Predicting how science self-efficacy and identity contributes to postsecondary STEM degree selection

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Predicting how science self-efficacy and identity contributes to postsecondary STEM degree selection

By

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A Dissertation
Submitted to the Faculty of
Mississippi State University
in Partial Fulfillment of the Requirements
for the Degree of Doctor of Philosophy
in Community College Leadership
in the Department of Educational Leadership

Mississippi State, Mississippi

May 2023
One of the earliest indications that a student may be interested in STEM paths is the students’ own self-efficacy for science as well as how they may see themselves in a STEM career as part of their science self-identity (Schlegel et al., 2019). Currently, there is a need to contribute to research that can assist agencies such as the National Science Foundation (NSF), Department of Education and the National Academy of Sciences in advising the nation, including high schools and postsecondary institutions on ways to increase the enrollment of students in STEM-related careers. This study examined the extent to which science self-efficacy and science identity are related to postsecondary STEM degree selection, with special attention to how factors like race, gender, SES status and urbanicity influence science self-efficacy and science identity and how they may be predicative of postsecondary STEM degree selection. Correlation analysis was conducted to quantify the relationship between science identity and STEM degree selection, as well as between science self-efficacy and STEM degree selection. Correlation analysis by subgroup was conducted to examine differences in science identity and science self-efficacy between students based on the demographic characteristics. And binary
logistic regression was conducted using the inputs of science identity, science self-efficacy, and demographic characteristics as variants to estimate STEM degree selection.

Results of this study suggests that science identity and science self-efficacy are positively correlated with a student selecting a STEM degree. Relationships between science identity and self-efficacy with STEM degree selection among the demographic characteristics was also positively correlated. Black/African Americans and students from the lowest SES both are less likely to select a degree in STEM, while all other demographics show a positive predictive pattern. This work can be used to guide science education policy at the local, state, and national levels, and to direct science education programming in formal and informal settings including those at the high school level in ways to better prepare and encourage students into STEM careers.
DEDICATION

I would like to dedicate this dissertation to my family. Their steadfast support, encouragement, and guidance have made it possible for me to complete this work. This work would not have been possible without their support and the support of many others who have encouraged me along the way.
ACKNOWLEDGEMENTS

First, I would like to acknowledge the guidance and direction provided by Dr. Carol Cutler White and the rest of my dissertation committee, Drs. Linda Coats, Mark Fincher, and the graduate coordinator Dr. Stephanie King. The advice and guidance they provided was instrumental in completion of this work. The department of Educational Leadership and Mississippi State University were also so willing to assist with any needs that arose throughout this process.

Second, I would like to acknowledge Dr. Christa Winkler in the department of Educational Leadership at Mississippi State University for her assistance with the statistical analysis and interpretations in this work.

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CHAPTER I
INTRODUCTION

Background of the Study

Over the last decade there has been growing concern about the lack of students majoring in the Science, Technology, Engineering and Mathematics (STEM) fields. This concern has led to such an issue, they are now routinely part of the national political agenda. Community colleges have always been an area of higher education that are able to adapt quickly to a changing workforce, needs, and policy changes.

One of the greatest advantages of a community college is that it can offer what is needed at a particular time and to a particular population to increase the economic needs of a community or region. For this reason, beginning in 2009, President Barack Obama called for an increase in educational attainment to help increase the United States’ thumbprint on the global economy (England-Siegerdt & Andreas, 2012). Presidents Bush and Obama both realized the need for vocational education to enhance the number of associate degrees and applied bachelor’s degrees in STEM (U.S. Department of Labor, 2005; White House, 2012). In his February 12, 2013 State of the Union Address, President Obama called for one million more STEM graduates over the next decade (Obama, 2013).

In January of 2022 the Biden administration along with the Departments of State and Homeland Security announced new actions to advance predictability and clarity for pathways for domestic and international STEM scholars, students, researchers, and experts to contribute to
innovation and job creation efforts across America (White House, 2022). In addition, according to the American Institute of Physics STEM FY22 Budget Outlook, STEM education programs across federal agencies are receiving budget increases under the House’s and Senate’s spending proposals for fiscal year 2022, portions of which will support diversity and inclusion initiatives proposed by the Biden administration (American Institute of Physics, 2021). These funds will support increased funding for most major STEM education programs, increase the participation of underrepresented groups in STEM fields and improve STEM education capacity at minority-serving institutions, and develop programs that support both STEM and non-STEM education activities that include strategies to help encourage learners at an early age to begin thinking about careers in STEM (American Institute of Physics, 2021).

**Community Colleges and Workforce Development**

Community colleges are engines of workforce and economic development. The Georgetown Center on Education and the Workforce reports 65% of jobs in 2020 will require some form of postsecondary education, and many of those jobs do not require a bachelor’s degree. Workforce development at the postsecondary level is one of the major initiatives of community colleges, and thus is a continually changing feature of the community college mission. The need for workforce development and thus the need to adjust the focus of the college’s mission are not a product of governmental regulation or policy, but a development of the needs of the community that are indicated by the community leaders and industry leaders within the community (O’Banion, 2019). Major challenges for an effective workforce development approach to providing educated workers include: 1) curriculum developed and driven by the needs of the local workforce and industry; 2) ensuring ways to meet the needs for a diverse workforce and diverse needs of the local industry while also ensuring strategies to help
these diverse populations succeed in community college; 3) mix of classroom and practical learning that will ensure the students have applicable skills with many of these skills and equipment taught from similar to those found in the workforce. Ensuring a workforce development mission that addresses these three challenges is a challenge to many colleges and requires the evolution of the college, often quickly, to meet these needs for the local industry. An important consideration to developing a STEM workforce is to know the factors which incite students to select STEM as a career intention. The science self-efficacy and science identity of an individual are factors which can promote early selection of STEM career intent as well as promote STEM degree selection.

Science Self-Efficacy and Identity

For many years, the relationship between students’ attitudes and ideals of their own self-efficacy and identity for a particular subject has been an important area of study for higher education. This is very true of students’ science self-efficacy and identity in contributing to STEM degree selections at the postsecondary level. The general body of research in STEM degree intent suggests that students’ beliefs about their abilities in a science subject help them form future goals and attain success within STEM fields.

Belief in one’s ability to perform a specific task is referred to as self-efficacy. Self-efficacy influences the choices individuals make in term of goal choice, the effort expended to reach those goals, and persistence when difficulties arise (Bandura, 1997; Pajares, 2005). Self-efficacy is a significant predictor of both the level of motivation for a task and ultimately task performance (Bandura & Locke, 2003); on average, individuals with high STEM self-efficacy perform better and persist longer in STEM disciplines relative to those lower in STEM self-efficacy. Whereas the most influential source of STEM self-efficacy for males is mastery
experience, the most influential sources of STEM self-efficacy for females are practical experience and social persuasion (Zeldin & Pajares, 2000). Gender differences, favoring men, have been observed in STEM self-efficacy, and in the probability of success in STEM-related fields (Schunk & Pajares, 2002). The major reason for this difference in gender is confidence in STEM courses, which is related to self-efficacy. The “gender gap” develops with advanced high school math and science success and grows at each successive stage with women holding progressively lower numbers of 2- and 4-year degrees in STEM and STEM professions.

Studies concerned with student persistence and success in academic settings indicate that student identity is related to a “sense of fit” with other academics and the academic world (Syed et al., 2011). Several studies have found that having a science identity provides better prediction of academic performance and persistence than racial or ethnic background on its own (Bonous-Hammart, 2000; Hazari et al., 2010; Osborne & Walker, 2006). Identification as a scientist has been viewed as having three overlapping concepts: competence in valued science practices, performance of these practices that makes them visible to others, and recognition for that performance by people who matter (Carlone & Johnson, 2007).

**Underrepresented Groups in STEM**

Aurah (2017) states that science self-efficacy, beliefs and gender contribute to academic achievement. Her study demonstrated the effects of gender in STEM careers. This would suggest that it is often more likely the loss of self-confidence rather than any other factor that may influence the outcomes of female students. This idea of the loss of confidence in a personal belief that you can do something may also contribute to differences seen in other racial and socioeconomic groups.
Underrepresented minorities may also experience uncertainty about how well they fit in the academic environment (Estrada et al., 2016; Syed et al., 2011). Perceptions of inadequate capabilities and/or poor fit and identity can result in withdrawal from academic programs and opportunities (Hausmann et al., 2007; Lee et al., 2015; Walton & Cohen, 2007). However, it may be that a research internship, as part of a STEM program, might provide the opportunity to test one’s ability to learn scientific content and methods. Moreover, the chance to associate with research mentors and other science students might help to overcome doubts about self-efficacy. Of course, a negative experience might also enhance doubts and threats (Estrada et al., 2018).

One critique of this body of research is that most of these studies used small samples or samples of convenience, making estimation of factors and effects difficult to predict in subgroups. For example, Adelman (1998), Marra et al (2009), and Estrada et al. (2016) found that factors for gender gaps include women’s beliefs in the usefulness of STEM for their future career goals, lack of role models, and women having more developed communal goals, as opposed to individualistic goals as men. Marra et al. (2009) suggest that recent reduction in gender differences can be partly attributed to more equitable preparation in mathematics and science. Ethnicity and socio-economic status are also known to influence intention for STEM careers, most importantly by poorer academic success for under-represented groups (Estrada et al, 2016). While these studies show differences and the possibility of the gaps in these differences changing, the consensus of these studies was drawn from samples obtained from currently enrolled STEM students, not looking at earlier indications that may have occurred in the students’ minds before entering the disciplines.
Statement of the Problem

According to the Office of Naval Research (2010), interest in STEM-related subjects and degrees remains low. The study reports that only one third of U.S. eighth graders are interested in STEM majors and just over 5% of high school seniors will get a postsecondary degree in a STEM field. This shortage of STEM workers and related concern for future academic and economic sustainability is a major concern with continuing decreases in STEM graduates (Committee on Prospering in the Global Economy of the 21st Century, 2007). Three years later it was still evident that significant strides had not been made in attempts to attract students to the STEM pipeline (Committee on Underrepresented Groups and the Expansion of the Science and Engineering Workforce Pipeline, 2011). Moreover, with the current STEM work force, the United States cannot continue to compete in a global economy that is increasingly more scientifically and technology-based without skilled STEM talent (Committee on Prospering in the Global Economy of the 21st Century, 2007). These developments and trends continue to be of growing interest in the science education and policy communities. Of specific concern is how to determine and encourage innovative and effective ways to promote interest in STEM at early ages with hopes of leveraging that interest to encourage more students to pursue STEM careers.

A popular explanation for the lack of U.S. students majoring in STEM is that they cannot “see” themselves in STEM or relate to science (Carlone & Johnson, 2007). This lack of a science self-efficacy and science identity affects their interest in science and their career choice goals. This had led science educators and policy makers to focus on engaging students in STEM through hands-on, inquiry-based lessons in school as well as through informal science programs that give students a chance to explore science at their own pace. These strategies have been in place with the hope of increasing interest in science and ultimately STEM career choice.
However, with the emergence of many of these outreach programs and science and math curriculum reforms, there are still low numbers of American students majoring in STEM fields (Carlone & Johnson, 2007).

While there is some literature on attracting students to the STEM pipeline at the college level, improving science self-efficacy, science identity, and fostering STEM career intent of high school students, specifically underrepresented groups, remain understudied as a means of increasing the STEM workforce (Committee on Underrepresented Groups and the Expansion of the Science and Engineering Workforce Pipeline, 2011). This study seeks to fill a gap in the current understandings of how students’ science self-efficacy and science identity with STEM degree selection has led to the research problem for this study, which is to determine if science self-efficacy and science identity predict or influence degree selections within the STEM disciplines. A nationally representative sample of 9th graders’ science self-efficacy, science identity, and STEM career intent will be used to predict these factors to provide insights to science educators and policy makers about how to foster these constructs that are linked to increasing and diversifying the STEM pipeline. Additionally, factors such as race and gender have been examined to determine their influence on the relationship between science self-efficacy, science identity, and STEM career intent (Byars-Winston, 2006; Nauta & Epperson, 2003). Other factors, such as socioeconomic status (SES) and location or urbanicity of a student’s school, have been shown to have direct and indirect influences on science interest and STEM career intent (Lent et al., 2008).
Purpose of the Study

Using data from the High School Longitudinal Study of 2009 (HSLS:09), the purpose of this study is to determine if a predictive relationship exists between individual student science identity and science self-efficacy to postsecondary STEM degree selection. This study is an extension of the HSLS:09, consisting of a stratified random sample of 21,444 participants from 944 public and private high schools during the fall 2009 academic year. HSLS is representative of the 50 United States and the District of Columbia (Ingels et al., 2011). The HSLS:09 is an ideal data set to explore the factors that predict science self-efficacy, science identity and STEM degree selection because it is a nationally representative sample and contains several variables related to science self-efficacy, science identity and STEM career intent.

This study draws on Social Cognitive Career Theory (SCCT) proposed by Lent et al. (1994). This framework suggests that the ultimate goals of science career intent and career choice are mediated by science self-efficacy and science identity. The framework further suggests that several factors influence science self-efficacy, science identity, and therefore career intent. These factors include background characteristics such as race and gender, SES, and urbanicity. Based on the SCCT model, there are pathways that directly and indirectly affect career intent, but all the pathways are mediated by science self-efficacy and science identity. The factors that affect science self-efficacy and science identity, and the role that these play in influencing career intent make this framework ideal for studying the STEM trajectories and career intent.

Another theory is Holland's (1997) Career Choice Theory. Holland’s theory is centered on the notion that most people fit into one of six personality types: Realistic, Investigative, Artistic, Social, Enterprising, and Conventional (RIASEC), which maintains that in choosing a
career, people prefer jobs where they can be around others who are like them or share a similar identity (Holland, 1997). They search for environments that will let them use their skills and abilities, and express their attitudes and values, while taking on enjoyable problems and roles, which they use to justify self-efficacy and in particular science self-efficacy. Behavior is determined by an interaction between personality and environment and these share themes with science self-efficacy and science identity which make this framework influential in helping to understand how science self-efficacy and science identity influence STEM career intent (Sheldon et al., 2020).

**Theoretical Framework**

Two theoretical frameworks used in this study are the social-cognitive career theory by Bandura (Locke, 1987) and Lent et al. (1994), and Career Choice Theory (RIASEC) by Holland (1997). Social-cognitive career theory is a process by which individuals use personal beliefs in determining their professional career development, as well as other non-personal factors that influence or constrain career choices. Social-cognitive framework includes three major aspects in career development: 1) a formation and development of interests that align with one’s career aspirations; 2) selection of coursework and academic choices that coincide with these interests; and 3) excellence in performance and a persistence in these educational and professional pursuits. These relationships of science identity or predisposition and science self-efficacy integrated into the social-cognitive career theory and how they are influenced by choice making is displayed in Figure 1.
Figure 1

Integration of Science Identity as Defined by Predisposition and Science Self-Efficacy Into the Social-Cognitive Career Theory and the Effects of Choice Making

Direct relations between variables are indicated with solid lines; moderated effects are shown with dashed lines. Copyright 1993 by R.W. Lent, S.D. Brown, and G. Hackett.

This is a relevant model to this study because it links a students’ academic behavior to the higher education choices that influence future career behaviors. Schaub and Tokar (2005) suggests that the social cognitive theory indicates a person’s interests were mediated through their self-efficacy and identity with the goals and career aspirations in which they showed an interest. The study also went further to suggest that the extent of this mediation supports Holland’s themes of career choice and that learning experiences are strongly related to self-efficacy and identify and can be mediated with strong reinforcements. The roles of self-efficacy and identity are also linked to this theory in that affective and social concepts will drive an individuals’ career goals and satisfaction, which was suggested by Lent and Brown in 2008 to incorporate interventions that seem to influence career intents. This was further extended into
developing models of how counseling and early interventions in formal and informal ways can influence the career planning of students (Lent & Brown, 2019).

Another significant framework for this study was developed in 1997 by Holland and is called the Career Choice Theory (RIASEC), which maintains that in choosing a career, people prefer jobs where they can be around others who are like them. Holland’s theory is centered on the notion that most people fit into one of six personality types: Realistic, Investigative, Artistic, Social, Enterprising, and Conventional (Holland, 1997). While many students may place in multiple personality types, according to Lent & Savickas (1994), most STEM degree majors would fit in the investigative group based upon having interests in discovery, research, observation, investigative, and problem-solving skills that are part of one’s science identity. Sheldon et al. (2020) state that individuals who fit into the models of RIASEC will find greater satisfaction and well-being in the career intentions that align with the personality type. This would suggest that this model is a good model to use in understanding the influence of personality traits, including one’s self-efficacy and identity especially in science to predict and influence STEM career intent.

**Research Questions**

The primary purpose of this study is to examine the extent to which science self-efficacy and science identity are related to postsecondary STEM degree selection, with special attention to how factors like race, gender, SES status and urbanicity influence science self-efficacy and science identity. This work extends the literature on the STEM pipeline by considering these factors related to science self-efficacy and science identity and how they may be predicative of postsecondary STEM degree selection.
The research questions that guide this study are:

1. What is the relationship between science identity and science self-efficacy with STEM degree selection from the HSLS:09?
2. How does the relationship between science identity and science self-efficacy vary by race, gender, SES, and location of school?
3. Is science self-identity and science self-efficacy predictive of postsecondary STEM degree selection?

**Overview of Methods**

This quantitative study used a correlational research design to determine if a relationship exists between individual student science identity, science self-efficacy, and postsecondary STEM degree selection. This study is an extension of the HSLS:09, consisting of a stratified random sample of 21,444 participants from 944 public and private high schools during the fall 2009 academic year. HSLS is representative of the 50 United States and the District of Columbia (Ingels et al., 2011). It represents multiple races, ethnicities, genders, SES, and location of schools.

Student questionnaires were used to collect demographic information such as gender, race, ethnicity, and urbanicity, which was defined as location of school as city, suburb, town, or rural. SES was calculated using parent/guardians' education, occupation, and family income. Science identity was determined by a questionnaire asking how the student agreed with these statements: “You see yourself as a science person” and “Others see me as a science person.” Science self-efficacy was determined using assessments in science examinations and assignments, questionnaires on confidence on doing an excellent job on science tests, understanding science textbooks, and science course skill mastery. It also inquired into
postsecondary STEM degree selection based on the first major or field of study the respondent
had declared.

Correlation analysis was conducted to quantify the relationship between science identity
and STEM degree selection, as well as between science self-efficacy and STEM degree
selection. Correlation analysis by subgroup was conducted to examine differences in science
identity and science self-efficacy between students based on the demographic characteristics
gender, race, ethnicity, SES, and location of school. Finally, binary logistic regression was
conducted using the inputs of science identity, science self-efficacy, gender, race, ethnicity, SES,
and location of school as variants to estimate STEM degree selection.

Table 1 provides information about the research questions, variables from the HSLS:09
used, and data analysis procedure used for the research.

Table 1

<table>
<thead>
<tr>
<th>Research question</th>
<th>Variable(s) that will be used to answer the question</th>
<th>Data analysis procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>What is the relationship between science identity and science self-efficacy with STEM degree selection from the HSLS:09?</td>
<td>Science identity based on how the students see themselves and how others see them; Science self-efficacy based on science examinations, understandings of science textbooks, mastery skills in science courses and mastery of science assignments</td>
<td>Correlation analysis to quantify the relationship between science identity and science self-efficacy with STEM degree selection</td>
</tr>
<tr>
<td>How does the relationship between science identity and science self-efficacy vary by race, gender, SES, and location of school?</td>
<td>Gender, race, ethnicity, SES, and location of school demographics.</td>
<td>Correlation analysis by subgroup to examine differences in science identity and science self-efficacy based on demographic characteristics.</td>
</tr>
<tr>
<td>Is science self-identity and science self-efficacy predictive of postsecondary STEM degree selection?</td>
<td>First degree major selected as STEM</td>
<td>Logistic regression using science identity, science self-efficacy, gender, race, ethnicity, SES, and urbanicity as variants to estimate STEM degree selection</td>
</tr>
</tbody>
</table>
Delimitations of the Study

This study is an extension of the HSLS:09 and thus has some limitations. The primary purpose of this study was to examine only 9th Grade student-level factors to predict STEM degree selection. Therefore, making predictions beyond the freshman year related to science identity, science self-efficacy and STEM career intent cannot be made.

- The study was conducted only on the data for 9th graders.
- Only student data are included in this study.
- Parent or guardian data were only used in the determination of SES.
- Teacher and counselor factors that predict science self-identity, science self-efficacy and STEM career intent were not used.

Significance of the Study

The significance of this study lies in the fact many of the studies to date on the factors that influence science self-efficacy, science identity and postsecondary STEM degree selection have not incorporated multiple demographic factors that influence science self-efficacy and science identity, limiting our ability to understand the relative contributions of different factors that are involved in the formation of science self-efficacy, science identity and postsecondary STEM degree selection. This study directly addressed this limitation.

One of the earliest indications that a student may be interested in STEM paths is the students’ own self-efficacy for science as well as how they may see themselves in a STEM career as part of their science self-identity (Schlegel et al., 2019). Currently, there is a need to contribute to research that can assist agencies such as the National Science Foundation (NSF), Department of Education and the National Academy of Sciences in advising the nation,
including high schools and postsecondary institutions on ways to increase the enrollment of students in STEM-related careers.

This work extends the literature on the STEM pipeline by considering influences on science self-efficacy and science identity. The results from this work can be used to guide science education policy at the local, state, and national levels, and to direct science education programming in formal and informal settings including those at the high school level.

**Definition of Key Terms**

The following definitions were used in this study:

1. *Career choice theory* is defined as when choosing a career, people prefer jobs where they can be around others who are like them. They search for environments that will let them use their skills and abilities, and express their attitudes and values, while taking on enjoyable problems and roles. Behavior is determined by an interaction between personality and environment (Nor Zainudin et al., 2020).

2. *Holland’s career choice theory (RIASEC)* is defined as a method of choosing a career where people prefer jobs where they can be around others who are like them and use their skills and abilities, and express their attitudes and values, while taking on enjoyable problems and roles. Holland’s theory is centered on the notion that most people fit into one of six personality types: Realistic, Investigative, Artistic, Social, Enterprising, and Conventional (Holland, 1997).

3. *Science identity* is defined as competence in valued science practices, performance of these practices that makes them visible to others, and recognition for that performance by others especially within the STEM community (Carlone & Johnson, 2007). The HSLS:09
defines this as a participants’ answers to how they agree or disagree with the statements “You see yourself as a science person” and/or “Others see me as a science person.”

4. **Science self-efficacy** is defined as a judgment about one’s ability to organize and execute the courses of action necessary to attain a specific goal (Bandura, 1997; Pajares, 2005; Zimmerman, 2000). The HSLS:09 defines this as a participants’ answers to how confident are they on doing an excellent job on science tests, how certain they can understand the science textbook, how certain they can master skills in science courses, and how confident they can do an excellent job on science assignments.

5. **Social-cognitive career theory** is defined as the means which individuals use personal beliefs in determining their professional career development, as well as other non-personal factors that influence or constrain career choices (Bandura, 1986; Lent et al., 1994).

6. **SES** is an acronym for socioeconomic status. It is defined by the HSLS:09 as a construct calculated using parent/guardians' education, occupation, and family income.

7. **STEM** is an acronym for Science, Technology, Engineering, and Mathematics.

8. **STEM career intent** is defined as the intention or goal action to major in a STEM field with the goal of pursuing a career in a STEM field (Britner & Pajares, 2006).

9. **Urbanicity** is defined and used by the HSLS:09 to characterize the locale of a participant’s school as either city, suburb, town, or rural.

**Organization of the Study**

This chapter provided background and contextual information about the need to increase the numbers of qualified STEM talent with a special focus on how race, gender, SES, and urbanicity influence ones’ science self-efficacy and science identity when choosing postsecondary
degrees which will increase the STEM pipeline. The lack of science self-efficacy and science identity plays a significant role in the STEM career choice, especially of underrepresented groups (Navarro et al., 2007). Students with high science self-efficacy and science identity tend to perform better academically and are more likely to select postsecondary degrees in STEM and have higher rates of STEM career intent.

Chapter I contains an introduction to the chapter that includes the background of the study, the statement of the problem, the purpose of the study, theoretical framework, research questions, overview of methods, delimitations of the study, significance of the study, and definition of key terms. Chapter II is a review of the related literature. Chapter III presents the methodology including a description of the research design, research questions, research context, population, instrumentation, data collection procedures, and data analysis procedures. Chapter IV provides the results and findings of this study including a description of the sample, results from each research question, and a summary of the results. Chapter V contains summary, discussion, conclusions, and recommendations from this study including discussion of findings, limitations, and general recommendations for practitioners, policymakers, and future research.
CHAPTER II
LITERATURE REVIEW

Introduction

This chapter will be divided into four sections. It will begin by providing information on science self-efficacy and science identity. It will then provide information on STEM career intent and how this influences STEM degree selection. Next it will provide information on career choice theories that provide a basis for how science self-efficacy and science identity influence choice of career. And finally, it will provide information on differing demographics including gender, race/ethnicity, SES, and urbanicity and how they play a role in development of science self-efficacy, science identity and STEM degree selection. The chapter will end with a summary of the most important studies and themes, why more research is needed in this topic, as well as how this study will advance those needs.

The purpose of this study is to determine if a correlation exists between individual student science identity and science self-efficacy to postsecondary STEM degree selection. This study will draw on SCCT proposed by Lent et al. (1994). This framework suggests that an individual’s ultimate goals of science career intent and career choice are influenced by one’s science self-efficacy and science identity. The framework also suggests that several factors influence science self-efficacy, science identity, and degree selection that leads to career intention. These factors include background characteristics such as race and gender, SES, and urbanicity. Another theory is Holland's (1997) Career Choice Theory (RIASEC), which
maintains that in choosing a career, people prefer jobs where they can be around others who are like them or share a similar identity. They search for environments that will let them use their skills and abilities, and express their attitudes and values, while taking on enjoyable problems and roles, which they use to justify self-efficacy and in particular science self-efficacy.

Science Self-Efficacy and Science Identity

Science Self-Efficacy

For many years, the relationship between students’ attitudes and ideals of their own self-efficacy and identity for a particular subject has been an important area of study for higher education. This is very true of students’ science self-efficacy and identity in contributing to STEM degree selections at the postsecondary level. The general body of research in STEM degree intent suggests that students’ beliefs about their abilities in a science subject help them form future goals and success within the STEM fields.

Belief in one’s ability to perform a specific task is referred to as self-efficacy (Rittmayer & Beier, 2008). Self-efficacy influences the choices individuals make in term of goal choice, the effort expended to reach those goals, and persistence when difficulties arise (Bandura, 1997; Pajares, 2005). Self-efficacy is a significant predictor of both the level of motivation for a task and ultimately task performance (Bandura & Locke, 2003); on average, individuals with high STEM self-efficacy perform better and persist longer in STEM disciplines relative to those lower in STEM self-efficacy. Whereas the most influential source of STEM self-efficacy for males is mastery experience, the most influential sources of STEM self-efficacy for females are practical experience and social persuasion (Zeldin & Pajares, 2000). Gender differences, favoring men, have been observed in STEM self-efficacy, and in the probability of success in STEM-related fields (Schunk & Pajares, 2002). The major reason for this difference in gender is confidence in
STEM courses, which is related to self-efficacy. The “gender gap” develops with advanced high school math and science success and grows at each successive stage with women holding progressively lower numbers of 2- and 4-year degrees in STEM and STEM professions.

One of the earliest indications that a student may be interested in STEM paths are the students’ own self-efficacy for science as well as how they may see themselves in a STEM career as part of their science self-identity (Schlegel et al., 2019). Schlegel and colleagues in 2019 concluded that enhancing curriculum at an early age can foster a development of science self-efficacy. This is critical in understanding the needs of this current study to justify the need to know a student’s own science self-efficacy to better develop curriculum and advisement that will enhance the STEM pipeline. Currently, there is a need to contribute to research that can assist agencies such as the NSF, Department of Education, and the National Academy of Sciences in advising the nation, including high schools and postsecondary institutions on ways to increase the enrollment of students in STEM related careers.

Another major concern is the need to diversify the STEM pipeline and to better understand the concerns and needs of other underrepresented minorities within the sciences. Syed et al. (2019) examined how science self-efficacy was important in better understanding specific ways in which support programs for the STEM disciplines could lead to increased commitment of a student to a career in STEM and encourage STEM degree selection. The main ingredients of supporting underrepresented groups in STEM according to Syed et al. (2019) was with these STEM support activities: research experiences, mentor influence and involvement, community involvement, academic support, and financial support. This is related to the proper development of science self-efficacy and thus encouragement to enter and continue in a STEM degree.
It is widely recognized that comprehensive solutions must address multiple levels of analysis, covering institutional structures, relational factors, social impacts, and individual differences (Syed et al., 2011). In other words, targeting any one level of analysis is likely to be insufficient, and yet focused efforts must be made at each level. Therefore, it is critically important to understand the development and timeline of the development of science self-efficacy and science identity to better support the STEM pipeline.

Science self-efficacy can also include how well a student performs on STEM examinations, overall GPA, and how well they can master skills related to science and thus how these skills relate to a career in STEM (Ding et al., 2015; Johnson & Muse, 2017). In 2015, Ding et al. concluded that students had highest academic achievement in courses of interest, therefore indicating a relationship between degree determination and achievement. This is significant in science self-efficacy because if one’s self-efficacy aligns with the career they most identify with, then they will often excel in these courses and thus be more apt to choose a career in these fields, such as STEM careers. This is also significant from the opposite consideration as was reported by Milsom and Coughlin (2017) with the results of their study suggesting that satisfaction and self-efficacy in chosen career courses were significant predictors of higher overall grade point averages and thus higher congruence with degree selections.

**Science Identity**

Studies concerned with student persistence and success in academic settings indicate that student identity is related to a “sense of fit” with other academics and the academic world (Syed et al., 2011). Several studies have found that having a science identity provides better prediction of academic performance and persistence than racial or ethnic background on its own (Bonous-Hammarth, 2000; Osborne & Walker, 2006; Hazari et al., 2010). Identification as a scientist has
been viewed as having three overlapping concepts: competence in valued science practices, performance of these practices that makes them visible to others, and recognition for that performance by people who matter (Carlone & Johnson, 2007).

Mentoring plays a significant role in the development of a student within the STEM disciplines but may also contribute to the social and identity development of students. According to Haeger and Fresquez (2016), mentoring has two major functions: learning essential tasks of STEM and supporting the socioemotional development of a student. The understanding of how socioemotional development contributes to science identity has been further investigated by Robnett et al. (2018), their studies support the idea that mentoring is critical in the development of emotional abilities that foster science identity and ultimately support the student academically and with career choice and development.

Jang (2015) examined the important competencies needed to succeed in STEM careers. This study found that the second most important factor, second only to cognitive skills, for STEM competency is mentoring and how this can develop the identity with a career. This study went on to include that these social competencies gained from an adequate mentoring program in the workplace will help develop teamwork skills, trust, respect and cooperation, which are all critical skills of someone who strongly identifies as a science and STEM-related individual.

Syed et al. (2019) concluded that science identity partially mediated the association between science self-efficacy and commitment to a science career. This pattern of science self-efficacy affecting identity and identity affecting commitment to a career aligns with Lent’s social cognitive model of career choice. That model sees self-efficacy as a necessary precursor to the development of interest in a particular career (Lent & Brown, 1996). In other words, we are drawn to what we are good at. In that study, they uncovered that science support experiences
appear to drive self-efficacy and identity. These findings provide robust evidence for science identity and self-efficacy as inseparable psychological processes that underlie the utility of engaging students in research and integrating them into a community of scientists to develop their science self-efficacy and science identity.

To examine how science identity develops into predictors of STEM achievement and career intent, Robinson et al. (2019) specifically identified three science identity trajectories, reflecting three groups of students with distinct patterns of change. The High-and-Stable group consisted of students reporting very high science identity throughout the entire school year, the Moderate-and-Slightly-Increasing group included students reporting moderately high science identity that increased very slightly throughout the school year, and the Moderate-and-Declining group reported moderate initial levels of science identity with rapid declines across the school year. These results show a positive correlation in the Moderate-and-Slightly-Increasing group was significant, while the non-significant difference between the slopes of the High-and-Stable group and the Moderate-and-Slightly-Increasing group reinforce the notion that the increases observed in the Moderate-and-Slightly-Increasing group are very slight and potentially not meaningfully different from the stability observed in the High-and-Stable group. Thus, the differences observed for these two groups may be because of the overall initial differences in levels of science identity. Since students largely did not appear to decline in their science identity beliefs, this would not potentially affect STEM degree selection.

**STEM Career Intent**

Factors such as race and gender have been examined to determine their influence on the relationship between science self-efficacy, science identity, and STEM career intent (Byars-Winston, 2006; Nauta & Epperson, 2003). Other factors, such as SES and location or urbanicity
of a student’s school has been shown to have direct and indirect influences on science interest and STEM career intent (Lent et al., 2008).

The lack of science self-efficacy and science identity plays a significant role in the STEM career choice, especially of underrepresented groups (Navarro et al., 2007). Students with high science self-efficacy and science identity tend to perform better academically and are more likely to select postsecondary degrees in STEM with higher rates of STEM career intent.

Mangu et al. (2015) investigated motivational factors that help predict STEM career intentions. That study examined the attitudes of 9th graders who identified as being interested in STEM as newcomers and further classified these students as leavers if they did not persist in STEM career choices by the 11th grade. Results show clearly that US high schoolers typically change their career intentions between grades 9 and 11. This 2-year period is one of high decision changes, with people originally STEM intending no longer remaining interested, while others not originally STEM intending beginning to see STEM as a potential future pathway. The interest, science identity, and science self-efficacy of these leavers and newcomers reflect their changing views towards mathematics and science subject matter. Leavers tended to grow more disillusioned with STEM, while newcomers tended to grow more enamored with STEM (Mangu et al., 2015). This is a substantial finding in relation to this study as it demonstrates that science identity and science self-efficacy are predictors of career choice, but that they are also easily swayed. This could be the reason why so many students have an interest in STEM, but without the proper science identity and self-efficacy development and reinforcement they do not persist in these career choices. Mangu et al. (2015) went on the suggest that students’ experiences in mathematics and science courses, parental support, and extracurricular activities are the greatest motivators and developers
of science identity and self-efficacy that in turn encouraged these students to maintain a STEM degree path and ultimately STEM career intention.

The role of science identity and self-efficacy is an important predictor of a student’s interest, and in some cases persistence, in the STEM fields, but it does not always relate to STEM career intentions with STEM degree selection. Chemers et al. (2011) examined these effects and noted that a strong leadership and teamwork self-efficacy would support and encourage more science self-efficacy and ultimately a higher STEM career intention. This study demonstrated that the effects of science support activities on commitment to a career in science are fully mediated by science self-efficacy and science identity. Remarkably their predicted model showed significant effects of leadership/teamwork self-efficacy on science self-efficacy and STEM career intentions. This further demonstrates the strong connection between science identity and science self-efficacy in the development of STEM aspirations, but even further to encourage and support the commitment to the STEM degree pathway and ultimately a STEM career.

Research further suggests that the long-term development of STEM career intent can be positively influenced by repeat participation in STEM outreach programs, through interaction with role models and mentors, and by participation in positive and engaging science learning environments (Ricks, 2006). The goal of STEM outreach programs and/or interventions is to expose students to STEM careers by providing engaging experiences that they would not normally encounter in their school environments. The intended outcomes of these programs are that participants will choose to pursue these careers and feel equipped to succeed. One study suggests that positive influences on STEM career intent include experiences with informal and non-formal science settings, mentors, and knowing someone in a STEM field (Packard & Nguyen, 2003).
Interest in science during a student’s middle school and high school years has also been proven to predict STEM career intent (VanLeuvan, 2004; Villarejo et al., 2008).

The literature suggests that opportunities for students to engage in scientific research improve interest in STEM and STEM career intent (Committee on Underrepresented Groups and the Expansion of the Science and Engineering Workforce Pipeline, 2011). Summer enrichment programs and undergraduate research experiences offer a chance to do this (Vanleuvan, 2004). For example, a summer bridge program at the University of Akron designed to encourage students to consider choosing STEM careers found that 86% of the participants went on to choose STEM careers because of that program (Zhe et al., 2010). Similarly, a summer bridge program at Bowling Green State University found that early acclimation to a university through a summer program influenced students to attend and choose STEM majors (Gilmer, 2007).

**Career Choice**

**Social-Cognitive Career Choice Theory**

A theoretical framework used in this study is the social-cognitive career theory (SCCT) by Bandura (1986) and Lent et al. (1994). SCCT is a process by which individuals use personal beliefs in determining their professional career development, as well as other non-personal factors that influence or constrain career choices. Social-cognitive framework includes three major aspects in career development: 1) a formation and development of interests that align with one’s career aspirations; 2) selection of coursework and academic choices that coincide with these interests; and 3) excellence in performance and a persistence in these educational and professional pursuits.

Schaub and Tokar (2005) suggest that SCCT indicates a person’s interests were mediated through their self-efficacy and identity with the goals and career aspirations in which they
showed an interest. The study also went further to suggest that the extent of this mediation supports Holland’s themes of career choice and that learning experiences are strongly related to self-efficacy and identity and can be mediated with strong reinforcements. The roles of self-efficacy and identity are also linked to this theory in that affective and social concepts will drive an individuals’ career goals and satisfaction, which was suggested by Lent and Brown (2008) to incorporate interventions that seem to influence career intents. This was further extended into to developing models of how counseling and early interventions in formal and informal ways can influence the career planning of students (Lent & Brown, 2019).

**Holland’s Career Choice Theory**

Another significant framework for this study was developed by Holland (1997) called Career Choice Theory (RIASEC), which maintains that in choosing a career, people prefer jobs where they can be around others who are like them. Holland’s theory is centered on the notion that most people fit into one of six personality types: Realistic, Investigative, Artistic, Social, Enterprising, and Conventional (Holland, 1997). While many students may place in multiple personality types, according to careerkey.org (2019), most STEM degree majors would fit in the investigative group based upon having interests in discovery, research, observational, investigative, and problem-solving skills that are part of one’s science identity. Sheldon et al. (2020) state that individuals who fit into the models of RIASEC will find greater satisfaction and well-being in the career intentions that aligns with the personality type. This would suggest that this model is a good model to use in understanding the influence of personality traits, including ones’ self-efficacy and identity, especially in science, to predict and influence STEM career intent.
Zainudin et al. (2020) state that an individual’s career satisfaction is based on how well their personality traits related to career intention, such as self-efficacy and identity, align with the environment of the work or career. This research also concluded that the Holland RIASEC model should be considered part of self-awareness, and thus self-efficacy and identity, of an individual. The RIASEC model helps individuals explore career options to better understand and select future career planning such as degree selection (Zainudin et al., 2020). Students are less likely to change their major when they know themselves well. Research showed that, greater interest in a major would lead a student to be more enthusiastic about their coursework, thus creating higher satisfaction with the major and commitment to the degree choice (Allen & Robbins, 2010). This would suggest that the Holland model is a good model to use in understanding the influence of self-awareness, including ones’ self-efficacy and identity especially in science to predict and influence STEM career intent as well as STEM degree completion to enhance the STEM pipeline.

**Demographics**

**Gender**

While gender is a biological factor, sex is a sociocultural concept that has profound influence on career choice, especially for girls and women in nontraditional careers such as STEM. A study by Nauta and Epperson (2003) tested a version of the SCCT model on 204 high school girls who voluntarily attended science or math-related conferences. The goal of the 4-year longitudinal study was to predict the choice of a STEM college major and STEM self-efficacy and outcome expectations in college. The girls were surveyed prior to and after entering college. The results showed a direct link between ability and self-efficacy. In addition, the results
indicated that college STEM outcome expectations were associated with plans to continue in a STEM field.

The study of science self-efficacy is one strategy to address the low representation of women and minorities in STEM and has been a promising area of research for the last decade (Dietz et al., 2002). Aurah (2017) states that science self-efficacy, beliefs and gender contribute to academic achievement. Her study demonstrated the effects of gender in STEM-related careers. This would suggest that it is often more likely the loss of self-confidence rather than any other factor that may influence the outcomes of female students. This idea of the loss of confidence in a personal belief that you can do something may also contribute to differences seen in other racial and socioeconomic groups.

While women are gaining strides in the biological sciences, they remain severely underrepresented in other STEM fields and continue to report lower science self-efficacy compared to their male counterparts (Quimby & DeSantis, 2006). Furthermore, Heilbronner (2012) found that college-educated women recalled having lower self-efficacy than men when asked to reflect on their college education and their decision to enter biological fields as opposed to other STEM areas because of a lack in confidence in their abilities to perform with their male counterparts.

Nosek and Smyth (2011) address unconscious bias, or implicit social cognition, that may affect the STEM gender gap in two ways: 1) causing early STEM influences (e.g., teachers, administrators, parents) to unintentionally behave differently toward females than toward males in STEM-related contexts and by 2) undermining girls’ and women’s interest, feeling of belonging, willingness to persist, and actual achievement in math and science fields. It is important that a thorough understanding of this bias may better facilitate the early decisions
about STEM and moreover establishing lasting science self-efficacy and science identities that lead to more STEM degree selection. This study will help address how these attitudes of science self-efficacy and science identity develop at the secondary level and help to develop resources to intercede at an earlier time.

Another major issue seen in gender differences within the STEM fields was examined by Cheryan et al. (2017) and examined the belief that people in STEM have masculine traits and interests. The study concluded that student’s stereotypes about the proportion of men in the STEM field and the perception of needing or having more masculine traits and interests correspond with the gender disparities seen in STEM. The idea that one may need or possibly develop masculine traits could affect the development of ones’ science self-efficacy and identity and therefore could be a major reason for loss of these identities and less diverse STEM pipelines.

The influence of gender on the ideas of how important science courses are to science self-efficacy and identity have been observed by several studies which indicate elementary, middle, and high school girls typically rate science and mathematics as more important subjects for them than boys do (Else-Quest et al., 2013; Selkirk et al., 2011; Teshome et al., 2001). High school girls report valuing science more highly than boys across racial groups (i.e., African American, Latino, Asian American, and White) (Else-Quest et al., 2013). A component of this study was to examine the effects of science course mastery and course examination success as it relates to science self-efficacy and identity. If this is true that girls value these courses more than boys, then it may also represent that this is less of the reason that we see the gender gap and that other factors contribute to this disparity.
An interesting overarching factor described by Cheryan et al. (2017) that explains why there are greater gender disparities in some STEM fields is insufficient early (i.e., precollege) experience in computer science, engineering, and physics than in biology, chemistry, and mathematics. There are three components of insufficient early experience. First, there are fewer course offerings in some STEM fields than others. Second, students have more freedom to decide which courses to take in some STEM fields than others. Third, there are gender gaps in early experience in some STEM fields but not others. This study not only supports the findings of gender gaps within STEM, but also may provide direction of how urbanicity may play a role as schools located in different urbanicities may have more, or less, options and opportunities to foster these developments of science self-efficacy and identity.

A study from Rodriguez and Blaney (2020) focuses on the persistence of feminism within STEM disciplines. In this study a comparison of overall female students with Latina women shows that unlike for White students, even in heavily Latinx-populated areas of the country (e.g., the Southwest region of the United States), experiences of sexism, racism, and isolation continue to influence feelings of belonging for Latina students in STEM careers. Further, although the Latinx population may have a substantial presence in this region, states in the Southwest (e.g., Arizona, Texas, Nevada) have some of the worst disparities between the number of high school graduates in the state and enrollment in STEM degree programs. This study demonstrates that despite greater numbers of Latinx students entering higher education, STEM education may remain as an area that most Latina students would find as isolating and excluded. This study helps to bridge the gap between gender and race in how they influence STEM degree selection, and it may also help to address the disparities of regionalities and urbanicity effects.
**Race and Ethnicity**

The role of race and ethnicity has direct influence on career choice because they may influence how and what kind of access one may have to STEM education, science experiences, and STEM career information. Underrepresented minorities may experience uncertainty about how well they fit in the academic environment (Estrada et al., 2016; Syed et al., 2011). Perceptions of inadequate capabilities and/or poor fit and identity can result in withdrawal from academic programs and opportunities (Hausmann et al., 2007; Lee et al., 2015; Walton & Cohen, 2007). However, it may be that a research internship, as part of a STEM program, might provide the opportunity to test one’s ability to learn scientific content and methods. Moreover, the chance to associate with research mentors and other science students might help to overcome doubts about self-efficacy. Of course, a negative experience might also enhance doubts and threats (Estrada et al., 2018).

Byars-Winston (2006) employed SCCT to examine the relationship between Racial Ideology and self-efficacy, outcome expectations, career interests and perceived career barriers on Black undergraduates. The theory proposes four racial ideologies (nationalist, assimilationist, humanist, and oppressed minority) that represent how Black people should act. The results showed support for two (nationalist and assimilationist) of the four racial ideologies in predicting the assessed sociocognitive variables. The study also showed support for the SCCT model in those interests predicted career considerations. The overall implication of the work is that it offers support for including race-specific factors in career choice examinations.

Gwilliam and Betz (2001) examined the reliability and validity of three measures of science and math self-efficacy of Black and White college students. The measures were found to be reliable in both racial groups and predicted considerations of majors and careers in the
sciences. Specifically, they found that with Black women, science self-efficacy was found to influence science career choice. Gender differences in both math and science self-efficacy were found with males having higher efficacy in both cases.

To better understand the beliefs and experiences of underrepresented students who are actively pursuing a career in STEM, Kricorian et al. (2020) conducted a study that was focused on a diverse population that is nearly all women and people of color. The majority (54%) stated that meeting a STEM professional of their own gender and ethnicity would be effective encouragement to pursue STEM. A similar percentage (56%) believed that media exposure to gender- and ethnicity-matched STEM professionals would be effective encouragement. Most (73%) demonstrated a growth mindset and had strong family support to pursue STEM (68%). Only two-thirds (66%) felt they belonged in STEM careers, and 30% agreed that people in their STEM classes are a lot like them. This would suggest that educators should focus on inclusive learning by highlighting the accomplishments of diverse STEM professionals to help strengthen science self-efficacy and identity with STEM career intentions.

A study of Mexican American middle school students’ goal intentions in math and science by Navarro et al. (2007) provided partial support for the SCCT model because it showed past performance in math and science and perceived parental support influenced self-efficacy. Self-efficacy predicted expected outcomes, which also correlated with interest and career goals. The difference in this study with Mexican Americans was when comparing to White students. White and Mexican American students showed similar predicted outcomes for science performance and indicated that it had little effect on predicting STEM intention. Furthermore, White student parental support showed slightly lower correlation than that of Mexican American students. These contradicting results suggest background factors may interrelate to
sociocognitive factors differently for the Mexican American student population compared to others.

Ethnic minorities state that low confidence or science self-efficacy is one reason for choosing non-STEM majors and careers. Lewis (2003) highlights this lack of confidence in science as one of six factors contributing to the underrepresentation of minorities in STEM fields and suggests the need for further research into the role of science self-efficacy to increase ethnic diversity within the STEM disciplines.

A study of the racial and gender differences in how sense of belonging influence a decision to major in STEM was conducted by Rainey et al. (2018) that identified four key factors that contribute to sense of belonging for all students interviewed: interpersonal relationships, perceived competence, personal interest, and science identity. This would suggest that students who remain in STEM majors may have a greater sense of belonging than those who leave STEM, and that students from underrepresented groups are less likely to feel they belong. This highlights structural and cultural features of STEM careers, that continue to privilege white males.

**Socioeconomic Status**

SES has been shown to have direct and indirect influences on science interest and STEM career intent (Lent et al., 2008). A study by Niu (2017) examined patterns of choice of STEM majors in college by students from different family SES backgrounds. Results from that study show that low-SES students are disadvantaged in the pursuit of STEM majors. Higher family SES compensates for negative predictors of STEM enrollment, such as gender and race, and strengthens the effect of positive predictors, such as math and science preparation. The gender and racial gaps in STEM enrollment narrow for students from higher SES families, and the
positive correlation between math and science preparation and STEM enrollment strengthens with the increase of family SES, except for lowest SES students. Results indicate that low-SES students may not possess the information and/or skills necessary to make well-informed decision of STEM degree selection.

Shaw and Barbuti (2010) found SES played a role in the percentage of students who persisted in a STEM trajectory and those who switched degree paths. The study showed a higher SES had about a 5% lower likelihood of switching from a STEM career intention. It also showed that higher SES had about a 5% higher likelihood of persisting in a STEM career intention. Taken together, these results can indicate that SES plays a role in the development and persistence in STEM career intentions.

Another study from Saw et al. (2018) indicated that female, Black, Hispanic, and low SES students were less likely to show, maintain, and develop an interest in STEM careers during high school years. Compared with White boys from higher SES background, girls from all racial/ethnic and SES groups, as well as Black and Hispanic boys from lower SES groups, consistently had lower rates of interest, persistence, and developing an interest in STEM fields. These findings highlight the instability of STEM career aspirations within SES groups and continue to support the need to address science self-efficacy and identity to diversify the STEM pipeline. It is also important to address these issues of self-efficacy and identity earlier and among a much more diverse underrepresented populations including differing SES.

To better understand the mechanism of how lower SES influences STEM aspirations, Blums et al. (2016) used data from the National Institute of Child Health and Human Development Study of Child Care and Youth Development. This study addresses gaps in previous research linking SES and STEM achievement in high school. Results indicate that
maternal education predicts the child’s early environment, which itself predicts the development of critical thinking and language, and thereby, STEM achievement. The implications of this suggest that effects of SES may be related to the family status and impacts of paternal involvement of the child and that these early developmental aspects may be affecting development of science self-efficacy and identity.

**Urbanicity**

Urbanicity, or a school’s locale (city, suburban, town, rural) was derived from previous NCES files which had classified the schools based on the U.S. Bureau of the Census classifications (Ingels et al., 2011). These classification systems apply classification based on the proximity to central cities. This is important as it can indicate the number of resources, financial support, and opportunity that exist for the school. Location or urbanicity of a student’s school has been shown to have direct and indirect influences on science interest and STEM career intent (Lent et al., 2008).

Unfried and Faber (2014) specifically looked at student interest in STEM careers and the effects of urbanicity. In this study two program evaluations of STEM education initiatives were conducted in the 2012-13 school year. The first evaluation investigated 5-9th grade STEM education initiative in rural counties of a southeastern state. This “Rural Initiative” consisted of various hands-on, problem-based STEM education activities from nationally recognized engineering and technology curricula (e.g., Project Lead the Way) to science-lab kits and STEM festivals. The second evaluation investigated a STEM initiative implemented across elementary, middle, and high schools in a single, large, urban district in the same southeastern state. This “Urban Initiative” consisted of schools which were in their first year of STEM-focused instructional interventions. The results of this study showed that while gender and school level
may be the most important predictor of STEM interest and career intention, students from groups overrepresented in STEM career pathways in the Urban Initiative expressed slightly higher interest in core STEM careers than their counterparts in the Rural Initiative. Interestingly, within the Rural Initiative, underrepresented students had slightly higher core STEM interest than their overrepresented peers in elementary and middle school, and roughly equal scores in high school. This trend was not found in the Urban Initiative. This would suggest that other social factors and demographics may play a more prominent role science self-efficacy and identity in relation to STEM career choice than urbanicity. However, these results would still support the notion that urbanicity could influence students more at the pre-high school level than at the high school level and could be predictors of development of science self-efficacy and identity at the early high school level.

Holian and Kelly (2020) supported the findings of Unfried and Faber (2014) when they examined urbanicity effects on STEM career intentions, a lower percentage of STEM intention designated students (17%) attended rural schools compared to non-STEM intention designated students (23%) and STEM students who left the degree trajectory (26%). There were not statistically significant differences in rates of STEM intention designated students or other occupational intention categories in schools classified as city, suburb, or town. This would continue to support the idea that rural localities have less interventions and support programs for science career aspirations; it would also suggest that more needs to be done to stimulate STEM aspirations and ultimately STEM career intentions in rural communities.
Summary

Chapter II provided a review of the pertinent literature that applies to the primary purpose of this study to examine the extent to which science self-efficacy and science identity predict postsecondary STEM degree selection, with special attention to how factors like race, gender, SES and urbanicity are related to science self-efficacy and science identity. The purpose of this study is to determine if a predictive relationship exists between individual student science identity and science self-efficacy to postsecondary STEM degree selection. This study draws on SCCT proposed by Lent et al. (1994). This framework suggests that the ultimate goals of science career intent and career choice are mediated by science self-efficacy and science identity. The framework further suggests that several factors influence science self-efficacy, science identity, and therefore career intent. These factors include background characteristics such as race and gender, SES, and urbanicity. Another theory is Holland's (1997) Career Choice Theory (RIASEC), which maintains that in choosing a career, people prefer jobs where they can be around others who are like them or share a similar identity.

Self-efficacy is a significant predictor of both the level of motivation for a task and ultimately task performance (Bandura & Locke, 2003); on average, individuals with high STEM self-efficacy perform better and persist longer in STEM disciplines relative to those lower in STEM self-efficacy. Another major concern is the need to diversify the STEM pipeline and to better understand the concerns and needs of other underrepresented minorities within the sciences. Syed et al. (2019) examined how science self-efficacy was important in better understanding specific ways in which support programs for the STEM disciplines could lead to increased commitment of a student to a career in STEM and encourage STEM degree selection. Studies concerned with student persistence and success in academic settings indicate that student
identity is related to a “sense of fit” with other academics and the academic world (Syed et al., 2011). Several studies have found that having a science identity provides better prediction of academic performance and persistence than racial or ethnic background on its own (Bonous-Hammarth, 2000; Hazari et al., 2010; Osborne & Walker, 2006). Science self-efficacy and science identity are being analyzed in the lens of how demographics like gender, race/ethnicity, SES, and urbanicity influence them and relate to STEM career intentions and STEM degree selection.

This study contributes to an ever-growing field of research into the issues which influence and direct student interest in science and STEM as well as postsecondary degree selection that will lead to STEM degree selections that ultimately contribute to the much-needed STEM pipeline within the United States. These findings can contribute to policy decisions as well as regional and local changes needed to improve this need. The methods of this study to examine the extent to which science self-efficacy and science identity predict postsecondary STEM degree selection will be discussed in the following chapter.
CHAPTER III
METHODOLOGY

Overview

The primary purpose of this study is to examine the extent to which science self-efficacy and science identity predict postsecondary STEM degree selection, with special attention to how factors like race, gender, SES and urbanicity are related to science self-efficacy and science identity. This study is an extension of the HSLS:09, consisting of a stratified random sample of 21,444 participants from 944 public and private high schools during the fall 2009 academic year. HSLS is representative of the 50 United States and the District of Columbia (Ingels et al., 2011). Data were collected using a stratified, 2-stage random sample design with participants throughout the United States representing multiple races, ethnicities, genders, SES, and location of schools. The HSLS:09 study focuses on understanding students’ trajectories from the beginning of high school into higher education and the workforce. The core research questions explore secondary to postsecondary transition plans and the paths into and out of STEM fields of study and careers.

This chapter will discuss the methodology and procedures used to facilitate this study. This chapter includes a description of the research design, the research questions used to guide this study, research sites, participants, instrumentation used, data collection procedures, data analysis, and a summary of the method.
Research Design

This quantitative study used a correlational research design to determine if a relationship exists between individual student science identity, science self-efficacy, and postsecondary STEM degree selection. Correlation analysis was conducted to quantify the relationship between science identity and STEM degree selection, as well as between science self-efficacy and STEM degree selection. Correlation analysis by subgroup was conducted to examine differences in science identity and science self-efficacy between students based on the demographic characteristics gender, race, ethnicity, SES, and location of school. Finally, binary logistic regression was used to examine the inputs of science identity, science self-efficacy, gender, race, ethnicity, SES, and location of school as variants to estimate STEM degree selection.

The purpose of this study is to examine the extent to which independent variables of science self-efficacy and science identity are related to the dependent variable of postsecondary STEM degree selection, with special attention to how factors like race/ethnicity, gender, SES and urbanicity relate to how science self-efficacy and science identity contribute to STEM degree selection.

Research Questions

The research questions that guide this study are:

1. What is the relationship between science identity and science self-efficacy with STEM degree selection from the HSLS:09?
2. How does the relationship between science identity and science self-efficacy vary by race, gender, SES, and location of school?
3. Is science self-identity and science self-efficacy predictive of postsecondary STEM degree selection?
**Research Sites**

The HSLS:09 sample schools were selected from the National Center for Education Statistics (NCES) files (Ingels et al., 2011). The primary sample of regular public and public charter schools was selected from the 2005–06 Common Core of Data (CCD), and the private schools were sampled from the 2005–06 Private School Universe Survey (PSS) (Ingels et al., 2011). A total of 48 mutually exclusive first-stage sampling strata were created for HSLS:09. The strata were defined by three variables: school type or sector (public, private–Catholic, private–other), region of the United States (Northeast, Midwest, South, West), and locale (city, suburban, town, rural).

All study-eligible schools on the CCD were given a school type classification of public (Ingels et al., 2011). School type on the PSS was determined by whether the religious affiliation was Roman Catholic, and all non-Catholic PSS private schools were classified in the private–other category. Within school type, the eligible schools were classified into four regions of the United States for the second stratification variable. The following assignments were made based on the physical location of the school: Northeast (CT, MA, ME, NH, NJ, NY, PA, RI, VT), Midwest (IA, IL, IN, KS, MI, MN, MO, ND, NE, OH, SD, WI), South (AL, AR, DC, DE, FL, GA, KY, LA, MD, MS, NC, OK, SC, TN, TX, VA, WV), and West (AK, AZ, CA, CO, HI, ID, MT, NM, NV, OR, UT, WA, WY).

The third stratification variable identified the locale (city, suburban, town, rural) derived from previous NCES files (Ingels et al., 2011). Prior to sample selection, the frame was additionally sorted to ensure a representative distribution across the United States and size of school. These strata were formed by cross classifying the following nine U.S. Census divisions:
New England/Middle Atlantic, East North Central, West North Central, South Atlantic, East South Central, West South Central, Mountain, and Pacific.

The national design called for the selection of a sufficient sample to yield 800 eligible, participating schools—600 public schools, 100 Catholic schools, and 100 private schools; data collection exceeded minimum requirements with a final sample of 944 schools representing the 50 United States and the District of Columbia (Ingels et al., 2011).

**Research Participants**

The NCES initially identified a sample of 1,890 eligible and nationally representative schools, stratified on region (Northeast, Midwest, South, West), locale (city, suburban, town, rural), and school type (public, private - Catholic, private - other private), with the goal of achieving a sample of 800 schools exceeded to a final sample of 944 schools (Ingels et al., 2011). A total of 26,310 students were sampled from these schools, for an average of 30 students per school. Of these 26,310 eligible sampled 9th graders, 21,444 (81.5% response rate) completed the questionnaires. The parent or guardian most familiar with the 9th grader’s school situation and household environment was asked to complete a questionnaire as well, sections of which are used to determine SES.

Of the 21,444 students who participated, the demographic/ethnicity representation was:
10,890 male (50.77%), 10,560 female (49.23%), 223 American Indian/Alaska Native (1.04%), 2,140 Asian, non-Hispanic (10.00%), 2,680 Black/African American (12.52%), 3,520 Hispanic (16.40%), 12,630 White, non-Hispanic (58.90%), 250 other race/more than one race/missing value (1.15%) (Ingels et al., 2011; Wagstaff, 2014).
**Instrumentation**

The base-year instrument design of the HSLS:09 was in the form of self-administered student and parent/guardian questionnaires that elicited demographic information such as gender, race, and ethnicity; language background; and school experiences in the current and previous school year (including mathematics and science experiences and course enrollment). It also inquired into constructs such as science self-efficacy and science identification and high school, postsecondary, and career plans. A second follow-up interview was conducted with the same participants in 2016 that elicited information on the degree selected as a first major.

**Base-Year Student Questionnaire**

The student questionnaire was divided into eight sections defined as sections A-H. Section A collected contact information for the student. Section B asked for the 9th grader’s demographic information including gender, race/ethnicity, and birth date. The next section, Section C, collected information on the 9th grader’s recent school experiences. Students were asked to indicate the school they attended in the previous school year (2008–09) and their grade level at that time. The 9th graders also reported their involvement in various mathematics and science activities since the beginning of the previous school year. Finally, the students identified the mathematics and science courses they took in the 8th grade and the final grade they earned in each. Section D gathered data on self-efficacy in mathematics and identification as a mathematics person. Section E gathered data on science, including science self-efficacy and science identity and asked a series of questions about the science course the 9th grader was taking in the fall of 2009. Section F included questions on attitudes about school, mathematics, and science. Other questions focused on whom the student talks to about education, career plans, and personal problems; friends’ attitudes about school and related behaviors; and STEM programs in
which the student had participated. Students were also asked to compare and evaluate males’ and females’ ability in mathematics, science, and English and language arts. Section G focused on high school, career, and college plans. Specifically, students were asked about their intentions to take further mathematics and science courses, and if they had a career or college plan. Finally, Section H, collected data on educational expectations, plans for the year after high school and college plans (see Appendix B).

**Base-Year Parent Questionnaire**

The parent questionnaire covered household members and their roles and characteristics; demographic data; information on immigration status and language use; and SES (education, occupation, income). The section of the parent questionnaire most pertinent to this study gathered information on the SES of the 9th grader’s parents, included each parent’s educational attainment, employment status, and current or most recent occupation. Household income and home ownership were also ascertained (see Appendix B).

**Follow-Up Questionnaire**

Degree selection was based on the first major or field of study the respondent had declared or decided upon and reported during the second follow-up questionnaire in 2016. The pertinent question asked on the HSLS:09 second follow-up instrument was, “What was your major or field of study for your [bachelor's degree/associate degree/ [first/second/third etc.] certificate/degree or certificate] [from [college/trade school attended]]?” Majors were classified as STEM (if first or second/double major is STEM) or not STEM using the U.S. Department of Education's Classification of Instructional Programs, 2010 edition (CIP 2010) (Radford et al., 2018). Table 2 lists the HSLS:09 variable data sets and how they were used in this study.
Table 2

*HSLS:09 Variables*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>X1SCIID</td>
<td>Science identity based on how the students see themselves and how others see them as a science person</td>
<td>Composite score computed using raw Likert-scale responses with 1=strongly agree, 2=agree, 3=disagree, and 4=strongly disagree</td>
</tr>
<tr>
<td>X1SEX</td>
<td>Sex/Gender</td>
<td>Categorical variable using the categories male or female</td>
</tr>
<tr>
<td>X1RACE</td>
<td>Race/Ethnicity</td>
<td>Categorical variable using the categories Amer. Indian/Alaska Native, non-Hispanic; Asian, non-Hispanic; Black/African American, non-Hispanic; Hispanic, race specified; more than one race, White, non-Hispanic</td>
</tr>
<tr>
<td>X4X2SES</td>
<td>SES based on parent’s educational attainment, employment status, and current or most recent occupation, and household income</td>
<td>Composite score computed using 2010 Standard Occupational Classification (SOC) taxonomy, household income, and parent education.</td>
</tr>
<tr>
<td>X4LOCALE</td>
<td>Location (Urbanicity) of high school classified as city, suburban, town, or rural</td>
<td>Categorical variable using the categories of city, suburban, town, and rural</td>
</tr>
<tr>
<td>X4RFDMJSTEM</td>
<td>Degree’s first major is STEM</td>
<td>Categorical variable using the categories of majors classified as STEM (if first or second/double major is STEM) or not STEM</td>
</tr>
</tbody>
</table>

**Data Collection Procedures**

All data used were from the public-use datasets available from the High School Longitudinal Study of 2009 found at [https://nces.ed.gov/](https://nces.ed.gov/); no restricted-use datasets were used in this study. Institutional Review Board (IRB) approval was obtained from Mississippi State University (MSU) (see Appendix A).
Recruitment of schools and school districts for the HSLS:09 study began a year prior to data collection and administration of questionnaires. All necessary approvals were obtained, and facilitators began administering the questionnaires and any pertinent follow-ups needed to gather the data of students and parents/guardians from September 8, 2009, through February 26, 2010 (Ingels et al., 2011).

Questionnaires were self-administered using a computer during in-school sessions to the student that elicited demographic information such as gender, race, and ethnicity; language background; and school experiences in the current and previous school year (including mathematics and science experiences and course enrollment). It also inquired into constructs such as science self-efficacy and science identification and high school, postsecondary, and career plans. If a student was unable to participate during the in-school sessions, a telephone interview was conducted using the same survey instrument. Questionnaires were also provided as self-administered computer based to parent/guardians to obtain various demographic information to help determine SES.

A second follow-up questionnaire was conducted at the end of March 2016 and asked about activities through the base-year until the end of February 2016 with the same participants from the base-year study. The 2016 questionnaire elicited information on the degree selected as a first major (Radford et al., 2018).

Data Analysis

The primary purpose of this study is to examine the extent to which independent variables of science self-efficacy and science identity are related to the dependent variable of postsecondary STEM degree selection, with special attention to how factors like race, gender, SES and urbanicity relate to how science self-efficacy and science identity contribute to STEM
degree selection. Table 3 describes the data analysis procedure that were used for each research question as well as the variables used in the data analysis.

Table 3

*Data Analysis Procedures*

<table>
<thead>
<tr>
<th>Research question</th>
<th>Variable(s) that will be used to answer the question</th>
<th>Data analysis procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>What is the relationship between science identity and science self-efficacy with STEM degree selection from the HSLS:09?</td>
<td>Science identity based on how the students see themselves and how others see them; Science self-efficacy based on science examinations, understandings of science textbooks, mastery skills in science courses and mastery of science assignments</td>
<td>Correlation analysis to quantify the relationship between science identity and science self-efficacy with STEM degree selection using composite scores computed using raw Likert-scale responses with 1=strongly agree, 2=agree, 3=disagree, and 4=strongly disagree</td>
</tr>
<tr>
<td>How does the relationship between science identity and science self-efficacy vary by race, gender, SES, and location of school?</td>
<td>Gender, race, ethnicity, SES, and location of school demographics.</td>
<td>Correlation analysis by subgroup to examine differences in science identity and science self-efficacy based on demographic characteristics using composite scores computed using raw Likert-scale responses with 1=strongly agree, 2=agree, 3=disagree, and 4=strongly disagree and Categorical variables for demographics separately</td>
</tr>
<tr>
<td>Is science self-identity and science self-efficacy predictive of postsecondary STEM degree selection?</td>
<td>First degree major selected as STEM</td>
<td>Logistic regression using the inputs of science identity, science self-efficacy, gender, race, ethnicity, SES, and location of school as variants to estimate STEM degree selection using composite scores computed using 2010 Standard Occupational Classification (SOC) taxonomy, household income, and parent education. Categorical variables using the categories of city, suburban, town, and rural. Categorical variable using the categories of majors classified as STEM (if first or second/double major is STEM) or not STEM</td>
</tr>
</tbody>
</table>
Correlation Analysis

Correlation is a statistical technique that can be used to measure and describe the relationship between two variables that are usually separate and are not manipulated (Gravetter & Wallnau, 2017). Using the comprehensive IBM Statistical Package for the Social Sciences (SPSS) software, correlation analysis was conducted to address research question one which was to quantify the relationship between science identity and STEM degree selection, as well as between science self-efficacy and STEM degree selection. Determining the linear correlation provides information about the relationship of the variables and the strength of this relationship. The degree of this relationship was measured using the Pearson $r$, where the degree of covariability of the variables, science identity and science self-efficacy, each were compared to the variability of STEM degree selection. Using the sample correlation coefficient:

$$r_{xy} = \frac{S_{xy}}{S_x S_y}$$  \hspace{1cm} (1)

where $S_{xy}$ is the sample covariance of science identity and STEM degree selection, as well as between science self-efficacy and STEM degree selection and $S_x, S_y$ are the sample standard deviations.

More specifically, Pearson $r$ values can range from -1 to 1. Thus, a correlation coefficient closer to zero will be interpreted as indicating a relationship of smaller magnitude, while a correlation coefficient closer to 1 or -1 will be interpreted as indicating a relationship of larger magnitude. A positive correlation coefficient will suggest that two variables move in the same direction (i.e., as one increases, the other increases), while a negative correlation coefficient will
suggest that two variables move in opposite directions (i.e., as one increases, the other decreases) (Gravetter & Wallnau, 2017).

**Correlation Analysis by Subgroup**

Correlations can be computed for subsets of the sample to understand how science identity and science self-efficacy relate (similarly or differently) to STEM degree selection across subpopulations of students. Using IBM SPSS statistical software, correlation analysis by subgroup was conducted to address research question two, which was to examine differences in science identity and science self-efficacy between students based on the demographic characteristics gender, race, ethnicity, SES, and location of school. In this method, the correlations between science identity and STEM degree selection, as well as science self-efficacy and STEM degree selection, were computed separately within each of the subgroups of gender, race, ethnicity, SES, and location of school. Using the sample correlation coefficient:

\[
 r_{xy} = \frac{s_{xy}}{s_x s_y} 
\]  

(2)

where \(s_{xy}\) is the sample covariance between science identity and STEM degree selection, as well as science self-efficacy and STEM degree selection were computed separately within each of the subgroups of gender, race, ethnicity, SES, and location of school, and \(s_x, s_y\) are the sample standard deviations. Those correlations can then be compared across each subgroup to identify meaningful similarities and/or differences in their magnitudes and directions.
Logistic Regression

To find the best mathematical description of the relationship between the categorical dependent variable (STEM degree selection) and the other variables of interest (e.g., science identity, science self-efficacy), this study used logistic regression (Gravetter & Wallnau, 2017). Logistic regression is an appropriate method for determining the likelihood of an event occurring (or not). In this study, binary logistic regression was used, as the dependent variable of interest indicates two possible outcomes: 1) STEM degree selection, 2) non-STEM degree selection.

Using IBM SPSS statistical software, binary logistic regression was conducted using the inputs of science identity, science self-efficacy, gender, race, ethnicity, SES, and location of school as variants to estimate STEM degree selection. In other words, logistic regression was used in this study to quantify the likelihood of students selecting a STEM degree, given certain levels of science identity, science self-efficacy, and background characteristics. Effect coding was used with these variables so that all effects interpreted would be in comparison to the average response rather than to a reference group (Mayhew & Simonoff, 2015). Using the following binary logistic regression model adapted from a study by Oshagbemi & Hickson (2003):

\[
\log\left(\frac{p(S=1)}{1-p(S=0)}\right) = \text{CONST} + \beta_1 \text{Science Identity} + \beta_2 \text{Science Self-Efficacy} + \beta_3 \text{Gender} + \beta_4 \text{Race} + \beta_5 \text{Ethnicity} + \beta_6 \text{SES} + \beta_7 \text{Urbanicity} \tag{3}
\]

S denotes the dependent variable of degree selected, and \( p(S=1) \) denotes the expected probability that \( S = 1 \), while each \( \beta \) represents the independent variables. The results of a binary logistic regression are computed as an odds ratio (\( \text{ExpB} \)) where 1 equals the midpoint, thus a value higher than 1 would indicate compared to an overall level, the event would be more likely, and a value less than 1 would indicate compared to an overall level, the event would be less likely.
Summary

Chapter III provided a detailed description of the methodology that was used in this study. It provides a research design conducted using datasets from the HSLS:09. It was divided into sections to provide information about the research sites, participants, and instrumentation as well as the data collection procedures and data analysis procedures that were used in this study.
CHAPTER IV
RESULTS AND FINDINGS

Overview

The primary purpose of this study is to examine the extent that independent variables of science self-efficacy and science identity are related to the dependent variable of postsecondary STEM degree selection, with special attention to how factors like race, gender, SES and urbanicity relate to how science self-efficacy and science identity contribute to STEM degree selection. This study is an extension of the HSLS:09, consisting of a stratified random sample of 21,444 participants from 944 public and private high schools during the fall 2009 academic year. HSLS is representative of the 50 United States and the District of Columbia (Ingels et al., 2011). Data were collected using a stratified, 2-stage random sample design with participants throughout the United States representing multiple races, ethnicities, genders, SES, and location of schools.

This quantitative study used a correlational research design to determine if a relationship exists between individual student science identity, science self-efficacy, and postsecondary STEM degree selection. Correlation analysis was conducted to quantify the relationship between science identity and STEM degree selection, as well as between science self-efficacy and STEM degree selection. Correlation analysis by subgroup was conducted to examine differences in science identity and science self-efficacy between students based on the demographic characteristics gender, race, ethnicity, SES, and location of school. Finally, logistic regression
was used to examine the inputs of science identity, science self-efficacy, gender, race, ethnicity, SES, and location of school as variants to estimate STEM degree selection. The research questions that guide this study are:

1. What is the relationship between science identity and science self-efficacy with STEM degree selection from the HSLS:09?
2. How does the relationship between science identity and science self-efficacy vary by race, gender, SES, and location of school?
3. Is science self-identity and science self-efficacy predictive of postsecondary STEM degree selection?

This chapter presents the analysis of data collected for this study. The presentation of results is divided into three main sections: 1) a description of the sample using descriptive statistics; 2) overall results with an examination of each research questions’ data; 3) a summary of the results.

**Description of Sample**

Data were obtained from 944 schools and a total of 26,310 students were sampled from these schools, for an average of 30 students per school. Of these 26,310 eligible sampled 9th graders, 21,444 (81.5% response rate) completed the questionnaires. The parent or guardian most familiar with the 9th grader’s school situation and household environment was asked to complete a questionnaire as well, sections of which are used to determine SES. Of the 21,444 students that participated, the demographic/ethnicity representation is shown in Table 4.
Table 4

*Frequencies and Percentages of Demographics of Respondents*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>10,890</td>
<td>50.8</td>
</tr>
<tr>
<td>Female</td>
<td>10,560</td>
<td>49.2</td>
</tr>
<tr>
<td><strong>Race/Ethnicity</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>American Indian/Alaska Native</td>
<td>223</td>
<td>1.04</td>
</tr>
<tr>
<td>Asian, non-Hispanic</td>
<td>2,140</td>
<td>10.0</td>
</tr>
<tr>
<td>Black/African American</td>
<td>2,680</td>
<td>12.5</td>
</tr>
<tr>
<td>Hispanic</td>
<td>3,520</td>
<td>16.4</td>
</tr>
<tr>
<td>White, non-Hispanic</td>
<td>12,630</td>
<td>58.9</td>
</tr>
<tr>
<td>Other</td>
<td>1941</td>
<td>8.3</td>
</tr>
<tr>
<td><strong>Location of High School (Urbanicity)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>City</td>
<td>4978</td>
<td>21.2</td>
</tr>
<tr>
<td>Suburb</td>
<td>5386</td>
<td>22.9</td>
</tr>
<tr>
<td>Town</td>
<td>2133</td>
<td>9.1</td>
</tr>
<tr>
<td>Rural</td>
<td>4658</td>
<td>19.8</td>
</tr>
<tr>
<td>Missing/non-response</td>
<td>6348</td>
<td>27.0</td>
</tr>
<tr>
<td><strong>Socioeconomic Status</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1&lt;sup&gt;st&lt;/sup&gt; quintile (lowest)</td>
<td>3434</td>
<td>14.6</td>
</tr>
<tr>
<td>2&lt;sup&gt;nd&lt;/sup&gt; quintile</td>
<td>3705</td>
<td>15.8</td>
</tr>
<tr>
<td>3&lt;sup&gt;rd&lt;/sup&gt; quintile</td>
<td>4233</td>
<td>18.0</td>
</tr>
<tr>
<td>4&lt;sup&gt;th&lt;/sup&gt; quintile</td>
<td>4553</td>
<td>19.4</td>
</tr>
<tr>
<td>5&lt;sup&gt;th&lt;/sup&gt; quintile (highest)</td>
<td>5519</td>
<td>23.5</td>
</tr>
<tr>
<td>Non-response</td>
<td>2059</td>
<td>8.8</td>
</tr>
</tbody>
</table>

**Results**

Descriptive statistics are presented in Table 5 for the variables being used in this study.

These include the maximum and minimum values, mean, and standard deviations.
Table 5

Descriptive Statistics for Study Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Science Identity</td>
<td>23,503</td>
<td>-.7911</td>
<td>2.66</td>
<td>-9.00</td>
<td>2.15</td>
</tr>
<tr>
<td>Science Self-Efficacy</td>
<td>23,503</td>
<td>-1.967</td>
<td>3.46</td>
<td>-9.00</td>
<td>1.83</td>
</tr>
<tr>
<td>Degree’s First Major is STEM</td>
<td>11,560</td>
<td>.23</td>
<td>.421</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Sex</td>
<td>23,497</td>
<td>–</td>
<td>–</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Race/Ethnicity</td>
<td>22,497</td>
<td>–</td>
<td>–</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>Urbanicity</td>
<td>17,155</td>
<td>–</td>
<td>–</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>SES</td>
<td>23,503</td>
<td>–</td>
<td>–</td>
<td>-8.00</td>
<td>2.37</td>
</tr>
</tbody>
</table>

Research Question 1

Research question 1 asked what is the relationship between science identity and science self-efficacy with STEM degree selection from the HSLS:09? To examine this question, correlation analysis was conducted with the independent variables of science self-efficacy and science identity related to the dependent variable of postsecondary STEM degree selection. The results of this correlation analysis are shown in Table 6.

The results shown in Table 6 show that the relationship was positive between science identity and STEM degree selection and was statistically significant ($r=.074, p<.001$). The data also show that the relationship was positive between science self-efficacy and STEM degree selection and was statistically significant ($r=.061, p<.001$). A positive relationship was also observed between science identity and science self-efficacy and was statistically significant ($r=.555, p=.000$).

The results of the relationship between science identity and science self-efficacy with STEM degree selection suggests that science identity and science self-efficacy are positively correlated and that each are positively correlated with a student selecting a STEM degree.
Table 6

*Correlations Between Science Identity & Science Self-Efficacy with STEM Degree Selection*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Science Identity</th>
<th>Science Self-Efficacy</th>
<th>STEM Degree Selection</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Science Identity</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pearson Correlation</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>23503</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Science Self-Efficacy</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pearson Correlation</td>
<td>.555*</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Significance (2-tailed)</td>
<td>.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>23503</td>
<td>23503</td>
<td></td>
</tr>
<tr>
<td><strong>STEM Degree Selection</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pearson Correlation</td>
<td>.074*</td>
<td>.061*</td>
<td>1</td>
</tr>
<tr>
<td>Significance (2-tailed)</td>
<td>&lt;.001</td>
<td>&lt;.001</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>11560</td>
<td>11560</td>
<td>11560</td>
</tr>
</tbody>
</table>

* Correlation is significant at the 0.01 level (2-tailed).

**Research Question 2**

Research question 2 asked, how does the relationship between science identity and science self-efficacy vary by race, gender, SES, and location of school? To examine this question, correlation analysis was conducted with the independent variables of science self-efficacy and science identity related to the dependent variable of postsecondary STEM degree selection then by subgrouping into gender, race/ethnicity, urbanicity, and SES. The results of these correlation analyses by subgroup are shown in Tables 7-10.

The results shown in Table 7 show that the relationship was positive between science identity and STEM degree selection for males and was statistically significant \((r=.064, p<.001)\). The data also show that the relationship was positive between science self-efficacy and STEM degree selection for males and was statistically significant \((r=.053, p<.001)\). The relationship was also positive between science identity and STEM degree selection for females and was statistically significant \((r=.077, p<.001)\). The data also show that the relationship was positive
between science self-efficacy and STEM degree selection for females and was statistically significant ($r=.064, p<.001$).

The results of the relationship between science identity and science self-efficacy with STEM degree selection suggests that both are positively correlated in males. The results of the relationship between science identity and science self-efficacy with STEM degree selection suggests that science identity and science self-efficacy are positively correlated in females. Science identity and science self-efficacy are also positively correlated with a student selecting a STEM degree for both males and females.

Table 7

*Correlations Between Science Identity & Science Self-Efficacy with STEM Degree Selection Using Gender as a Subgroup*

<table>
<thead>
<tr>
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<th>Science Self-Efficacy</th>
<th>STEM Degree Selection</th>
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<td>.053*</td>
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<td>&lt;.001</td>
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<td>.064*</td>
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<td>&lt;.001</td>
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<tr>
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</table>

* Correlation is significant at the 0.01 level (2-tailed).
The results shown in Table 8 show that the relationship between science identity and STEM degree selection for American Indian/Alaska natives and was not statistically significant ($r=.105, p=.432$). The data also show that the relationship was positive between science self-efficacy and STEM degree selection for American Indian/Alaska natives and was statistically significant ($r=.264, p=.046$). The relationship was positive between science identity and STEM degree selection for Asian, non-Hispanics and was statistically significant ($r=.089, p=.002$). The data also show that the relationship was positive between science self-efficacy and STEM degree selection for Asian, non-Hispanics and was statistically significant ($r=.123, p=<.001$). The relationship was positive between science identity and STEM degree selection for Black/African Americans and was statistically significant ($r=.074, p=.015$). The data also show that the relationship was positive between science self-efficacy and STEM degree selection for Black/African Americans and was statistically significant ($r=.082, p=.007$). The relationship was positive between science identity and STEM degree selection for Hispanics and was statistically significant ($r=.108, p=<.001$). The data also show that the relationship was positive between science self-efficacy and STEM degree selection for Hispanics and was statistically significant ($r=.081, p=.002$). The relationship was positive between science identity and STEM degree selection for White, non-Hispanics and was statistically significant ($r=.122, p=<.001$). The data also show that the relationship was positive between science self-efficacy and STEM degree selection for White, non-Hispanics and was statistically significant ($r=.048, p=<.001$). The results show that the relationship between science identity and STEM degree selection for other races and was not statistically significant ($r=.038, p=.247$). The results show that the relationship between science self-efficacy and STEM degree selection for other races and was not statistically significant ($r=.020, p=.540$).
The results of the relationship between science identity and science self-efficacy with STEM degree selection suggests that science identity and science self-efficacy are positively correlated in Asians, non-Hispanics, Black/African Americans, Hispanics, and White, non-Hispanics. Science identity and science self-efficacy are also positively correlated with a student selecting a STEM degree in Asians, non-Hispanics, Black/African Americans, Hispanics, and White, non-Hispanics. The relationships were not statistically significant in American Indian/Alaska natives using science identity as a measure or using science identity and science self-efficacy as measures in other races.

Table 8

Correlations Between Science Identity & Science Self-Efficacy with STEM Degree Selection
Using Race/Ethnicity as a Subgroup

<table>
<thead>
<tr>
<th>Variable</th>
<th>Science Identity</th>
<th>Science Self-Efficacy</th>
<th>STEM Degree Selection</th>
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<td>&lt;.001</td>
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<td>.264**</td>
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</tr>
<tr>
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Table 8 (continued)

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<td>.081*</td>
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The results shown in Table 9 show that the relationship between science identity and STEM degree selection for students who attended high schools located in cities was positive and was statistically significant ($r=.059$, $p<.001$). The data also show that the relationship was positive between science self-efficacy and STEM degree selection for students who attended high schools located in cities and was statistically significant ($r=.064$, $p<.001$). The relationship was positive between science identity and STEM degree selection for students who attended high schools located in suburbs and was statistically significant ($r=.095$, $p<.001$). The data also show that the relationship was positive between science self-efficacy and STEM degree selection for students who attended high schools located in suburbs and was statistically significant ($r=.054$, $p=.001$). The relationship was positive between science identity and STEM degree selection for students who attended high schools located in towns and was statistically significant ($r=.066$, $p=.017$). The data also show that the relationship was positive between science self-efficacy and STEM degree selection for students who attended high schools located in towns and was statistically significant ($r=.065$, $p=.020$). The relationship was positive between science identity
and STEM degree selection for students who attended high schools located in rural areas and was statistically significant ($r = .074$, $p = <.001$). The data also show that the relationship was positive between science self-efficacy and STEM degree selection for students who attended high schools located in rural areas and was statistically significant ($r = .062$, $p = <.001$).

The results of the relationship between science identity and science self-efficacy with STEM degree selection suggests that science identity and science self-efficacy are positively correlated in students who attended high schools in city, suburb, rural, and town locations. Science identity and science self-efficacy are also positively correlated with a student selecting a STEM degree in students who attended high schools in city, suburb, rural, and town locations.

Table 9

Correlations Between Science Identity & Science Self-Efficacy with STEM Degree Selection Using Urbanicity as a Subgroup

<table>
<thead>
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<th>Science Self-Efficacy</th>
<th>STEM Degree Selection</th>
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</thead>
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<tr>
<td>Pearson Correlation</td>
<td>-.019</td>
<td>.058</td>
<td>1</td>
</tr>
<tr>
<td>Significance (2-tailed)</td>
<td>.863</td>
<td>.603</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>83</td>
<td>83</td>
<td>83</td>
</tr>
</tbody>
</table>

* Correlation is significant at the 0.01 level (2-tailed).
** Correlation is significant at the 0.05 level (2-tailed).
The results shown in Table 10 show that the relationship between science identity and STEM degree selection for students of the 1st quintile (lowest) SES was not statistically significant ($r=.030, p=.316$). The data also show that the relationship between science self-efficacy and STEM degree selection for students of the 1st quintile (lowest) SES was not statistically significant ($r=.014, p=.652$). The data also shows that the relationship between science identity and STEM degree selection for students of the 2nd quintile SES was not statistically significant ($r=.029, p=.255$). The data also show that the relationship between science self-efficacy and STEM degree selection for students of the 2nd quintile SES was not statistically significant ($r=.022, p=.385$). The data also show that the relationship between science identity and STEM degree selection for students of the 3rd quintile SES was not statistically significant ($r=.009, p=.698$). The data also shows that the relationship between science self-efficacy and STEM degree selection for students of the 3rd quintile SES was not statistically significant ($r=.021, p=.373$). The data also show that the relationship between science identity and STEM degree selection for students of the 4th quintile SES was positive and statistically significant ($r=.072, p<.001$). The data also show that the relationship between science self-efficacy and STEM degree selection for students of the 4th quintile SES was not statistically significant ($r=.036, p=.065$). The data also show that the relationship between science identity and STEM degree selection for students of the 5th quintile (highest) SES was positive and statistically significant ($r=.106, p<.001$). The data also show that the relationship between science self-efficacy and STEM degree selection for students of the 5th quintile (highest) SES was positive and statistically significant ($r=.087, p<.001$).

The results of the relationship between science identity and science self-efficacy with STEM degree suggests that science identity and science self-efficacy are positively correlated
within the highest socioeconomic groups (4th and 5th quintiles) and that each of these groups are positively correlated with a student selecting a STEM degree.

Table 10

*Correlations Between Science Identity & Science Self-Efficacy with STEM Degree Selection*

*Using SES as a Subgroup*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Science Identity</th>
<th>Science Self-Efficacy</th>
<th>STEM Degree Selection</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1st Quintile (lowest)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Science Identity</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pearson Correlation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Significance (2-tailed)</td>
<td>.510*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>3297</td>
<td>3297</td>
<td></td>
</tr>
<tr>
<td>Science Self-Efficacy</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pearson Correlation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Significance (2-tailed)</td>
<td>&lt;.001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>3297</td>
<td>3297</td>
<td></td>
</tr>
<tr>
<td>STEM Degree Selection</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pearson Correlation</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Significance (2-tailed)</td>
<td>.316</td>
<td></td>
<td></td>
</tr>
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<td>1092</td>
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<td><strong>2nd Quintile</strong></td>
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</tr>
<tr>
<td>Pearson Correlation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Significance (2-tailed)</td>
<td>.567*</td>
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<td></td>
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<td>N</td>
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</tr>
<tr>
<td>Pearson Correlation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Significance (2-tailed)</td>
<td>.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>3672</td>
<td>3672</td>
<td></td>
</tr>
<tr>
<td>STEM Degree Selection</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pearson Correlation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Significance (2-tailed)</td>
<td>.255</td>
<td></td>
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</tr>
<tr>
<td>N</td>
<td>1539</td>
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<tr>
<td><strong>3rd Quintile</strong></td>
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<td>Science Identity</td>
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</tr>
<tr>
<td>Pearson Correlation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Significance (2-tailed)</td>
<td>.586*</td>
<td></td>
<td></td>
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<td>N</td>
<td>3930</td>
<td>3930</td>
<td>3930</td>
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<td>Science Self-Efficacy</td>
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<tr>
<td>Pearson Correlation</td>
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<td></td>
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</tr>
<tr>
<td>Significance (2-tailed)</td>
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<td>N</td>
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<td>Variable</td>
<td>Science Identity</td>
<td>Science Self-Efficacy</td>
<td>STEM Degree Selection</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>------------------</td>
<td>-----------------------</td>
<td>-----------------------</td>
</tr>
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<td>STEM Degree Selection</td>
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</tr>
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<td>Significance (2-tailed)</td>
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<td>Science Identity</td>
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<td></td>
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<tr>
<td>Pearson Correlation</td>
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<td></td>
</tr>
<tr>
<td>Significance (2-tailed)</td>
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<tr>
<td>Pearson Correlation</td>
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<td></td>
</tr>
<tr>
<td>Significance (2-tailed)</td>
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<td></td>
</tr>
<tr>
<td>N</td>
<td>4546</td>
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<td></td>
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<td>STEM Degree Selection</td>
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<td></td>
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<tr>
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<td>.065</td>
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<tr>
<td>N</td>
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<td>5th Quintile (highest)</td>
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<td></td>
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<tr>
<td>Pearson Correlation</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Significance (2-tailed)</td>
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<tr>
<td>N</td>
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<td>Science Self-Efficacy</td>
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<td></td>
<td></td>
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<tr>
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<tr>
<td>Significance (2-tailed)</td>
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<td></td>
</tr>
<tr>
<td>N</td>
<td>5474</td>
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<td></td>
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<td></td>
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<tr>
<td>Pearson Correlation</td>
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<td>.087*</td>
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<tr>
<td>Significance (2-tailed)</td>
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<td>&lt;.001</td>
<td></td>
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<tr>
<td>N</td>
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<tr>
<td>Non-response</td>
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<tr>
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</tr>
<tr>
<td>Pearson Correlation</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Significance (2-tailed)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>2584</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Science Self-Efficacy</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Pearson Correlation</td>
<td>.367*</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Significance (2-tailed)</td>
<td>&lt;.001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>2584</td>
<td></td>
<td></td>
</tr>
<tr>
<td>STEM Degree Selection</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pearson Correlation</td>
<td>.051</td>
<td>.064</td>
<td>1</td>
</tr>
<tr>
<td>Significance (2-tailed)</td>
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<td>.150</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>500</td>
<td>500</td>
<td>500</td>
</tr>
</tbody>
</table>

* Correlation is significant at the 0.01 level (2-tailed).
Research Question 3

Research question 3 asked, is science self-identity and science self-efficacy predictive of postsecondary STEM degree selection? To examine this question, binary logistic regressions using the inputs of science identity, science self-efficacy, gender, race/ethnicity, urbanicity, and SES as variants to estimate STEM degree selection were conducted. The results of these binary logistic regressions are shown in Tables 11-15.

The results shown in Table 11 show that based on the binary logistic regression analysis that science identity is predictive of STEM degree selection and was statistically significant ($B=.065, \text{Exp}(B)=1.068, p<.001$). The binary regression analysis also show that science self-efficacy is predictive of STEM degree selection and was statistically significant ($B=.021, \text{Exp}(B)=1.021, p=.012$).

The results of the binary logistic regression between science identity and science self-efficacy with STEM degree selection suggests that compared to all other students, one is more likely to select a degree in STEM when having science identity. The results also suggest one is more likely to select a degree in STEM when having science self-efficacy.

Table 11

<table>
<thead>
<tr>
<th></th>
<th>B</th>
<th>S.E.</th>
<th>Wald</th>
<th>df</th>
<th>Sig.</th>
<th>Exp(B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Science Identity</td>
<td>0.065</td>
<td>0.012</td>
<td>29.179</td>
<td>1</td>
<td>&lt;.001</td>
<td>1.068*</td>
</tr>
<tr>
<td>Science Self-Efficacy</td>
<td>0.021</td>
<td>0.008</td>
<td>6.382</td>
<td>1</td>
<td>0.012</td>
<td>1.021*</td>
</tr>
<tr>
<td>Constant</td>
<td>-1.157</td>
<td>0.024</td>
<td>2338.43</td>
<td>1</td>
<td>0</td>
<td>0.315</td>
</tr>
</tbody>
</table>

* Significance at the 0.01 level
The results shown in Table 12 show that based on the binary logistic regression analysis that gender is predictive of STEM degree selection and was statistically significant ($B=0.47$, $Exp(B)=1.6$, $p<.001$).

The results of the binary logistic regression between gender and STEM degree selection suggests that compared to all other students, males are more likely than females to select a degree in STEM.

### Table 12

<table>
<thead>
<tr>
<th>Gender</th>
<th>B</th>
<th>S.E.</th>
<th>Wald</th>
<th>df</th>
<th>Sig.</th>
<th>$Exp(B)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>0.47</td>
<td>0.023</td>
<td>423.884</td>
<td>1</td>
<td>&lt;.001</td>
<td>1.6*</td>
</tr>
<tr>
<td>Constant</td>
<td>-1.223</td>
<td>0.023</td>
<td>2873.66</td>
<td>1</td>
<td>0</td>
<td>0.294</td>
</tr>
</tbody>
</table>

* Significance at the 0.01 level

The results shown in Table 13 show that based on the binary logistic regression analysis that the racial/ethnic identification of Asian, non-Hispanic is predictive of STEM degree selection and was statistically significant ($B=0.895$, $Exp(B)=2.448$, $p<.001$). The binary regression analysis also shows that the racial/ethnic identification of Black/African American is predictive of STEM degree selection and was statistically significant ($B=-0.435$, $Exp(B)=0.647$, $p<.001$). The binary regression analysis shows that the racial/ethnic identifications of American Indian/Alaska Native ($B=-0.236$, $Exp(B)=0.79$, $p=0.38$), Hispanic ($B=-0.154$, $Exp(B)=0.857$, $p=0.079$), and White, non-Hispanic ($B=-0.07$, $Exp(B)=0.932$, $p=0.353$) are all not predictive of STEM degree selection.

The results of the binary logistic regression between race/ethnicity and STEM degree selection suggests that compared to all other students, Asian, non-Hispanics are more likely to
select a degree in STEM. The results also suggest that compared to all other students, Black/African Americans are less likely to select a degree in STEM.

Table 13

*Binary Logistic Regression Analysis of Race/Ethnicity with STEM Degree Selection*

<table>
<thead>
<tr>
<th></th>
<th>B</th>
<th>S.E.</th>
<th>Wald</th>
<th>df</th>
<th>Sig.</th>
<th>Exp(B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>American Indian/Alaska Native</td>
<td>-0.236</td>
<td>0.269</td>
<td>0.768</td>
<td>1</td>
<td>0.381</td>
<td>0.79</td>
</tr>
<tr>
<td>Asian, non-Hispanic</td>
<td>0.895</td>
<td>0.085</td>
<td>111.814</td>
<td>1</td>
<td>&lt;.001</td>
<td>2.448*</td>
</tr>
<tr>
<td>Black/African American</td>
<td>-0.435</td>
<td>0.096</td>
<td>20.424</td>
<td>1</td>
<td>&lt;.001</td>
<td>0.647*</td>
</tr>
<tr>
<td>Hispanic</td>
<td>-0.154</td>
<td>0.088</td>
<td>3.085</td>
<td>1</td>
<td>0.079</td>
<td>0.857</td>
</tr>
<tr>
<td>White, non-Hispanic</td>
<td>-0.070</td>
<td>0.075</td>
<td>0.864</td>
<td>1</td>
<td>0.353</td>
<td>0.932</td>
</tr>
<tr>
<td>Constant</td>
<td>-1.216</td>
<td>0.071</td>
<td>289.467</td>
<td>1</td>
<td>&lt;.001</td>
<td>0.296*</td>
</tr>
</tbody>
</table>

* Significance at the 0.01 level

The results shown in Table 14 show that based on the binary logistic regression analysis that attending high school in a city location ($B=.063$, $Exp(B)=1.065$, $p=.09$), attending high school in a suburb location ($B=.083$, $Exp(B)=1.086$, $p=.024$), attending high school in a town location ($B=-.054$, $Exp(B)=.947$, $p=.312$), and attending a high school in a rural location ($B=-.092$, $Exp(B)=.912$, $p=.021$) are all not predictive of STEM degree selection.

Table 14

*Binary Logistic Regression Analysis of Urbanicity with STEM Degree Selection*

<table>
<thead>
<tr>
<th></th>
<th>B</th>
<th>S.E.</th>
<th>Wald</th>
<th>df</th>
<th>Sig.</th>
<th>Exp(B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>City</td>
<td>0.063</td>
<td>0.037</td>
<td>2.88</td>
<td>1</td>
<td>0.09</td>
<td>1.065</td>
</tr>
<tr>
<td>Suburb</td>
<td>0.083</td>
<td>0.037</td>
<td>5.129</td>
<td>1</td>
<td>0.024</td>
<td>1.086</td>
</tr>
<tr>
<td>Town</td>
<td>-0.054</td>
<td>0.054</td>
<td>1.02</td>
<td>1</td>
<td>0.312</td>
<td>0.947</td>
</tr>
<tr>
<td>Rural</td>
<td>-0.092</td>
<td>0.04</td>
<td>5.326</td>
<td>1</td>
<td>0.021</td>
<td>0.912</td>
</tr>
<tr>
<td>Constant</td>
<td>-1.226</td>
<td>0.024</td>
<td>2507.28</td>
<td>1</td>
<td>0</td>
<td>0.294</td>
</tr>
</tbody>
</table>

* Significance at the 0.01 level
The results shown in Table 15 show that based on the binary logistic regression analysis that the 1st quintile (lowest) SES ($B=-.196, \exp(B)=.822, p=.003$), the 2nd quintile of SES ($B=-.193, \exp(B)=.825, p=<.001$), the 3rd quintile of SES ($B=-.146, \exp(B)=.864, p=.006$), and the 5th quintile (highest) of SES ($B=.432, \exp(B)=1.541, p=<.001$) are all predictive of STEM degree selection. The results show that the 4th quintile SES ($B=.103, \exp(B)=1.108, p=.023$) is not predictive of STEM degree selection.

The results of the binary logistic regression between SES and STEM degree selection suggests that compared to all other students, being in the 5th quintile (highest) SES are more likely to select a degree in STEM. The results also suggest that compared to all other students, being in the 1st quintile (lowest), 2nd quintile, and 3rd quintile SES are all less likely to select a degree in STEM.

Table 15

<table>
<thead>
<tr>
<th>SES Quintile</th>
<th>B</th>
<th>S.E.</th>
<th>Wald</th>
<th>df</th>
<th>Sig.</th>
<th>Exp(B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st Quintile (lowest)</td>
<td>-0.196</td>
<td>0.067</td>
<td>8.664</td>
<td>1</td>
<td>0.003</td>
<td>0.822*</td>
</tr>
<tr>
<td>2nd Quintile</td>
<td>-0.193</td>
<td>0.058</td>
<td>11.091</td>
<td>1</td>
<td>&lt;.001</td>
<td>0.825*</td>
</tr>
<tr>
<td>3rd Quintile</td>
<td>-0.146</td>
<td>0.053</td>
<td>7.545</td>
<td>1</td>
<td>0.006</td>
<td>0.864*</td>
</tr>
<tr>
<td>4th Quintile</td>
<td>0.103</td>
<td>0.045</td>
<td>5.203</td>
<td>1</td>
<td>0.023</td>
<td>1.108</td>
</tr>
<tr>
<td>5th Quintile (highest)</td>
<td>0.432</td>
<td>0.038</td>
<td>130.515</td>
<td>1</td>
<td>&lt;.001</td>
<td>1.541*</td>
</tr>
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<td>0.027</td>
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<td>1</td>
<td>0</td>
<td>0.266</td>
</tr>
</tbody>
</table>

* Significance at the 0.01 level

Summary of Results

Chapter IV presented an overview of the results, description of the sample, and results from each research question. The sample description included frequencies and percentages of the demographics of the respondents used in this study, including gender, race/ethnicity, urbanicity,
and SES. Descriptive statistics were also presented for science identity, science self-efficacy, degree’s first major was STEM, gender, race/ethnicity, urbanicity, and SES that were used in the analysis.

This study is an extension of the HSLS:09, consisting of a stratified random sample of 21,444 participants from 944 public and private high schools during the fall 2009 academic year. HSLS is representative of the 50 United States and the District of Columbia (Ingels et al., 2011). Data were collected using a stratified, 2-stage random sample design with participants throughout the United States representing multiple races, ethnicities, genders, SES, and location of schools. This quantitative study used a correlational research design to determine if a relationship exists between individual student science identity, science self-efficacy, and postsecondary STEM degree selection and once the data was identified it was analyzed using IBM SPSS version 28.0.

The results of the relationship between science identity and science self-efficacy with STEM degree selection suggests that science identity and science self-efficacy are positively correlated and that each are positively correlated with a student selecting a STEM degree. This was further examined by subgroups of gender, race/ethnicity, urbanicity, and SES and how these correlated with STEM degree selection. The results of the relationship between science identity and science self-efficacy with STEM degree selection among the gender subgroups male and female; within the race/ethnicity subgroups Asian, non-Hispanics, Black/African Americans, Hispanics, and White, non-Hispanics; within the urbanicity subgroups city, suburb, town, and rural; and within the highest socioeconomic subgroups suggests that science identity and science self-efficacy are positively correlated and that each are positively correlated with a student selecting a STEM degree.
The results of the binary logistic regression between science identity and science self-efficacy with STEM degree selection suggests that compared to all other students, one is more likely to select a degree in STEM when having science identity and/or science self-efficacy. To further examine factors that can be predictive of STEM degree selection, this study showed that compared to all other students, males are more likely to select a degree in STEM while females are less likely to select a degree in STEM. With race/ethnicity and STEM degree selection, the analysis suggests compared to all other students, that Asian, non-Hispanics are more likely to select a degree in STEM, while Black/African Americans are less likely to select a degree in STEM. Using urbanicity as a predictor of STEM degree, the analysis shows that they are not predictive of STEM degree selection. Finally, the results of the binary logistic regression between SES and STEM degree selection suggests compared to all other students, that being in the 5th quintile (highest) SES are more likely to select a degree in STEM, while being in the 1st quintile (lowest), 2nd quintile, and 3rd quintile SES are all less likely to select a degree in STEM. Further discussions and conclusions of these results will be included in Chapter V with implications and recommendations for policy, practice, and future research.
CHAPTER V
SUMMARY, DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS

Overview

Chapter V is a summation of this research study to determine if correlations exist between science identity and science self-efficacy in selection of a STEM degree and if they are predictive of STEM degree selection. The chapter begins with a summary of the results organized by findings from each research question, along with discussion of the findings in relation to reviewed literature, including conclusions. The limitations of the study will be addressed, and recommendations will be made for practitioners and policymakers as well as for future research.

Summary of Results

The purpose of this study was to examine the extent to which independent variables of science self-efficacy and science identity are related to the dependent variable of postsecondary STEM degree selection, with special attention to how factors like gender, race/ethnicity, urbanicity, and SES relate to how science self-efficacy and science identity contribute to STEM degree selection. This study is an extension of the HSLS:09, consisting of a stratified random sample of 21,444 participants from 944 public and private high schools during the fall 2009 academic year. HSLS is representative of the 50 United States and the District of Columbia (Ingels et al., 2011). Data were collected using a stratified, 2-stage random sample design with participants throughout the United States representing multiple races, ethnicities, genders, SES,
and location of schools. The HSLS:09 study focuses on understanding students’ trajectories from the beginning of high school into higher education and the workforce.

The results of this study suggest the relationship between science identity and science self-efficacy are positively correlated with a student selecting a STEM degree, and further examined by subgroups of gender, race/ethnicity, urbanicity, and SES and how these correlated with STEM degree selection. The results of this study suggest the relationship between science identity and science self-efficacy with STEM degree selection among the gender subgroups male and female; within the race/ethnicity subgroups Asian, non-Hispanics, Black/African Americans, Hispanics, and White, non-Hispanics; within the urbanicity subgroups city, suburb, town, and rural; and within the highest socioeconomic subgroups suggests that science identity and science self-efficacy are positively correlated with a student selecting a STEM degree.

The results of this study suggest that science identity and science self-efficacy along with other factors can be predictive of STEM degree selection and suggests that compared to all other students, one is more likely to select a degree in STEM when having science identity and/or science self-efficacy. To further examine factors that can be predictive of STEM degree selection, this study showed that compared to all other students, males are more likely to select a degree in STEM while females are less likely to select a degree in STEM. With race/ethnicity and STEM degree selection, the analysis suggests compared to all other students, that Asian, non-Hispanics are more likely to select a degree in STEM, while Black/African Americans are less likely to select a degree in STEM. Using urbanicity as a predictor of STEM degree, the analysis shows that they are not predictive of STEM degree selection. Finally, the results of the binary logistic regression between SES and STEM degree selection suggests compared to all other students, that being in the 5th quintile (highest) SES are more likely to select a degree in
STEM, while being in the 1st quintile (lowest), 2nd quintile, and 3rd quintile SES are all less likely to select a degree in STEM.

Discussion of Findings and Conclusions

Research Question 1

Research question 1 asked, what is the relationship between science identity and science self-efficacy with STEM degree selection from the HSLS:09? To examine this question a correlational analysis was conducted and the results of the relationship between science identity and science self-efficacy with STEM degree selection suggests that science identity and science self-efficacy are positively correlated and that each are positively correlated with a student selecting a STEM degree.

A closer look at the results of this correlation analysis show that science identity and science self-efficacy are both significantly related to STEM degree selection and that they both are almost equally positively related to STEM degree selection. These results are consistent with previous literature that states self-efficacy influences the choices individuals make in term of goal choice, the effort expended to reach those goals, and persistence when difficulties arise (Bandura, 1997; Pajares, 2005). One of the earliest indications that a student may be interested in STEM paths are the students’ own self-efficacy for science as well as how they may see themselves in a STEM career as part of their science self-identity (Schlegel et al., 2019). Schlegel et al. (2019) concluded that enhancing curriculum at an early age can foster a development of science self-efficacy and this only enhances the significance of this study and the need to foster these identities and self-efficacies early in a student’s education. Studies concerned with student persistence and success in academic settings indicate that student identity is related to a “sense of fit” with other academics and the academic world (Syed et al., 2011). Several
studies have found that having a science identity provides better prediction of academic performance and persistence than racial or ethnic background on its own (Bonous-Hammarth, 2000; Osborne & Walker, 2006; Hazari et al., 2010). It is also important to note previous literature by Syed et al. (2019) concluded that science identity partially mediated the association between science self-efficacy and commitment to a science career. This pattern of science self-efficacy affecting identity and identity affecting commitment to a career aligns with Lent’s social cognitive model of career choice. That model sees self-efficacy as a necessary precursor to the development of interest in a particular career (Lent & Brown, 1996).

The findings of this study are consistent with the theoretical framework, SCCT by Bandura (1986) and Lent et al. (1994). SCCT is a process by which individuals use personal beliefs in determining their professional career development, as well as other non-personal factors that influence or constrain career choices. Showing a positive correlation between science identity and science self-efficacy align with the theory that a person will align their professional choices with personal beliefs, and in particular science identity and science self-efficacy with STEM degree selection.

Research Question 2

Research question 2 asked, how does the relationship between science identity and science self-efficacy vary by race, gender, SES, and location of school? To examine this question correlational analyses were conducted and the results of the relationship between science identity and science self-efficacy with STEM degree selection among the subgroups of gender; racial/ethnic subgroups Asian, non-Hispanics, Black/African Americans, Hispanics, and White, non-Hispanics; urbanicity subgroups; and the highest socioeconomic groups suggests that
science identity and science self-efficacy are positively correlated and that each are positively correlated with a student selecting a STEM degree.

Factors such as race and gender have previously been examined to determine their influence on the relationship between science self-efficacy, science identity, and STEM career intent (Byars-Winston, 2006; Nauta & Epperson, 2003). Other factors, such as SES and location or urbanicity of a student’s school has been shown to have direct and indirect influences on science interest and STEM career intent (Lent et al., 2008).

**Gender**

The results of this study examining how the relationship between science identity and science self-efficacy with STEM degree selection vary among genders show that science identity and science self-efficacy are both significantly related to STEM degree selection in both males and females, and that both males and females are almost equally positively related to STEM degree selection when they also expressed a science identity and science self-efficacy.

Gwilliam and Betz (2001) found sex differences in both math and science self-efficacy were found with males having higher efficacy in both cases, which is consistent with the findings of this study. While women are gaining strides in the biological sciences, they remain severely underrepresented in other STEM fields and continue to report lower science self-efficacy compared to their male counterparts (Quimby & DeSantis, 2006). The results of this study are consistent with a study by Nauta and Epperson (2003) which tested a version of the SCCT model on 204 high school girls who voluntarily attended science or math-related conferences. The goal of the 4-year longitudinal study was to predict the choice of a STEM college major and STEM self-efficacy and outcome expectations in college. The girls were surveyed prior to and after entering college. The results showed a direct link between ability and self-efficacy. In addition,
the results indicated that college STEM outcome expectations were associated with plans to continue in a STEM field.

**Race/Ethnicity**

The results of this study examining how the relationship between science identity and science self-efficacy with STEM degree selection vary among race/ethnicity show that science identity and science self-efficacy are both significantly related to STEM degree selection in Asians, non-Hispanics, Black/African Americans, Hispanics, and White, non-Hispanics. Science identity and science self-efficacy are also positively related with a student selecting a STEM degree in Asians, non-Hispanics, Black/African Americans, Hispanics, and White, non-Hispanics. All these relationships were almost equal between science identity and science self-efficacy except in the cases of White, non-Hispanics, in this group it was found that science identity showed a much stronger relation than science self-efficacy. Relationships were not found in American Indian/Alaska natives using science identity as a measure or using science identity and science self-efficacy as measures in STEM degree selection.

The findings of this study are consistent with the need to diversify the STEM pipeline and to better understand the concerns and needs of underrepresented minorities, including Black/African Americans and Hispanics, within the sciences. Ethnic minorities state that low confidence or science self-efficacy is one reason for choosing non-STEM majors and careers. Lewis (2003) highlights this lack of confidence in science as one of six factors contributing to the underrepresentation of minorities in STEM fields. Syed et al. in 2019 examined how science self-efficacy was important in better understanding specific ways in which support programs for the STEM disciplines could lead to increased commitment of a student to a career in STEM and encourage STEM degree selection. The main factors supporting underrepresented groups in
STEM according to Syed et al. (2019) was these STEM support activities: research experiences, mentor influence and involvement, community involvement, academic support, and financial support. This is related to the proper development of science self-efficacy and thus encouragement to enter and continue in a STEM degree. Byars-Winston (2006) employed SCCT to examine the relationship between Racial Ideology and self-efficacy, outcome expectations, career interests and perceived career barriers on Black undergraduates and this is consistent with this study for support of the SCCT model in those interests predicted career considerations.

One issue that may also be playing a role in the results of this study was a study of Mexican American middle school students’ goal intentions in math and science by Navarro et al. (2007) which provided partial support for the SCCT model because it showed past performance in math and science and perceived parental support influenced self-efficacy. Self-efficacy predicted expected outcomes, which also correlated with interest and career goals. The difference in this study with Mexican Americans was when comparing to White students. White and Mexican American students showed similar predicted outcomes for science performance and indicated that it had little effect on predicting STEM intention. Furthermore, White student parental support showed slightly lower correlation than that of Mexican American students. These contradicting results suggest background factors may interrelate to sociocognitive factors differently for the Mexican American student population compared to others and may be contributing the differences seen in this study.

Urbanicity

The results of this study examining how the relationship between science identity and science self-efficacy with STEM degree selection vary among location of high school suggests that science identity and science self-efficacy are positively related in students who attended high
schools in city, suburb, rural, and town locations. Science identity and science self-efficacy are also positively related with a student selecting a STEM degree in students who attended high schools in city, suburb, rural, and town locations. All these relationships were almost equal between science identity and science self-efficacy with STEM degree selection.

The findings of this study are consistent with a study by Unfried and Faber (2014) that specifically looked at student interest in STEM careers and the effects of urbanicity and moreover the results of that study that relate to other predictors of STEM degree selection. The results of this study showed that while gender and school level may be the most important predictor of STEM interest and career intention, students from groups overrepresented in STEM career pathways in the Urban Initiative study conducted by Unfried and Faber (2014) expressed slightly higher interest in core STEM careers than their counterparts in the Rural Initiative. Interestingly, within the Rural Initiative, underrepresented students had slightly higher core STEM interest than their overrepresented peers in elementary and middle school, and roughly equal scores in high school. This trend was not found in the Urban Initiative. This would suggest that other social factors and demographics may play a more prominent role science self-efficacy and identity in relation to STEM career choice than urbanicity which is consistent with this study in finding very little differences in the groups.

**Socioeconomic Status**

The results of this study examining how relationship between science identity and science self-efficacy with STEM degree vary among SES suggests that science identity and science self-efficacy are positively related within the highest socioeconomic groups (4th and 5th quintiles) and that each of these groups are positively related with a student selecting a STEM degree with the
5th quintile (highest) being about double that of the 4th quintile and considerably higher than those of the 1st quintile (lowest), 2nd quintile, and 3rd quintile.

SES has been shown to have direct and indirect influences on science interest and STEM career intent (Lent et al., 2008). This study is consistent with a study by Niu (2017) which examined patterns of choice of STEM majors in college by students from different family socioeconomic (SES) backgrounds. Results from that study show that low-SES students are disadvantaged in the pursuit of STEM majors, this can include availability of educational resources, career guidance pathways, and lower family involvement in educational pursuits. Higher family SES compensates for negative predictors of STEM enrollment, such as gender and race, and strengthens the effect of positive predictors, such as math and science preparation. The gender and racial gaps in STEM enrollment narrow for students from higher SES families, and the positive correlation between math and science preparation and STEM enrollment strengthens with the increase of family SES, except for lowest SES students.

The findings of this study are also consistent with a previous study from Saw et al. (2018) which indicated that female, Black, Hispanic, and low SES students were less likely to show, maintain, and develop an interest in STEM careers during high school years. Compared with White males from higher SES background, females from all racial/ethnic and SES groups, as well as Black and Hispanic males from lower SES groups, consistently had lower rates of interest, persistence, and developing an interest in STEM fields.

A study by Shapiro et al. (2017) concludes that transfer rates may be the reason for higher SES students not remaining in community colleges and obtaining these much-needed STEM jobs. Higher SES students tend to start at community colleges at a similar rate as lower SES students but transfer to 4-year institutions at a higher rate and may be obtaining more
general degrees in STEM and that the bulk of the employment needed in STEM could better be fulfilled by those with degrees from technical or community colleges.

**Research Question 3**

Research question 3 asked is science self-identity and science self-efficacy predictive of postsecondary STEM degree selection? To examine this, logistic regressions were conducted and the results of the binary logistic regression between science identity and science self-efficacy with STEM degree selection suggests that one is more likely to select a degree in STEM when having science identity and/or science self-efficacy. Further examination of predictive measures of STEM degree were obtained in this study.

**Gender**

Using gender as a predictive measure of STEM degree selection with science identity and science self-efficacy shows that compared to females, males are more likely to select a degree in STEM.

The findings of this study are consistent with findings seen in gender differences within the STEM fields examined by Cheryan et al. (2017) which examined the belief that people in STEM have masculine traits and interests. The study concluded that student’s stereotypes about the proportion of men in the STEM field and the perception of needing or having more masculine traits and interests correspond with the gender disparities seen in STEM. This study also seems to provide support to how influence of gender on the ideas of how important science courses are to science self-efficacy and identity have been observed by several studies which indicate elementary, middle, and high school girls typically rate science and mathematics as more important subjects for them than boys do (Else-Quest et al., 2013; Selkirk et al., 2011; and
High school girls report valuing science more highly than boys across racial groups (i.e., African American, Latino, Asian American, and White) (Else-Quest et al., 2013). If this is true that girls value these courses more than boys, then it may also represent that this is less of the reason that we see the gender gap and that other factors contribute to this disparity.

**Race/Ethnicity**

With race/ethnicity and STEM degree selection, the analysis suggests that compared to all other races Asian, non-Hispanics are more likely to select a degree in STEM, while compared to all other races Black/African Americans are less likely to select a degree in STEM. All other race/ethnicities studied do not show a predictive measure with STEM degree selection.

The role of race and ethnicity have direct influence on career choice because they may influence how and what kind of access one may have to STEM education, science experiences, and STEM career information. Underrepresented minorities may experience uncertainty about how well they fit in the academic environment (Estrada et al., 2016; Syed et al., 2011). This study is consistent with a study by Byars-Winston (2006) which employed SCCT to examine the relationship between Racial Ideology and self-efficacy, outcome expectations, career interests and perceived career barriers on Black undergraduates. The theory proposes four racial ideologies (nationalist, assimilationist, humanist, and oppressed minority) that represent how Black people should act. The results showed support for two (nationalist and assimilationist) of the four racial ideologies in predicting the assessed sociocognitive variables, and since most Black students align with the oppressed minority, they may not develop or think they can pursue a career in STEM. The study also showed support for the SCCT model in those interests predicted career considerations.
**Urbanicity**

Using urbanicity as a predictor of STEM degree, the analysis shows that they are not predictive of STEM degree selection. Location or urbanicity of a student’s school has been shown to have direct and indirect influences on science interest and STEM career intent (Lent et al., 2008).

The findings of this study are consistent with a study by Holian and Kelly (2020) which examined urbanicity effects on STEM career intentions and found a lower percentage of STEM intention designated students (17 %) attended rural schools compared to non-STEM intention designated students (23 %) and STEM students who left the degree trajectory (26 %). And like in this study, there were not statistically significant differences in rates of STEM intention designated students or other occupational intention categories in schools classified as city, suburb, or town.

**Socioeconomic Status**

The results of this study examining SES as a predictive measure of STEM degree selection suggests that compared to all other students, being in the 5th quintile (highest) SES are more likely to select a degree in STEM. The results also suggest that compared to all other students, being in the 1st quintile (lowest), 2nd quintile, and 3rd quintile SES are all less likely to select a degree in STEM.

The findings of this study are consistent with a study from Shaw and Barbuti (2010) which found SES played a role in the percentage of students who persisted in a STEM trajectory and those who switched degree paths. The study showed a higher SES had about a 5% lower likelihood of switching from a STEM career intention. It also showed that higher SES had about a 5% higher likelihood of persisting in a STEM career intention.
Limitations

This research is limited by several factors that were not addressed in the HSLS:09 study questionaries and by additional considerations that would have benefited the questions of this research. This research was limited by the following:

- Data were collected only from students entering their 9th grade year of education;
- Science self-efficacy was not measured over time;
- No measures of what is happening in the classroom, such as strategies to enhance science teaching were collected;
- Data lack a measure of the effectiveness of school related and extracurricular science activities and how they may influence science identity and science self-efficacy;
- Some measures are based on test performance, which may not always be an accurate measure of science identity and science self-efficacy;
- Survey contained non-responses and missing responses for some data points.

Recommendations for Practitioners and Policymakers

Several implications arose from this study for practitioners and policymakers. This research contributes to the existing related research on student’s self-examination on their career trajectories and importantly on science identity and self-efficacy on STEM degree selection. This research provides practitioners and policymakers more knowledge in making future decisions regarding the need to increase STEM enrollment to meet the needs of the current workforce. Science identity and self-efficacy are very useful constructs that can be used to further examine STEM career intent. Based on this study’s findings, community college practitioners and policymakers should seek ways to help foster student science identity and self-efficacy. The
positive correlation between science identity and science self-efficacy aligns with social-cognitive career choice theory in that a person will align their professional choices with personal beliefs. This study confirms the correlation between science identity and science self-efficacy with STEM degree selection. Recommendations for increasing STEM degree selection include the following

- Community colleges can work to incorporate opportunities for students to engage in scientific research to improve interest in STEM and STEM career intent (Committee on Underrepresented Groups and the Expansion of the Science and Engineering Workforce Pipeline, 2011). Summer enrichment programs and undergraduate research experiences offer a chance to do this (Vanleuvan, 2004).

- Another means to expand the development of STEM interest is to initiate summer bridge programs. The University of Akron found that 86% of the summer bridge program participants went on to choose STEM careers (Zhe et al., 2010). Community colleges are well equipped to offer these types of summer programs.

- This study found that females are less likely to select a degree in STEM when they have science identity and self-efficacy when compared to males which will more likely select a degree in STEM when they have science identity and self-efficacy. Given this fact, it is recommended that practitioners and policymakers expand ways to encourage females with interest in science to consider degrees in STEM. Community colleges should work with high schools to address unconscious bias as noted by Nosek and Smyth (2011), or implicit social cognition, that may affect the STEM gender gap in two ways: (1) causing early STEM influences (e.g., teachers, administrators, parents) to, unintentionally, behave differently toward females than toward males in STEM-related contexts and by (2)
undermining girls’ and women’s interest, feeling of belonging, willingness to persist, and actual achievement in math and science fields. Another program that empowers women in STEM, and to provide hands-on educational camps as well as introducing young women to STEM are WiSTEM (Women in STEM) programs that are open to high school age females and are facilitated by community colleges (Venkat & Kunadharaju, 2021). These programs are often week-long educational intensive workshops where young women are introduced to STEM by other women in the fields, making this a perfect program for community colleges that have the facilities and faculty to offer these opportunities to young women to enhance the science identity and science self-efficacy for high school age females, also being offered in community colleges allow a perfect opportunity to introduce these students to potential STEM degree programs.

- Community colleges should specifically implement measures that control for unconscious bias based on gender stereotyping in educators at early grade levels, and encourage interests in STEM in females with mentoring, career shadowing, and STEM research involvement with female peers at earlier grade levels, Community colleges have additional resources and support services which can encourage and promote this mentoring, including outreach programs to area high schools, summer education programs, and mentoring bridge programs with local universities which provide residential summer bridge programs that recruit students to community colleges from diverse backgrounds (Lenaburg, et al., 2012). These mentoring bridge programs show that increasing a student’s confidence and motivation, along with strong mentoring that continued after the summer program, was the most valuable for success. Community
colleges can use these types of programs to not only increase a student’s science identity and science self-efficacy, but also to increase awareness of STEM degree programs.

- While race/ethnicity has traditionally been a predictor of science self-efficacy and STEM career intent, this study suggests that Black/African Americans are less likely to select a degree in STEM. Based on the findings of this study, it is suggested that practitioners and policymakers seek ways to reduce racial disparity within the STEM degree selection. Many underrepresented minorities have perceptions of inadequate capabilities and/or poor fit and identity that can result in withdrawal from academic programs and opportunities (Hausmann et al., 2007; Lee et al., 2015; Walton & Cohen, 2007). A recommendation would be to implement a research internship, as part of a STEM program, that might provide the opportunity to test one’s ability to learn scientific content and methods. Moreover, the chance to associate with research mentors and other science students might help to overcome doubts about self-efficacy. Another recommendation would be that educators should focus on inclusive learning by highlighting the accomplishments of diverse STEM professionals, to help strengthen science self-efficacy and identity with STEM career intentions.

- Community colleges can work to increase federal funding through programs such as the NSF’s Louis Stokes Alliance for Minority Participation (LSAMP) program. The grant program works to increase science identity and science self-efficacy and the STEM workforce within underrepresented minority communities including Black/African American and Hispanics by pairing students in community colleges with a mentor. The mentor works with the student to help them navigate college, provides mentoring and
networking opportunities with STEM professionals and disciplines, and undergraduate research opportunities (Botanga et al., 2021; Pezold, et al., 2022).

- SES can be a predictor of many issues surrounding a student’s education and well-being. This study shows that the lowest SES to be less likely to select a degree in STEM, while the highest SES is more likely to select a degree in STEM. Practitioners and policymakers should seek ways to identify and foster STEM development that address the needs of the lowest socioeconomic groups. While challenging, implementing early family involvement into a student’s education would not only improve academic success, but may ultimately improve STEM identity. Community colleges can play an important role in the initial development of science identity and science self-efficacy through early outreach and programming. Encouraging STEM careers is an important step that community colleges can take to reach this demographic and help meet the needs of the workforce.

- Although a student’s high school location did not negatively impact a student’s science identity and self-efficacy, it was, however, not predictive of STEM degree selection. This study would recommend that practitioners and policymakers should seek ways to identify differences in urbanicity that could be predictive of STEM degree selection. This study continues to support the idea that rural localities have less interventions and support programs for science career aspirations; it would also suggest that more needs to be done to stimulate STEM aspirations and ultimately STEM career intentions in rural communities. Since many students may attend rural schools, it may be necessary for high schools and community colleges to explore rural STEM education that addresses the issues associated with STEM in rural contexts (Harris & Hodges, 2018). According to
Harris and Hodges (2018), the lack of student interest in STEM from rural areas is due to parental values of STEM, local relevancy, and outreach disparities. Policymakers should consider targeted interventions for schools in rural locales to offer more extracurricular STEM enrichment programs. The programs could focus on addressing STEM in agriculture and biotechnology associated with agriculture, plant, and animal sciences, this could also be in cooperation with community colleges, local industries, and libraries. Community colleges could develop degrees or degree pathways that meet these unique challenges for rural STEM.

- Given this study’s findings, it is recommended the HSLS:09 survey collect data on other background factors within racial/ethnic populations. These could be issues such as family make-up, historical backgrounds, and other family members outside of the immediate family unit that are influencing a student’s development of identity. The HSLS is weighted heavily toward White student respondents and thus the data reflect this overweight for White students. Adding additional questions about racial/ethnic background would enable researchers to investigate disparities seen within the race and ethnicities that may not currently be enabled.

- The study’s findings also point to the need for the HSLS to start earlier where science self-efficacy and identity are forming. This would enable researchers to repeat the longitudinal study, using the same base-year and follow up questionnaires, with middle school students and parent/guardians. This would provide critical data about the times when science identity and science self-efficacy would be forming in a student. The results can be compared to the existing HSLS data to find gaps in this development and areas
where improvement is needed to help practitioners and policymakers in proposing interventions that could lead to stronger STEM career intention.

**Recommendations for Future Research**

As community colleges seek to encourage and maintain more STEM degree candidates, further research is needed on what factors influence students into a STEM career trajectory as well as what factors may influence degree selection. The following recommendations for future research should be considered:

- One gap in the current understanding is at the middle school level, where much of the first STEM exposure and science education occurs. A future direction of this research would be to repeat a similar longitudinal study, like the HSLS and asking the same base-year and follow-up questions, examining science identity and science self-efficacy and their correlation with a student selecting a STEM degree at the middle school level. Identifying when this development begins would be critical in understanding how to mediate these measures. This would fill an important gap in our understanding of the trajectory of science identity and science self-efficacy as well as better align programs to enrich these identities with STEM degree selections to meet the workforce demands.

- Examining changes in science identity and self-efficacy with STEM career intent over time, which may provide more insight into the trajectories involved during the STEM career choice process as well as the development of science identity and self-efficacy. A future direction of this research would be to examine how a student’s science identity and self-efficacy change once they enter postsecondary degree programs, in particular community colleges, with an emphasis on if this is due to extraneous changes or due to changes in a sense of belonging or sense of achievement.
• Examination of teaching practices in the classroom, such as science teaching strategies, which may influence science identity and self-efficacy. A future direction of this research would be to examine how high schools of different locations differ in STEM resources, education, and career resources; it may also be of importance to examine SES in correlation with the high school locations.

• This study conflicts with previous work by Navarro et al. (2007) which suggested that White and Hispanic students showed similar outcomes for science performance and efficacy which had little impact on predicting STEM intention. The findings of this study do not show a correlation with Hispanics science identity or science self-efficacy in predicting STEM degree selection. These contradicting results would suggest that other background factors, such as socio-cognitive factors, may differ in Hispanics compared to other ethnicities that account for this. A possible future study would examine these social factors that influence these differences in differing racial/ethnicities. Finding correlations among these factors and science identity and science self-efficacy would help understand these issues and then to determine how these may be predictive of STEM degree selection.

Conclusion

An important consideration to developing a STEM workforce is to know the factors which incite students to select STEM as a career intention. The science identity and science self-efficacy of an individual are factors which can promote early selection of STEM career intent as well as promote STEM degree selection. A popular explanation for the lack of U.S. students majoring in STEM is that they cannot “see” themselves in STEM or relate to science (Carlone & Johnson, 2007). This lack of a science identity and science self-efficacy affects their interest in
science, and their career choice goals. This study attempted to seek answers to factors that could influence science identity and self-efficacy and ultimately STEM degree selection. Community colleges can play an expanded role in the development of science identity and self-efficacy through collaboration and outreach.
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APPENDIX A

INSTITUTIONAL REVIEW BOARD APPROVAL
EXEMPTION DETERMINATION

The review of your research study referenced above has been completed. The HRPP had made an Exemption Determination as defined by 45 CFR 46.104(d).4. Based on this determination, and in accordance with Federal Regulations, your research does not require further oversight by the HRPP.

Employing best practices for Exempt studies is strongly encouraged such as adherence to the ethical principles articulated in the Belmont Report, found at www.hhs.gov/ohrp/regulations-and-policy/belmont-report/# as well as the MSU HRPP Operations Manual, found at www.orc.msstate.edu/humansubjects. As part of best practices in research, it is the responsibility of the Principal Investigator to ensure that personnel added after this Exemption Determination notice have completed IRB training prior to their involvement in the research study. Additionally, to protect the confidentiality of research participants, we encourage you to destroy private information which can be linked to the identities of individuals as soon as it is reasonable to do so.

Based on this determination, this study has been inactivated in our system. This means that recruitment, enrollment, data collection, and/or data analysis CAN continue, yet personnel and procedural amendments to this study are no longer required. If at any point, however, the risk to participants increases, you must contact the HRPP immediately. If you are unsure if your proposed change would increase the risk, please call the HRPP office and they can guide you.

If this research is for a thesis or dissertation, this notification is your official documentation that the HRPP has made this determination.

If you have any questions relating to the protection of human research participants, please contact the HRPP Office at irb@research.msstate.edu.

We wish you success in carrying out your research project.
APPENDIX B

BASE-YEAR QUESTIONNAIRES
SECTION A: Student Background

What is your sex?
Male
Female

Are you Hispanic or [Latino/Latina]?
Yes
No

* Which of the following are you?
Mexican, Mexican-American, Chicano Cuban
Dominican
Puerto Rican
Central American such as Guatemalan, Salvadoran, Nicaraguan, Costa Rican, Panamanian, or Honduran
South American such as Colombian, Argentine, or Peruvian
Other Hispanic or Latino or Latina

[In addition to learning about your Hispanic background, we would also like to know about your racial background.] Which of the following choices describe your race? You may choose more than one. (Check all that apply.)
White
Black or African American
Asian
Native Hawaiian or other Pacific Islander
American Indian or Alaska Native

* Which one of the following are you?
Chinese
Filipino
Southeast Asian such as Vietnamese or Thai
South Asian such as Indian or Sri Lankan
Other Asian such as Korean or Japanese

What is your birth date?
Month Day Year
1991 or earlier 1992
1993
What was the first language you learned to speak when you were a child? Was it...
English
Spanish
Another language
English and Spanish equally or
English and another language equally?

* What is the [other] language you first learned to speak?
A European language, such as French, German, or Russian
A Chinese language
A Filipino language
A Southeast Asian language such as Vietnamese or Thai
A South Asian language such as Hindi or Tamil
Another Asian language such as Japanese or Korean
A Middle Eastern language such as Arabic or Farsi, or
Another language

* How often do you speak [this language] with your mother or female guardian at home?
Never
Sometimes
About half the time
Most of the time
Always
No mother or female guardian in your household

* How often do you speak [this language] with your friends?
Never
Sometimes
About half the time
Most of the time
Always

SECTION B: Previous School Experiences

What grade were you in last school year (2008-2009)?
7th Grade
8th Grade
9th Grade
You were in an ungraded program

During the last school year (2008-2009), did you attend [current school] or did you attend a different school?
[current school]
Different school
You were homeschooled

* During the last school year (2008-2009), what school did you attend?
   School Name
   City
   State/Foreign County

Since the beginning of the last school year (2008-2009), which of the following activities have you participated in? (Check all that apply.)
Math club
Math competition
Math camp
Math study groups or a program where you were tutored in math
Science club
Science competition
Science camp
Science study groups or a program where you were tutored in science
None of these

Since the beginning of the last school year (2008-2009), how often have you done the following science activities?
Read science books and magazines
Never
Rarely
Sometimes
Often
Accessed web sites for computer technology information
Never
Rarely
Sometimes
Often
Visited a science museum, planetarium or environmental center
Never
Rarely
Sometimes
Often

* What math course did you take in the 8th grade? If you took more than one math course, please choose your most advanced or most difficult course.
Math 8
Advanced or Honors Math 8 not including Algebra
Pre-algebra
Algebra I including IA and IB
Algebra II or Trigonometry
Geometry
Integrated Math
Other advanced math course such as pre-calculus or calculus
Other math

* What was your final grade in this math course?
(If your school uses numerical grades only, please answer in terms of the letter equivalent. If you don't know the equivalent, assume that ...)
90 to 100 is an "A"
80 to 89 is a "B"
70 to 79 is a "C"
60 to 69 is a "D"
Anything less than 60 is "below D")
A
B
C
D
Below D
Your class was not graded

* What science course did you take in the 8th grade? If you took more than one science course, please choose your most advanced or most difficult course.
Science 8
General Science or General Science 8
Biology
Life science
Pre-AP or pre-IB Biology
Chemistry
Earth Science
Environmental Science
Integrated Science
Principles of Technology
Physical Science
Physics
Other science course

* What was your final grade in this science course?
(If your school uses numerical grades only, please answer in terms of the letter equivalent. If you don't know the equivalent, assume that ...)
90 to 100 is an "A"
80 to 89 is a "B"
70 to 79 is a "C"
60 to 69 is a "D"
Anything less than 60 is "below D")
A
B
C
D
Below D
Your class was not graded
SECTION C: Math Experiences

Now we are going to ask you a few questions about your experiences with math.

How much do you agree or disagree with the following statements? You see yourself as a math person
Strongly agree
Agree
Disagree
Strongly disagree
Others see you as a math person
Strongly agree
Agree
Disagree
Strongly disagree

When you are working on a math assignment, how often do you think you really understand the assignment?
Never
Rarely
Sometimes
Often

Are you currently taking a math course this fall? [Were you taking a math course in the fall of 2009?]
Yes
No

* What math course(s) are you currently taking this fall? [What math course(s) were you taking in the fall (2009)?] (Check all that apply.)
Algebra I including IA and IB Geometry
Algebra II
Trigonometry
Review or Remedial Math including Basic, Business, Consumer, Functional or General math
Integrated Math I
Statistics or Probability
Integrated Math II or above
Pre-algebra
Analytic Geometry
Other advanced math course such as pre-calculus or calculus
Other math course

* Why are you taking [fall 2009 math course]? [If late December or later add: If you are no longer taking this course, think back to the fall when you answer this question and the questions that follow.] (Check all that apply.)
You really enjoy math
You like to be challenged
You had no choice, it is a school requirement
The school counselor suggested you take it
Your parent(s) encouraged you to take it
A teacher encouraged you to take it
There were no other math courses offered
You will need it to get into college
You will need it to succeed in college
You will need it for your career
It was assigned to you
Some other reason
You don’t know why you are taking this course

* How much do you agree or disagree with the following statements about your [fall 2009 math course]?* You are enjoying this class very much
Strongly agree
Agree
Disagree
Strongly disagree
You think this class is a waste of your time
Strongly agree
Agree
Disagree
Strongly disagree
You think this class is boring
Strongly agree
Agree
Disagree
Strongly disagree

* How much do you agree or disagree with the following statements about the usefulness of your [fall 2009 math] course? What students learn in this course... is useful for everyday life. Strongly agree
Agree
Disagree
Strongly disagree
will be useful for college.
Strongly agree
Agree
Disagree
Strongly disagree
will be useful for a future career.
Strongly agree
Agree
Disagree
Strongly disagree
* How much do you agree or disagree with the following statements about your [fall 2009 math] course?
You are confident that you can do an excellent job on tests in this course
Strongly agree
Agree
Disagree
Strongly disagree
You are certain that you can understand the most difficult material presented in the textbook used in this course
Strongly agree
Agree
Disagree
Strongly disagree
You are certain that you can master the skills being taught in this course Strongly agree
Agree
Disagree
Strongly disagree
You are confident that you can do an excellent job on assignments in this course
Strongly agree
Agree
Disagree
Strongly disagree

* How much do you agree or disagree with the following statements about [your math teacher]?
Remember, none of your teachers or your principal will see any of the answers you provide.
Your math teacher...
values and listens to students' ideas.
Strongly agree
Agree
Disagree
Strongly disagree
treats students with respect.
Strongly agree
Agree
Disagree
Strongly disagree
treats every student fairly.
Strongly agree
Agree
Disagree
Strongly disagree
thinks every student can be successful.
Strongly agree
Agree
Disagree
Strongly disagree
thinks mistakes are okay as long as all students learn.
Strongly agree
Agree
Disagree
Strongly disagree
treats some kids better than other kids.
Strongly agree
Agree
Disagree
Strongly disagree
makes math interesting.
Strongly agree
Agree
Disagree
Strongly disagree
treats males and females differently.
Strongly agree
Agree
Disagree
Strongly disagree
makes math easy to understand.
Strongly agree
Agree
Disagree
Strongly disagree

SECTION D: Science Experiences

Now we are going to ask you a few questions about your experiences with science.

How much do you agree or disagree with the following statements? You see yourself as a science person
Strongly agree
Agree
Disagree
Strongly disagree
Others see you as a science person
Strongly agree
Agree
Disagree
Strongly disagree

When you are working on a science assignment, how often do you think you really understand the assignment?
Never
Rarely
Sometimes
Often

Are you currently taking a science course this fall?
[Were you taking a science course in the fall of 2009?]
Yes
No

* What science course(s) are you currently taking this fall?
[What science course(s) were you taking in the fall (2009)?]
(Check all that apply.)
Biology I
Earth Science
Physical Science
Environmental Science
Physics I
Integrated Science I
Chemistry I
Integrated Science II or above
Anatomy or Physiology
Advanced Biology such as Biology II, AP, or IB
Advanced Chemistry such as Chemistry II, AP, or IB
General Science
Principles of Technology
Life Science
Advanced Physics such as Physics II, AP or IB
Other earth or environmental sciences such as ecology, geology, oceanography, or meteorology
Other biological sciences such as botany, marine biology, or zoology
Other physical sciences such as astronomy or electronics
Other science course

* Why are you taking [fall 2009 science course]?
[If late December or later add: If you are no longer taking this course, think back to the fall when you answer this question and the questions that follow.]
(Check all that apply.)
You really enjoy science
You like to be challenged
You had no choice, it is a school requirement
The school counselor suggested you take it
Your parent(s) encouraged you to take it
A teacher encouraged you to take it
There were no other science courses offered
You will need it to get into college
You will need it to succeed in college
You will need it for your career
It was assigned to you
Some other reason
You don’t know why you are taking this course

* How much do you agree or disagree with the following statements about your [fall 2009 science] course?
You are enjoying this class very much
Strongly agree
Agree
Disagree
Strongly disagree
You think this class is a waste of your time
Strongly agree
Agree
Disagree
Strongly disagree
You think this class is boring
Strongly agree
Agree
Disagree
Strongly disagree

* How much do you agree or disagree with the following statements about the usefulness of your [fall 2009 science] course? What students learn in this course...
is useful for everyday life.
Strongly agree
Agree
Disagree
Strongly disagree
will be useful for college.
Strongly agree
Agree
Disagree
Strongly disagree
will be useful for a future career.
Strongly agree
Agree
Disagree
Strongly disagree

* How much do you agree or disagree with the following statements about your [fall 2009 science] course?
You are confident that you can do an excellent job on tests in this course
Strongly agree
Agree
Disagree
Strongly disagree
You are certain you can understand the most difficult material presented in the textbook used in this course
Strongly agree
Agree
Disagree
Strongly disagree
You are certain you can master the skills being taught in this course
Strongly agree
Agree
Disagree
Strongly disagree
You are confident that you can do an excellent job on assignments in this course
Strongly agree
Agree
Disagree
Strongly disagree

* How much do you agree or disagree with the following statements about [your science teacher]? Remember, none of your teachers or your principal will see any of the answers you provide. Your science teacher...
values and listens to students’ ideas.
Strongly agree
Agree
Disagree
Strongly disagree
treats students with respect.
Strongly agree
Agree
Disagree
Strongly disagree
treats every student fairly.
Strongly agree
Agree
Disagree
Strongly disagree
thinks every student can be successful.
Strongly agree
Agree
Disagree
Strongly disagree
thinks mistakes are okay as long as all students learn.
Strongly agree
Agree
Disagree
Strongly disagree
treats some kids better than other kids.
Strongly agree
Agree
Disagree
Strongly disagree
makes science interesting.
Strongly agree
Agree
Disagree
Strongly disagree
treats males and females differently.
<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>makes science easy to understand.</td>
<td>Strongly agree</td>
<td>Agree</td>
<td>Disagree</td>
</tr>
</tbody>
</table>

SECTION E: Home and School

Now we are going to ask you a few questions about your experiences at home and in school.

How much do you agree or disagree with the following statements about your current school?

- **You feel safe at this school**
  - Strongly agree
  - Agree
  - Disagree
  - Strongly disagree

- **You feel proud being part of this school**
  - Strongly agree
  - Agree
  - Disagree
  - Strongly disagree

- **There are always teachers or other adults in your school that you can talk to if you have a problem**
  - Strongly agree
  - Agree
  - Disagree
  - Strongly disagree

- **School is often a waste of time**
  - Strongly agree
  - Agree
  - Disagree
  - Strongly disagree

- **Getting good grades in school is important to you**
  - Strongly agree
  - Agree
  - Disagree
  - Strongly disagree

How often do you...

- go to class without your homework done?
  - Never
  - Rarely
  - Sometimes
  - Often

- go to class without pencil or paper?

---
Never
Rarely
Sometimes
Often
go to class without books?
Never
Rarely
Sometimes
Often
go to class late?
Never
Rarely
Sometimes
Often

Not including lunch or study periods, what is your favorite school subject?
English
Foreign Language
Science
Art
Music
Mathematics
Physical Education or Gym
Religion
Health Education
Computer Education or Computer Science
Social Studies, History, Government, or Civics
Career preparation class such as health professions, business, or culinary arts
Other

Not including lunch or study periods, what is your least favorite school subject?
English
Foreign Language
Science
Art
Music
Mathematics
Physical Education or Gym
Religion
Health Education
Computer Education or Computer Science
Social Studies, History, Government, or Civics
Career preparation class such as health professions, business, or culinary arts
Other

How much do you agree or disagree with the following statements?
Studying in school rarely pays off later with good jobs
Strongly agree
Agree
Disagree
Strongly disagree
Even if you study, you will not be able to get into college
Strongly agree
Agree
Disagree
Strongly disagree
Even if you study, your family cannot afford to pay for you to attend college
Strongly agree
Agree
Disagree
Strongly disagree
Working is more important for you than attending college
Strongly agree
Agree
Disagree
Strongly disagree

Since the beginning of the last school year (2008-2009), which of the following people have you talked with about which math courses to take this year? (Check all that apply.)
Your mother or female guardian
Your father or male guardian
Your friends
A favorite teacher
A school counselor
None of these people

Since the beginning of the last school year (2008-2009), which of the following people have you talked with about which science courses to take this year? (Check all that apply.)
Your mother or female guardian
Your father or male guardian
Your friends
A favorite teacher
A school counselor
None of these people

Since the beginning of the last school year (2008-2009), which of the following people have you talked with about which courses to take this year other than math and science courses? (Check all that apply.)
Your mother or female guardian
Your father or male guardian
Your friends
A favorite teacher
A school counselor
None of these people
Since the beginning of the last school year (2008-2009), which of the following people have you talked with about going to college?
(Check all that apply.)
Your mother or female guardian
Your father or male guardian
Your friends
A favorite teacher
A school counselor
None of these people

Since the beginning of the last school year (2008-2009), which of the following people have you talked with about possible jobs or careers when you are an adult?
(Check all that apply.)
Your mother or female guardian
Your father or male guardian
Your friends
A favorite teacher
A school counselor
None of these people

Since the beginning of the last school year (2008-2009), which of the following people have you talked with about personal problems?
(Check all that apply.)
Your mother or female guardian
Your father or male guardian
Your friends
A favorite teacher
A school counselor
None of these people

As far as you know, are the following statements true or false for your closest friend? Your closest friend...
gets good grades.
True
False
is interested in school.
True
False
attends classes regularly.
True
False
plans to go to college.
True
False

How much do you agree or disagree with each of the following statements?
If you spend a lot of time and effort in your math and science classes...
you won’t have enough time for hanging out with your friends.
Strongly agree
Agree
Disagree
Strongly disagree
you won’t have enough time for extracurricular activities.
Strongly agree
Agree
Disagree
Strongly disagree
you won’t be popular.
Strongly agree
Agree
Disagree
Strongly disagree
people will make fun of you.
Strongly agree
Agree
Disagree

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

English or language arts
Females are much better
Females are somewhat better
Females and males are the same
Males are somewhat better
Males are much better

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

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

During a typical weekday during the school year how many hours do you spend...
working on math homework and studying for math class?
Less than 1 hour
1 to 2 hours
2 to 3 hours
3 to 4 hours
4 to 5 hours
5 or more hours

working on science homework and studying for science class?
Less than 1 hour
1 to 2 hours
2 to 3 hours
3 to 4 hours
4 to 5 hours
5 or more hours
working on homework and studying for the rest of your classes?
Less than 1 hour
1 to 2 hours
2 to 3 hours
3 to 4 hours
4 to 5 hours
5 or more hours
participating in extracurricular activities such as sports teams, clubs, band, student government?
Less than 1 hour
1 to 2 hours
2 to 3 hours
3 to 4 hours
4 to 5 hours
5 or more hours
working for pay not including chores or jobs you do around your house?
Less than 1 hour
1 to 2 hours
2 to 3 hours
3 to 4 hours
4 to 5 hours
5 or more hours
spending time with your family?
Less than 1 hour
1 to 2 hours
2 to 3 hours
3 to 4 hours
4 to 5 hours
5 or more hours
hanging out or socializing with your friends?
Less than 1 hour
1 to 2 hours
2 to 3 hours
3 to 4 hours
4 to 5 hours
5 or more hours
watching television or movies?
Less than 1 hour
1 to 2 hours
2 to 3 hours
3 to 4 hours
4 to 5 hours
5 or more hours playing video games?
Less than 1 hour
1 to 2 hours
Are you participating in any of the following programs?

- Talent Search
  - Yes
  - No
- Upward Bound
  - Yes
  - No
- Gear Up
  - Yes
  - No
- AVID (Advancement in Individual Determination)
  - Yes
  - No
- MESA (Mathematics, Engineering, Science Achievement)
  - Yes
  - No

SECTION F: Plans for Postsecondary Education

Now we are going to ask you a few questions about your plans for school and college as you progress through high school.

Including this year, how many years of math do you expect to take during high school?

- One year
- Two years
- Three years
- Four or more years

* What are the reasons you plan to take more math courses during high school? (Check all that apply.)
  - Taking more math courses is required to graduate
  - Your parents will want you to
  - Your teachers will want you to
  - Your school counselor will want you to
  - You are good at math
  - You will need more math courses for the type of career you want
Most students who are like you take a lot of math courses
You enjoy studying math
Taking more math courses will be useful for getting into college
Taking more math courses will be useful in college
Your friends are going to take more math courses
Some other reason
You don’t know why, you just probably will

* Do you plan to enroll in...
an Advanced Placement (AP) calculus course?
   Yes
   No
   You haven't decided yet
   You don't know what this is
an International Baccalaureate (IB) calculus course?
   Yes
   No
   You haven't decided yet
   You don't know what this is

Including this year, how many years of science do you expect to take during high school?
One year
Two years
Three years
Four or more years

* What are the reasons you plan to take more science courses during high school? (Check all that apply.)
   Taking more science courses is required to graduate
   Your parents will want you to
   Your teachers will want you to
   Your school counselor will want you to
   You are good at science
   You will need more science courses for the type of career you want
   Most students who are like you take a lot of science courses
   You enjoy studying science
   Taking more science courses will be useful for getting into college
   Taking more science courses will be useful in college
   Your friends are going to take more science courses
   Some other reason
   You don’t know why, you just probably will

* Do you plan to enroll in...
an Advanced Placement (AP) science course?
   Yes
   No
   You haven't decided yet
   You don't know what this is
an International Baccalaureate (IB) science course?
An "education plan" or a "career plan" is a series of activities and courses that you will need to complete in order to get into college or be successful in your future career. Have you put together...
a combined education and career plan
an education plan only
a career plan only or
none of these?

* Who helped you put your [education and career/education/career] plan together? (Check all that apply.)
  A counselor
  A teacher
  Your parents
  Someone else
  No one

Have you taken or are you planning to take...
the PSAT?
No
Yes
You haven't decided yet
You don't know what this is
the SAT?
No
Yes
You haven't decided yet
You don't know what this is
American College Testing Service (ACT) test?
No
Yes
You haven't decided yet
You don't know what this is
an Advanced Placement (AP) test?
No
Yes
You haven't decided yet
You don't know what this is
a test for the International Baccalaureate (IB)?
No
Yes
You haven't decided yet
You don't know what this is
How sure are you that you will graduate from high school?
Very sure you'll graduate
You'll probably graduate
You probably won't graduate
Very sure you won't graduate

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

SECTION G: Life After High School
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

Now we are going to ask you a few questions about your future life after high school.
We understand that you may not have thought a lot about some of these questions or you may not have all of the information right now. If you are unsure about how to answer a question, please make your best guess. Your thoughts are very important to us.

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

As things stand now, how far in school do you think you will get?
Less than high school
High school diploma or GED
Start but not complete an Associate's degree
Complete an Associate's degree
Start but not complete a Bachelor's degree
Complete a Bachelor's degree
Start but not complete a Master's degree
Complete a Master's degree
Start but not complete a Ph.D., M.D., law degree, or other high level professional degree
Complete a Ph.D., M.D., law degree, or other high level professional degree
Don't know

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

* How sure are you that you will go on to college to pursue a Bachelor's degree after you leave high school?
Very sure you'll go
You'll probably go
You probably won't go
Very sure you won't go

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

Whatever your plans, do you think you have the ability to complete a Bachelor's degree?
Definitely
Probably
Probably not
Definitely not

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

Would you be disappointed if you did not graduate from college with a Bachelor's degree by the time you are 30 years old?
Yes
No

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

What do you plan to do during your first year after high school?
(check all that apply.)
Enroll in an Associate's degree program in a two-year community college or technical institute
Enroll in a Bachelor's degree program in a college or university

131
Obtain a license or certificate in a career field
Attend a registered apprenticeship program
Join the armed services Get a job
Start a family
Travel
Do volunteer or missionary work
Not sure what you want to do

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
* Are you more likely to attend a public or private 4-year college, or have you not thought about this yet?
  Public
  Private
  Haven't thought about this

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
* Are you more likely to attend an in-state or out of state 4-year college, or have you not thought about it yet?
  In-state
  Out of state
  Haven't thought about this

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
* Have you gotten information about the cost of tuition and mandatory fees at a specific [in-state public/out-of-state public/private] college?
  Yes
  No

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
* What is the cost of one year's tuition and mandatory fees at that public 4-year college in your state? Include the cost of courses and required fees such as student activity fees and student health fees. Do not include optional expenses such as room and board.

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
* Is that tuition and mandatory fees only, or does that also include other fees such as room and board?
  Tuition and mandatory fees only
  Tuition, mandatory fees, and other fees

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
* What is the cost of one year's tuition and mandatory fees at that private 4-year college? Include the cost of courses and required fees such as student activity fees and student health fees. Do not include optional expenses such as room and board.

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
* Is that tuition and mandatory fees only, or does that also include other fees such as room and board?
  Tuition and mandatory fees only
  Tuition, mandatory fees, and other fees

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
* What is the cost of one year's tuition and mandatory fees at that out-of-state public 4-year college? Include the cost of courses and required fees such as student activity fees and student health fees. Do not include optional expenses such as room and board.
* Is that tuition and mandatory fees only, or does that also include other fees such as room and board?
- Tuition and mandatory fees only
- Tuition, mandatory fees, and other fees

* What is your best estimate of the cost of one year's tuition and mandatory fees at a public 4-year college in your state?
- Include the cost of courses and required fees such as student activity fees and student health fees. Do not include optional expenses such as room and board.

* Is that tuition and mandatory fees only, or does that also include other fees such as room and board?
- Tuition and mandatory fees only
- Tuition, mandatory fees, and other fees

* How confident are you in the accuracy of your estimate of the cost of one year’s tuition and mandatory fees at a public 4-year college in your state? Are you...
- very confident
- somewhat confident or
- not at all confident?

As things stand now, what is the job or occupation that you expect or plan to have at age 30?
- You don't know
- No
- Yes

* How much have you thought about this choice? Have you thought about it...
- not at all
- a little
- somewhat or
- a lot?

When you talk about your plans for the future, would you say you talk...
- mostly to your parents
- more to your parents than your friends
- to your parents and your friends about the same
- more to your friends than your parents
- mostly to your friends or
- you don't talk to your parents or to your friends about your plans for the future?
Parent/Guardian Base-Year Questionnaire

U.S. Department of Education High School Longitudinal Study of 2009
National Center for Education Statistics OMB No: 1850-0852

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

INTRODUCTION
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* Just to confirm, our records indicate that [your 9th grader] is [male/female]. Is this correct?
Yes
No
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
* What is [your 9th grader]'s sex?
Male
Female
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
SECTION A: Family Structure
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
Now we have some questions about [your 9th grader]'s family.

What is your relationship to [your 9th grader]?
Biological mother
Biological father
Adoptive mother
Adoptive father
Stepmother
Stepfather
Foster mother
Foster father
Female partner of [your 9th grader]'s parent or guardian
Male partner of [your 9th grader]'s parent or guardian
Grandmother
Grandfather
Other female relative
Other male relative
Other female guardian
Other male guardian

* Does [your 9th grader] have biological, adoptive, step- or foster parents who live in your household?
Yes, one parent in household
Yes, two parents in household
No parents in household

* What is this parent’s relationship/are these parents’ relationships to [your 9th grader]?
First Parent:
Biological mother
Biological father
Adoptive mother
Adoptive father
Stepmother
Stepfather
Foster mother
Foster father
Second Parent:
Biological mother
Biological father
Adoptive mother
Adoptive father
Stepmother
Stepfather
Foster mother
Foster father

* Do you have a spouse or partner who lives in the same household as you and [your 9th grader]?
Yes, a spouse
Yes, a partner
No

* What is your [spouse/partner]'s relationship to [your 9th grader]?
Biological mother
Biological father
Adoptive mother
Adoptive father
Stepmother
Stepfather
Foster mother
Foster father
Female partner of 9th grader's parent or guardian
Male partner of 9th grader's parent or guardian
Grandmother
Grandfather
Other female relative
Other male relative
Other female guardian
Other male guardian

* [What is [your/this parent's] current marital status?/What is the marital relationship of these parents?]
Married
Divorced
Separated
Never Married
Widowed
We would like to know how many people live in your household including yourself, [any parents/guardians], and [your 9th-grader]. How many people living in your household are...

18 years of age or older?

How much of the time does [your 9th grader] live with you?

All of the time
More than half of the time
Half of the time
Less than half of the time or
None of the time

* With whom does [he/she/your 9th-grader] live most of the time when not living with you?

With another parent
With another adult relative
With a friend
At boarding school
With a nonrelated adult guardian(s)
By [himself/herself/himself or herself]
Other

Does [your 9th-grader] have any siblings who are currently attending [your 9th-grader's school] or have attended [your 9th-grader's school] within the past 5 years? Please include all brothers and sisters including adopted siblings, stepsiblings, and foster siblings.

Yes
No

How many older siblings does [your 9th grader] have? Please include all older brothers and sisters including adopted siblings, stepsiblings, and foster siblings.

SECTION B: Family’s Origin and Language

Now we would like to learn about your family’s origin.

[Are you/Is parent #1] Hispanic or [Latino/Latina]?

Yes
No

* Which one of the following [are you/is parent #1]?

Mexican, Mexican-American or Chicano/Chicana
Cuban
Dominican
Puerto Rican
Central American such as Guatemalan, Salvadoran, Nicaraguan, Costa Rican, Panamanian, or Honduran
South American such as Colombian, Argentinean, or Peruvian or
Other Hispanic or Latino/Latina
[In addition to learning about [your/parent #1’s] Hispanic background, we would also like to know about [your/his/her] racial background.]
Which of the following choices describe [your/parent #1’s] race? You may choose more than one. (Check all that apply.)
White
Black or African American
Asian
Native Hawaiian or other Pacific Islander
American Indian or Alaska Native

Which one of the following [are you/is parent #1]? Chinese
Filipino
Southeast Asian such as Vietnamese or Thai
South Asian such as Asian Indian or Sri Lankan or Other Asian

In what year [were you/was parent #1] born?

[Were you/was parent #1] born in the United States, in Puerto Rico or another U.S. territory, or in another country?
United States
Puerto Rico or another U.S. territory
Another country

* In which country [were you/was parent #1] born?

* In what year did [you/parent #1] come to the United States to stay permanently?

* Is [parent #2] Hispanic or [Latino/Latina]?
Yes
No

* Which one of the following is [parent #2]?
Mexican, Mexican-American or [Chicano/Chicana] Cuban
Dominican
Puerto Rican
Central American such as Guatemalan, Salvadoran, Nicaraguan, Costa Rican, Panamanian, or Honduran
South American such as Colombian, Argentinean, or Peruvian or Other Hispanic or [Latino/Latina]

* [In addition to learning about [parent #2’s] Hispanic background, we would also like to know about [parent #2’s] racial background.] Which of the following choices describe [parent #2’s] race? You may choose more than one. (Check all that apply.)
White
Black or African American
Asian
Native Hawaiian or other Pacific Islander
American Indian or Alaska Native

* Which one of the following is [parent #2]?
  Chinese
  Filipino
  Southeast Asian such as Vietnamese or Thai
  South Asian such as Asian Indian or Sri Lankan or
  Other Asian

* In what year was [parent #2] born?

* Was [parent #2] born in the United States, in Puerto Rico or another U.S. territory, or in another country?
  United States
  Puerto Rico or another U.S. territory
  Another country

* In which country was [parent #2] born?

* In what year did [parent #2] come to the United States to stay permanently?

Now we have a question about your 9th grader.
Was [your 9th grader] born in the United States, in Puerto Rico or another U.S. territory, or in another country?
United States
Puerto Rico or another U.S. territory
Another country

* In which country was [he/she] born?

* In what year did [he/she] come to the United States to stay permanently?

* In what grade was [your 9th grader] placed when [he/she] started school in the United States?
  Pre-kindergarten
  Kindergarten
  1st grade
  2nd grade
  3rd grade
  4th grade
  5th grade
  6th grade
  7th grade
  8th grade
  9th grade

Is any language other than English regularly spoken in your home?
Yes
No

* What languages other than English are regularly spoken in your home? (Check all that apply.)
  Spanish
  A European language other than Spanish such as French, German or Russian
  A Chinese language
  A Filipino language
  A Southeast Asian language such as Vietnamese, Thai or Cambodian
  A South Asian language such as Hindi or Tamil
  Another Asian language such as Japanese or Korean
  A Middle Eastern language such as Arabic or Farsi
  Another language

* Is English also regularly spoken in your home?
  Yes
  No

* What language do you usually speak to [your 9th grader] in your home?
  English
  Spanish
  A European language other than Spanish (such as French, German or Russian)
  A Chinese language
  A Filipino language
  A Southeast Asian language (such as Vietnamese, Thai, or Cambodian)
  A South Asian language (such as Hindi or Tamil)
  An Asian language (such as Japanese or Korean)
  A Middle Eastern language (such as Arabic or Farsi)
  Another language

* What language does [he/she] usually speak to you in your home?
  English
  Spanish
  A European language other than Spanish (such as French, German or Russian)
  A Chinese language
  A Filipino language
  A Southeast Asian language (such as Vietnamese, Thai, or Cambodian)
  A South Asian language (such as Hindi or Tamil)
  An Asian language (such as Japanese or Korean)
  A Middle Eastern language (such as Arabic or Farsi)
  Another language

* How difficult is it for you to participate in activities at [your 9th grader]'s school because you or member's of your family speak a language other than English? Would you say...
  very difficult
  somewhat difficult or
  not at all difficult?
Has [your 9th grader] ever been enrolled in a program for English language learners (ELLs) such as English as a Second Language (ESL), English immersion, or bilingual education?
Yes
No
Don't know

* Is [he/she] currently enrolled in an English as a Second Language (ESL), English immersion, or bilingual education program?
Yes
No
Don't know

SECTION C: Parent's Education and Occupation

Next we would like some information about your family's educational background and occupations.

What is the highest level of education [you have/parent #1 has] completed?
Less than high school
High school diploma or GED
Associate's degree
Bachelor's degree
Master's degree
Educational Specialist diploma
Ph.D., M.D., law degree, or other high level professional degree

* What was the major field of study for [your/parent #1’s] [highest degree completed]?

* What was the major field of study for [your/parent #1’s] Bachelor’s degree?

* [Have you/Has parent #1] started, but not completed, any work on a degree beyond [highest degree completed]?
(If [you have/parent #1 has] started more than one of the degrees listed below, please select the higher degree.)
No, [you have/parent #1 has] not started any other degree
Yes, started but not completed an Associate’s degree
Yes, started but not completed a Bachelor’s degree
Yes, started but not completed a Master's degree
Yes, started but not completed an Education Specialist diploma
Yes, started but not completed a Ph.D., M.D., law degree, or other high level professional degree

During the past week, did [you/parent #1] work for pay or income? (If [you/parent #1] held a job but [was/were] not working because of temporary illness, vacation, strike, or jury duty answer “yes.”)
Yes
No

* [Have you/Has parent #1] ever held a regular job for pay or income?
* About how many total hours per week [do/does/did] [you/he/she] usually work for pay or income, counting all jobs?

* [What is / In [your/her/his] most recent job, what was] [your/her/his] job title? If [you/she/he] [have/has/had] more than one job, describe the one at which [you/she/he] [work/works/worked] the most hours. What [do/does/did] [you/she/he] actually do in that job? That is, what [are/were] [your/her/his] main activities or duties?*

* What is the highest level of education [parent #2] has completed?
  - Less than high school
  - High school diploma or GED
  - Associate's degree
  - Bachelor's degree
  - Master's degree
  - Educational Specialist diploma
  - Ph.D., M.D., law degree, or other high level professional degree

* What was the major field of study for [parent #2's] [highest degree completed]?

* What was the major field of study for [parent #2's] Bachelor's degree?

* Has [parent #2] started, but not completed, any work on a degree beyond [highest degree completed]?
  - No, [he/she] has not started any other degree
  - Yes, started but not completed an Associate's degree
  - Yes, started but not completed a Bachelor's degree
  - Yes, started but not completed a Master's degree
  - Yes, started but not completed an Education Specialist diploma
  - Yes, started but not completed a Ph.D., M.D., law degree, or other high level professional degree

* During the past week, did [parent #2] work for pay or income? (If [he/she] held a job but was not working because of temporary illness, vacation, strike, or jury duty answer “yes.”)
  - Yes
  - No

* Has [he/she] ever held a regular job for pay or income?
  - Yes
  - No

* About how many total hours per week does [does/did] [parent #2] usually work for pay or income, counting all jobs?
* [What is / In [parent #2] most recent job, what was] [parent #2's] job title? If [parent #2]
[has/had] more than one job, describe the one at which [parent #2] [works/worked] the most
hours. What [does/did] [parent #2] do in that job? That is, what [are/were] [parent #2's] main
activities or duties?

Income is a key family characteristic that factors into many research questions including how
family finances affect students’ ability to go to college. This information is critically important to
the success of this study and will be kept completely confidential.

What was your total household income from all sources prior to taxes and deductions in
calendar year 2008? Please include all income such as income from work, investments and
alimony.

* We understand that you may not be able to provide an exact number for your family’s income.
However, it would be extremely helpful if you would indicate which of the following ranges best
estimates your total household income from all sources prior to taxes and deductions in
calendar year 2008. Please include all income such as income from work, investments and
alimony.

$15,000 or less
$15,001 - $35,000
$35,001 - $55,000
$55,001 - $75,000
$75,001 - $95,000
$95,001 - $115,000
$115,001 - $135,000
$135,001 - $155,000
$155,001 - $175,000
$175,001 - $195,000
$195,001 - $215,000
$215,001 - $235,000
More than $235,000

Do you...
pay mortgage towards or own your home rent your home or
have some other arrangement?

SECTION D: Previous Educational Experiences

Now we have some questions about [your 9th grader]’s previous educational experiences.

Since starting kindergarten, has [your 9th grader] repeated any grades?
Yes
No

* What grades did [he/she] repeat?
(Check all that apply.)
Kindergarten
1st Grade
2nd Grade
3rd Grade
4th Grade
5th Grade
6th Grade
7th Grade
8th Grade
9th Grade

Has a doctor, health care provider, teacher, or school official ever told you that [your 9th grader] has any of the following conditions?

- Specific learning disability
  - Yes
  - No

- Any developmental delay that affects [his/her] ability to learn
  - Yes
  - No

- Autism, Asperger's Disorder, pervasive developmental disorder, or other autism spectrum disorder
  - Yes
  - No

- Hearing problems or vision problems that cannot be corrected with glasses or contact lenses
  - Yes
  - No

- Bone, joint, or muscle problems
  - Yes
  - No

- Intellectual disability or mental retardation
  - Yes
  - No

- Attention Deficit Disorder or Attention Deficit Hyperactive Disorder, that is, ADD or ADHD
  - Yes
  - No

Does [your 9th grader] currently receive Special Educational Services? Students receiving these services often have an Individualized Education Plan (IEP).

- Yes
- No
- Don't know

Is [your 9th grader] currently taking medication for ADD or ADHD?

- Yes
- No

Compared with other 9th graders, would you say [your 9th grader] experiences a lot, a little, or no difficulty in the following areas?

- Learning, understanding, or paying attention
  - A lot of difficulty
  - A little difficulty
  - No difficulty
Speaking, communicating, or being understood
A lot of difficulty
A little difficulty
No difficulty
Feeling anxious or depressed
A lot of difficulty
A little difficulty
No difficulty
Behavior problems, such as acting-out, fighting, bullying, or arguing
A lot of difficulty
A little difficulty
No difficulty
Making and keeping friends
A lot of difficulty
A little difficulty
No difficulty

Since starting kindergarten, has [your 9th grader] skipped any grades?
Yes
No

* What grades did [he/she] skip?
(Check all that apply.)
Kindergarten
1st Grade
2nd Grade
3rd Grade
4th Grade
5th Grade
6th Grade
7th Grade
8th Grade

Is [your 9th grader] currently enrolled in any honors classes?
Yes
No

How many times has [your 9th grader] changed schools since [he/she] entered kindergarten?
Do not count changes that occurred as a result of promotion to the next grade or level, for instance, a move from an elementary school to a middle school or from a middle school to a high school in the same district.

Since starting kindergarten, has [your 9th grader] ever stopped going to school for a period of a month or more other than for illness, injury or vacation?
Yes
No

Since starting kindergarten, has [he/she] ever been suspended or expelled from school? Do not count detentions.
During the last school year (2008-2009), how many times were you or another family member contacted by the school about [your 9th grader]'s...

problem behavior in school?

Never

Once or twice

Three or four times

More than four times

poor attendance record at school?

Never

Once or twice

Three or four times

More than four times

poor academic performance?

Never

Once or twice

Three or four times

More than four times

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SECTION E: Parent's Involvement

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Next we have some questions about your involvement in [your 9th grader]'s school, education and [his/her] home life.

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

Is [your 9th-grader's school] a regularly assigned school or a school that you chose?

Assigned

Chosen, or

[your 9th grader] was assigned to [your 9th-grader's school], but you would have chosen it if you had a choice.

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

Since the beginning of this school year (2009-2010), have you or other adults in your household...

attended a general school meeting such as an open house or a back-to-school night?

Yes

No

attended a meeting of the parent-teacher organization or association?

Yes

No

gone to a regularly scheduled parent-teacher conference with [your 9th grader]'s teacher?

Yes

No

attended a school or class event such as a play, dance, sports event or science fair because of [your 9th grader]?

Yes

No

served as a volunteer in [your 9th grader]'s classroom or elsewhere in the school?

Yes
During this school year, about how many days in an average week do you or another adult in your household help [your 9th grader] with homework? Would you say...
never
less than once a week
1 or 2 days a week
3 or 4 days a week or
5 or more days a week?

How confident do you feel about your ability to help [your 9th grader] with the homework [he/she] has this year in each of the following subjects?
Math
Very confident
Somewhat confident
Not at all confident
Science
Very confident
Somewhat confident
Not at all confident
English or language arts
Very confident
Somewhat confident
Not at all confident

In general, how would you compare males and females in the following subjects?
Math
Females are much better
Females are somewhat better
Females and males are the same
Males are somewhat better
Males are much better
Science
Females are much better
Females are somewhat better
Females and males are the same
Males are somewhat better
Males are much better
English or language arts
Females are much better
Females are somewhat better
Females and males are the same
Males are somewhat better
Males are much better

During the last 12 months, has [your 9th-grader] participated in any of the following activities outside of school?
(Check all that apply.)
Music, dance, art, or theater
Organized sports supervised by an adult
Religious youth group or religious instruction
Scouting or another group or club activity
Academic instruction outside of school such as from a Saturday Academy, learning center, personal tutor or summer school program A math or science camp
Another camp
None of these

During the last 12 months, which of the following activities have you or another family member done with [your 9th grader]?
(Check all that apply.)
Visited a zoo, planetarium, natural history museum, transportation museum, or a similar museum
Worked or played on a computer together
Built or fixed something such as a vehicle or appliance
Attended a school science fair
Helped [your 9th grader] with a school science fair project
Discussed a program or article about math, science, or technology
Visited a library
Gone to a play, concert, or other live show
None of these

SECTION F: 9th Grader’s Future

Now we have several questions about [your 9th grader]'s future.

If there were no barriers, how far in school would you want [your 9th grader] to go?
Less than high school
High school diploma or GED
Start but not complete an Associate’s degree
Complete an Associate’s degree
Start but not complete a Bachelor’s degree
Complete a Bachelor’s degree
Start but not complete a Master’s degree
Complete a Master’s degree
Start but not complete a Ph.D., M.D., law degree, or other high level professional degree
Complete a Ph.D., M.D., law degree, or other high level professional degree

As things stand now, how far in school do you think [he/she] will actually get?
Less than high school
High school diploma or GED
Start but not complete an Associate’s degree
Complete an Associate’s degree
Start but not complete a Bachelor’s degree
Complete a Bachelor’s degree
Start but not complete a Master’s degree
Complete a Master’s degree
Start but not complete a Ph.D., M.D., law degree, or other high level professional degree
Complete a Ph.D., M.D., law degree, or other high level professional degree
Don't know
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
Whatever [your 9th grader]’s plans, do you think [he/she] has the ability to complete a Bachelor’s degree? Would you say...
definitely
probably
probably not or
definitely not?
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
Have you or anyone in your family talked with a counselor or teacher about the academic requirements for admission to a college or a technical institute after high school?
Yes
No
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
* Do you think [your 9th grader] will start [his/her] college education at...
a technical institute
a community college or other Associate’s granting school besides a technical institute
a Bachelor’s granting 4-year college or
you have not thought about this yet?
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
* When do you think [he/she] will start [his/her] education after high school?
Within 3 months after completing high school
Within 6 months after completing high school
Within one year after completing high school
More than one year after completing high school
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
* Would you say [he/she] is more likely to attend a public or private 4-year college, or have you not thought about this yet?
Public
Private
Haven't thought about this yet
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
* Is [he/she] more likely to attend an in-state or out-of-state public college, or have you not thought about this yet?
In-state
Out-of-state
Haven't thought about this yet
* Have you gotten information about the cost of tuition and mandatory fees at a specific [in-state public/out-of-state public/private] college?  
Yes  
No

* What is the cost of one year’s tuition and mandatory fees at that public 4-year college in your state?  

* Is that tuition and mandatory fees only, or does that also include other fees such as room and board?  
Tuition and mandatory fees only  
Tuition, mandatory fees, and other fees

* What is the cost of one year’s tuition and mandatory fees at that private 4-year college?  
Include the cost of courses and required fees such as student activity fees and student health fees. Do not include optional expenses such as room and board.  

* Is that tuition and mandatory fees only, or does that also include other fees such as room and board?  
Tuition and mandatory fees only  
Tuition, mandatory fees, and other fees

* What is the cost of one year’s tuition and mandatory fees at that out-of-state public 4-year college?  
Include the cost of courses and required fees such as student activity fees and student health fees. Do not include optional expenses such as room and board.  

* Is that tuition and mandatory fees only, or does that also include other fees such as room and board?  
Tuition and mandatory fees only  
Tuition, mandatory fees, and other fees

* What is your best estimate of the cost of one year’s tuition and mandatory fees at a public 4-year college in your state?  
Include the cost of courses and required fees such as student activity fees and student health fees. Do not include optional expenses such as room and board.  

* Is that tuition and mandatory fees only, or does that also include other fees such as room and board?  
Tuition and mandatory fees only  
Tuition, mandatory fees, and other fees

* How confident are you in the accuracy of your estimate of the cost of one year’s tuition and mandatory fees at a public 4-year college in your state? Would you say...  
very confident  
somewhat confident, or not at all confident?

* Do you or does anyone in your family plan to help [your 9th grader] pay for [his/her] education after high school?  
Yes  
No
You have not thought about this yet

* What grade was [he/she] in when you or someone in your family began to financially prepare for [his/her] education after high school? Would you say...
  - before 1st grade
  - between the 1st and 6th grades
  - in the 7th, 8th, or 9th grades, or you have not begun to prepare?

* About how much money have you set aside for [his/her] future educational needs?
  - None
  - $2,000 or less
  - $2,001-$5,000
  - $5,001-$10,000
  - $10,001-$15,000
  - $15,001-$25,000
  - $25,001-$35,000
  - $35,001-$60,000
  - More than $60,000

* Have you or anyone in your family opened any type of account to save for [your 9th grader]'s college education, for example, a 529 plan, a Coverdell Education Savings Account or Education IRA, or a prepaid tuition account?
  - Yes
  - No