FACTORS CONTRIBUTING TO SCIENCE SELF-EFFICACY IN AN EARLY COLLEGE HIGH SCHOOL SETTING

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DEDICATION

To the One True God…..Creator, Ruler, and Sustainer of All. For you are my HELP; the one who sustains me.

To N. Mason, My mother and my strength. Thank you for your unconditional love, support, and your constant reminder to pray, work hard, and never give up! You are the most wonderful, loving, and giving mother. Love you always, your B. O.

To Michelle and Fallie-Wokie, Thank you for your emotional and spiritual support. Your perseverance and strength in the face of your own personal adversities has been model for me to never give up. Thanks for all your prayers, laughter, and willingness to stand with me.

To my family. Thanks for all your prayers and support.

To the Grays. Thanks for being my “Home away from Home”.

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ABSTRACT

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Science self-efficacy is critical to the achievement and participation of students in science. The purpose of this study was to explore the factors (age, attitudes towards math, school climate, school rigorous expectations, and the number of advanced math and science courses taken) contributing to science self-efficacy in an Early College High School setting. The sample consisted of 113 students from three Early College High Schools in North Texas. The tools used were the Science Self Efficacy Questionnaire (SSEQ), Attitudes Towards Math Inventory (ATMI), Panorama Student Survey Scales About the School—School Climate and Rigorous Expectation subscales, and a demographic questionnaire. Correlation analyses revealed a significant positive correlation between Science Self-Efficacy total scores and School Climate total scores. Moreover, higher ATMI total scores and School Climate total scores significantly predicted higher Science-Self Efficacy total scores.

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CHAPTER I

INTRODUCTION

There has been a growing concern about the lack of students in the United States majoring in Science, Technology, Engineering, and Mathematics (STEM). A 2012 report by the President's Council of Advisor's on Science and Technology (PCAST) recommended that America's competitiveness in in science, technology, engineering, and math over the next decade lies in the increase of the number of STEM graduates by one million to meet the demands of projected employment needs. The report also cited that within the first two years of post-secondary education, 60% of high school graduates majoring in a STEM degree pathway switch to a non-STEM major. In its 2014 report, the National Science Foundation Report on Women, Minority, and Persons with Disability in STEM, reported that females accounted for 25% of individuals who completed a bachelor degree and attained a STEM career compared to 75% who were males. Only 2.4% of underrepresented minorities completed a bachelor degree and attained a STEM career compared to 69.3% Caucasian. In recent years, STEM education has been the focus of both federal and state initiatives. These initiatives include the development of high quality science teaching and ways to increase the diversity of students choosing a STEM pathway during post-secondary education.

Statement of the Problem

Science is important for competitiveness in the global economy. For the U.S to remain competitive in the coming years, the number of students enrolling and completing postsecondary STEM degrees must increase. A 2013 report by the Office of the National Science Foundation found that American students' interests in STEM subjects and degrees is still on the decline. According to this study, only 5% of graduating high school seniors will obtain a college degree in STEM and a third of eight graders in the U.S are interested in STEM and STEM majors. Moreover, the Trends in International Mathematics and Science Study (TIMSS) did not show significant changes in the U.S. fourth and eighth grade science performance from 2007 – 2009.

However, later research in 2015 showed a two-point gain in U.S. science achievement in the eighth grade while fourth grade science achievement showed no significant change (National Center for Education Statistics, 2015). Research conducted by the National Assessment of Educational Progress (NAEP) showed a more positive trend in assessment data. According to the NAEP's representative sample of 122,000 students, average science scores for the nation increased 4 points between 2009 and 2015 in both grades 4 and 8 but no significant change in grade 12 (National Center for Educational Statistics, 2015a). Additionally, scores in 2015 were higher in Grades 4 and 8 in all three science content areas (physical sciences, life sciences, and earth and space sciences) compared to 2009. However, there was no change in science area scores for twelfth grade students. The 2015 NAEP study also showed the narrowing of the achievement gap among Caucasian, Hispanic and Black students when compared to the 2009 study.

Larger gains in scores in 2015 among Hispanics and African American students when compared to their Caucasian peers in the study accounted for a smaller score gap in grades four and eight. No significant changes were found in 2015 among Hispanics and African Americans when compared to their Caucasian peers. The average science scores at grade twelve for Caucasian students was 36 points higher than their African American peers and 24 points higher than their Hispanic peers in 2015 (National Center for Educational Statistics, 2015b).

There was no significant change in average science scores between male and females students at grade 4 but higher average science scores for males than females in both Grades 8 and 12 in the 2015 study (National Center for Educational Statistics, 2015b). The study also found that male students out performed female students in all three science content areas at the eighth grade-level. Male students at the twelve grade level outperformed their female peers in physical and earth and space science, while there was no gender gap in the life sciences. These results show a slow improvement in science education and achievement. Even with the significant gains in some areas, achievement results for girls, Hispanics, and African Americans do not reflect improvement in science education. The results of the NAEP and the TIMMS studies have shown some promising results at the basic and proficient levels of achievement but extremely low marks at the advanced level. The improvement of science education is necessary to close the achievement gap for all groups. This means that educators must look for those factors that support and encourage students to study science. When studying science, students apply simple and sometimes complex mathematical concepts to reinforce scientific concepts and understanding.

Academic achievement in high school is central to a student's choice to study science in college. Studying science helps students understanding how things exists and function in the world while math helps students acknowledge and relate scientific discoveries, data collection, establishing evidence, and disproving or proving scientific theories (Chiu, 2008; Seki & Menon, 2007). Academic self-efficacy is a student's belief and confidence in their abilities to successfully achieve on an academic task or attain an academic goal (Bandura, 1997; Linnenbrink & Pintrich, 2002). Academic self-efficacy has been widely researched and studies have examined academic self-efficacy in the areas of science, math, and language arts, and as a global construct. Research has shown that males and females have different academic self-efficacies (Bornholt, Goodnow, & Cooney, 1994; Jacobs, 1991; Oakes, 1990; Simpkins, Davis-Kean, & Eccles, 2006).

Moreover, studies have shown that minorities and females are underrepresented in STEM professions (National Science Foundation, 2008; President's Council of Advisors on Science and Technology, 2005).

Self-efficacy beliefs affect academic performance in science (Nicholls, Wolfe, Basterfield-Sacre, & Shuman, 2010; Zeldin & Pajares, 2000). Students who have strong beliefs that they can achieve in mastering science tasks are more likely to select science activities (Nicholls et al., 2010; Zeldin & Pajares, 2000). Studies have shown that science self-efficacy is associated with science related course choices across grade levels (Else-Quest, Mineo, & Higgins, 2013; Lau & Roeser, 2002). According to Pajares and Schunk (2002), STEM self-efficacy is positively related to a student's interest and engagements. Studies have shown that regardless of age, gender, domain, or academic disciplines, students with higher self-efficacy will achieve a better academic performance and will enroll in challenging courses within their self-efficacy domains (Lodewyk & Winne, 2005; Louis & Mistele, 2012). Moreover, the quality of a school's academic environment is an important predictor of students' achievement in middle and high schools (Lee & Smith 1997; McEvoy & Welker, 2000).

Research Questions

Based on relevant literature, the following null hypotheses were developed to address the research questions.

1) There are no significant differences in Science Self Efficacy Questionnaire scores when compared by gender or ethnicity of students.

2) There are no significant differences in Attitudes Towards Math Inventory scores when compared by gender or ethnicity of students.

3) There are no significant differences in School Climate scores and School Rigorous Expectations scores when compared by gender or ethnicity of students.

4) There are no significant correlations between Science Self Efficacy Questionnaire scores and Attitudes Towards Mathematics Inventory scores, Panorama Student Survey Scales About the School—School Climate and School Rigorous Expectations subscale scores, and number of advanced courses in science and math.

5) Which factors or combinations of factors predict higher Science Self-Efficacy scores in Early College High School students?

H_0: Variables entered into a multiple regression analysis, including age, Attitudes Toward Math Inventory scores, School Climate scores, School Rigorous Expectations scores, and number of advanced course in science and math, are not significant predictors of Science Self Efficacy Questionnaire scores.

Purpose of the Study

Using Bandura's (1997) self-efficacy theory as a theoretical framework, the purpose of this study was to examine (a) the variables of gender, ethnicity, age, perceptions of school climate and academic rigor, attitudes toward mathematics, and number of advanced math and science courses in high school; and (b) how these factors contribute to students' science self-efficacy. This study contributes to the growing body of knowledge concerning gender differences among minority high school students and science self-efficacy.

Theoretical Framework

According to Bandura's (1977) social cognitive theory, individuals are more likely to choose academic or career activities in domains that they believe will offer the best outcomes and tend to avoid behaviors that present negative outcomes. In reference to this theory, individuals will choose academic careers in the domains of math or science because they believe in the positive outcomes and may avoid behavior or choices that will present negative outcomes. Based on past learning experiences, individuals will develop an expectation of the outcomes from performing the behavior producing the outcome. Bandura (1997) provided a theoretical explanation for human behavioral change by establishing the framework of self-efficacy.

Importance of the Study

Studies have found that for student in grades four through twelve, science self-efficacy was a strong predictor of science interest (Fan, Lindt, Arroyo-Giner, & Wolters, 2009; Fast et al, 2010; McMahon, Wemsman, & Rose, 2009; Nicholls et al., 2010).

Minorities made up 29% of college educated professionals in 2006, but accounted for only 9% of professionals who were college educated in the STEM fields (Bianchini, 2013). Furthermore, the lack of females and minorities in science is relevant for several reasons. First, females and minorities account for 50.9% and 25% of the U.S. population respectively (Wang, Eccles, & Kenny, 2013). Secondly, this is a significant portion of the growing population. It will be in the best interest of the nation's quest for global competitiveness to study ways to increase interest and participation in STEM fields by females and minorities. This study will provide teachers, administrators, and researchers with information relevant to developing programs that support girls' and minorities' preparation for STEM related careers.

Delimitations of the Study

The following were delimitations of this study:

1. Eligibility for participation in this study was restricted to students enrolled in three North Texas Early College High School programs located in North Texas.
2. Participation was limited to 9th to 12th grade students between the ages of 13 – 19. This is the age range of students enrolled in high school.
3. Most Early College students were First Generation College bound students.

4. Consent for students to participate was provided by their parents. Assent was provided by the students.

Definition of Terms

The definition of terms provides an understanding of the constructs included in this study. The following definitions were applied in this study.

1. *Self-efficacy*: Bandura (1977) defined self-efficacy as the belief of an individual in his or her ability to perform a specific task.
2. *Academic Self-efficacy*: Usher and Pajares (2006) described academic self-efficacy as the belief that a student has in his or her ability to perform academic tasks.
3. *School Climate*: The National School Climate Council (2007) defined school climate as the experiences of school life and the reflected norms, goals, values, teaching-leaning practices, organization structures, and interpersonal relationships.
4. *Advanced Science Class*: Advanced placement science classes are classes that are designed by the College Board. If students are successful in these classes and earn a score of three or better on a five point scale, they may receive college credit for the course or an advanced placement in a higher course level when they enroll in college. A dual-credit science class taken at a community college may also serve as an advanced class. Students earning a grade of C or better will receive credit when they enroll at a 2-year or 4-year college (Texas Education Agency, 2001).

5. *Attitudes towards Math*: an attitude towards mathematics is a person's positive or negative emotion towards mathematics (Tapia & Marsh, 2004)
6. *Early College High School*: Schools that allow students least likely to attend college a pathway to attain up to 60 college credits and a high school diploma at no cost to the student. Early College High Schools offer rigorous instructions, increased college readiness, and a reduction in the barriers to college access (Texas Education Agency, 2007).

Summary

Minorities and females are underrepresented in STEM professions. Academic achievement in high school is central to a student's choice to study science in college. Academic self-efficacy has been widely researched and studies have examined academic self-efficacy in the areas of science, math, and language arts, and as a global construct. This study examined a) the variables of gender, age, perceptions of school climate, attitudes toward mathematics, and number of advanced math and science courses in high school; and b) how these factors contribute to students' science self-efficacy.

CHAPTER II

REVIEW OF RELATED LITERATURE

This chapter contains the review of literature related to self-efficacy and academic self-efficacy (math and science) in students. The theoretical framework is described, followed by an overview of self-efficacy. The next section examines the literature on academic self-efficacy and variables that affect academic self-efficacy as it relates science and math among middle and high school students. The purpose of this literature review is to examine the influence of gender, ethnicity, school climate, and attitudes towards math on academic self-efficacy as it relates to science among minority high school students in an Early College High School setting.

Theoretical Framework

According to Bandura's (1977) social cognitive theory, individuals are more likely to choose academic or career activities in domains that they believe will offer the best outcomes and tend to avoid behaviors that present negative outcomes. In reference to this theory, individuals will choose academic careers in the domains of math, science, or English because they believe in the positive outcomes and may avoid behavior or choices that will present negative outcomes. Based on past learning experiences, individuals will develop an expectation of the outcomes from performing the behavior producing the outcome. Bandura (1997) provided a theoretical explanation for human behavioral change by establishing the framework of self-efficacy.

Definition and Overview of Self-Efficacy

Bandura (1977) provided a theoretical explanation for human behavioral change by establishing the framework of self-efficacy. Bandura (1977) defined self-efficacy as the belief an individual has in his or her ability to perform a specific task. According to Bandura (1977, 1997), individuals with high self-efficacy have a strong sense of personal well-being and tend to approach difficult tasks as challenges while seeking mastery of these tasks. According to Lent, Brown, and Gore (1997), when individuals are confronted with difficulties, self-efficacy beliefs help individuals in their choices of behavior and efforts, performance, and persistence. As described by Lent and Brown (2006), self-efficacy is not a single characteristic but a dynamic set of beliefs. These beliefs share a direct relationship to a specific set of actions. Bandura's (1997) social cognitive theory postulated that self-efficacy comes from the interpretation of information from four sources: (a) Mastery experiences, (b) vicarious learning experiences, (c) social persuasion experiences, and (d) psychological state.

Mastery experiences. According Bandura (1997), performing a task successfully builds and strengthens self-efficacy, hence, it is the most effective way of developing a strong sense of efficacy. Individuals who successfully complete a task have built a strong experience and will have the competence and confidence to complete similar tasks in the future. However, failing to successfully complete a task can weaken a mastery experience and hence weaken self-efficacy.

Vicarious learning experiences. The second source of self-efficacy comes from vicarious or social learning experiences (Bandura, 1997). These experiences occur when an individual witnesses other people who are similar perform and/or complete a task comparable to one the individual is considering. This raises the individual's beliefs that the individual also has the ability to master and succeed at that task. Studies conducted by Zeldin and Pajares (2000), which analyzed narratives of women who selected math related careers and continued to excel in math-related careers, found that vicarious learning and social persuasion experiences influenced self-efficacy in females.

Social persuasion experiences. Bandura asserted that social persuasion is the third source of self-efficacy. Verbal persuasion of an individual to believe that the skills and abilities to complete a task or a goal can influence one's personal beliefs about his or her abilities to master and complete said task or goals. According to Bandura (1977), social persuasion experiences have the largest impact on individuals who already believe that they are capable of completing the task.

Moreover, social persuasion makes individuals try harder to succeed and leads to development of personal efficacy. Hackett and Betz (1981) found that continual social and verbal messages directed to minorities and women about traditional roles in society can discourage these individuals concerning their abilities to succeed in a non-traditional social role. Zeldin, Britner, and Pajare's (2008) study explored the personal stories of women and men in STEM and their career choices found similar results previous research done by Zeldin and Pajares (2000). The study found that vicarious experiences and social persuasions were the primary sources of self-efficacy beliefs of women who pursue STEM careers while the primary source of self-efficacy beliefs for men was mastery experiences.

Psychological state. Physiological stress, emotional state, and reaction to situations can also impact how an individual feels about a specific situation and can affect self-efficacy. Bandura (1977) asserted that high levels of stress and anxiety often weakens confidence in an individual's abilities to perform a specified task and this will lead to a lower self-efficacy. It is believed that psychological states act as mediating sources that works in collaboration with other sources to either amplify or undermine an individual's ability to perform a specified task (Bandura, 1997; Hackett & Betz, 1981). Judgment about an individual's self-efficacy is affected by the mood. Positive mood tends to enhance self-efficacy while negative mood reduces or diminishes self-efficacy. Zedlin and Pajares (2000) found that depression and sadness tend to have a negative impact on self-efficacy and may negatively impact performance or completion of a task.

Academic Self-Efficacy

Academic self-efficacy is defined as a student's current capabilities and anticipated success to perform academic studies and achieve academic goals (Bandura, 1997; Jungert & Rosander, 2010). According to Bandura (1977), academic self-efficacy can influence motivation in the face of difficulties and can have an effect on specific causes of successes and failures. The level of performance, the amount of effort put forth by an individual, and the choice of tasks are positive influences of self-efficacy. There are different types of self-efficacy and academic self-efficacy is one of them. Usher and Pajares (2006) described academic self-efficacy as the belief that a student has in his or her ability to perform academic tasks. Academic self-efficacy is the measure by which an individual feels confident in his or her ability to perform and succeed at the applicable level in his or her academics.

Academic Self Efficacy and Academic Achievement

Studies have shown that there is a positive relationship between academic achievement and academic- self-efficacy. Academic self-efficacy can affect and influence a student's effort, goals, and persistence (Hejazi, Shahraray, Farsinejad, and Asgary, 2009; Linnenbrink & Pintich, 2003). Bassi, Steca, Della Fave, and Caprara (2007) examined a sample of 130 high school students (55 males, and 75 females) ranging in age from 15 to 19 years, assessed academic self-efficacy and its association with academic pursuits and academic aspirations. This study found that students with high self-efficacy felt more capable of managing their academic activities across three grade levels. Moreover, high self-efficacious students reported higher grades, higher aspirations, and high teacher evaluations while students who exhibited low self-efficacy reported spending less time on academic pursuits and less confidence in managing academic pursuits. According to Bassi et al. (2007), this study supported the correlation between self-efficacy and academic performance.

Motlagh, Amrai, Yazdani, Abderahim, and Souri's (2011) study also verified the relationship that exists between self-efficacy and academic achievement. This study consisted of a sample of 250 girls in an all-girl high school and the used the self-efficacy scale as an instrument. Regression analysis revealed that self-regulating, self-directing, and self-evaluation were positively correlated with academic achievement.

Academic Self-Efficacy: Gender and Ethnicity

Academic self-efficacy has been widely researched and research has used academic self-efficacy in areas of math, science, language arts, or as a global construct. Because of the different experiences and differences in academic self-efficacy that may be present during the course of education, research has shown that males and females have different academic self-efficacies (Bornholt et al., 1994; Jacobs, 1991; Oakes, 1990; Simpkins et al., 2006). According to Bornholt et al., (1994), when compared to females, males tend to have more positive perceptions in their abilities in mathematics and science with regards to their current performance. Findings also suggested that males and females may differ in how they view future performance (Bornholt et al., 1994; Jacobs, 1991). Females may perceive their success in math and science courses to be lower and may not choose a field in math and science when they matriculate to college (Bornholt et al., 1994; Jacobs, 1991).

Some empirical studies have documented that college academic achievement is lower for African Americans and Latinos than their Caucasian peers regardless of their first generation college status (Culpepper & Davenport, 2009; Good, Masewicz, & Vogel, 2010; Walton & Cohen, 2011). School climate and peer associations can affect students' beliefs about academic competence and performance (Fife, Bond, & Byars-Winston, 2011). Edman and Brazil (2009) examined the ethnic differences in perceptions of campus climate, social support, and academic efficacy among community college students and whether students' perceptions were associated with academic success. Using a sample of 475 (64% female and 36% male) students that consisted of 50 African

Americans, 75 Latinos, 146 Caucasians, and 204 Asians, Edman and Brazil (2009) found that Caucasian and African American students reported higher levels of cultural congruity and self-efficacy than Asian and Latino students. Moreover, there were observed ethnic differences in the relationship between students' perception and grade point average (GPA). Cultural congruity and efficacy correlated with GPA among Latino students, academic efficacy correlated with GPA among Asian students, while peer support and college environment correlated with GPA among Caucasian students.

This study found a lack of relationship between academic self-efficacy and GPA among African American and Caucasian students. Moreover, Edman and Brazil (2009) reported that a positive campus climate was one of the important components for African American and Latino students attending college and cautioned that negative perceptions of campus climate can contribute to low academic success. Many studies (Pajares, 1996; Pajares, Britner, & Valiante, 2000; Usher & Pajares, 2006; VanLeuvan, 2004) have documented attitudes towards math in middle and high school students in many academic settings such as middle schools, high schools, and college. However, no studies has been documented that looks at the attitudes towards mathematics in an Early College High School setting. Early College High Schools are institutions that predominately recruits African Americans and Latino first generation college students in as nontraditional academic setting. It will be of interest to study academic self-efficacy among minority youth in a non-traditional academic setting.

Science Self Efficacy

Academic self-efficacy can be divided into the different academic domains. Science self-efficacy is one of the domains of academic self-efficacy. Science self-efficacy predicts academic achievement because science efficacious individuals are motivated to succeed. Research has shown that an increased level of science self-efficacy has a positive effect on student's educational achievement and attainment (Bandura, 1997; Pajares and Schunk, 2002). According to Bandura (2001), the belief that a student holds in his or her capabilities will affect his or her motivation and will to act. The effect on motivation and will may impact performance.

Science Self Efficacy: Gender and Ethnicity

Weisgram and Bigler (2006) study of 691 middle school students that examined gender differences in science found that in the control groups, boys were more self-efficacious in science than girls but in the intervention groups, who attended presentations by female scientists and attended hands-on science activities had higher science self-efficacy than girls in the control group. However, a meta-analysis of 187 studies conducted by Huang (2013) found that males exhibited higher self-efficacy in mathematics, computer, and social sciences, while in the other academic areas, self-efficacy was either the same or higher in girls. Moreover, empirical studies examining gender differences in science self-efficacy in school age students found no significant differences in respect to gender (Britner & Pajeres, 2006; Kiran & Sungur, 2012; Usher & Pajares, 2006).

An earlier studies showed that in the U.S. culture, children have the perception that scientists are white and male (Wenner, 2003). When it comes to abilities in math and science, White and Asian Americans are stereotyped for having high abilities in math and science while Latinos and African Americans are stereotyped as having low academic abilities in math and science in addition to lacking intelligence and being academically unengaged (Hudley & Graham, 2002; Sinclair et al., 2006; Wenner, 2003; Steele, 1997). Studies have examined gender differences in academic self-efficacy in many subject areas including science. There is no uniform consensus on science/STEM self-efficacy as it relates to gender and ethnic groups (Britner & Pajeres, 2006; Hudley & Graham, 2002; Steele, 1997; Sinclair, Hardin, & Lowery, 2006; Usher & Pajares, 2006; Wenner, 2003). Moreover, during the review of literature, no studies were found that documented academic or science self-efficacy in Early College High school settings. This study will contribute to the limited research on science self-efficacy as it relates to gender and ethnicity in an Early College High School setting.

Math and Science Course Selection and Self-Efficacy

Self-efficacy beliefs affect academic performance in science and students who have strong beliefs that they can achieve in science and math tasks and activities are more likely to select science and math tasks and activities (Bandura, 1991, 1997). These students will work hard at their chosen tasks and activities, and most times succeed at these task and activities. Students who do not do well in science and math tasks and activities will avoid selecting science and math tasks and activities. Research has shown that math and science efficacy are associated with math and science achievements and math-related or science-related choices across grade levels (Else-Quest et al., 2013; Gwilliam & Betz, 2001; Kupermintz, 2002; Lau & Roeser, 2002).

According to Schunk and Pajares (2002), STEM self-efficacy is positively related to a student' interest and engagements therefore students with high science and math self-efficacy will enroll in more challenging science and math courses (Watt, 2006). However, interest is shown to be more highly related to a student self-efficacy than the student actual ability (Bandura, 1991). This concept of interest versus ability in relation to self-efficacy could be used to explain why many girls lose interest in STEM courses and activities as they progress through high school. Smist and Owen (1994) found that attitudes, aptitudes, and attributions were strong predictors of science self-efficacy in high school students.

Dalton, Ingels, Downing, and Bozick (2007) examined data collected by the National Center for Educational Statistics (NCES). This data consisted of surveys from three high school graduating classes in 1982, 1988, and 2004 found that student expectation of finishing a bachelor's degree had a positive and significant effect on the completion of a calculus course. Studies have documented science and math efficacies and achievements. No study has examined the combined effects science course-taking and math course-taking on science self-efficacy in an Early College High School setting. Moreover, no documented studies were found relating to advanced and dual-credit math-science course selection as predictors of science self-efficacy in an Early College High School setting. This study intends to explore this issue and contribute to research in this area.

Attitudes Towards Mathematics

According to Zelley, Mariane, and Elaine (2005), a persons' attitude is the positive or negative views about a place, event, person, or thing. The person, place, thing, or event is referred to as the attitude object. The three different components of attitudes are the cognitive, affective, and behavioral component of attitudes (Eagly & Chaiken 1993; Maio & Haddock, 2010). The way a person thinks or believes about the attitude object is the cognitive component of attitude. Persons' feelings or emotions associated with the attitude object is the affective component of attitude while the persons' tendency to respond in the attitude object is referred to as the behavioral component of attitude. Therefore the cognitive, affective, and behavioral components of attitudes are interconnected.

Attitudes towards mathematics are regarded as the like or dislike for mathematics. There have been different interpretations of the clear definition of attitudes towards mathematics. According to Zan and Di Martino (2007), an attitude towards mathematics is a person positive or negative emotion temperament towards mathematics. Hart (1989) defined attitudes towards mathematics as a persons' emotions, beliefs, and behaviors towards mathematics. However, Neale (1969) defined attitudes towards mathematics as the tendency to engage or avoid mathematics and math related activities. From the three definition stated above, one can see that attitudes towards mathematics has cognitive, affective, and behavioral components. Students develop positive attitudes towards math because the student associates positive experiences with math. Some studies have shown that students have a positive attitude towards math (Tezer & Karasel, 2010; Yilmaz, Altun, & Olkun, 2010).

Attitudes Towards Mathematics: Gender and Ethnicity

Attitudes can be gender related and attitudes towards mathematics can also be gender related as many individuals believe that boys do better at mathematics than girls. This belief can affect girl's mathematical confidence and may lead to a negative attitude towards math. But research findings have been contradictory and these findings have shown no significant differences in attitudes towards math between girls and boys (Köğce, Yıldız, Aydın, & Altındağ, 2009; Mohd, Mahmood, & Ismail, 2011; Nicolaidou & Philippou, 2003). However, a study conducted by Farooq and Shah (2008) with a sample of 685 (379 males and 306 females) 10th grade students selected conveniently from 10 private and public sector schools in Pakistan found no significant differences in the confidence of male and female students at the secondary level but found that student success in mathematics depended on their attitudes towards mathematics.

However, a study conducted by Else-Quest, Linn, and Hyde (2010) which analyzed the 2003 trend in the International Mathematics and Science Study (TIMSS) and the Programme for International Student Assessment (PISA) reported that in 69 countries, males had higher levels of confidence, self-concept, and more positive math attitudes. Research conducted by Brown and Leeper (2010) with a sample of 345 girls between the ages of 13 –18 years investigated the relationship between perceived academic sexism and adolescence girls 'competence in math and science. Analyses of the data revealed that older European American adolescents and both older and younger

Latina adolescents who have experienced more academic sexisms in math and science felt less competent than girls who had experienced less academic sexisms in math and science.

Attitudes Towards Mathematics and Science Self-Efficacy

Studies have shown that relationships exist between attitudes and self-efficacy (Pajares & Miller, 1994; Stramel, 2010; Usher, 2009). A student attitude towards mathematics can have a positive or negative effect on the learning of mathematics. Students with positive attitudes towards mathematics tend to perform well in mathematics and develop high self-efficacy towards mathematics and subjects with math-related content. Research by Ma (2003) and Wang (2013) suggested that prior math achievement influences a student attitude and STEM self-efficacy as well as STEM outcomes. Using data from the Education Longitudinal Study of 2002, Wang (2013) theorized that 10th grade students' math attitudes and math achievement scores influenced their 12th grade math –attitudes, math-self-efficacy beliefs, exposure to math and science, and intent to enter into a STEM field of study.

Wang conducted a follow-up study of these students as senior and a second follow-up two years after high school. Wang (2013) found that math-self-efficacy, exposure to math and science, and entrance into the STEM field were significantly and positively influenced by the students 10th grade variables (Math attitudes and math achievements). These finding strongly suggests that there are significant effect of prior math attitudes, achievements, and self-efficacies on STEM outcomes.

Maltese and Tai (2011) also found that race, math grades, prior math scores, math and science attitudes, interests, and self-efficacies, and expectations of having a STEM career at the age of 30 were strong predictors or enrolment and completion of a STEM degree. Thus far, literature has examined the relationship between math attitudes, math achievement to STEM as a discipline and to STEM self-efficacy. There is not much research that has studied the relationship that exists between math attitudes and traditional sciences taught within American high school. Most research in science or STEM is focused on STEM career outcomes. With the heavy use of mathematics in high school chemistry and physics classes, this study sought to study math attitudes and its relationship to science (biology, chemistry, and physics) efficacy in high school students. The Science Self Efficacy Questionnaire (SSEQ) (Smist, 1993) was used to measure students' beliefs about their competence to perform and complete science related tasks in biology, chemistry, and physics.

School Climate and Academic Outcomes

The Texas Education Agency (TEA) defines school climate as the feelings and attitudes that are produced by a school's environment. According to TEA, indicators of a positive school climate and welcoming learning environment are increased attendance and reduced discipline referrals. Studies by Lee and Smith (1997) and by McEvoy and Welker (2000) found that the quality of a school's academic environment is an important predictor of student achievement in middle and high schools. Effective school leaders set high academic standards and believe in their abilities to improve student outcomes.

Therefore, students are encouraged to do their best and experience superior growth in math and science achievement (Hoy, Tarter, & Hoy, 2006; Ma & Wilkins, 2002).

The climate of a school shapes the quality of interactions as it relates to students, teachers, parents, and school personnel (National School Climate Council, 2007). School climate also shapes the values and goals of a school and can shape school experience as it relates to the quality of teaching and learning, school and community relationships, and school environment (National School Climate Council, 2007). There exists no universal definition of school climate, but the research literature defines school climate on the basis of four variables: academic, community, safety, and institutional environment (Wang & Degol, 2016). According to Wang & Degol (2016), academic climate has its focus on the quality of instruction, teacher preparation, instruction, professional development, and the academic atmosphere of a school.

Interpersonal relationships within a school are characterized by the community variable of school climate ((Wang & Degol, 2016). Safety involves the physical and emotional security provided by the school environment through consistent and fair discipline systems and practices. The institutional environment is the structural and organizational aspects of a school (Wang & Degol, 2016). In a comprehensive study conducted by Voight, Austin, and Hanson (2013), 1,715 California middle and high school students were surveyed using the School Climate Index (SCI), a school level indicator developed for the California Department of Education. This study investigated how school climate and personnel resources related to the likelihood of academic success, the differences in school climate in successful and unsuccessful schools, and the practical implications for improving academic achievement. The research findings indicated that successful schools scored twice higher on the SCI than unsuccessful schools.

Moreover, the study found a positive association between school climate, personnel, and students' academic success. The practical implications of the study demonstrated that safe and supported students performed well in school. Using a sample of 2,560 participants from the 2007–2008 School Survey on Crime and Safety, Sulak (2016) examined the relationships between school climate factors (such as disciplinary behaviors and school size) and academic achievement on standardized tests at a suburban school. Findings from this study indicated that schools with greater than 50% minority students and educating a population of 20% –50% minority students with widespread disciplinary behavior showed an increase in students scoring below the 15th percentile on standardized exam while schools in low crime areas and less disciplinary behaviors saw a reduction in the number of students scoring below the 15th percentile on standardized tests.

Very few studies have examined school climate, gender, and ethnicity. Some studies have found that boys hold a more negative perceptions' of school climate than girls (Buckley, Storino, & Sebastiani, 2003; Slaugther-Defoe & Carlson, 1996). Slaughter-Defoe and Carlson, (1996) found that Latinos emphasized teacher fairness, caring, and praise of effort as important aspects of school climate.

Early College High Schools

An Early College High Schools Initiative was launched by the Bill and Melinda Gates foundation in 2002 to increase opportunities for underserved students to earn a post-secondary certificate or degree. An Early College High School is a partnership between school districts, community colleges, and universities to offer high school students a chance of earning an associate degree or up to two year of college credits that may lead to a bachelors' degree at little or no cost to the student and their families. Since the launching of the Early College High School Initiative in 2002, more than 240 Early College High Schools have opened in the United Sates. Data collected by Jobs for the Future (2013) reported that 90% of Early College High School students' graduate high school versus the national rate of 78%. Moreover, 94% of Early College High School graduates earn some college credits for free and nearly one-quarter of students earn an associate's degree by the time they finish high school.

The American Institute for Research (2013) conducted a study that examined whether attending an Early College High School increased postsecondary outcomes. The study evaluated the impact of Early College High Schools on high school graduation, college enrollment, and degree achievement. This study used retrospective data of 10 Early College High Schools in five states and a cohort of 2,458 students from three cohort years. Students who were offered admissions to Early College High School by the lottery formed the intervention group while students not offered admissions formed the comparison group. The study reported that from 2005 to 2011, 86% of the intervention group graduated high school versus 81% of the comparison students. Post-secondary college degree earned by Early College High School graduates was 22% compared to 2% of the comparison students. Moreover, 80% of Early College High School graduates enrolled in a postsecondary program while 71% of comparison group students enrolled in postsecondary programs.

Summary

Bandura provided a theoretical explanation for human behavioral change by establishing the framework of self-efficacy. According to Bandura, individuals with high self-efficacy have a strong sense of personal well-being and tend to approach difficult tasks as challenges while seeking mastery of these tasks. The literature review provided the sources of self-efficacy, academic self-efficacy, and how academic self-efficacy relates to gender and ethnicity. Moreover, the review of literature provided the current and past state of the research on science self-efficacy, math and science course selections, and students' attitudes towards math. This chapter also reviewed Early College High Schools settings and performance.

CHAPTER III

METHODOLOGY

Introduction

The previous chapter reviewed and discussed the literature on academic self-efficacy with a specific focus on science and variables important to this study. This chapter provides a description of how the researcher conducted and processed the information. Comparisons by gender and ethnicity were planned to examine how female and minority students reported their beliefs about science self-efficacy, attitudes toward mathematics, and perceptions of school climate and school rigorous expectations. The study also investigated the factors or combination of factors (e.g., gender, attitudes towards math, number of advanced math and science course taken, school climate, rigor, and student's age) influencing science self–efficacy in an Early College High School setting.

Research Questions

The following null hypotheses were developed to address the research questions.

1) There are no significant differences in Science Self Efficacy Questionnaire scores when compared by gender or ethnicity of students.

2) There are no significant differences in Attitudes Towards Math Inventory scores when compared by gender or ethnicity of students.

3) There are no significant differences in School Climate scores and School Rigorous Expectations scores when compared by gender or ethnicity of students.

4) There are no significant correlations between Science Self Efficacy Questionnaire scores and Attitudes Towards Mathematics Inventory scores, Panorama Student Survey Scales About the School—School Climate and School Rigorous Expectations subscale scores, and number of advanced courses in science and math.

5) Which factors or combinations of factors predict higher Science Self-Efficacy scores in Early College High School students?

$H_{0:}$ Variables entered into a multiple regression analysis, including age, Attitudes Toward Math Inventory scores, School Climate scores, School Rigorous Expectations scores, and number of advanced course in science and math, are not significant predictors of Science Self Efficacy Questionnaire scores.

Research Procedures

This quantitative study used a descriptive research design. Quantitative research methods explain a phenomenon by collecting and analyzing numerical data through mathematically based methods (Aliaga & Gunderson, 2000). This study used convenience sampling with volunteers who obtained parental consent and provided assent to participate in the research study.

Population

The population of this study included eligible students enrolled in grades 9 –12 on three Early College Campuses located within North Central Texas. Collectively, 84% of the students at all three campuses qualified for free and reduced lunch, and 27% were students with limited English proficiency. The sample consisted of 85% Hispanics or Latinos, 13% African Americans, and 2% identified with other racial and ethnic groups.

Sample

An a priori power analysis was conducted using G*Power 3.1.9 to determine the minimum sample size required to find significance with a desired level of power set at .80, an alpha (α) level at .05, and a moderate effect size of .15 (f^2). Based on the estimated population of 500, it was determined that a minimum of 98 participants were required to ensure adequate power for the multiple linear regression. Preliminary analyses a needed minimum sample sizes of 98 participants (Cohen, 1988; Erdfelder, Faul, & Buchner, 1996; Faul, Erdfelder, Lang, & Buchner, 2007). Participants for this study were enrolled in one of the three campuses and volunteered to participate in the study. A convenience sample included students whose parents had provided a signed informed consent and students who completed the assent forms.

Research Setting

The current study was conducted at three Early College campuses in North Central, Texas. Early Colleges is an initiative by the Texas Education Agency that allows students least likely to attend college to get a head start in earning up to 60 college credits hours with a high school diploma at no costs. Students at Early College high schools are exposed to a rigorous high school curriculum of Pre-advanced Placement, Advanced Placement, and dual credit courses.

Protection of Human Subjects

Protection of the participants' human rights is vital when conducting research. This study was conducted in accordance with the requirements instituted by the Texas Woman's University Institutional Review Board (IRB) and the Independent School District Research Review Board (RRB) (see Appendix A). Applications were submitted and approved by the IRB and RRB before data was collected. All efforts were taken to minimize risks to the participants. These risks included minimal loss of time, potential loss of confidentiality, and possible discomfort.

Recruitment Procedures

The researcher obtained permission from the assistant district superintendent and principals of the three Early College High Schools for data collection procedures. An application was filed with the Texas Woman's University IRB and approval was received to collect data (see Appendix A). An application was filed with an Independent School District RRB and approval was received to collect data. A flyer describing the purpose and procedures for the study and contact information for the researcher was distributed to students (see Appendix B). Students took home two copies of the consent form and returned one copy signed by a parent or guardian in a sealed envelope. English and Spanish versions of the consent forms were made available. Students who were willing to participate in the study signed and submitted an assent form.

Data Collection

The research questionnaires and inventories were administered by the researcher and the research assistant after consent and assent forms were signed and collected and stored in a locked storage cabinet in the secure office of the researcher. Students who returned the consent form completed the assent form and questionnaires in a group setting in a private room at the high school before or after school hours. Completed research packets were sealed, collected, and stored in a safe location in a locked filing cabinet in the researcher' secure office at home.

Instrumentation

A demographic questionnaire was used to gather information about the participants of the study. The research tools: Attitudes Towards Math Inventory (Tapia & Marsh, 2004) (see Appendix D), Science Self-Efficacy Questionnaire (Smist, 1993) (see Appendix E), Panorama Student survey-School Climate (Gehlbach & Brinkworth, 2011) (see Appendix F), and Panorama Student survey-School Rigorous Expectations (Gehlbach & Brinkworth, 2011) were administered to measure the factors that affect Science Self-Efficacy scores in an Early College High School setting (see Appendix G).

Demographic Form

The demographic form included the age, gender, ethnicity, grade in school, and parents' educational attainment. In addition, the demographic form solicited information about the participants' enrollment and completion in science (i.e., biology, chemistry, and physics), advanced placement math and science, and dual credit math and science classes (see Appendix C).

Panorama Student Survey Scales About the School

The Panorama Student Survey (PSS) Scales About the School was developed by Gehlbach and Brinkworth (2011) to measure school climate. Pilot samples came from school districts in the southeastern United States (Sample 1) and from a large diverse high school in the southwestern United States (Sample 2). Sample 1 consisted of 4,225 students and Sample 2 consisted of 2,994 students. The sample also included large populations of English language learners as well as native English speakers. The reliability estimates for coefficient alpha for every scale are 0.70 or greater. Structural validity was established through confirmatory factor analysis. Convergent validity was determined by using alternate forms of the questionnaire. Correlations with similar scales provided additional evidence of validity. The PSS scales about the School consists of 10 subscales. The subscales that were used in this research are the School Climate and the School Rigorous Expectations. The questions are measured on a 5 – point Likert scale, with a higher rating representing a more positive perception.

Attitudes Toward Mathematics Inventory (ATMI)

Developed by Tapia and Marsh (2004), the Attitudes Towards Mathematics Inventory (ATMI) measures students' math attitudes and investigates the various dimensions of attitudes students have towards math. This 49-item instrument assesses confidence, anxiety, value, enjoyment, motivation, and parent/teacher expectations. The ATMI uses a 5– point Likert scale with (A) *strongly disagree* and (E) *strongly agree*. Tapia and Marsh sampled 545 high school students who were enrolled in math classes. The scale contains 12 items that were reversed scored so that appropriate values could be analyzed. Tapia and Marsh (2004) reported a Cronbach's alpha of 0.96 and construct validity was established based on literature reviews and judgment of the authors. Tapia and Marsh (2004) also conducted a test-retest that yielded a score with a coefficient of 0.89 and the coefficients of the subscales were: Self-confidence 0.88; Value, 0.70; Enjoyment 0.84; and Motivation 0.78.

Science Self-Efficacy Questionnaire

The Science Self-Efficacy Questionnaire (SSEQ) (Smist, 1993) measured students' beliefs about their competence to perform and complete science related tasks. The SSEQ is a self-administered questionnaire that consists of 26 items that are rated from A = "*quite a lot*" to E = "*very little*." The original SSEQ was field-tested on 826 New England high school students. The mean age of participants in the original sample was sixteen and more than half of the sample had taken biology and chemistry. The sample was predominately Caucasian (86%). The SSEQ was found to be reliable. The Cronbach's alphas ranged from 0.8 – 0.93 as reported by the author (Smist, 1993). The four factors displayed satisfactory inter-correlations (ranging from 0.26 – 0.42) and showed acceptable internal consistency reliabilities: Biology Self-efficacy (8 items, $\alpha = 0.86$); Chemistry Self-efficacy (6 items, $\alpha = 0.85$); Physics Self-efficacy (5 items, $\alpha = 0.89$); Laboratory Self-efficacy (7 items, $\alpha = 0.70$). A total score is calculated by summing the four factor scores.

Plans for Data Analyses

Reponses to the demographic form and research surveys were entered into SPSS for analyses. Demographic data included the total number of participants, gender, ethnicity, age, grade level, science and math AP and Dual Credit course enrollment or course completion. Demographic data were reported using frequencies and percentages.

Students' total scores on the SSEQ and ATMI were compared by ethnicity and gender using analysis of variance tests (ANOVAs). Multivariate analysis of variance tests (MANOVAs) were calculated for the subscale scores of the SSEQ, the ATMI, and the PSS (School Climate and School Rigorous Expectations) to compare groups by ethnicity and gender. Pearson correlations examined relationships between the SSEQ total scores and the variables ATMI total score, PSS School Climate and PSS School Rigorous Expectations total scores, and total number of advanced math and science courses.

Multiple regression was used to find which factors or combination of factors were predictors of higher Science Self-Efficacy total scores. The predictor variables in this analysis were age, number of advanced high school science and math courses taken, ATMI total scores, and PSS School Climate total scores and PSS School Rigorous Expectations total scores. The dependent variable was the SSEQ scores. Multiple linear regression is an extension of simple linear regression that is used to find the association between two or more independent variables and a single continuous dependent variable. Data were entered using simultaneous regression. Simultaneous regression entry builds a model that assesses whether one continuous dependent variable can be predicted from a set of predictor variables. Table 1 provides a summary of the variables, instruments, statistics, and display of data used in this study.

Table 1

Summary of Research Analyses

Purpose	Instrument(s)	Variables	Statistics	Display of Data
Description of Sample	Demographic Form	19 items	Frequencies and Percentages	Tables and graphs
There are no significant differences in Science Self Efficacy Questionnaire scores when compared by gender or ethnicity of students.	Science Self Efficacy Questionnaire (SSEQ)	Biology Subscale (6 items) Chemistry Subscale (6 items) Physics Subscale (5 items) Laboratory Subscale (7 items)	Means and Standard Deviations ANOVA (total score) MANOVA (subscale scores)	Tables and graphs
There are no significant differences in Attitudes Towards Math Inventory scores when compared by gender or ethnicity of students.	Attitudes Toward Mathematics Inventory (ATMI)I	Self Confidence Subscale (15 items) Value Subscale (10 items) Enjoyment (10 items) Motivation (5 items)	Means and Standard Deviation Means and Standard Deviation Means and Standard Deviation	Tables and graphs
There are no significant differences in School Climate scores and School Rigorous Expectations scores when compared by gender or ethnicity of students.	PSS Scales About the School Subscales	School Climate Subscale (5 items) School Rigorous Expectations Subscale (5 items)	Means and Standard Deviations MANOVA (subscale scores)	Tables and graphs

Purpose	Instrument(s)	Variables	Statistics	Display of Data
There are no significant correlations between Science Self Efficacy Questionnaire scores and Attitudes Towards Mathematics Inventory scores, Panorama Student Survey Scales About the School—School Climate and School Rigorous Expectations subscale scores, and number of advanced courses in science and math.	SSEQ ATMI PSS School Climate PSS School Rigorous Expectations Demographic Form	SSEQ total score ATMI total score PSS School Climate total score PSS School Rigorous Expectations total score Total number of advanced courses	Means and Standard Deviations	Table
Which factors or combination of factors predict higher science self-efficacy scores in Early College High School students?	SSES ATMI PSS School Climate PSS School Rigorous Expectations Demographic Form	Total scores for SSES, ATMI, School Climate, School Rigorous Expectations, gender, ethnicity, and number of advanced math and science classes	Multiple regression	Table

Summary

The research study was planned to compare students' beliefs, attitudes, and perceptions concerning science self-efficacy, mathematics, school climate, and school rigor by gender and ethnicity. Moreover, this study also examined which individual or combined factors of age, academic rigor, school climate, attitudes towards math, and the number of advanced science and math courses taken predicted higher science self-efficacy scores within an Early College High school setting. The study was approved by the Texas Woman's University IRB and conducted on three Early College High school campuses in North Central Texas. Issues regarding research ethics, confidentiality, consent and assent forms, and the protection of human subjects were addressed. Students who returned signed consent forms were administered a packet containing the demographic form, the ATMI, the SSEQ, the PSS School Climate, and PSS School Rigorous Expectations surveys. Data were analyzed using SPSS. The results of the study are presented in the following chapter.

CHAPTER IV

RESULTS

Introduction

The purpose of this study was to compare by gender and ethnicity the students' beliefs, attitudes, and perceptions concerning science self-efficacy, mathematics, school climate, and school rigor. In addition, the study identified the factors or combination of factors that were strong predictors of SSEQ scores of students in an Early College High School setting. Chapter four contains information pertaining to the analyses of data. The research hypotheses were answered by analyzing responses to the demographic form, the SSEQ, the ATMI, the PSS School Climate survey, and the PSS School Rigorous Expectations survey. The data were analyzed in three different stages. Descriptive statistics were conducted to quantitatively describe and characterize the sample. For each instrument, the frequencies and percentages for item responses were tabulated. Subscale and total scale score means and standard deviations were calculated. The total mean scores for each instrument were then compared by gender and by ethnicity. This was followed by bivariate analysis to determine the relationships between the SSEQ total score and the total scores of the ATMI, PSS School Climate and PSS School Rigorous Expectations. Finally, regression analysis using the simultaneous entry model was conducted to investigate the influence of the independent variables (number of advanced math and science courses taken, ATMI scores, School Climate total scores, and School Rigorous Expectation total scores) on the dependent variable (SSEQ total scores).

Description of the Sample

Data were collected from students enrolled at three Early College High School campuses in North Central Texas. The student demographic form elicited students' information including grade level, age, ethnicity, maternal and paternal levels of education, and Dual Credit or Advanced Placement courses taken. The sample of 113 students included 11 ninth graders, 46 tenth graders, 14 eleventh graders, and 42 twelfth graders. Ages ranged from 14 to 18, with an average of 16.2 years.

Ethnicity and Gender

Ethnic background reported by students included 72% Latinos (n = 82), 24% African Americans (n = 26), 3% Asian/Pacific Islanders (n = 4), and 1% other who identified as inter-racial (n = 1). Students in the sample were predominately Latinos, as shown in Figure 1.

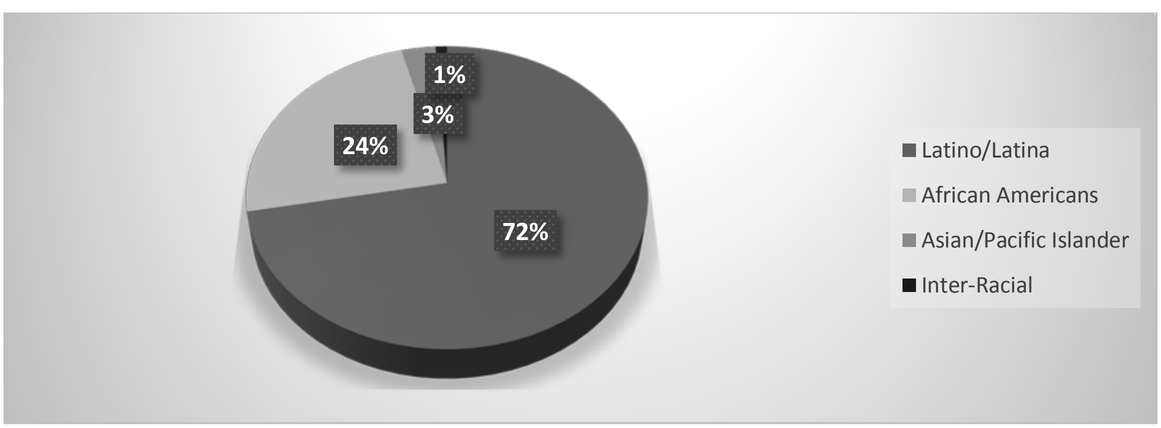

Figure 1. Ethnicity of students.

The participants included 60 (53.1%) females and 53 (46.9%) males (Figure 2). This provided a balanced sample by gender.

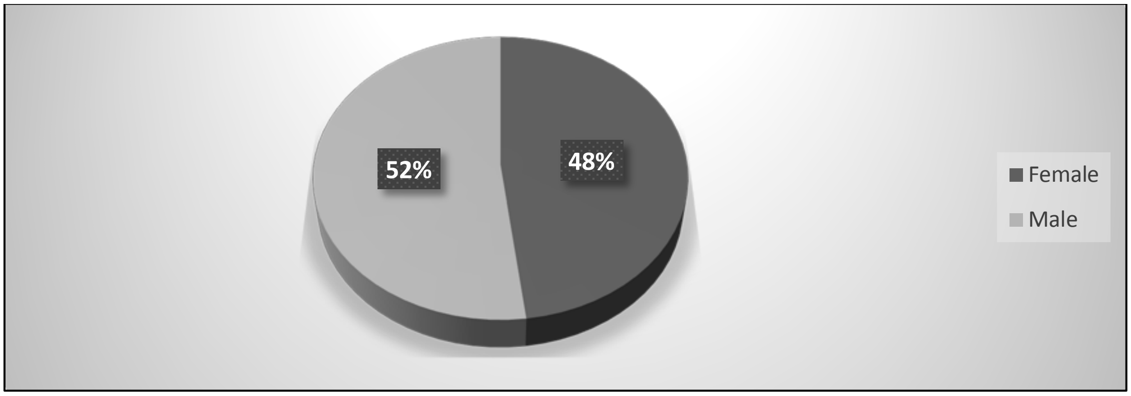

Figure 2. Gender of students.

Education Levels of Parents

Participants were asked to identify the highest levels of their parents' educational attainment. The results are displayed in Table 2. The analyses indicated that the majority of parents of participants had attained an eighth-grade education. More fathers had high school completion than mothers, while mothers' college attendance or attainment of a college degree was higher than fathers' college attendance or attainment of a college degree.

High School Science and Math Courses

All students in the sample had completed or were enrolled in high school biology as tabulated in Table 3. Advanced Placement science and math courses taken by students in the sample are displayed in Table 4. Advanced Placement calculus, biology, and chemistry were the most frequent courses taken by students.

Table 2

Parents' Levels of Education

Levels	Mother (*n* = 113)		Father (*n* = 113)	
	f	%	*f*	%
School to Eight Grade	59	52.2	55	48.7
High School Diploma/GED	20	17.7	33	29.2
Some College	17	15.0	14	12.4
College	17	15.0	11	9.7

Table 3

Frequencies and Percentages of High School Science Courses

Course Titles	*n*	*f*	%
Biology	113	113	100
Chemistry	113	97	85.0
Physics	113	53	46.9

Table 4

Frequencies and Percentages of High School Advanced Placement (AP) Science and Math Courses

Course Titles	*n*	*f*	%
AP Biology	113	11.0	10.0
AP Chemistry	113	11.0	10.0
AP Environmental Science	113	2.0	1.8
AP Calculus	113	21.0	19.0
AP Statistics	113	6.0	5.3

Dual Credit Science and Math Courses

Dual Credit courses are courses students enrolled in for college credit and credit towards high school graduation. Table 5 displays the frequencies and percentages of Dual Credit science and or math classes. College Algebra, Trigonometry and two semesters of science are required for an associate's degree.

Tables 5

Frequencies and Percentages for Dual Credit Science and Math Courses

Course Titles	*f*	%
Biology Non-Science Major	20.0	18.0
Biology Science Major	6.0	5.4
Chemistry Non-Science Major	6.0	5.4
Chemistry Science Major	7.0	6.2
College Algebra	36.0	32.0
College Trigonometry	26.0	23.0
College Statistics	1.0	1.0

Analyses of Survey Instruments

This study examined the differences on the measures of science self-efficacy, attitudes towards math, school climate, and school rigor in relation to the gender and ethnicity of students in the sample. This study also investigated the factors or combination of factors that affect science self-efficacy scores in an Early College High School setting.

Science Self-Efficacy

The SSEQ by Smist (1993) measured the beliefs about high school students' competence to perform in biology, chemistry, physics, and laboratory tasks. The SSEQ consists of four subscales (Biology, Chemistry, Physics, and Laboratory). Data analyses of the SSEQ were conducted according to recommendations of Smist (1993). The calculated reliability for the total SSEQ was 0.93 which is comparable to that reported by Smist (1993) with a range of 0.85 – 0.93.

For each subscale, participants were asked to select responses that ranged from "*Quite a Lot*" to "*Very Little*." For display purposes, responses were collapsed into three categories that included "*Quite a Lot to A Lot*," "*Neutral*," and "*Very Little to A Little*."

Biology subscale. The subscale contained eight items and measured students' beliefs about the competence to perform in high school biology "Getting good grades in biology" (65.5%) and "Answering questions in biology class" (61%) were the most frequent responses submitted by participants. Table 6 represents the frequencies and percentages of the SSEQ Biology subscale.

Chemistry subscale. The Chemistry subscale consisted of six items and that measured students' beliefs about the competence in high school chemistry. The participants strongly supported "Getting good grades in chemistry" as a measure of belief about competence in chemistry. Table 7 represents the frequencies and percentages of the SSEQ Chemistry subscale.

Table 6

Frequencies and Percentages of Biology Subscale of the Science Self Efficacy Questionnaire

	Response Anchors					
	Quite a Lot to A Lot		Neutral		Very Little to A Little	
Items	*f*	%	*f*	%	*f*	%
Doing well on a biology exam	57	50.5	38	33.6	18	15.9
Getting good grades in biology	74	65.5	27	23.9	12	10.6
Answering questions in biology class	61	61.0	30	26.5	14	12.4
Understanding concepts in a biology textbook	48	42.4	38	33.6	27	23.9
Taking essay tests in biology.	47	41.6	25	22.1	41	36.3
Asking questions in biology class.	60	53.1	33	29.2	10	17.6

Table 7

Frequencies and Percentages of Chemistry Subscale of the Science Self Efficacy Questionnaire

	Response Anchors					
	Quite a Lot to A Lot		Neutral		Very Little to A Little	
Items	*f*	%	*f*	%	*f*	%
Using chemical formulas and equations	65	56.5	37	32.7	11	9.7
Doing chemistry homework problems well	69	61.1	25	22.1	19	16.8
Asking questions in chemistry class	69	61.1	23	20.4	21	18.6
Understanding concepts in a chemistry textbook	64	56.7	28	24.8	21	18.6
Getting good grades in chemistry	71	62.9	27	23.9	15	13.2
Understanding abstract chemical concepts	61	53.9	31	27.4	21	18.5

Physics subscale. The physics subscale consisted of five items and measured students' beliefs about competence to perform in high school physics. Participants strongly supported "Getting good grades in physics" as a measure of belief in competence in physics. Table 8 represents the frequencies and percentages of the SSEQ Physics subscale.

Table 8.

Frequencies and Percentages of Physics Subscale of the Science Self Efficacy Questionnaire

	Response Anchors					
	Quite a Lot to A lot		Neutral		Very Little to A Little	
Items	*f*	%	*f*	%	*f*	%
Doing physics lab experiments well.	53	46.9	32	28.3	28	24.8
Doing physics homework problems well.	51	45.1	34	30.1	28	24.7
Understanding concepts in a physics textbook.	45	39.8	33	29.2	35	30.9
Asking questions in physics class.	55	48.7	23	20.4	35	30.9
Getting good grades in physics.	60	53.1	24	21.2	29	25.6

Laboratory subscale. The laboratory subscale consists of eight items and it measured students' beliefs about competence in conducting lab experiments. Participants strongly supported "Handling laboratory chemicals" and Performing lab experiments with simple machines" as a measure of belief in competence in laboratory. Table 9 represents the frequencies and percentages of the SSEQ Laboratory subscale.

Table 9.

Frequencies and Percentages of Laboratory Subscale of the Science Self Efficacy Questionnaire

	Response Anchors					
	Quite a Lot to A Lot		Neutral		Very Little to A Little	
Items	*f*	%	*f*	%	*f*	%
Using a computer in science classes	57	50.4	17	15.0	39	34.5
Using a microscope.	69	61.0	27	23.9	17	15.1
Lighting a laboratory (Bunsen) burner.	60	53.1	25	22.1	28	24.4
Winning a science fair award for a biology project.	46	27.0	27	23.9	40	35.4
Handling laboratory chemicals.	72	63.8	22	19.5	19	16.8
Performing lab experiments using electricity.	65	57.6	23	20.4	25	22.1
Performing lab experiments with simple machines.	79	69.9	19	16.8	15	13.2
Doing science activities for fun.	69	61.1	25	22.1	19	16.8

Attitudes Towards Math Inventory

Attitudes Towards Math Inventory (ATMI) developed by Tapia and Marsh (2004), measured students' math attitudes and investigates the various dimensions of attitudes students have towards math. The ATMI consists of four subscales (Self-confidence, Value, Enjoyment, and Motivation). Data analyses of the ATMI were conducted according to recommendations by Tapia and Marsh (2004). The calculated reliability for the total ATMI was 0.91, which is acceptable but slightly lower when compared to reliability of 0.96 obtained by Tapia and Marsh (2004)

Participants were asked to make responses that ranged from “Strongly Disagree” to “Strongly Agree” on a five-point scale. In each subscale responses were collapsed into three categories that ranged from “Strongly Disagree to Disagree,” “Neutral,” and “Strongly Agree to Agree” for display purposes.

Self Confidence subscale. The Self Confidence subscale contained 15 items and measured measure students’ confidence and self-concept of their performance in mathematics. Participants (80%) reported being uncomfortable in a math class. However, participants (81%) believed that they were good at solving math problems. Table 10 represents the frequencies and percentages of the self-confidence subscale.

Value subscale. The Value of mathematics subscale contained 10 items and measured students’ beliefs on the relevance and worth of mathematics in their lives now and in the future. Participants expressed desires to develop mathematical skills (97%) and believed that studying math will help with problem solving in other areas (98%). Table 11 represents the frequencies and percentages of the Value subscale.

Enjoyment subscale. The Enjoyment of mathematics subscale contained 10 items and measured the degree to which students enjoy taking math classes and working on mathematics. Participants reported being comfortable answering questions in math class (92%). Table 12 represents the frequencies and percentages of the Enjoyment subscale.

Table 10.

Frequencies and Percentages of Self Confidence Subscale of the Attitudes Towards Mathematics Inventory

	Response Anchors					
	Strongly Disagree to Disagree		Neutral		Agree to Strongly Agree	
Items	*f*	%	*f*	%	*f*	%
Mathematics is one of my most dreaded subjects.	27	23.9	40	35.4	44	40.7
My mind goes blank and I am unable to think clearly when working with mathematics.	27	18.6	22	19.5	70	61.9
Studying mathematics makes me feel nervous.	17	15.0	25	22.1	71	62.9
Mathematics makes me feel uncomfortable.	19	16.8	13	11.5	80	70.8
I am always under a terrible strain in a math class.	15	13.2	24	21.2	74	65.6
When I hear the word mathematics, I have a feeling of dislike.	85	75.2	21	18.6	7	6.20
It makes me nervous to even think about having to do a mathematics problem.	74	65.5	31	27.4	8	7.10
Mathematics does not scare me at all.	22	19.5	26	23.0	65	57.5
I have a lot of self-confidence when it comes to mathematics.	17	15.0	31	27.4	62	55.8
I am able to solve mathematics problems without too much difficulty.	12	10.6	38	33.6	63	55.7
I expect to do fairly well in any math class I take.	15	13.3	23	20.4	75	66.4
I am always confused in my mathematics class.	19	16.8	26	23.0	68	60.2

Table 11

Frequencies and percentages of value subscale of the Attitudes Towards Mathematics Inventory

	Response Anchors					
	Strongly Disagree to disagree		Neutral		Agree to Strongly Agree	
Items	*f*	%	*f*	%	*f*	%
Mathematics is a very worthwhile and necessary subject.	11	9.7	15	13.3	87	77.0
I want to develop my mathematical skills.	8	7.1	7	6.2	98	86.7
Mathematics helps develop the mind and teaches a person to think.	7	6.2	21	18.6	85	75.3
Mathematics is important in everyday life.	8	7.1	31	27.4	74	65.4
Mathematics is one of the most important subjects for people to study.	13	11.5	25	22.1	75	66.4
High school math courses would be very helpful no matter what I decide to study.	8	7.1	18	15.9	87	77.0
I can think of many ways that I use math outside of school.	12	10.6	31	27.4	70	61.9
I think studying advanced mathematics is useful.	0	0.0	2	1.8	80	79.7
I believe studying math helps me with problem solving in other areas.	0	0.0	3	16.0	97	85.7
A strong math background could help me in my professional life.	7	6.2	14	12.4	92	81.4

Table 12

Frequencies and Percentages of Enjoyment Subscale of the Attitudes Towards Mathematics Inventory.

	Response Anchors					
	Strongly Disagree to disagree		Neutral		Agree to Strongly Agree	
Items	*f*	%	*f*	%	*f*	%
I get a great deal of satisfaction out of solving a mathematics problem.	13	11.5	15	13.3	85	75.2
I have usually enjoyed studying mathematics in school.	4	3.6	28	24.8	81	71.7
Mathematics is dull and boring.	28	24.1	20	17.7	65	57.6
I like to solve new problems in mathematics.	9	8.0	18	15.9	86	76.1
I would prefer to do an assignment in math than to write an essay.	13	11.5	20	17.7	80	70.8
I really like mathematics.	27	23.9	38	33.6	48	42.5
I am happier in a math class than in any other class.	41	27.7	28	24.8	54	47.8
Mathematics is a very interesting subject.	14	12.4	22	19.5	77	68.1
I am comfortable expressing my own ideas on how to look for solutions to a difficult problem in math	9	8.0	21	18.6	84	74.7
I am comfortable answering questions in math class.	7	6.2	14	12.4	92	81.4

Motivation subscale. The Motivation of mathematics subscale contained five items and measured students' interest in mathematics and their desires to pursue studies in mathematics. Eighty-nine percent of participants disagreed with the statement "I would like to avoid using mathematics in college." The participants (80%) responded favorably to the appeal and challenge of mathematics. Table 13 represents the frequencies and percentages of the Motivation subscale.

Table 13

Frequencies and Percentages of Motivation Subscale of the Attitudes Towards Math Inventory

	Response Anchors					
	Strongly Disagree to Disagree		Neutral		Agree to Strongly Agree	
Items	*f*	%	*f*	%	*f*	%
I am confident that I could learn advanced mathematics.	14	12.3	19.0	16.8	80.0	70.8
I would like to avoid using mathematics in college.	10	8.8	14.0	12.4	89.0	78.8
I am willing to take more than the required amount of mathematics.	6	5.3	29.0	25.7	78.0	69.0
I plan to take as much mathematics as I can during my education.	2	1.0	23.0	20.4	79.0	69.9
The challenge of math appeals to me.	2	1.8	21.0	18.6	80.0	79.7

Panorama Student Survey Subscales

The PSS Scales About the School were developed by Gehlbach and Brinkworth (2011) for Panorama Education to measure students' perception of teaching, learning, and the school environment. The survey consists of 10 subscales. The subscales used in this research were the School Climate and the School Rigorous Expectations.

School Climate subscale. The school climate subscale consists of five items and measured students' perceptions of the overall social and learning climate of the school. The calculated reliability of the school-climate subscale was 0.83 which was higher when compared to 0.79 obtained by the authors (Gehlbach & Brinkworth, 2011). The questions were measured on a 5-point Likert scale, with a higher ratings representing a more positive perception. Table 14 represents the frequencies and percentages of the School-

Climate subscale. Participants (74%) responded positively to the positive energy at school. Table 14 represents the frequencies and percentages of the School-Climate Instrument.

School Rigorous Expectation subscale. The school rigorous expectations subscale consists of five items and measured students' perceptions of how much their teachers hold them to high expectations around effort. The calculated reliability of the School Rigorous Expectations subscale was 0.76 compared to 0.82 obtained by previous research (Gehlbach & Brinkworth, 2011). The questions were measured on a five-point Likert scale, with a higher rating representing a more positive perception. Table 15 represents the frequencies and percentages of the School Rigorous Expectations subscale. Participants responded favorably to teachers' encouragement (80%) and expectations (83%).

Table 14

Frequencies and Percentages of the School Climate Subscale

	Response Anchors					
Items	Almost Never to Once in a While		Sometimes		Frequently to Almost Always	
	f	%	*f*	%	*f*	%
How often do your teachers seem excited to be teaching your classes?	7	6.2	20	17.7	85	75.2
	Very Unfair to Slightly Unfair		Neither Unfair Nor Unfair		Slightly Fair to Very Fair	
	f	%	*f*	%	*f*	%
How fair or unfair are the rules for the students at this school?	27	23.8	13	11.5	73	64.6
	Very Unpleasant to Slightly Unpleasant		Neither Pleasant Nor Unpleasant		Slightly Pleasant to Very Pleasant	
	f	%	*f*	%	*f*	%
How pleasant or unpleasant is the physical space at your school?	17	15.0	15	13.3	81	71.7
	Very Negative to Slightly Negative		Neither Negative Nor Positive		Somewhat Positive To Very Positive	
	f	%	*f*	%	*f*	%
How positive or negative is the energy of the school?	10	8.8	19	16.8	84	74.0
	Hurts My Learning Tremendously to Some to Hurts My Learning A Little		Neither Helps Nor Hurts My Learning		Helps My Learning A Little to Helps My Learning Tremendously	
	f	%	*f*	%	*f*	%
At your school, how much does the behavior of other students hurt or help your learning?	18	15.9	38	33.6	57	50.4

Table 15

Frequencies and Percentages of School Rigorous Expectations Subscale

Items	Response Anchors					
	Almost Never to Once in a While		Sometimes		Frequently to Almost Always	
	f	%	*f*	%	*f*	%
How often do your teachers make you explain your answers?	5	4.4	78	69.0	87	76.9
	Not at All Likely to Slightly Likely		Somewhat Likely		Quiet Likely to Extremely Likely	
	f	%	*f*	%	*f*	%
When you feel like giving up on a difficult task, how likely is it that your teachers will make you keep trying?	10	8.9	18	15.9	83	73.5
	Do Not Encourage Me At All to Encourage Me A Little		Encourage Me Some		Encourage Me Quite A Bit to Encourage Me A Tremendous Amount	
	f	%	*f*	%	*f*	%
How much do your teachers encourage you to do your best?	4	3.5	18	15.9	90	79.6
	Almost Never to Once in a While		Sometimes		Frequently to Almost Always	
	f	%	*f*	%	*f*	%
How often do your teachers take time to make sure you understand the material	5	4.4	19	16.8	84	75.1
	Not High At All to Slightly High		Somewhat High		Quite High to Extremely High	
	f	%	*f*	%	*f*	%
Overall, how high are your teachers' expectations of you?	3	2.7	15	13.3	94	83.2

Comparisons by Gender and Ethnicity

Hypothesis one: There are no significant differences in Science Self Efficacy Questionnaire scores when compared by gender or ethnicity of students.

The total scale mean score was determined by adding the item ratings for the 27 items in the questionnaire and dividing by the number of items. Gender differences were compared using an analysis of variance test (ANOVA) and it was found that males scored significantly higher than females. Differences by ethnicity were compared with an ANOVA and no significant differences were found based on ethnic groups. Subscale mean scores were calculated by adding the item ratings in each subscale and dividing by the number of items. A MANOVA was computed to compare the set of subscale scores by gender. There was a statistically significance difference in SSEQ total scores based on gender, F (4,107) = 4.9, $p < .001$; Wilk's $\lambda = .844$, Partial $\eta^2 = .96$. The scores for male students were significantly higher than the scores for females. Among the subscale scores, biology, physics, and laboratory scores were significantly different by gender with males scoring higher. Scores for male students in the chemistry subscale were higher but not significantly higher. The means and standard deviations by gender are displayed in Table 16. Figure 3 portrays the mean scores.

Table 16

Means and Standard Deviations for Science Self-Efficacy Questionnaire Subscale Scores by Gender

Subscale	Females (n = 59)		Males (n = 53)	
	Mean	SD	Mean	SD
Biology	3.18	0.79	3.75	0.80
Chemistry	3.55	0.95	3.76	0.95
Physics	2.84	1.10	3.51	1.10
Laboratory	3.26	0.93	3.76	0.90
SSEQ Total	3.21	0.94	3.70	0.94

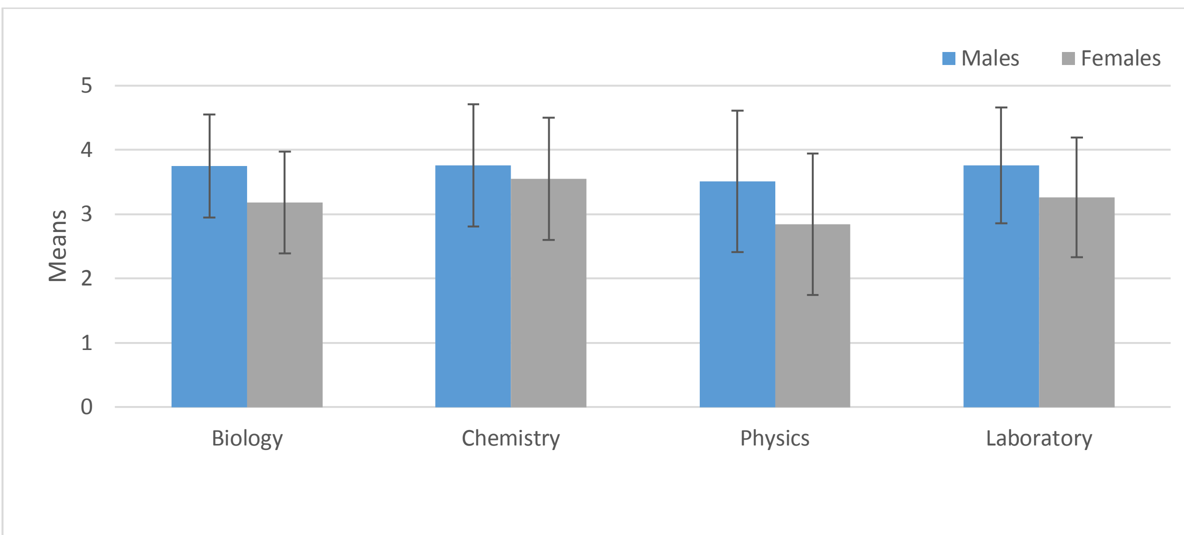

Figure 3. Means of Science Self Efficacy subscale scores.

A MANOVA was computed to compare the set of subscale scores by ethnic group focused on African American and Latino students because the numbers in Asian Pacific/Islanders and Interracial groups were too low. SSEQ scores based on ethnic groups was not statistically significant, F (4, 107) = 2.0, $p < .98$; Wilk's $\lambda = .93$, Partial $\eta^2 = .94$. There was no significant difference found when SSEQ total scores were compared by ethnic groups. A significant difference was found in the laboratory subscale with Latino students scoring significantly higher than the African American students. Scores for Latino students in the Biology, Chemistry, and Physics subscale were higher, but not significantly higher. The means and standard deviations are displayed in Table 17. Figure 4 portrays the mean scores.

Table 17

Means and Standard Deviations for Science Self-Efficacy Questionnaire Subscale Scores by Ethnic Groups

Subscale	African Americans (*n* = 26)		Latino/Latina (*n* = 82)	
	Mean	SD	Mean	SD
Biology	3.15	0.90	3.52	0.81
Chemistry	3.54	0.87	3.67	0.91
Physics	2.92	1.22	3.24	1.07
Laboratory	3.11	0.95	3.50	0.93
SSEQ	3.18	0.99	3.50	0.93

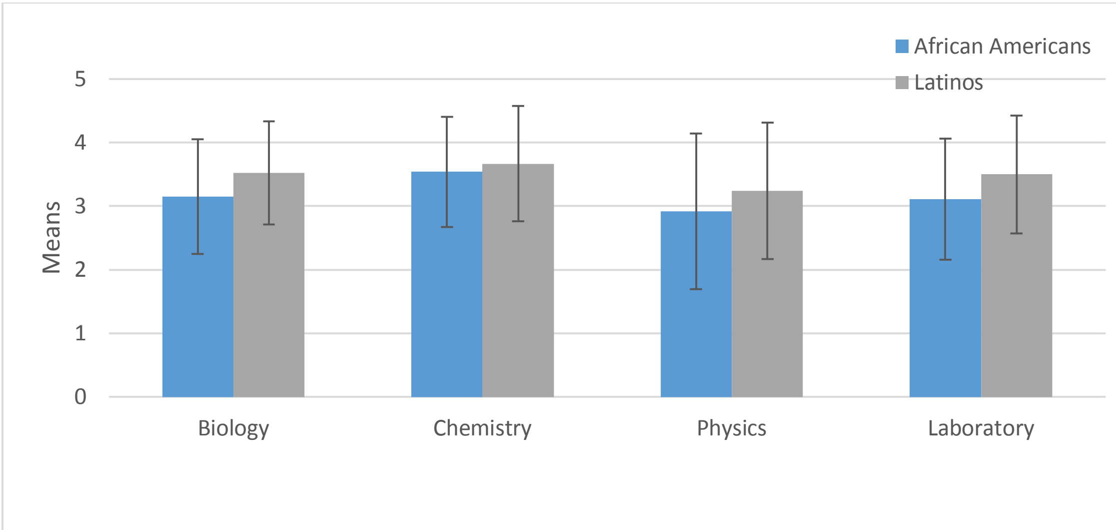

Figure 4. Means of Science Self Efficacy subscale scores by ethnic groups.

Summary of the Findings: SSEQ Scores

The key findings in Science SSEQ scores when compared by gender or ethnicity are as follows.

- The scores for male students were significantly higher than the scores for females on the SSEQ total scale score.
- Subscale scores, Biology, Physics, and Laboratory scores were significantly different by gender with males scoring higher.
- Male students scored higher than female students in Chemistry but the scores were not significant enough.
- A significant difference was found in the Laboratory subscale with Latino students higher than African American students.

Hypothesis two: There are no significant differences in Attitudes towards Math Inventory scores when compared by gender or ethnicity. The total scale mean score was determined by adding the item ratings for the 40 items in the questionnaire and dividing by the number of items. Gender differences were compared using an analysis of variance test (ANOVA) and no significant differences were found by gender and ethnic groups.

Subscale mean scores were calculated by adding the item ratings in subscale. The total scale score was determined by adding the item ratings for the 40 items in the questionnaire. A MANOVA was computed to compare the set of subscale scores (i.e., self-confidence, enjoyment, value, and motivation) by gender. There was no statistically significance difference in ATMI total scores based on gender, $F\ (4,107) = 1.55$, $p < .193$; Wilk's $\lambda = .94$, Partial $\eta^2 = .06$. Males scored significantly higher than females in the enjoyment of mathematics subscale. There was no significant difference found when the ATMI total scale scores and ATMI subscales scores were compared by gender. The means and standard deviations by gender are displayed in Table 18. Figure 5 portrays the mean scores.

Table 18

Means and Standard Deviations for Attitudes Towards Math Inventory Scores by Gender

Subscale	Males (n = 60)		Females (n = 53)	
	Mean	SD	Mean	SD
Self Confidence	3.46	0.56	3.40	0.53
Value	4.12	0.59	3.96	0.56
Enjoyment	3.85	0.56	3.60	0.57
Motivation	4.00	0.58	3.83	0.46
ATMI Total	3.91	0.61	3.91	0.61

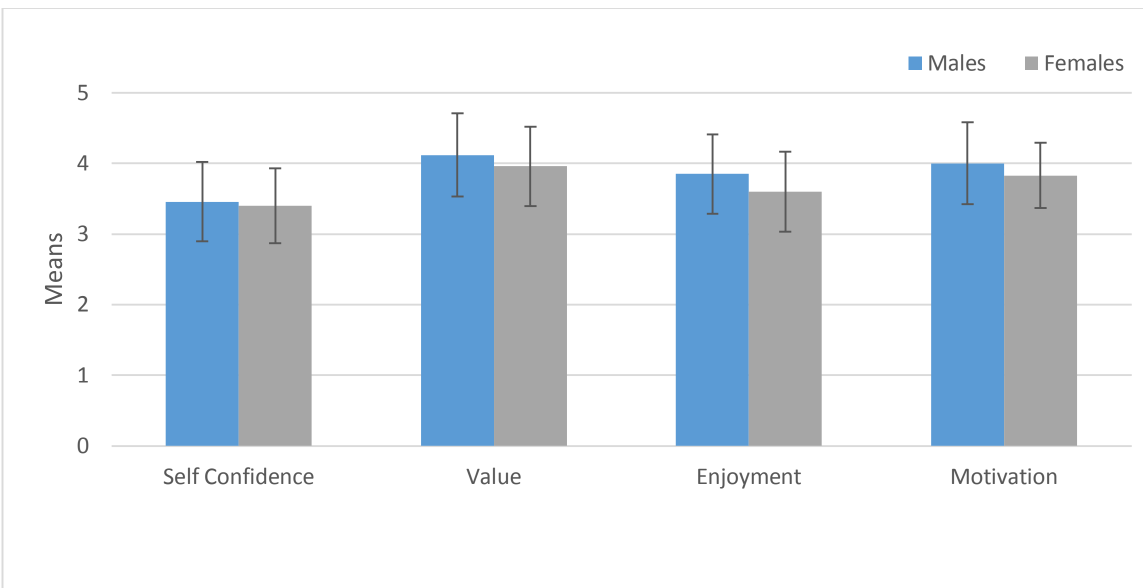

Figure 5. Means of Attitudes Towards Math subscale scores by gender.

A MANOVA was computed to compare the set of subscale (self-confidence, enjoyment, value, and motivation) scores by ethnic group focused on African American and Latino students because the numbers in Asian Pacific/Islanders and Interracial groups were too low. ATMI scores based on ethnic groups were not statistically significant, *F* (4,

107) = .44, $p < .777$; Wilk's $\lambda = .98$, Partial $\eta^2 = .02$. There were no significant differences found when the ATMI total scale scores and ATMI subscale scores were compared by ethnic groups. The means and standard deviation by ethnic groups are displayed in Table 19. Figure 6 portrays mean scores.

Table 19

Means and Standard Deviations for Attitudes Towards Math Inventory Scores by Ethnic Groups

Subscale	African Americans (n = 27)		Latino (n = 80)	
	Mean	SD	Mean	SD
Self Confidence	3.41	0.64	3.42	0.63
Value	3.90	0.66	4.07	0.70
Enjoyment	3.60	0.51	3.73	0.60
Motivation	3.84	0.60	3.92	0.62
ATMI Total	3.87	0.64	3.80	0.64

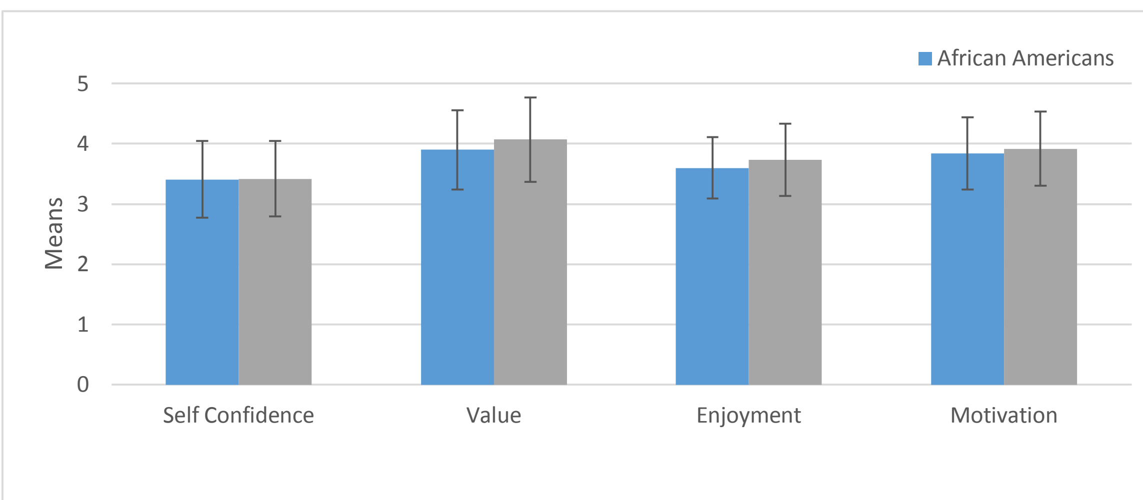

Figure 6. Means of Attitudes Towards Math subscale scores by ethnic groups.

Summary of the Findings: ATMI Scores

The key findings in Science ATMI scores when compared by gender or ethnicity are as follows:

- There was no significant difference found when the ATMI total scale scores and ATMI subscales scores were compared by gender.
- Males scored significantly higher than females in the enjoyment of mathematics subscale.
- No significant difference were found when the ATMI total scale scores and ATMI subscales scores were compared by ethnic groups.

Hypothesis three. There are no significant differences in students' school climate scores and School Rigorous Expectations scores when compared by gender or ethnicity.

A MANOVA was computed to compare the scores of school climate and school rigorous expectations by gender. The mean scores were calculated by adding the item ratings in School Climate scale. The same was done for the school rigorous expectations subscale. There was a statistically significance difference in School Climate scores based on gender, F (2, 110) = 4.9, $p < .009$; Wilk's $\lambda = .92$, Partial $\eta^2 = .08$. Males scored significantly higher than females on the school climate scale scores. There was a significant difference found when the school climate scale scores were compared by gender. There was no significant difference found when the School Rigorous Expectations scales were compared by gender. Males scored higher than females but not significantly higher. The means and standard deviation by gender are displayed in table 20. Figure 7 portrays mean scores.

Table 20

Means and Standard Deviations for PSS-School Climate and School Rigor Subscale Scores by Gender

	Females (n = 59)		Males (n = 53)	
	Mean	SD	Mean	SD
School Climate	23.0	6.00	27.0	5.30
School Rigorous Expectations	20.0	3.30	21.3	3.20

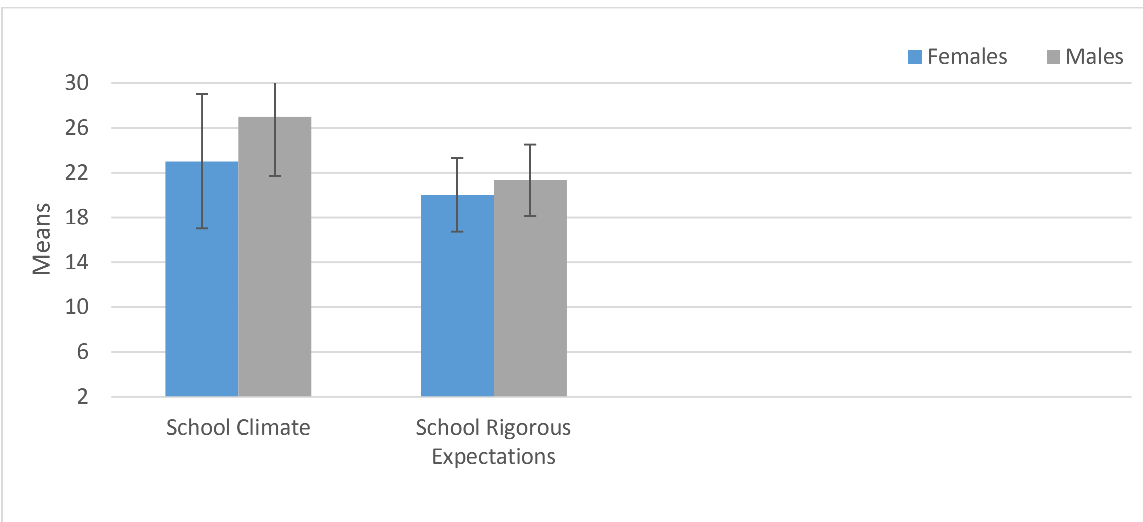

Figure 7. Means of PSS-School Climate and School Rigorous Expectations Subscale Scores by gender.

A MANOVA was computed to compare the scores by ethnic group. There was a statistically significance difference in School Climate scores based on ethnic groups, F (2, 110) = 5.4, $p < .006$; Wilk's $\lambda = .91$, Partial $\eta^2 = .009$. Latino students scored significantly higher than African American students in the school climate scale. There was no significant difference found when the school rigorous expectations scale was compared by ethnic group. The means and standard deviation by ethnic group are displayed in Table 21. Figure 8 portrays mean scores.

Table 21

Means and Standard Deviations for PSS-School Climate and School Rigor Subscale Scores by Gender

	African Americans (n = 27)		Latinos (n = 82)	
	Mean	SD	Mean	SD
School Climate	22.0	6.13	26.0	5.20
School Rigorous Expectations	20.0	3.90	21.3	3.00

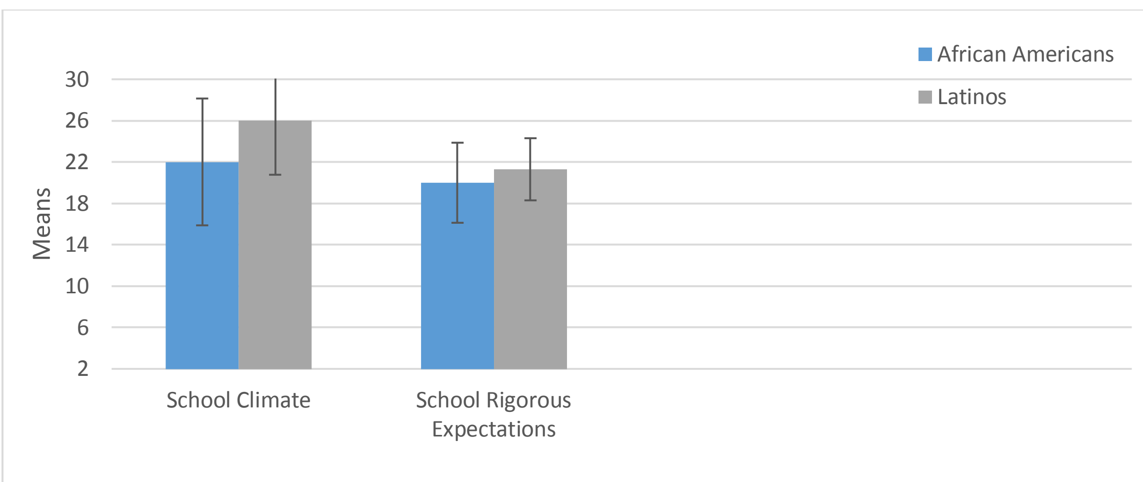

Figure 8. Means of PSS- School Climate and School Rigorous Expectations by ethnic groups.

Summary of the Findings: School Climate and Rigor Scores

The key findings in School Climate scores and the School Rigorous Expectation scores when compared by gender or ethnicity are as follows:

- There was a significant difference found when the School Climate scale scores were compared by gender. Males scored significantly higher than females in the School Climate scale scores.
- There was a significant difference found when the School Climate scale was compared by ethnic group. Latino/Latina scored significantly higher than African American in the school climate scale scores.
- There was a significant difference found when the school rigorous expectations scale was compared by ethnic group. Latino/Latina scored significantly higher than African American on the rigorous expectations scale scores

Hypothesis four. There are no significant correlations between Science Self Efficacy Questionnaire scores and ATMI scores, PSS school climate and school rigorous expectations scores, and number of advanced courses in science and math.

To answer this question, Pearson correlations were used to measure the strength and direction of the linear relationships that existed between Science Self Efficacy Scale total scores and the Attitudes Towards Math Inventory, the PSS School Climate total scores, PSS School Rigorous Expectations total scores, age, and the number of advanced math and science courses. All correlations between SSEQ total scores and the selected variables were significant. The correlations with the number of science and the number of math courses taken by students were negative, indicating an inverse relationship with science self-efficacy. Table 22 portrays the correlation coefficients and probabilities.

Table 22

Correlations between Science Self Efficacy Questionnaire scores, Attitudes Towards Mathematics Inventory Scores, PSS School Climate, PSS School Rigorous Expectation Scores), Total Math-Courses and Total Science Courses

	ATMI	School Climate	School Rigorous Expectations	Age	Advanced Science	Advanced Math
SSEQ	0.48**	0.58**	0.47**	0.34**	-0.26**	-0.39**

**$p < .01$

Summary of the Findings: Correlation Analysis

The key findings in school correlations between Science Self Efficacy Questionnaire scores and Attitudes Towards Mathematics Inventory scores, Panorama Student Survey Scales About the School scores, and number of advanced courses in science and math, and students' ages are as follows.

- SSEQ and School Climate positively correlated, Pearson's r (113) = 0.58, $p < .01$.
- SSEQ and ATMI positively correlated, Pearson's r (113) = 0.48, $p < .01$
- SSEQ and School Rigor positively correlated, Pearson's r (113) = 0.47, $p < .01$

Overarching research question. Which factors or combination of factors predict higher science self-efficacy scores in Early College High School students?

To answer this question, a regression analysis was used to test which factor significantly predicted Science Self Efficacy scores. The predictor variables were gender, ethnicity, ATMI total mean scores, Rigorous Expectations total Scores, School Climate total Scores, Math total Scores, and Science total Scores. A multiple linear regression was calculated to predict Science Self-Efficacy Scores based on the students' gender, ethnicity, ATMI total mean scores, Rigorous Expectations total Scores, School Climate total Scores, Math Total Scores, and Science Total Scores. A significant regression model was found F (7,102) = 17.76, $p < 0.001$), with an R^2 of 0.55. It was found that higher ATMI total scores significantly predicted higher Science-Self Efficacy scores as well as higher school climate total scores. Table 23 portrays the regression analysis.

Table 23

Summary of Regression Analysis for Variables Predicting Science Self Efficacy Total Scores (n = 113)

Predictors	B	SE B	β	*t*	*p*
Gender	.154	.104	0.110	0.142	0.142
Ethnicity	.004	.038	0.008	0.913	0.913
ATMI total	.550	.105	0.38	0.000	0.000
Rigorous Expectation total	.039	.94	0.04	0.677	0.677
School Climate Total	.052	.011	0.43	0.000	0.000
Math Number of Courses	.072	.054	0.114	0.184	0.184
Science Number of Course	.080	.078	0.085	0.306	0.306
R^2	.549				

Summary of the Findings: Factors Predicting Science Self Efficacy

The key findings in identifying the factors that predicted Science Self Efficacy in this sample of students in an Early College High School setting are as follows:

- Higher ATMI mean scores significantly predicted higher Science-Self Efficacy scores
- Higher school climate total scores significantly predicted higher Science-Self Efficacy scores.

CHAPTER V

DISCUSSIONS

When studying science, students apply simple and sometimes complex mathematical concepts to reinforce scientific concepts and understanding. Studying science helps students' understanding of how things exist and function in this world while math helps students reveal and relate scientific discoveries, data collection, establishing evidence, and proving or disproving scientific theories (Chui, 2008; Seki & Menon, 2007). Self-efficacy beliefs affect academic performance in science (Nicholls et al., 2010; Zeldin & Pajares, 2000). There are many variables that contribute to a student's science self-efficacy. This chapter presents the findings of this study, conclusions supported by the findings, recommendations for practice, and recommendation for future research related to the factors contributing to science self-efficacy in an Early College High School setting.

Overview

The purpose of this study was to examine (a) the variables of gender, age, perceptions of school climate, attitudes toward mathematics, and number of advanced math and science courses in high school; and (b) how these factors contributed to students' science self-efficacy. This study contributes to the growing body of knowledge concerning science self-efficacies and gender differences among minority high school students in an Early College High School setting.

Setting and Participants

This quantitative study used a descriptive research design involving 113 students from three Early College High Schools in North Central Texas. Participants who returned signed consent forms were administered a demographic questionnaire, the SSEQ (Smist, 1994), The ATMI (Tapia & Marsh, 2004), The PSS Scales About the School—School Climate subscale (Gehlbach & Brinkworth 2011), and the PSS Scales About the School—School Rigorous Expectations subscale (Gehlbach & Brinkworth 2011).

Instrumentation and Data Analyses

Reponses to the demographic questionnaires and research inventories were entered into SPSS for analyses. Demographic data including the total number of participants, age, gender, ethnicity, grade level, science and math Advanced Placement, and Dual Credit courses were reported using frequencies and percentages.

Research Question and Hypotheses

The study was comprised of an overarching research question from which hypotheses were draw: The research question and hypotheses are stated below.

Research Question: Which factor or combination of factors predict higher Science Self-Efficacy Questionnaire scores in Early College High School students?

$H_{0:}$ Variables entered into a multiple regression analysis, including age, Attitudes Toward Math Inventory scores, School Climate scores, School Rigorous Expectations scores, and numbers of advanced courses in science and math, are not significant predictors of Science Self Efficacy Questionnaire total scores.

1) There are no significant differences in Science Self Efficacy Questionnaire scores when compared by gender or ethnicity of students.

2) There are no significant differences in Attitudes Towards Math Inventory scores when compared by gender or ethnicity of students.

3) There are no significant differences in School Climate scores and School Rigorous Expectations scores when compared by gender or ethnicity of students.

4) There are no significant correlations between Science Self Efficacy Questionnaire scores and Attitudes Towards Mathematics Inventory scores, Panorama Student Survey Scales About the School—School Climate and School Rigorous Expectations subscale scores, and numbers of advanced courses in science and mathematics.

Findings

Hypothesis One

There are no significant differences in Science Self Efficacy Questionnaire scores when compared by gender or ethnicity.

In response to Hypothesis #1, participants' responses to the SSEQ (Smist, 1993) were analyzed. The participants were asked questions pertaining to their beliefs and competence to perform in high school biology, chemistry, physics, and laboratory. The frequencies and percentages were reported in Tables 6, 7, 8, and 9. A majority of the participants responded positively to getting good grades in biology (66%), chemistry (63%), and physics (53%) as a measure of competence. Moreover, the participants strongly supported "handling laboratory chemicals" (64%) and "performing lab experiments with simple machines" (70%) as evidence of competence in laboratory.

Upon inspection, the study found differences between male and female students' SSEQ scores. Male students exhibited significantly higher Science Self-Efficacy scores than their female counterparts. Although the issue surrounding gender differences in science self-efficacy is inconclusive, earlier studies have suggested that males have higher science self-efficacies than females (Bornholt, et al, 1994; Jacobs, 1991). A meta-analysis of 187 studies conducted by Huang (2013) found that males exhibited higher self-efficacy in mathematics, Computer science, and social sciences while in the other academic areas, self-efficacy was either the same or higher in females. Moreover, empirical studies examining gender differences in science self-efficacy in school age students found no significant differences in respect to gender (Britner & Pajeres, 2006; Kiran & Sungur, 2011; Usher & Pajares, 2006). The current study also found male students scored significantly higher than females in Biology, Physics, and Laboratory subscale reported scores. These findings are consistent with Smist's (1993) study with high school students during the development of the SSEQ. Gender differences in academic self-efficacies may be explained by the social cognitive theory which suggests that self-efficacy expectations may differ due to the process of socialization which gives men and women different perceptions of gender appropriate tasks, activities, and occupations (Bandura, 1997).

This study found no significant differences when the SSEQ total scores were compared by ethnic groups. When the total scores were compared, Latino students scoring significantly higher than African American students on the Laboratory subscale. Scores for Latino students in the Biology, Chemistry, and Physics subscales were higher but not significantly higher. In accordance with Bandura's self-efficacy theory, this study demonstrated that students' beliefs in their abilities can affect their performance within a content area (Bandura, 1997). Results of this study indicated significant differences in gender but no significant differences by ethnic groups on Science Self Efficacy scores of students in an Early College High School setting.

Hypothesis Two

There are no significant differences in Attitudes Towards Math Inventory scores when compared by gender or ethnicity.

The ATMI (Tapia & Marsh, 2004) was used to measure various dimensions of attitudes students have towards math. Analyses of the data revealed no significant differences when the ATMI total scales when compared by gender. While the set of subscale scores were not significantly different overall by gender, male participants scored higher than female participants on the Enjoyment of Mathematics subscale. Several previous studies have reported significant differences in boys and girls concerning attitudes towards math (Asante, 2012; Eshun, 2004; Sanchez, Zimmerman, & Ye, 2004) while other studies did not identify any differences (Etsey & Snetzler, 1998; Georgiou, Stavrinides, & Kalavana, 2007; Mohamed & Waheed, 2011). Students in the current study expressed being uncomfortable in a math class even though they were good at solving math problems. However, 98% of the participants believed that studying math will help with problem solving in other academic disciplines.

This study also found no significant difference in the ATMI total scores and the ATMI subscales when compared by ethnic groups. The participants in this study represented two ethnic groups: African Americans and Latinos/Latinas. However, earlier studies by Chen and Stevenson (1995) found that Asian American students reported more positive math attitudes than Caucasian and Latino students. Results of this study indicated no significant gender or ethnic group differences in ATMI scores in an Early College High School setting.

Hypothesis Three

There are no significant differences in School Climate Student scores and the School Rigorous Expectations scores when compared by gender or ethnicity.

The School Climate subscale measured students' perceptions of the overall social and learning climate of the school (Gehlbach & Brinkworth 2011). The School Rigorous Expectations subscale measured students' perceptions of how much their teachers held them to high expectations around effort. This study found significant differences on School Climate scores by gender and no significant difference in School Climate scores by ethnic groups. Male participants scored significantly higher than female participants on the School Climate subscale scores. Moreover, this study found no significant differences on the School Rigorous Expectations subscale scores when compared by gender and a significant difference in School Rigorous Expectations subscale scores when compared by ethnic groups. Latinos score significantly higher than African Americans on the School Rigorous Expectations subscale.

While some studies found that boys hold more negative perceptions of school climate than girls (Buckley et al, 2003; Slaugther-Defoe & Carlson, 1996), the current study found the opposite with boys attaining a higher and more positive score on the

School Climate subscale scores than girls. Findings in this study were similar to findings in other studies (Slaugther-Defoe & Calson, 1996) that investigated School Climate and ethnic groups with Latinos scoring higher than other ethnic groups. Studies by Slaughter-Defoe and Carlson (1996) found that Latinos emphasized teacher fairness, caring, and praise of effort as important aspects of school climate. The expectations set by the school and its teachers include the level of performance and behavior for students. Studies have shown that when students have a firm belief that teachers hold high rigorous expectations of their academic and behavioral performance, they do better.

Hypothesis Four

There are no significant correlations between Science Self Efficacy Questionnaire scores and Attitudes Towards Mathematics Inventory scores, Panorama Student Survey Scales About the School—School Climate and School Rigorous Expectations subscale scores, numbers of advanced courses in science and math, and students' ages.

This study found significant correlations between Science Self Efficacy total scores and ATMI total scores, School Climate total scores, School Rigorous Expectations total scores, numbers of advanced courses in math and science, and students' ages. Science Self-Efficacy had a positive significant correlation with School Climate. Science Self Efficacy scores moderately correlated with School Rigorous Expectations scores. However, Science Self Efficacy total scores negatively correlated with numbers of advanced courses in science and math, and students' ages.

Schools with healthy school climates promote high academic standards which support students attitudes, academic and social learning (MacNeil, Prater, and Busch, 2009). This may be true for students enrolled in an Early College High School. Students enrolled in an Early College High School are academically engaged and motivated to achieve a high school diploma and a college level associate's degree. This tends to increase confidence in their perceived levels of ability and provides a boost to their academic beliefs.

According to Bandura and Cervone (1983), cognitive engagement aids an individual's belief in his or her abilities. The academic attitudes, school climate and rigorous expectations, math and science advanced courses, and the students' ages are variables that may collectively drive positive science self-efficacy in students. Schunk and Pajares (2002) found that STEM self-efficacy was positively related to students' interest and engagement. Therefore, students with high science and math self-efficacy are more likely to enroll in more challenging science and math courses (Watt, 2006). However, interest is shown to be more highly related to a students' self-efficacy than the students' actual abilities (Bandura, 1991).

Overarching Research Question

Which factor or combination of factors predict higher Science Self-Efficacy Questionnaire scores in Early College High School students?

$H_{0:}$ Variables entered into a multiple regression analysis, including age, ethnicity, gender, Attitudes Toward Math Inventory scores, School Climate scores, School Rigorous Expectations scores, and numbers of advanced course in science and math, are not significant predictors of Science Self Efficacy Questionnaire total scores.

A multiple linear regression was calculated to predict Science Self-Efficacy Questionnaire total scores based on the students' age, gender, ethnicity, ATMI total mean scores, Rigorous Expectations total scores, School Climate total scores, total number of math courses, and total number of science courses. This study found that a combination of higher ATMI total scores and higher School Climate scores significantly predicted higher SSEQ total scores. Ma (2003) and Wang (2013) suggested that prior math achievement influences a student's attitude and STEM self-efficacy as well as STEM outcomes. Smist and Owen (1994) found that attitudes, aptitudes, and attributions were strong predictors of science self-efficacy in high school students.

In the current study, math attitudes and perceptions of school climate were strong predictors of science self-efficacy in an Early College High School setting. The definition of school climate used in this study was strongly geared towards the teaching-learning practices at school, students' experiences and interpersonal relationships, and the school environment. McEvoy and Welker (2000) found that the quality of a school's academic environment was an important predictor of student achievement in middle and high schools. Effective school leaders set high academic standards and believe in their abilities to improve student outcomes. Therefore, students who are encouraged to do their best tend to experience superior growth in math and science achievement (Hoy et al., 2006; Ma & Wilkins, 2002). This study supports Bandura's (1977, 2001) theory of self-efficacy in that it demonstrates how students' perception of their academic capabilities increases when they are exposed to an engaging learning experience and environment. The increase of positive perceptions in students' academic abilities may drive their motivation and self-efficacies.

Conclusions

The purpose of this current study was to investigate the factors that promote science self-efficacy in an Early College High School setting. This study used the SSEQ (Smist and Owen, 1994) to measure students' science self-efficacy, the ATMI (Tapia and Marsh, 2004) to measure math attitudes, the PSS Student School Climate survey (Gehlbach & Brinkworth 2011) to measure the perceptions of the overall social and learning climate of the school, and the Student School Rigorous Expectations survey (Gehlbach & Brinkworth 2011) measured students' perceptions of how much their teachers hold them to high expectations around effort. In addition, a demographic questionnaire was developed to gather information about age, gender, ethnicity, parental educational status, and math and science courses taken. This study was an important endeavor to contribute to the very limited number of studies about students enrolled in Early College High School campuses in Texas and throughout the United States. Moreover, this study also investigated the science self-efficacy, school climate, school rigorous expectations, and attitudes towards math as they related to students' ethnicity and gender. The findings of this study led to the following conclusions.

1. The results showed that the total scores for male students were significantly higher than the scores for females on the Science Self Efficacy Questionnaire. The differences found between male and female students suggest that any

intervention designed to improve academic self-efficacy as it relates to science must take gender differences and gender socialization into consideration.

2. The results showed that there was no significant difference in Science Self-Efficacy Questionnaire scores by ethnic group. The results showed no significant difference found when the ATMI total scale and ATMI subscales were compared by gender and ethnic groups. These findings highlight that attitudes towards math may not be based on gender or ethnic group but on students' perceptions and beliefs in their abilities to do math and the usefulness of mathematics in their lives.
3. The results showed a significant difference found when the School Climate subscale scores were compared by gender. Males scored significantly higher than females on the School Climate subscale scores. Latinos scored significantly higher than African Americans on the School Climate subscale scale scores. Research concerning school climate and school rigorous expectations and the role these variables play in students' academic self-efficacies as they relate to gender and ethnic groups are limited. More research examining these variables is needed.
4. The results showed a positive and highly significant correlation between SSEQ total scores and School Climate total scores. Moreover, significant correlations were also found to exist between SSEQ and the total scores of all measures.
5. The results showed that the combined factors of higher ATMI total scores and higher SSEQ total scores significantly predicted higher SSEQ total scores. The

results showed that positive socio-emotional learning environment and students' attitudes and beliefs are key motivating factors for minority student's success.

Limitations

Despite this study contribution to the literature, it has several limitations. First, this study was limited to specific Early College High School sites for the selection of participants but not all Early College High School programs in North Central Texas. This limitation may have led to the low number of Asian/Pacific Islanders and Inter-racial participants who participated in the study. Moreover, this study was limited to a sample of students who were willing to participate in the study. Second, this study only accounted for science self-efficacy as a source of academic self-efficacy therefore conclusions cannot be made for all areas in science, technology, engineering, and math.

Implications

Findings from this study provide several implications for educators, administrators, and parents. This study was conducted to contribute to the limited pool of studies on students enrolled in Early College High School programs. Moreover, the study was conducted to help close the gaps on science self-efficacy research in minority populations of school aged population. Programs such as Early College High Schools could serve as a gateway for building positive attitudes towards science and math in both females and minority populations. With early exposure to mastery experiences, students may build confidence and become motivated to study and major in science when they matriculate to a four-year university. According to Bandura (1997), mastery experiences provide the opportunity to practice, gain skills and strategies to carry out tasks effectively. Educators and administrators should encourage students and provide a rigorous learning environment that fosters a positive school climate. This study has shown that a school climate that promotes excellence and embrace diversity can become a driving force in the development of positive attitudes towards math and science and increase science self-efficacy in students.

Recommendations

The following recommendations are for educators, school administrators, and school districts based on the results and conclusion of the study.

Teacher Recommendations

1. Teaching strategies and used in the classroom and the climate of the course can increase students' self-efficacy. Teaching strategies with significant contributions to science self-efficacy includes collaborative learning environments, electronic applications, and inquiry lab activities (Fencl & Scheel, 2005). Teachers should use multiple instructional practices that incorporate mastery experiences.
2. Mastery experiences build students' confidence, support positive attitudes, and strengthen their beliefs in accomplishing science specific tasks (Schunk & Pajares, 2002). This in turn builds their science self-efficacy. This study found that perceptions of school climate and attitudes towards math were strong predictors of science self-efficacy in this sample.
3. Help and encourage students to establish and lay out learning strategies and have students verbalize their learning strategies and plan. Ensure that students are using

their learning strategies as they proceed through academic tasks (Schunk & Pajares, 2002).

4. Challenge students by setting short term learning goals that are attainable. Compare students' performance to their learning goals and not to the performance of other students (Bandura, 1997).

Administrators Recommendations

1. Administrators must foster a social learning climate that drives positive academic attitudes. Moreover, educators should infuse vicarious learning experiences and social persuasions into their STEM curriculum. This will provide an avenue for students to observe and practice science and receive positive and genuine feedback.
2. Establish peer models as form of reinforcement in school and encourage teachers to use peer modeling in their classrooms. Students can learn from watching other students carry out tasks successfully. Moreover, encourage a diversity in the selection of peer models such as diversity in age, gender, ethnic groups (Margolis & Mccabe 2006).
3. Administrators should encourage parents to expose their children, especially girls, to science. Early College High School and other schools should provide vicarious learning experiences. According to Bandura (1997), vicarious experiences are important especially when students are exposed to limited mastery experiences. Research has shown that vicarious learning is a powerful stimulus for girls' self-efficacy (Seymour, 1995; Zeldin & Pajares, 2000).

School District Recommendations

1. School districts should design professional development for science and math teachers that focus on the sources of self-efficacy. Moreover, districts should encourage lesson designs and planning that incorporates mastery experiences.
2. Districts should invest in brining speakers and presenters across gender and race to demonstrate scientific concepts and spark student's interest in science. It is important for economically disadvantaged minority student and females to see someone of their ethnic group or gender in science, technology, engineering, and math profession. This vicarious learning experience can be a catalyst for science self-efficacy.

Future Research

The following recommendations are suggested for future research on factors promoting science self-efficacy in an Early College High School setting:

1. The incorporation of a qualitative aspect to the research should be added to understand the factors that lead to increases and decreases of science self-efficacy scores.
2. Research that compare attitudes towards science and math among Early College High School students who are housed on community college campuses with those who are bused to the community college campuses to take Dual Credit classes.
3. Research that examines the sources of self-efficacy in an Early College High School setting.

Summary

This study investigated the factors that promote Science Self-Efficacy in an Early College High School setting. This chapter summarized the study and provided discussions about the findings, limitations, implications, recommendations for educators and administrators, and recommendations for future research.

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APPENDIX A

Institutional Review Board Approval Letter

TWU
TEXAS WOMAN'S UNIVERSITY
DENTON DALLAS HOUSTON

Institutional Review Board
Office of Research and Sponsored Programs
P.O. Box 425619, Denton, TX 76204-5619
940-898-3378
email: IRB@twu.edu
http://www.twu.edu/irb.html

DATE: February 20, 2017

TO: Mr. Bennett O'Connor
Family Sciences

FROM: Institutional Review Board (IRB) - Denton

Re: Approval for Factors Contributing to Science - Self Efficacy in Adolescents in an Early College High School Setting (Protocol #: 19431)

The above referenced study was reviewed at a fully convened meeting of the Denton IRB (operating under FWA00000178). The study was approved on 2/20/2017. This approval is valid for one year and expires on 2/20/2018. The IRB will send an email notification 45 days prior to the expiration date with instructions to extend or close the study. It is your responsibility to request an extension for the study if it is not yet complete, to close the protocol file when the study is complete, and to make certain that the study is not conducted beyond the expiration date.

If applicable, agency approval letters must be submitted to the IRB upon receipt prior to any data collection at that agency. A copy of the approved consent form with the IRB approval stamp is enclosed. Please use the consent form with the most recent approval date stamp when obtaining consent from your participants. A copy of the signed consent forms must be submitted with the request to close the study file at the completion of the study.

Any modifications to this study must be submitted for review to the IRB using the Modification Request Form. Additionally, the IRB must be notified immediately of any adverse events or unanticipated problems. All forms are located on the IRB website. If you have any questions, please contact the TWU IRB.

cc. Dr. Karen Petty, Family Sciences
Dr. Lin Moore, Family Sciences
Graduate School

APPENDIX B

Study Flyer

VOLUNTEERS NEEDED FOR A RESEARCH SURVEY ON FACTORS THAT CONTRIBUTE TO SCIENCE-SELF EFFICACY AT AN EARLY COLLEGE HIGH SCHOOL

We are looking for student volunteers to complete questionnaires on science self-efficacy, attitudes towards math, and scales about the school. Science self-efficacy is a student's belief and competence in school science tasks. Attitudes towards math describe the tendency for a student to respond positively or negatively towards mathematics. The scales about the school look at the social learning climate of the school.

If you and your child are interested, please sign the consent form and return the completed form to room W-23.

Thank you!

Contact Information

Bennett O'Connor, M.S.
Principal Investigator
BOConner@dallasisd.org
214-xxx-xxxx

Dr. Lin Moore
Faculty Advisor
LMoore@twu.edu
940-898-2210

This study has been reviewed and approved by the Institutional Review Board, Texas Woman's University, and the Research and Review Board of Dallas Independent School District

"There is a potential risk of loss of confidentiality in all email, downloading, electronic meetings, and internet transactions."

APPENDIX C

Demographic Information Form

Demographic Information Form

Instructions: Please provide a response for each of the following questions:

1. **ID #**______________________________

2. AGE: _________

3. GRADE IN SCHOOL _______

4. GENDER

Female ○ Male ○

5. ETHNICITY?
African American ○ Asian/Pacific Islander ○ Caucasian ○ Latino ○

Other: __________________

6. PARENTS LEVEL OF EDUCATION
Mother/Stepmother
School to 8th grade ○ High School Diploma/GED ○ Some College ○ College ○

Father/Stepfather
School to 8th grade ○ High School Diploma/GED ○ Some College ○ College ○

7. Have you taken Biology in High School?
YES ○ NO ○

8. Have you taken Chemistry in High School?
YES ○ NO ○

9. Have you taken Physics in High School?
YES ○ NO ○

10. Are you currently enrolled in AP Science Course?
YES ○ NO ○
If yes, name them:____

11. Are you currently enrolled in AP Math Course?
YES ○ NO ○

If yes, name them:____

12. Are you currently taking a Dual-Credit Science Class or have taken a Dual Credit Science Class?
YES ○ NO ○

If yes, name them:____

13. Are you currently taking a Dual-Credit Math Class or have taken a Dual Credit Math Class?
YES ○ NO ○

If yes, name them:____

APPENDIX D

Attitudes Towards Math Inventory

ATTITUDES TOWARD MATHEMATICS INVENTORY

Directions: This inventory consists of statements about your attitude toward mathematics. There are no correct or incorrect responses. Read each item carefully. Please think about how you feel about each item. Darken the circle that most closely corresponds to how the statements best describes your feelings. Use the following response scale to respond to each item.

PLEASE USE THESE RESPONSE CODES:

A – Strongly Disagree
B – Disagree
C – Neutral
D – Agree
E – Strongly Agree

1. Mathematics is a very worthwhile and necessary subject.
2. I want to develop my mathematical skills.
3. I get a great deal of satisfaction out of solving a mathematics problem.
4. Mathematics helps develop the mind and teaches a person to think.
5. Mathematics is important in everyday life.
6. Mathematics is one of the most important subjects for people to study.
7. High school math courses would be very helpful no matter what I decide to study.
8. I can think of many ways that I use math outside of school.
9. Mathematics is one of my most dreaded subjects.
10. My mind goes blank and I am unable to think clearly when working with mathematics.
11. Studying mathematics makes me feel nervous.
12. Mathematics makes me feel uncomfortable.
13. I am always under a terrible strain in a math class.
14. When I hear the word mathematics, I have a feeling of dislike.
15. It makes me nervous to even think about having to do a mathematics problem.
16. Mathematics does not scare me at all.
17. I have a lot of self-confidence when it comes to mathematics
18. I am able to solve mathematics problems without too much difficulty.
19. I expect to do fairly well in any math class I take.
20. I am always confused in my mathematics class.
21. I feel a sense of insecurity when attempting mathematics.
22. I learn mathematics easily.
23. I am confident that I could learn advanced mathematics.
24. I have usually enjoyed studying mathematics in school.
25. Mathematics is dull and boring.
26. I like to solve new problems in mathematics.
27. I would prefer to do an assignment in math than to write an essay.
28. I would like to avoid using mathematics in college.
29. I really like mathematics.
30. I am happier in a math class than in any other class.
31. Mathematics is a very interesting subject.
32. I am willing to take more than the required amount of mathematics.
33. I plan to take as much mathematics as I can during my education.
34. The challenge of math appeals to me.
35. I think studying advanced mathematics is useful.
36. I believe studying math helps me with problem solving in other areas.
37. I am comfortable expressing my own ideas on how to look for solutions to a difficult problem in math.
38. I am comfortable answering questions in math class.
39. A strong math background could help me in my professional life.
40. I believe I am good at solving math problems.

APPENDIX E

Science Self Efficacy Questionnaire

SCIENCE QUESTIONNAIRE

Please try to answer all the items below. However, you are not required to complete this questionnaire, and you may omit any items that you do not want to answer.

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 letters that best represent your beliefs.

A B C D E

quite a lot <-------------------------> very little

CONFIDENCE

A B C D E 1. Using a computer in science classes.

A B C D E 2. Understanding concepts in a biology textbook.

A B C D E 3. Using chemical formulas and equations.

A B C D E 4. Doing well on a biology exam.

A B C D E 5. Doing chemistry homework problems well.

A B C D E 6. Doing physics lab experiments well.

A B C D E 7. Using a microscope.

A B C D E 8. Lighting a laboratory (Bunsen) burner.

A B C D E 9. Winning a science fair award for a biology project.

A B C D E 10. Handling laboratory chemicals.

A B C D E 11. Doing physics homework problems well.

A B C D E 12. Taking essay tests in biology.

A B C D E 13. Performing lab experiments using electricity.

A B C D E 14. Getting good grades in biology.

A B C D E 15. Answering questions in biology class.

A B C D E 16. Asking questions in chemistry class.

A B C D E 17. Memorizing factual information.

A B C D E 18. Understanding concepts in a chemistry textbook.

A B C D E 19. Asking questions in biology class.

A B C D E 20. Learning about famous scientists.

A B C D E 21. Understanding concepts in a physics textbook.

A B C D E 22. Getting good grades in chemistry.

A B C D E 23. Understanding abstract chemical concepts.

A B C D E 24. Asking questions in physics class.

A B C D E 25. Getting good grades in physics.

A B C D E 26. Performing lab experiments with simple machines.

A B C D E 27. Doing science activities for fun.

APPENDIX F

School Climate Subscale

SCALES ABOUT THE SCHOOL

School Climate

Perceptions of the overall social and learning climate of the school.

Grades 6-12

Item	Response Anchors						
How often do your teachers seem excited to be teaching your classes?	Almost never	Once in a while	Sometimes	Frequently	Almost always		
How fair or unfair are the rules for the students at this school?	Very unfair	Somewhat unfair	Slightly unfair	Neither unfair nor fair	Slightly fair	Somewhat fair	Very fair
How pleasant or unpleasant is the physical space at your school?	Very unpleasant	Somewhat unpleasant	Slightly unpleasant	Neither pleasant nor unpleasant	Slightly pleasant	Somewhat pleasant	Very pleasant
How positive or negative is the energy of the school?	Very negative	Somewhat negative	Slightly negative	Neither negative nor positive	Slightly positive	Somewhat positive	Very positive
At your school, how much does the behavior of other students hurt or help your learning?	Hurts my learning a tremendous amount	Hurts my learning some	Hurts my learning a little bit	Neither helps nor hurts my learning	Helps my learning a little bit	Helps my learning some	Helps my learning a tremendous amount

APPENDIX G

School Rigorous Expectations Subscale

PANORAMA EDUCATION

School Rigorous Expectations

How much students feel that their teachers hold them to high expectations around effort, understanding, persistence and performance in class.

Grades 6-12

Item	Response Anchors				
How often do your teachers make you explain your answers?	Almost never	Once in a while	Sometimes	Frequently	Almost always
When you feel like giving up on a difficult task, how likely is it that your teachers will make you keep trying?	Not at all likely	Slightly likely	Somewhat likely	Quite likely	Extremely likely
How much do your teachers encourage you to do your best?	Do not encourage me at all	Encourage me a little	Encourage me some	Encourage me quite a bit	Encourage me a tremendous amount
How often do your teachers take time to make sure you understand the material?	Almost never	Once in a while	Sometimes	Frequently	Almost always
Overall, how high are your teachers' expectations of you?	Not high at all	Slightly high	Somewhat high	Quite high	Extremely high