Journal of Educational Psychology*, *90*(2), 202-209.

Wentzel, K. R. (2002). Are effective teachers like good parents? Teaching styles and student adjustment in early adolescence. *Child Development*, *73*(1), 287-301.

Wentzel, K. R. (2003). Sociometric status and adjustment in middle school: A longitudinal study. *The Journal of Early Adolescence*, *23*(1), 5-28.

Wentzel, K. R. (2009). Peers and academic functioning at school. *Handbook of Peer Interactions, Relationships, and Groups.*, (pp. 531-547). New York, NY, US: Guilford Press, xvii, 654 pp.

Wentzel, K. R. (2012). Teacher-student relationships and adolescent competence at school. In *Interpersonal relationships in education* (pp. 19-35). The Netherlands: Sense Publishers.

Wentzel, K. R., & Brophy, J. E. (2014). *Motivating students to learn*. Routledge.

Wentzel, K. R. & Miele, D. (2016). Teacher-student relationships. In *Handbook of Motivation at School* (p. 211). New York, NY: Routledge.

Wilkins, J. (2006). *An examination of the student and teacher behaviors that contribute to good student-teacher relationships in large urban high schools* (Unpublished doctoral dissertation). Buffalo, NY: the State University of New York.

Wilson, D. M., Bates, R., Scott, E. P., Painter, S. M., & Shaffer, J. (2015). Differences in Self-efficacy among Women and Minorities in STEM. *Journal of Women and Minorities in Science and Engineering*, *21*(1).

Wong, B. (2015). Careers "From" but not "in" science: Why are aspirations to be a scientist challenging for minority ethnic students? *Journal of Research in Science Teaching*, *52*(7), 979-1002.

Wong, E. H., Wiest, D. J., & Cusick, L. B. (2002). Perceptions of autonomy support, parent attachment, competence and self-worth as predictors of motivational orientation and academic achievement: An examination of sixth-and ninth-grade regular education students. *Adolescence*, *37*(146), 255.

Wu, J., Hughes, J. N., & Kwok, O. (2010). Teacher-student relationship quality type in elementary grades: Effects on trajectories for achievement and engagement. *Journal of School Psychology, 48*(5), 357-387.

Wu L., Liu W., Liu J. (2009). A longitudinal study of children's aggressive behaviors based on multivariate mixed models with incomplete data. *Canada Journal of Statistics, 37*, 435-452.

Wubbels, T. (1985). Discipline Problems of Beginning Teachers, Interactional Teacher

Behaviour Mapped Out. Presented at Annual Meeting of the American Educational Reiearch Association. Chicago, IL. Retrieved from Http://eric.ed.gov

Wubbels, T. (1993). Teacher-student relationships in science and mathematics classes (what research says to the science and mathematics teacher). Perth, Australia, National Key Centre for Science and Mathematics, Curtin University of Technology.

Wubbels T., & Brekelmans, M. (2005). Two decades of research on teacher-student relationships in class. *International Journal of Educational Research*, 43(1), 6-24.

Wubbels, T., & Brekelmans, M. (2012). Teacher–students relationships in the classroom. In *Second international handbook of science education* (pp. 1241-1255). Springer Netherlands.

Wubbels, T., Brekelmans, M., den Brok, P., & van Tartwijk, J. (2006). An interpersonal perspective on classroom management in secondary classrooms in the Netherlands. *Handbook of classroom management: Research, practice, and contemporary issues*, 1161-1191.

Wubbels, T., Brekelmans, M., & Hooymayers, H. P. (1991). Interpersonal teacher behavior in the classroom. In B. Fraser and H. Walberg (Eds.), *Educational environments: Evaluation, antecedents and consequences* (pp. 141-160). Oxford: Pergamon Press.

Wubbels, T., den Brok, P., van Tartwijk, J., & Levy, J. (Eds.). (2012). *Interpersonal relationships in education: An overview of contemporary research* (Vol. 3). New York, NY: Springer Science & Business Media.

Wubbels, T., & Levy, J. (1991). A comparison of interpersonal behavior of Dutch and American teachers. *International Journal of Intercultural Relations*, *15*(1), 1-18.

Wubbels, T., & Levy, J. (1993). *Do you know what you look like?: Interpersonal relationships in education*. Psychology Press.

Young, D. J., & Fraser, B. J. (1994). Gender differences in science achievement: Do school effects make a difference?. *Journal of Research in Science Teaching*, *31*(8), 857-871.

Young, D. M., Rudman, L. A., Buettner, H. M., & McLean, M. C. (2013). The influence of female role models on women's implicit science cognitions. *Psychology of Women Quarterly*, *37*(3), 283-292.

Xie, Y., Fang, M., & Shauman, K. (2015). Stem education. *Annual Review of Sociology*, *41*, 331-357.

Xie, Y., Shauman, K. A., & Shauman, K. A. (2003). *Women in science: Career processes and outcomes* (Vol. 26, No. 73.4). Cambridge, MA: Harvard University Press.

Xu, Y. J. (2008). Gender disparity in STEM disciplines: A study of faculty attrition and turnover intentions. *Research in Higher Education*, *49*(7), 607-24.

Zayas, L. E., & McGuigan, D. (2006). Experiences promoting healthcare career interest among high-school students from underserved communities. *Journal of the National Medical Association*, *98*(9), 1523.

Zeldin, A. L., & Pajares, F. (2000). Against the odds: Self-efficacy beliefs of women in mathematical, scientific, and technological careers. *American Educational Research Journal*, *37*(1), 215-246.

Zeldin, A. L., Britner, S. L., & Pajares, F. (2008). A comparative study of the self-efficacy beliefs of successful men and women in mathematics, science, and technology careers. *Journal of Research in Science Teaching*, *45*(9), 1036-1058.

Zettergren, P. (2003). School adjustment in adolescence for previously rejected, average and popular children. *British Journal of Educational Psychology*, *73*(2), 207-221.

Zhang, T., Solmon, M. A., & Gu, X. (2012). The role of teachers' support in predicting students' motivation and achievement outcomes in physical education. *Journal of Teaching in Physical Education*, *31*(4), 329-343.

Zimmerman, B. J., Bandura, A., & Martinez-Pons, M. (1992). Self-motivation for academic attainment: The role of self-efficacy beliefs and personal goal setting. *American educational research journal*, *29*(3), 663-676.

Appendix A

Permission to Use Science Self-efficacy Questionnaire Instrument

Re: Permission to use instrument

Julianne Smist <jsmist@springfieldcollege.edu>

Thu 6/25/2015 10:02 AM

To:Larry, Triaka <tlarry@liberty.edu>;

Hi Triaka,

Yes you have my permission and good luck with your research.

Julie Smist

On Mon, Jun 22, 2015 at 3:31 PM, Triaka Larry <tlarry@liberty.edu> wrote:

> Dear Dr. Smist,
>
> Hello, my name is Triaka Larry, and I am a doctoral candidate at Liberty University located in Lynchburg, VA under the supervision of Dr. Jillian Wendt. I am currently conducting research on the relationship between percieved self-efficacy and student-teacher relationships among Urban Title I students' achievement in science.
>
> I am writing to request permission to use, reproduce, and distribute your Science Self-efficacy Scale (1993) for purposes related to my dissertation research, as well as, adapt scale items to fit my study, if needed? I would truly appreciated your consideration of my request.
>
> Thank you again for your consideration and contributions to the field of science education.
>
> With best regards,
>
> Triaka Larry
>
> Doctoral Candidate, Liberty University

Appendix B

Permission to Use the Questionnaire on Teacher Interactions Instrument

Re: Permission to use instrument

Wubbels, T. (Theo) <T.Wubbels@uu.nl>

Mon 6/8/2015 2:50 PM

To:Larry, Triaka <tlarry@liberty.edu>;

Cc:Wendt, Jillian Leigh <jarnett@liberty.edu>;

Dear Triaka,
Thank you for your interest in the QTI. I'm happy to grant you permission to use it for your research. I would appreciate to be kept posted on your results,.
I hope your research will be successful.

Best
Theo

Theo Wubbels | Professor of Education, Acting Chair Department of Education, Faculty of Social and Behavioural Sciences | Utrecht University | PO Box 80.140, 3508 TC Utrecht, The Netherlands | phone +31 30 2533910 | President European Educational Research Association | t.wubbels@uu.nl | | www.uu.nl/staff/twubbels

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Van: <Larry>, Triaka <tlarry@liberty.edu>
Datum: maandag 8 juni 2015 20:05
Aan: Theo Wubbels <t.wubbels@uu.nl>
CC: "Wendt, Jillian Leigh" <jarnett@liberty.edu>
Onderwerp: Permission to use instrument

Dear Dr. Wubbels,
Hello, my name is Triaka Larry, and I am a doctoral candidate at Liberty University located in Lynchburg, VA under the supervision of Dr. Jillian Wendt. I am currently conducting research on the relationship between percieved self-efficacy and student-teacher relationships among Title I students' achievement in science.
I am writing to request permission to use, reproduce, and distribute the American version of the Questionnaire on Teacher Interaction (1993), which according to my research, was adapted from the Leary Model by yourself (Wubbels), Creton, Levy, and Hooymayers. Your instrument has been widely used and and accepted to be extremely reliable and will be valuable to my dissertation research. Also, I am asking if I can use this instrument for purposes related to my dissertation research, as well as, adapt scale items to fit my study, if needed? I would truly appreciated your consideration of my request.
Thank you again for your consideration and contributions to the field of education.
With best regards,
Triaka Larry. Ed.S
Doctoral Candidate, Liberty University
Cell: 678-431-6268

Appendix C

Informed consent form for participants

PARENT/GUARDIAN AND STUDENT CONSENT FORM
THE RELATIONSHIP BETWEEN PERCIEVED SELF-EFFICACY AND STUDENT-TEACHER RELATIONSHIPS AMONG TITLE I STUDENT ACHIEVEMENT IN SCIENCE

Triaka Larry, Doctoral Candidate
Liberty University
School of Education

You (for students 18 or over) or your child (for parents of minors) is invited to be in a research study of the relationship between student-perceived science self-efficacy and student perception of teacher interpersonal behaviors in their science classroom. You or your child was selected as a possible participant because you or he/she is currently a twelfth-grade student who has taken at least 3 or more science courses. I ask that you read this form and ask any questions you may have before agreeing to participate/allow your student to participate in the study.

Background Information

The purpose of this study is to investigate the influence of both student-perceived science self-efficacy and student perception of teacher interpersonal behaviors as factors that can affect science achievement in a highly diverse Title I school.

Procedures

If you agree to participate in this study, you or your child will be asked to complete two surveys, the Science Self-efficacy Questionnaire and Questionnaire on Teacher Interactions. It will only take 20-25 minutes to complete each questionnaire to determine you or your child's self-confidence in science as well as if their relationship with their science teacher influenced their grade in class. The questionnaires will be administered on the same day during your/your student's science class period. Also, you will be asked to provide your school student identification number on each questionnaire. By providing your school ID, the school will be able to provide your science grade in each of your biology, physical science or physics, and chemistry classes in order to calculate your overall science GPA. This will allow the researcher to determine if your science self-confidence and perception of your teacher classroom behaviors influence science achievement.

Risks and Benefits of being in the Study

There are no known risks within this research study outside of those encountered in daily life. The questionnaires will be administered in the science classroom without the teacher present to prevent the risk of bias. There are no direct benefits. The results of this study will help students,

teachers, and all stakeholders understand and gain knowledge into finding specific strategies to support and enhance student achievement in science.

Compensation
No compensation will be offered for participating in the study.

Confidentiality
All data and records from this study will be confidential. Published reports from this study will not include any identifying information or names of the participants involved. All student ID numbers will be replaced with randomly generated student ID numbers by the researcher. Participants' student ID numbers will be needed in order to match their academic data, such as science GPAs, to their completed questionnaires to explore the relationship between science self-efficacy, student-teacher relationships, and science academic achievement. Participants' science grade point averages will be provided by the guidance counselor at the school. Only the student ID numbers and science course grades will be provided to the researcher. Additionally, pseudonyms will be used within the final report, and all research records will be stored on a password-protected computer. The researcher will be the only person that will access these records. The faculty advisor, Dr. Jillian L. Wendt, will be the only other researcher that will see information that was obtained from the questionnaires used in this study. However, she will not have access to information linking data to specific students or student IDs. The results of the study will be available to participants upon written request.

Voluntary Nature of the Study
This study is voluntary. Your decision to participate/allow your student to participate in this study will not affect your/his or her grade in class, placement in other programs, or relationship with Liberty University. Upon deciding to participate in the study, you/your student is free to not complete the questionnaire and withdraw your/his or her submission at any time without harm by informing the researcher of your/his or her decision to not participate and return the questionnaires.

Contacts and Questions:
The researcher conducting this study is Triaka Larry, and you **are encouraged** to contact her at tlarry@liberty.edu. You may also contact the researcher's faculty advisor, Dr. Jillian L. Wendt at jarnett@liberty.edu.
If you have any questions or concerns and would like to contact someone other than me or the faculty advisor, you are encouraged to contact the Liberty University Institutional Review Board, 1971 University Blvd, Green Hall Suite 1887, Lynchburg, VA 24515 or email at irb@liberty.edu.

Please contact the researcher if you would like a copy of this information to keep for your records.

Statement of Consent:

I have read and understood the above information. I have asked questions and have received answers. I consent to participate or allow my child/student to participate in the study.

(NOTE: DO NOT AGREE TO PARTICIPATE OR ALLOW YOUR CHILD/STUDENT TO PARTICIPATE UNLESS IRB APPROVAL INFORMATION WITH CURRENT DATES HAS BEEN ATTACHED.)

Participant's Name (printed) _____

Signature of minor: _____ Date: _____

Signature of parent or guardian: _____Date: _____

Signature of investigator _____ Date_____

Appendix D

Student Recruitment Letter

Dear 12th Grade Students,

My name is Ms. Larry and I am a high school Biology teacher and doctoral student at Liberty University. I would like to invite you to complete two questionnaires on your perceived self-confidence in your science abilities as well as your perception of your science teacher's classroom behaviors.

These questionnaires will take no more than 15-20 minutes to complete. Only I will see the results of your responses, and they will not be shared with anyone else. You will be asked to write your school student ID numbers on the demographic section of the questionnaire, which will be used to match your academic data, such as your science course grade point averages, so that I can explore the relationship between your self-confidence in science and your relationship with your science teacher to determine if it influences your grade in class. All of your information will be kept confidential.

If you choose to participate in this study, a consent form will be given to you today. I will need for you and your parent(s) to sign, date, and return the consent form prior to completing the questionnaires for this study. Please return your signed consent form within one week. Thank you.

Best,

Triaka Larry

Appendix E

The Questionnaire on Teacher Interaction (American Version) with student identification and demographic information

This questionnaire asks you to describe the behavior of your Science teacher from last year. This is NOT a test. Your honest opinion is what is wanted. Your responses are confidential and anonymous.

REMEMBER, THIS SURVEY IS FOCUSING ON THE SCIENCE TEACHER YOU HAD LAST SCHOOL YEAR ONLY.

This questionnaire has 64 sentences about your science teacher. For each sentence, circle the number corresponding to your response. For example:

	Never				Always
This teacher expresses himself/herself clearly.	1	2	3	4	5

If you think that your teacher always expresses himself/herself clearly, circle the 4. If you think your teacher never expresses himself/herself clearly, circle the 0. You also can choose the numbers 1, 2 and 3 which are in between. If you want to change your answer, cross it out and circle a new number. Thank you for your cooperation.

Student Demographics

Please circle the appropriate response:

Age: 16 17 18 19 20

Gender: Male or Female

Race/Ethnicity (*Check one*):

- ☐ White or Caucasian
- ☐ Black/African American
- ☐ Hispanic/Latino
- ☐ Other

Previous Science Courses Taken (*Check all that apply*):

- ☐ Biology
- ☐ Chemistry
- ☐ Physical Science
- ☐ Physics

PLEASE BEGIN QUESTIONNAIRE

NEVER ALWAYS

1 2 3 4 5

	Never				Always
1. My teacher is strict.	1	2	3	4	5
2. We have to be silent in class.	1	2	3	4	5
3. My teacher talks enthusiastically about science.	1	2	3	4	5
4. My teacher trusts us.	1	2	3	4	5
	Never				Always
5. My teacher is concerned when we do not understand something.	1	2	3	4	5
6. If we don't agree with our teacher we can talk to our teacher about it.	1	2	3	4	5
7. My teacher threatens to punish us.	1	2	3	4	5
8. We can decide some things in class.	1	2	3	4	5
	Never				Always
9. My teacher is demanding.	1	2	3	4	5
10. My teacher thinks we cheat.	1	2	3	4	5
11. My teacher will explain things again.	1	2	3	4	5
12. My teacher thinks we don't know anything.	1	2	3	4	5
	Never				Always
13. If we want something my teacher is willing to cooperate.	1	2	3	4	5
14. My teacher's tests are hard.	1	2	3	4	5
15. My teacher helps us with our work.	1	2	3	4	5
16. My teacher gets angry unexpectedly.	1	2	3	4	5
	Never				Always
17. If we have something to say my teacher will listen.	1	2	3	4	5
18. My teacher sympathizes with us.	1	2	3	4	5
19. My teacher tries to make us look foolish.	1	2	3	4	5
20. My teacher's standards are very high.	1	2	3	4	5
	Never				Always
21. We can influence our teacher.	1	2	3	4	5
22. We need our teacher's permission before we can speak.	1	2	3	4	5
23. My teacher seems uncertain.	1	2	3	4	5
24. My teacher looks down on us.	1	2	3	4	5
	Never				Always
25. We have the opportunity to choose assignments, which are most interesting to us.	1	2	3	4	5
26. My teacher is unhappy.	1	2	3	4	5
27. My teacher lets us fool around in class.	1	2	3	4	5
28. My teacher puts us down.	1	2	3	4	5
	Never				Always
29. My teacher takes a personal interest in us.	1	2	3	4	5
30. My teacher thinks we can't do things well.	1	2	3	4	5
31. My teacher explains things clearly.	1	2	3	4	5
32. My teacher realizes when we do not understand.	1	2	3	4	5

	Never				Always
33. My teacher lets us get away with a lot in class.	1	2	3	4	5
34. My teacher is hesitant.	1	2	3	4	5
35. My teacher is friendly.	1	2	3	4	5
36. We learn a lot from this teacher.	1	2	3	4	5
	Never				Always
37. My teacher is someone we can depend on.	1	2	3	4	5
38. My teacher gets angry quickly.	1	2	3	4	5
39. My teacher acts as if he/she does not know what to do.	1	2	3	4	5
40. The teacher holds our attention.	1	2	3	4	5
	Never				Always
41. My teacher is too quick to correct us when we break a rule.	1	2	3	4	5
42. My teacher lets me boss her/him around.	1	2	3	4	5
43. My teacher is impatient.	1	2	3	4	5
44. My teacher is not sure what to do when we fool around.	1	2	3	4	5
	Never				Always
45. My teacher knows everything that goes on in the classroom.	1	2	3	4	5
46. It is easy to make a fool out of my teacher.	1	2	3	4	5
47. My teacher has a sense of humor.	1	2	3	4	5
48. My teacher allows us a lot of choice in what we study.	1	2	3	4	5
	Never				Always
49. My teacher gives us a lot of free time in class.	1	2	3	4	5
50. My teacher can take a joke	1	2	3	4	5
51. My teacher has a bad temper.	1	2	3	4	5
52. My teacher is a good leader. .	1	2	3	4	5
	Never				Always
53. If we don't finish our homework we're scared to go to class.	1	2	3	4	5
54. My teacher seems dissatisfied.	1	2	3	4	5
55. My teacher is timid.	1	2	3	4	5
56. My teacher is patient.	1	2	3	4	5
	Never				Always
57. My teacher is severe when marking papers.	1	2	3	4	5
58. My teacher is suspicious.	1	2	3	4	5
59. It is easy to pick a fight with my teacher.	1	2	3	4	5
60. My teacher's class is pleasant.	1	2	3	4	5
	Never				Always
61. We are afraid of my teacher.	1	2	3	4	5
62. My teacher acts confidently.	1	2	3	4	5
63. My teacher is sarcastic.	1	2	3	4	5
64. My teacher is lenient.	1	2	3	4	5

Appendix F

Science Self-Efficacy Questionnaire

How much confidence do you have about doing each of the behaviors listed below? If you have not had physics, predict your confidence level. Circle the numbers that best represent your beliefs.

Very Little **Quite a lot**

1 2 3 4 5

CONFIDENCE

	Very Little				Quite a lot
1. Using a computer in science classes.	1	2	3	4	5
2. Understanding concepts in a biology textbook.	1	2	3	4	5
3. Using chemical formulas and equations.	1	2	3	4	5
4. Doing well on a biology exam.	1	2	3	4	5
5. Doing chemistry homework problems well.	1	2	3	4	5
6. Doing physics lab experiments well.	1	2	3	4	5
7. Using a microscope.	1	2	3	4	5
8. Lighting a laboratory (Bunsen) burner.	1	2	3	4	5
9. Winning a science fair award for a biology project.	1	2	3	4	5
10. Handling laboratory chemicals.	1	2	3	4	5
11. Doing physics homework problems well.	1	2	3	4	5
12. Taking essay tests in biology.	1	2	3	4	5
13. Performing lab experiments using electricity.	1	2	3	4	5
14. Getting good grades in biology.	1	2	3	4	5
15. Answering questions in biology class.	1	2	3	4	5
16. Asking questions in chemistry class.	1	2	3	4	5
17. Memorizing factual information.	1	2	3	4	5
18. Understanding concepts in a chemistry textbook.	1	2	3	4	5
19. Asking questions in biology class.	1	2	3	4	5
20. Learning about famous scientists.	1	2	3	4	5
21. Understanding concepts in a physics textbook.	1	2	3	4	5
22. Getting good grades in chemistry.	1	2	3	4	5
23. Understanding abstract chemical concepts.	1	2	3	4	5
24. Asking questions in physics class.	1	2	3	4	5
25. Getting good grades in physics.	1	2	3	4	5
26. Performing lab experiments with simple machines.	1	2	3	4	5
27. Doing science activities for fun.	1	2	3	4	5

Appendix G

School District Permission Letter

Office of Research & Evaluation

[redacted]

October 13, 2016

Research/Principal Investigator: Triaka Larry
Institution: Liberty University
Study Title: Perceived Self-Efficacy and Student-Teacher Relationships among Diverse Title I Students' Achievement in Science

Triaka Larry,

Your request to conduct your research in [redacted] been **approved** by the [redacted] Research Screening Committee. A few things to consider as you begin your research:

1. Please coordinate with the principal at [redacted] to recruit students to participate in your study. Research activities should not interrupt instructional time and should be conducted with approval from the school principal.

2. Your assurance of maintaining confidentiality of the participants must be strictly followed. Pseudonyms for individuals and schools, as well as references to [redacted] as "a large urban school system," are required in the title and text of your study before publication or presentation.

3. Please submit a completed copy of the final research study to the Office of Research and Evaluation.

Please contact Curtis Grier at [redacted] if you need any further assistance.

Sincerely,

[redacted]

John Keltz

Appendix H

Liberty IRB Approval Letter

LIBERTY UNIVERSITY.
INSTITUTIONAL REVIEW BOARD

October 14, 2016

Triaka A. Larry
IRB Approval 2621.101416: Perceived Self-Efficacy and Student-Teacher Relationships among Diverse Title I Students' Achievement in Science

Dear Triaka A. Larry,

We are pleased to inform you that your study has been approved by the Liberty IRB. This approval is extended to you for one year from the date provided above with your protocol number. If data collection proceeds past one year, or if you make changes in the methodology as it pertains to human subjects, you must submit an appropriate update form to the IRB. The forms for these cases were attached to your approval email.

Thank you for your cooperation with the IRB, and we wish you well with your research project.

Sincerely,

[redacted]

G. Michele Baker, MA, CIP
Administrative Chair of Institutional Research
The Graduate School

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