Out of School Time Science Programs: Examining a Program's Impacts on the Science Identities of Middle School Female Participants

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Elizabeth Ripley MacTavish
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Dedication

I dedicate this dissertation to my grandparents, Claude and Helen Lawson. For almost forty years, I have witnessed the unselfish manner in which you both give everything for our family. I hope that you view this achievement as a part of the precedent of hard work and determination you have set for your children, grandchildren, and great grandchildren. Thank you for being incredible role models by always supporting and loving us all.

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Abstract

Science education reform efforts emphasize teaching science for all Americans, and identify scientific literacy as the principle goal of science education (American Association for the Advancement of Science [AAAS], 1993; National Research Council [NRC], 1996). Despite the goal of scientific literacy, some students, especially females and minorities, consider science irrelevant to their personal interests or career goals. Additionally, research pinpoints middle school as a period when female students begin to lose interest in science (Farenga, 1999; Hill et al., 2010).

Decades of research have documented the gender achievement gap, yet little research has been focused on the science identity gap (Archer et al., 2013). We do know girls often do not identify with science regardless of test scores (Archer et al., 2013; Sadker, Sadker & Zittleman, 2009). This lack of research makes a strong argument that the science identity gap limits girls' participation in science beyond secondary schooling.

One solution to increasing students' science involvement and development of science identities is through the implementation of out-of-school time (OST) science programs. However, there is limited research on how these programs change female participants' perceptions of their science abilities. This study examines the impacts of a science OST program in an East Tennessee middle school on the identify construction of its females participants.

An exploratory sequential mixed methods research designed was used to answer three research questions. First, the "Science and Me" survey (SMS) instrument was designed and administered to both boys and girls. Survey results guided the development of a focus group discussion guide for Phase 2. Next, data from four female only focus groups provided insight into the development of middle school females' science identities by distinguishing parental or home assistance, teachers' instructional approaches, media outlets, and peer relationships as major influences on females' science identities. It was concluded that when girls view these influences as positively supporting their science abilities, they feel confident and interested in pursuing informal science programs. Further, the OST program was shown to positively impact the continued construction of their science identities.

Preface

This dissertation is original, unpublished, independent work by the author, E. MacTavish.

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CHAPTER I: INTRODUCTION AND GENERAL INFORMATION

Science education reform has played a significant part in the education discussion for decades. Along the way, a multitude of government actions have transpired, reports have been published, and organizations established to improve science education (Bybee, 1997; Collins, 1998; DeBoer, 2000; DeBoer, 2011; Jolly, 2009; Lee & Luykx, 2005). These efforts to reform science education for America's students emphasize providing students with the science instruction, support, and resources needed to produce scientifically literate citizens (DeBoer, 2000). Efforts also include teaching science for all Americans and identifying scientific literacy as the principle goal of science education (American Association for the Advancement of Science [AAAS], 1993; National Research Council [NRC], 1996).

Most recently, a multi-state collaborative effort set the stage for the Next Generation Science Standards (NGSS) (2015) that were developed to ensure scientific and technological literacy in K-12 students. These new science standards recommend rich content across multiple disciplines (NGSS, 2015). The NGSS also support rigorous science instruction that prepares students to enter the workforce with the skills required to contribute to innovation in our economy and to develop scientific literacy. Although there is no consensus on the definition for scientific literacy, a review of the literature offers various sources that cite scientific literacy as the ability to read and understand media accounts of science and scientific issues (Hazen & Trefil, 1991), the ability to make informed decisions on socio-scientific issues, and actively participate in a technologically advanced democracy (Bybee, 1997). Regardless of differing views, the scientific community agrees that "the world is changing" (DeBoer, 2000, p. 586) and it should be the goal of science education to keep pace with these changes.

Despite the NGSS and science education reform efforts, many students consider science irrelevant to their personal interests or career goals because they lack the understanding that science plays a significant role in job requirements and career success (Kadlec, Friedman, & Ott, 2007). Minorities and females are especially vulnerable to problems associated with achieving scientific literary resulting in a deeply rooted struggle in science education for equity. Gardner (1975) claimed that gender is "probably the most significant variable related toward pupils' attitude to science" (p. 22). Gender inequity is validated by research showing that boys tend to view science in a more positive way than girls and as more relevant to their life through all age groups (Chetcuti & Kioko, 2012; Farenga & Joyce, 1999; Jones et al., 1997; Jovanovic & King, 1998; Osborne et al., 2003; Schreiner & Sjoberg, 2007).

Additionally, middle school students represent an endangered group (Farenga, 1999) as these students begin to lose interest in science (Hill et al., 2010). This loss of interest during middle school stems from adolescents' physical and emotional changes due to students' misconceptions of science as an isolated, non-creative profession; and the move from concrete to more abstract concepts (Brickhouse et al., 2000). To challenge these notions, recent reform measures have initiated a shift in science classroom instruction from the traditional teacher-centered delivery style to a student-centered inquiry-based approach. This shift poses challenges for students (Blumenfeld et al., 2006; Davis & Miyake, 2004) because of the increase in cognitive demands placed upon them by the inquiry approach. Consequently, an area receiving considerable attention is the cognitive development research in adolescence. Strauch (2003) explains that the teenage brain experiences a period of pruning in which the cognitive functions of the brain are developed when heavily used connections in the brain are strengthen while unused connections diminish. In other words, when specific intellectual practices are provided the most time, there are greater opportunities to strengthen brain connections associated with those practices. These practices, and their related connections, will forever impact the student (Wilson and Horch, 2002). This research helps explain the difficulties many middle school students face when transitioning from concrete instruction to abstract instruction in the science classroom. More importantly, it provides a clearer explanation of the science challenges female students will face when they fail to make the essential neurological connections in middle school.

Middle school education reform measures have tasked science teachers to increase students' interest in science to encourage greater student enrollment in high school science courses beyond those required for graduation. Ultimately, more interest in science and pursuit of advanced science courses will contribute to an increase in students' selection of science-related careers. Current science reform efforts are focused on the recruitment and retention of females in science fields through the federal government's efforts to "expand STEM education and career opportunities for underrepresented groups" (whitehouse.gov, 2012) by slowing the K-16 science "pipeline" leak. Recent data showed that, in general, girls perform equal to or better than their male counterparts on science state and national assessments at both the middle and high school level (National Center for Educational Statistics, 2013) and girls are pursuing post-secondary education rates higher than their male counterparts. For example, in 2013 women received nearly 53% of all bachelor degrees in the U.S. (Digest of Educational Statistics, 2015). However, in K-12 science education, girls often do not identify with science regardless of test scores (Archer et al., 2013; Sadker, Sadker & Zittleman, 2009). Part of the reason for this disconnect is that while decades have been spent addressing the academic achievement gap between girls and boys, very little research has been focused on the science identity gap (Archer et al., 2013). This lack of research makes a strong argument that the science identity gap limits girls' participation in science beyond secondary schooling.

One solution to increasing female students' science involvement and development of science identities is through the implementation of out-of-school time (OST) programs. OST refers to the hours in which school-age children are not in school (National Institute on Out-of School Time, 2003) and doing "something other than activities mandated by school attendance" (Lauer et al., 2006). As Bell et al. (2009) explain in their report, OST programs have multiplied in the last decade in an effort to increase young people's exposure to science. The plethora of recent research continues to highlight these positive actions to further expose youth to science beyond the classroom walls.

Statement of the Problem

Researchers and policymakers have become increasingly interested in the role of OST programs over the last 20 years (Green et al., 2013). Participation in youth programs has been linked to identify exploration, gains in human and social capital, and connections between youth and their schools and communities (Lauer et al., 2006; Mahoney et al., 2005). Promising evidence shows that participation in OST programs leads to positive outcomes including improved academic achievement, reduction of risky behaviors, increased civic engagement, and improved psychological functioning (Mahoney et al., 2005; Mahoney et al., 2009). Also, middle school OST programs have been shown to play a crucial role in supporting youth at a time when they begin to make decisions about courses in high school (Akos et al., 2007; Tai et al., 2006).

Title I of the Elementary and Secondary Education Act (ESEA) of 1965 initiated funding of supplemental education help in the form of extended time through summer school and OST programs (Cooper et al., 2000) to assist at-risk populations. In fact, low-income children need after-school opportunities and are more likely to benefit from these opportunities than middle-income children (Miller, 2003; Cosden et al., 2001). Multiple variables attributed to this conclusion including the tendency of at-risk students to live in less safe neighborhoods, require supervision by adults, and the increased need for structured and secure afterschool care (Lauer et al., 2006). Also, these students traditionally require education experiences that supplement school activities to prevent academic failures (Cooper et al., 2000; Borman & D'Agostino, 1996). The additional experiences provided by OST programs also strengthen connections in the brain that might otherwise disappear if left unused. In this sense, OST programs help to construct cognitive development in the adolescent brain as supported by neurological pruning research.

In addition, science OST programs have paved the road for early exposure to STEM-related careers especially with underrepresented groups like females. Even with increased opportunities to interact with science content in OST programs, there is limited research on how these programs change female participants' perceptions of their science abilities. According to the Girl Scouts Research Institute (GSRI) 2012 report, 74% of teen girls are interested in science-related content, and while efforts are made to increase exposure, there is still a need to study female self-efficacy. It is essential for OST programs to move female participants from having an interest in science to developing "identities as people who like science, understand science, want to do science, and can persevere in STEM majors and careers" (Adams, 2014, p. 14). My study will examine the impacts of an OST program on the development of female participants' science identity.

Purpose of the Study

The purpose of this study is to examine the impacts of a middle school OST program on the science identities of female participants. The study initially assessed the science identities of middle school non-participants compared to program participants to understand what motivates students to participate and whether applicants are predisposed to science as a personal interest. Finally, the study collected data on female OST program participants' science identities through focus group discussions. This approach allowed me to identify specific parts of the OST program that supported positive development of females' science identities.

In the end, there are several questions that guided my research.

- How do middle school students' perceptions of science differ between girls and boys?
- What factors contribute to middle school females' construction of their science identities?
- How does participation in a science OST program impact middle school females science identities?

I believe these questions contribute to a growing body of research on female science identities specifically during middle school when many females dismiss science as a possible career goal. This study responds to calls from science education reformers for deeper and more rigorous approaches for understanding how and why some girls pursue and succeed in science (National Academies, 2007) and others do not.

Significance of the Study

A thorough review of the literature highlights a substantial investment by researchers in the area of underrepresented groups in science education. The research also shows that the development of OST programs helps to engage underrepresented groups in science. However, there is a significant gap in the research regarding the impacts of OST programs on the development of female students' science identity development. This study contributes to a foundation of research in science education that is critical to supporting female students' development of science identities through programs outside of the regular school day. The data collected and presented in this study are beneficial to schools and community organizations that wish to plan, modify, or implement OST programs. Results from this study help to guide OST program organizers with information about how to increase and sustain female participation, as well as support females pursuing a career in science related fields.

Definition of Terms

In reviewing the literature, I identified several key terms with multiple accepted definitions. For the purpose of my study, I have clarified how the terms are used and applied to my research by providing the following definitions. I have provided references for each definition as it exists within the literature.

At-risk students - "used to describe students or groups of students who are considered to have a higher probability of failing academically or dropping out of school. The term may be applied to students who face circumstances that could jeopardize their ability to complete school, such as homelessness, incarceration, teenage pregnancy, serious health issues, domestic violence, transiency (as in the case of migrant-worker families), or other conditions, or it may refer to learning disabilities, low test scores, disciplinary problems, grade retentions, or other learning-related factors that could adversely affect the educational performance and attainment of some students." (Hidden Curriculum, 2014)

Identity - "a set of meanings that define who one is when one is an occupant of a particular role in society, a member of a particular group, or claims particular characteristics that identify him or her as a unique person" (Burke and Stets, 2009, p.3)

Identity construction - construction involves the passive experience of being “made” by external forces…but out identity is also a product of the claims we make. The claims may build on the messages we receive from the world around us or may depart from them, rejecting them, adding to them, or refining them.” (Cornell & Hartman, 2007, p. 83).

Identity theory (IT) - the theory of role identity when one “act[s] to fulfill the particular role, coordinating and negotiating interaction with role partners, and manipulating the environment to control the resources for which the role has responsibility” (Stets & Burke, 2000, p. 226).

Out-of-School Time (OST) - program that takes place during “the hours in which school-age children are not in school” when “children are doing something other than activities mandated by school attendance” (Lauer et al., 2006, p. 276); for this study, I will define OST programs using Eccles & Gootman’s (2002) eight features for characterizing high quality OST programs: a) physical and psychological safety, b) appropriate structure, c) supportive relationships, d) opportunities to belong, e) positive social norms, f) support for efficacy and mattering, g) opportunities for skill building, and h) integration of family, school, and community efforts.

Scientific literacy - for the purpose of this study is viewed as a socially defined concept that differs according to “eras in time, geographical regions, and communities or social conditions” (Laugksch, 2000, p. 84); with that said, a absolute definition of scientific literacy is impractical, but for the purpose of this study is viewed as “a set of science content knowledge, skills, and attitudes toward science” (Laugksch, 2000, p. 84) that is accepted and learned by all students

Science self-efficacy - “students’ belief in their ability to succeed in science tasks, courses, or activities” (Britner & Pajares, 2006, p. 486); students’ science self-efficacy influences their choices of science-related activities, the effort they expend on those activities, the perseverance they show when encountering difficulties, and the ultimate success they experience in science (Bandura, 1997; Britner & Pajares, 2001; Zeldin & Pajares, 2000)

Social identity theory (SIT) - the theory of social identity that means “being at one with a certain group, being like others in the group, and seeing things from the groups’ perspective” (Stets & Burke, 2000, p. 226)

STEM - the reform of science education in science, technology, engineering, and mathematics with respect to improving scientific literacy; integration of science, technology, engineering, and mathematics by “spelling out the knowledge, skills, and attitudes all students should acquire as a consequence of their total school experience” (AAAS, 1993, p.3)

Assumptions

In this section, I will provide an explanation of my personal beliefs as related to the study. When discussing each assumption, I will justify how each holds truth within my study. First, due to the possible role of outside influences mentioned in the limitations section, it is my assumption that a considerable portion of the OST program’s participants was predisposed to an interest in science. I believe this to be true because the program is advertised as a STEM program to a population of students who are academically proficient in science. These students must also make a time and financial commitment to the program which begs the idea that such a commitment would be supported by an interest in science. However, my study moves beyond science interests and focuses on the OST program’s impacts on components of science identities such as development and self-efficacy.

Next, I assume that students will honestly answer all questions asked on surveys and during focus groups. Students will be assured anonymity on all responses as I will use pseudonyms in the results section to identify focus group members. Survey respondents will be identified as a number in the results section to ensure confidentiality of responses. In addition, all participants are volunteers who may withdraw from the study at any time with no ramifications.

Finally, I assume that the survey instrument used in my study is reliable and valid. The survey used to assess the science interests and involvement of middle school students is aligned with the study's research questions. The survey instrument was previously used in a study entitled *Is Science Me? Exploring Middle School Students' STE-M Aspirations* published in the Journal of Science Education and Technology. In this study, Aschbacher et al. (2014) examined the "science ability beliefs and subjective task values" (p. 735) of students during the fall of their eighth grade year, and again, in the spring of their ninth grade year. The 10-page Likert scale survey instrument was piloted at the study's participating schools and students were debriefed to maximize item comprehensibility. Any item with poor reliability was eliminated from the survey. The efforts made by the authors strengthened the reliability and validity of this instrument. I have modified the instrument by eliminating questions focused on high school students. I also added an open-ended question at the end of the survey to allow students to include any areas they felt were not addressed about their science experiences, classes, and future plans. All of my modifications to the original survey instrument were approved by Aschbacher et al.

Limitations

In this section, I will address the limitations that exist within my study. These limitations represent conditions that may influence the outcome of the study of which I have no control. The first limitation is the socio-economic status of the study's student population. Although a considerable amount of research examines the positive impacts of OST programs on at-risk student populations, the OST program at the focus of this study serves a middle class, suburban student population. Little research exists on the impact of OST programs and middle class students due to the limited need of these students to require additional academic support or safe environments after school. It is my belief that female middle class students represent a high achieving and highly motivated academic population that currently remains untapped in regards to science related career potential. It is for this reason that I feel the focus on a middle class student population does not handicap my study but rather contributes to a gap in the literature.

Next, the study's female participants were self-selected into the science OST program. A majority of the participants over the eight year program have been females (approximately 80%). They have chosen to participate because they have both the grades and teacher recommendations for eligibility as discussed in the delimitations section. According to the U.S. Department of Education (2012), girls are earning math and science credits at the same rates as boys and are earning slightly higher grades in these classes. In order words, when a program requires proficient academic achievement it is likely that a considerable portion of the female population will qualify. I find the large female population of participants to be beneficial as my focus is on female science identity development.

Third, the timing of the program events and activities is a limitation. Due to restrictions imposed by the school system calendar, the program and related trip to the Outer Banks must take place during the spring semester. The timing of the trip is regulated by a state mandated testing window from mid-April to early May each school year. Also, due to this window, the school system restricts students from being off campus for field trips prior to tests as review and preparation are taking place in the classroom. Also, teachers are limited to taking trips when the testing window ends in mid- to late May. As a result of these conditions, the majority of work completed in the OST program is during the spring semester. The timing of events in the program has eliminated a population of students who play spring sports. This conflict has been brought to my attention through several conversations with parents and students regarding their choice not to apply to the program.

Finally, a report published by McCreedy and Dierking (2013) examined the “cascading influences” (p. 3) of girls’ experiences beyond the informal setting of STEM programs. Much like their study, a limitation in this study is that female participants have also been influenced by experiences outside the OST program. Influences at home, school, and community play a critical role in building connections and providing reinforcement for the development of their science identities. While the study will examine an OST program’s impacts on female participants’ science identity, it is important to acknowledge the possibility of countless outside influences also shaping their identities.

Delimitations

This section provides a review of the conditions imposed by the researcher during the study. These delimitations may influence the outcome of the study, but were considered necessary in aiding in the OST program’s development and implementation. First, student participants in the study have chosen to apply to the OST program based on several program application parameters. The program requires students maintain specific academic standards in order to be eligible for consideration into the program. The first application requirement is that student applicants must have a 3.5 cumulative GPA in all academic classes during the student's sixth and seventh grade year. Also, students must write and submit an essay about STEM education. Finally, students must have teachers' recommendations that reflect high character traits in the areas of responsibility, trustworthiness, respect, and citizenship. Students must have participated in community service projects either through the school, church, or other community organization.

According to the research on OST programs, these application requirements may eliminate a population of students who would benefit from the supplemental experiences and academic support of an OST program (Borman & D'Agostino, 1996; Cooper et al., 2000). However, these requirements are in place for several reasons. First, the program increases the students' academic workload outside the school day. By setting a GPA expectation, program coordinators ensure that students involved in the program are likely to complete program work with no negative consequences to school work. As mentioned in the limitations section, this often reflects well for the female population in the middle school who has shown to have significant academic achievement in math and science courses. Second, the essay requirement is in place to provide students with a platform to express their thoughts and ideas about STEM education. Students uncomfortable with writing or uninterested in the task may chose not to apply. However, the essay requirement is supported by research on student-center strategies. This research supports tasks that give students opportunities to reflect on personal experiences, organize their thoughts, and apply what they have learned (Mascolo, 2009) to the construction of their own understanding and knowledge of the world. Finally, teacher recommendations provide the school staff with an opportunity to communicate with program coordinators about students.

Teachers often provide insight about students that is easy to overlook on a report card or in an essay. Teacher recommendations also require students to take responsibility by approaching teachers, asking for recommendations and following up with teachers as needed.

A final delimitation of my study is the cost to participate. Although several grants have provided resources and fundraisers have contributed to tuition, the cost to families poses as a deterrent to many students who would consider participating. The main costs involved in the program reflect travel expenditures to the Outer Banks rather than requirements during program meetings or work sessions. This delimitation remains on the forefront of issues that are being addressed for future cohorts of students.

Organization of the Study

The remainder of this dissertation is organized into four chapters. In Chapter II, I provide a comprehensive and formal literature review that includes the theoretical orientation of my study, synthesis of my research findings, and a critique of previous research. Chapter III describes the research methodology. This chapter details my research design, target population, participant selection, procedures, instruments, study reliability and validity constructs, research questions, and details of the data analysis. In Chapter IV, I present study data and discuss how the data helps to answer the research questions. Finally, in Chapter V, I assess whether the dissertation addresses the problems that precipitated the study and make recommendations for the direction of future studies.

CHAPTER II: LITERATURE REVIEW

> "We cannot expect in the immediate future that all women who seek it will achieve full equality of opportunity. But if women are to start moving towards that goal, we must believe in ourselves or no one else will believe in us; we must match our aspirations with the competence, courage and determination to succeed."
>
> Rosalyn Yalow, Medical Physicist, 1977 Nobel Prize winner

The National Academies report (2007) targets the discrimination women are likely to face in the academic science, mathematics, and engineering pipeline. The report states that a large body of evidence exists claiming most people (men and women) hold implicit biases. Often these biases result in women being provided fewer opportunities in scientific field even when they have identical accomplishments to their male counterparts. Although this report focuses on the scientific career pipeline, these concerns are relevant to students in the K-12 setting. Such biases and other influences in the social context of a school can pose significant barriers to the development of a girl's sense of self, or identity. Learning how girls negotiate these socially constructed obstacles has led me to seek understanding about how and why some girls pursue and succeed in science while others do not.

Burke and Stets (2009) define identity as "the set of meanings that define who one is when one is an occupant of a particular role in society, a member of a particular group, or claims particular characteristics that identify him or her as a unique person" (p. 3). In other words, an individual exhibits the behaviors and actions of particular roles such as a student, teacher, or parent. The same individual reveals the behaviors and actions aligned with the identity of a particular group such as a religious organization, political party, or ethnicity. An individual can also project characteristics that make one unique or different from others like being athletic, outgoing, or creative. It is these meanings that define one's sense of self. It is also these meanings that confirm that individuals possess multiple identities influenced by the behaviors, thoughts, and emotions elicited by the roles and groups one claims.

In this chapter, I review literature that guides my understanding of the relationship between middle school female students' perception of their science abilities, and the actions and behaviors these female students exhibit. I seek to examine how female students' experiences in social contexts (science classroom and OST program participation) impact their science identities. Throughout this review, I reflect on the works of several researchers who support an overlap of social identity theory (SIT) and identity theory (IT) in education. Their research helps to outline my argument that blending SIT and IT reinforces my study's focus on female science identity construction in the middle school setting. Therefore, I begin by examining the differences and similarities of the two primary theories of identity. In my review of the theories, I explain the numerous components of identity construction that I maintain through my research. In aligning with a general identity theory, I present Carlone and Johnson's (2007) science identity model. This model is based on three dimensions of identity that support the construction of one's science identity. Next, I examine literature on gender and science by detailing the historical context as an explanation for current issues related to females' access to science. From there, I review the literature on current middle school environmental and social components including the science classroom and the female students in these science classes. Then, I provide a detailed account of successful out-of-school time (OST) programs and the impact of these programs on middle school students' science identities. Finally, I present the theoretical framework I employed as a lens through which to view the results and findings of this study.

Examining Identity Theories

SIT and IT serve as two conceptual frameworks on which researchers consider identity in a social paradigm. Researchers who align with SIT view identity as socially constructed within a group while researchers aligned with IT examine identity as it is constructed based on the roles in which one claims. Further separating SIT from IT, Stets and Burke (2000) note:

> Having a particular social identity means being at one with a certain group, being like others in the group, and seeing things from the groups' perspective. In contrast, having a particular role identity means acting to fulfill the expectations of the role, coordinating and negotiating interaction with role partners, and manipulating the environment to control the resources for which the role has responsibility. (p. 226)

Although these frameworks provide motivation for researchers to pursue different approaches when examining identity, my study provides a case for the integration of the theories within the context of the middle school science OST programs. Like Burke and Stets (2000), I perceive "substantial similarities and overlap between social identity theory and identity theory" (p. 224). Through the review of literature, I find it essential to highlight the constructs that mix SIT and IT to present a new general IT framework that has received little attention in the literature. In doing so, I begin by defining SIT and IT in Table 1 to better distinguish the uniqueness of each (Burke and Stets, 2009, p. 129).

Social Identity Theory (SIT)

SIT is defined as a person's ability to recognize his or her belonging to a social category or group (Hogg and Abrams, 1988). Stets and Burke (2000) claim that people are born into social categories and that the unique combination of those categories establishes one's social identity.

Table 1

Characteristics of role and social identities

Characteristics	Role Identity	Social Identity
Bases	Expectations tied to social positions	Social group
Definition	Meanings tied to role	Meanings tied to a social group
Activation of Identity	Salience	Accessibility and fit
Behavior	Complementary to others	Similar to others
Self-Reference	Me as role	We
Verification Outcome	Self-efficacy	Self-esteem

These social categories are only in place due to the existence of contrasting categories (Hogg and Abrams, 1988). For example, an individual can only identify with the Democratic Party because there are other political parties, or a student can only identify himself as an honors student because there are groups of non-honors students. As social identity researchers note, these categories exist in contrast to each other because "each has more or less power, prestige, status" (Stets and Burke, 2000, p. 225) than the others.

Social identity theories describe a person's membership in a group as self-categorization. This conceptualization occurs when one takes on the "attitudes, beliefs, and values, affective reactions, behavioral norms, styles of speech" (Stets and Burke, 2000, p. 225) relevant to the group. But, more importantly, is the person's acknowledgement that these attributes contradict other groups for which he does not belong. As a result, the person will internalize membership in his group as being positive and will judge other groups more negatively. As Stets and Burke

(2000) attest, this comparison creates "self-enhancing outcomes of the self" (p. 225) like self-esteem. Such components of social identity development largely contribute to how a person will derive his identity.

An aspect of SIT is the base of identity when one becomes a member of a group. A person who socially identifies with a specific group does so because of his or her "uniformity of perception and action among group members" (Stets and Burke, 2000, p. 226). The person adopts the socially structured behaviors required for group membership, and as a result, does not desire to differentiate himself from group members. He experiences a strong hold to the group; however, this hold is independent from influences among the individuals that comprise the group (Hogg & Hardie, 1992). Social identity theorists refer to the cognitive outcome of an individual's perception of their group as *social stereotyping*. Social stereotyping occurs when members of one group strengthen their identities as part of their group by perceiving their behaviors and attitudes as different from individuals in another group. The "in-group" versus "out-group" categorization creates homogenous perceptions with the in-group members (Haslam et al. 1996). The differences between the bases of identity in SIT and IT are at the core of identity research.

Another aspect of SIT is the activation, or *salience*, of an identity. Oakes (1987) defines an activated social identity as "one which is functioning psychologically to increase the influence of one's membership in that group on perception and behavior" (p. 118). He also clarifies that salience is not about the acknowledgement one receives from being a member of a group, but is it the internalization of the membership that is significant to the individual. In other words, individuals are part of groups because they perceive their actions and behaviors as fitting with the expectations of the groups. Social identity theorists also note that salience is a result of *accessibility* and *fit*. Oakes describes accessibility as "the readiness of a category to become activated in the person" (Burke & Stets, 2000, p. 230), and fit as the suitability of a group to help the individual accomplish personal goals. When an individual perceives a group as being both accessible and fit, the individual's identity as part of the group is activated.

Finally, SIT involves cognitive and motivational core processes. *Depersonalization* is the cognitive process in SIT in which an individual perceives his actions align with the norms of the group, and in turn, the individual associates himself with a social category "rather than a unique individual" (Burke and Stets, 2000, p. 231). Depersonalization is the result of salience of social identity. Once an individual's social identity is activated, he will "behave so as to enhance the evaluation of the in-group relative to the out-group and thereby to enhance [his] own self-evaluation as [a] group member" (p. 323). This motivational process is *self-esteem*.

Identity Theory (IT)

Simply, IT is the basis of understanding that individuals must behave in ways that consistently align with their identity so that views of the individual are consistent with identity meanings (Cast, 2003). IT has evolved over time into two separate sets of ideas that have provided researchers a more inclusive way of knowing how identities develop and function within people. In addition, this expansion of IT has opened doors for deeper and more rigorous research on identity construction.

The first set of ideas, *symbolic interactionism* (Stryker, 1980), is composed of two related bodies of work that contribute to the growth of IT. The first aspect of symbolic interactionism focuses on the influence of social structures on the self, whereas the second aspect examines the internal components of self-processes (Stryker & Burke, 2000). In other words, *symbolic interactionism* focuses on the links between external social structures as they affect the internal social structure of the self. Social interactions through a series of events help one establish an understanding of reality. The patterns created through these interactions are ongoing as individuals shape society.

The second set of ideas from which identity theory evolved is *perceptual control theory* (PCT) (Powers, 1973). As explained by Burke and Stets (2009), Powers work is focused on "the nature of control systems and provides an understanding of 'purpose and goals' "(p. 18). PCT is based on the belief that living organisms have control over there own perceptions, thus controlling their surroundings. Powers provides an example in his work of a driver traveling down the highway. The driver's objective is to direct the car in a particular direction while staying in his lane. When the driver is presented with a *disturbance* such as a patch of ice, he immediately seeks to counter the disturbance in order to stay on the road. The drive represents the "control system" as he works to maintain his goal of staying on the highway.

These two sets of ideas, symbolic interactionism and perceptual control theory, are extensions of IT. Together, the ideas establish what it means for an individual to construct a role identity. In addition, there are several aspects that differentiate IT from SIT. First, the base of IT (or role identity) "means acting to fulfill the expectations of the role, coordinating and negotiating interaction with role partners, and manipulating the environment to control the resources for which the role has responsibility" (Stets & Burke, 2000, p. 226). Therefore, if an individual desires to be a student, he internalizes the expectations of a student. He studies, completes assignments, listens in class, and participates as appropriate. The individual will also utilize textbooks, technology, and mentors to assist him in fulfilling the role of student even if he must adjust his daily routine to meet those requirements. Using this example, Stets and Burke (2000) would explain that the individual "adopt[ed] self-meanings and expectations to accompany the role" of student "as it relates to others in the group" (p. 227) or classroom. The individual then acts to "represent and preserve those meanings and expectations" (Thoits & Virshup, 1997, p. 107). Although a classroom may be filled with students, research shows that each student will view him or herself different from other students in the same class. Although a classroom represents a social group, there are different perspectives involved among the students in the group as each student negotiates and performs according to their view of a student. This interconnected uniqueness of roles is a significant distinction between IT and SIT.

Another aspect of IT is the activation of a role identity. As opposed to SIT, salience in IT is recognized as the likelihood that an identity will be activated in a situation (Stryker, 1980). In employing this view, identity theorist have separated the idea of salience and activation. The main focus for IT has been the commitment of an individual to an identity (Stryker & Serpe, 1994). As explained by Stets and Burke (2000), commitment is related to "the number of persons one is tied through an identity" (p. 230) and the strength of those ties. Theorists have observed that the stronger the commitment to an identity, the more probable the identity will be activated.

Finally, motivational processes reinforced one's commitment to an identity. As in SIT, self-esteem is considered a motivator in social group identity. Self-efficacy is the motivational process of IT. Individuals with high self-efficacy are those who "feel competent and effective" (Stets and Burke, 2000, p. 233) in his role. Self-efficacy is a product of one behaving in a manner that is consistent with meanings and expectations associated with the role. As an individual gains confidence in his abilities within the role, his self-efficacy increased. The cognitive process of self-verification is tied to this person's acceptance that he is capable of fulfilling the role. Burke and Stets (2009) agree that an individual with high self-efficacy is more likely to try difficult tasks and take advantage of opportunities, thus finding himself to be more successful in the role.

The previous section on SIT and this section on IT, introduce the thinking of the major social identity and identity theorists. By separating the two theories, I described how each are defined within research studies that solely focus on one or the other. For the purpose of my study, I present the idea that SIT and IT overlap in multiple ways providing an argument that the theories are moving in similar, rather than, opposing directions. In the next section, I offer instances when SIT and IT intersect to form a general theory of identity.

Fundamental Linking of SIT and IT

The work of Stets and Burke (2000) opens the door to a general theory of identity in which to frame research studies in education. Their research aims at “examining the self through the lens of both SIT and IT” (p. 225) in an effort to establish a more integrated view of the two theories. The benefits of assimilating the theories into a general identity theory help to avoid the redundancies found when separating the theories. Stets and Burke state that “one always and simultaneously occupies a role and belongs to a group, so that role identities and social identities are always and simultaneously relevant to, and influential on, perceptions, affect, and behavior” (p. 228). Therefore, an individual who is a doctor and a mother is at one time occupying a role and a social category. Because the theories share several central ideals, researchers find that integrating SIT and IT aid in “reinforce[ing] and complement[ing] the other” (p. 224). In this section, I support the integration of SIT and IT into a general identity theory for which I have framed my own work on middle school female identity construction.

Stets and Burke (2000) recognize three central areas in which the two identity theories are fundamentally linked. These areas include the bases of identity (categories/groups or roles), the concept of salience, and the core processes that result when an identity is triggered. In the previous two sections, I used the works of identity and social identity theorist to examine each area. For the purpose of linking the theories, I focus on the connectedness of IT and SIT.

In regards to the bases of identity, Stets and Burke acknowledge that there are differences in how one identifies oneself as part of a group as compared to one's identity within a role. However, they stress that both groups and roles are socially constructed. Therefore, a person is born into social groups and is recognized as an occupant of the group through his or her actions and behaviors. The SIT process of self-categorization is viewed in the same way that identification is viewed within IT. Society has established "expectations and meanings" (p. 225) associated with a social group and the individual roles within the group. These expectations form a core set of standards (or norms) within the group that guide behavior of the individuals who occupy positions within the group (roles). For example, a classroom of students and a teacher represents a group. Prior to students entering, the classroom was socially constructed with norms established by the teacher, administration, and community. However, these norms are not fully recognized until students adhere to the behavioral expectations aligned with the norms. It is then that students have fulfilled the role of student and member of the classroom group.

Regarding salience, the theories view identity activation in different ways; however, Stets and Burke (2000) perceive the theories as complementary of the other. "Both theories acknowledge the importance of the individual's goals and purposes" thus establishing "an understanding of the conditions for the probability of and the actual activation of an identity" (p. 231). Therefore, identities (role or social) have no effect on an individual without socially structured stimuli that manifests itself in the internal interest of the individual.

Also, I find that SIT and IT are linked through motivational processes. SIT views self-esteem as a single entity; however, Stets and Burke (2009) consider that self-esteem has two influential components: self-efficacy and self-worth. As explained by Burke and Stets (2009), individuals feel good about themselves when they are associated with particular groups" (self-esteem) and "they feel confident about themselves when playing out particular roles" (self-efficacy) (p. 128). This idea links the motivational processes of SIT and IT as role identity is embedded in social identity.

In closing, identity concepts are multifaceted and complex, being formed by intersecting characteristics such as gender, ethnicity, and social class, which can produce powerful ideas of what is/not appropriate or normal for one's sense of self (Archer et al., 2010). It is these concepts of identity that can profoundly shape an individual's educational decisions (Bourdieu & Passeron, 1997). In the next section, I present the science identity model work of Carlone and Johnson (2007) to better align the literature with the goals of this study.

Science Identity Model

Gee's theory of identity (1999) defined identity as "the kind of person one is seeking to be and enact in the here and now" (p.13) that requires the participation of others in order for one to be somebody (Buxton, Carlone, & Carlone, 2005). In other words, one cannot identify as a kind of person until one's actions are made visible to others and others recognize their abilities as skilled. Carlone and Johnson (2007) identity model addresses the aspects of science identity using three overlapping dimensions: competence, performance, and recognition. The model takes into account the "socially constructed nature of science identity" (Carlone & Johnson, 2007, p. 1190) based on the "assumption that one's gender, racial, and ethnic identities affect one's science identity" (p. 1191). The dimensions are defined as one's ability to understand science content (competence), one's abilities to adequately engage in scientific practices (performance), and the perception of one as a 'science person', as well as others perceiving one as a 'science person' (recognition). Figure 1 shows the interrelated dimensions of the science identity model.

Carlone and Johnson (2007) explain the model by stating that for someone to develop a science identity each dimension of the model must be highly valued by that person and be highly valued by others for that person. For example, an engineering student may perform scientific practices in the engineering field and demonstrate competency in engineering content, but if the person fails to be recognized by herself or others as a "science person", the person fails to construct a science identity. The three dimensions of this model explicitly connect how students negotiate the cultural norms of our society to construct science identities. It is this reason that Carlone and Johnson's science identity model is used to align the results and findings of this study with the literature on identity. In the next section, I review literature about the history of gender and science with the purpose of presenting groundwork that pinpoints the barriers females continue to face when navigating science.

Gender and Science

Research continues to show that females include their lack of confidence in their science abilities as a factor affecting their performance and interest in science (Clewell, Anderson, & Thorpe, 1992). Issues with confidence inevitably create barriers that affect the development of skills and overall achievement. Females who fail to construct a solid foundation of skills and background in science contribute to the differences in science career attainment between males and females (Beane, 1985; Turner, 1983). A focus on the history of gender and science provides an enlightening explanation of why females may be faced with these challenges.

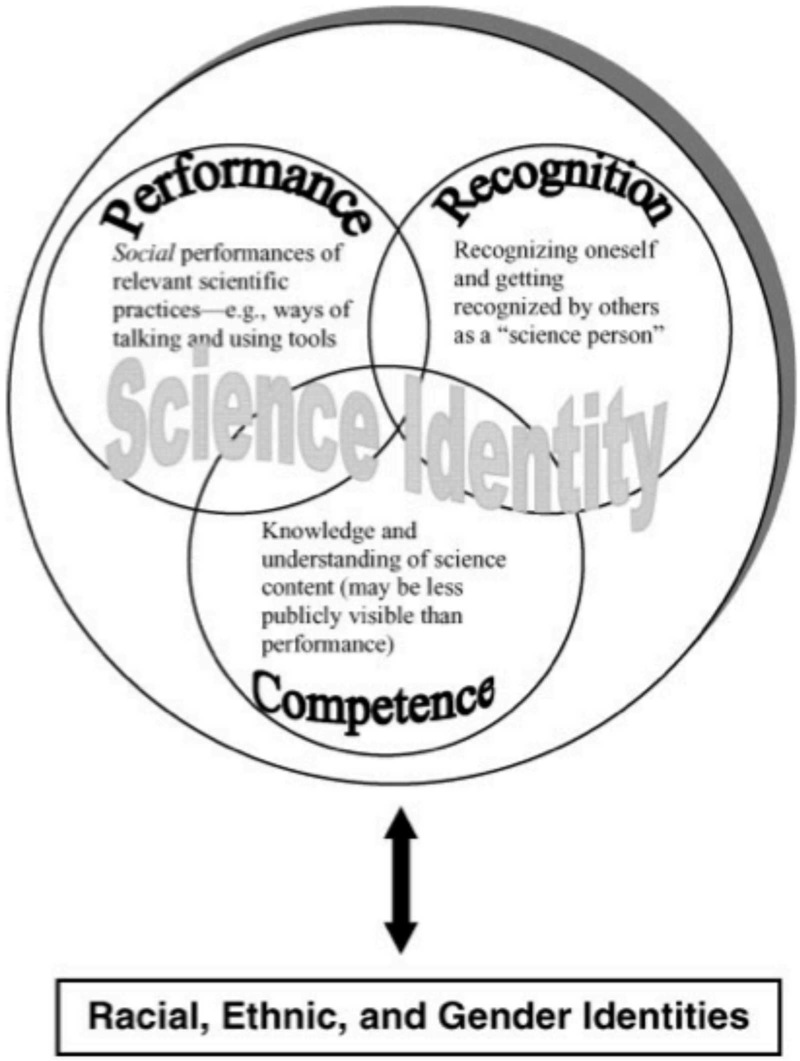

Figure 1. *Model of Science Identity (Carlone & Johnson, 2007, p. 1191)*

The Past and the Present of Science

Historically, science has been viewed as a masculine discipline in which females have been either excluded or marginalized (Watts, 2014). Even when women were acknowledged for scientific ventures in the past, it was done so in a different manner than with males. This set in motion a perception that females lack the ability to pursue science or be successful in science fields. This stereotype maintains its presence even in today's science classrooms despite the growth of research that shows females' invaluable contributions to science.

The gender stereotype in science has "increasingly excluded girls from physical sciences and mathematics" (Watt, 2014, p. 127) while steering them toward the biological sciences, or more domestic sciences involving health. This perception that females were only able to work in certain areas of science manifest itself in our education system early. As a result, females lacked the needed skills to pursue physical sciences because of their limited or nonexistent exposure. Because females failed to be properly educated in these science disciplines, they often performed poorly when assessed (Watt, 2014). Their poor performance was misinterpreted as an absence of ability, interest, or unsuitable rather than an acknowledgement of the imbalance that had been established in science education. Furthermore, fewer professional and academic opportunities were offered in biological and domestic sciences, thus reinforcing the perception that science was a masculine domain.

Another facet of the history of females in science is that females in a professional role will also consider their role within the family unit when making career decisions. While many females began to enter the workforce in the mid-twentieth century, many remained less interested in a professional career finding a "professional life and…a rich personal life were incompatible" (Valian, 2007, p. 31). When females stay home to raise their children, they account for a small population of the workforce perpetuating the belief that females lack the cognitive abilities to succeed in science fields. Even when they do enter professional science careers, females tend to pursue "helping careers such as teaching, education, social work, and nursing" (Halpern, 2007, p. 122) as those fields more appropriately align with their work in the home. Lippa (1998) claims the differences in the science fields pursued by males and females are the result of each gender's "strength of interest on the 'people versus things' dimension of individual differences scale" (p. 999) with females clearly favoring the 'people' end of the spectrum. Traditionally, females chose to study and pursue "fields that are more connected with their core identity, which is assumed to be heavily influenced by gender and gender roles" (Yazilitas et al., 2013, p. 532).

More recently, there has been a shift in the perception of females and science. More female students are enrolling in higher-level science courses, pursuing science majors, and succeeding in science fields. However, current research studies indicate that gender stereotype in science remains a challenge for females. The next section details several barriers females face in science as identified in the literature.

Barriers for Females in Science

In addition to the stereotypes established through history, there are several barriers that continue to challenge females in science. Some of the most difficult barriers to overcome are classroom instructional strategies used by teachers and social factors that include parental and peer support. These barriers are a daily presence in the lives of middle school females. As females internalize the negative influences of these barriers, their attitudes toward science are altered and they struggle with a lack of confidence. This lack of confidence in their abilities to negotiate science promotes setting low expectations in science and avoiding scientific challenges that would otherwise increase their science self-efficacy.

Studies report both male and females maintain similar confidence levels in their science ability in primary school; however, females' confidence levels begin to decrease as they enter puberty, specifically middle school (Archer et al., 2010). One reason for this change in females is that the instructional strategies used by their teachers often fail to increase their interest in science. Clewell et al. (1992) claim that the approaches used in science classrooms fail to complement the learning styles of females. Female students tend to make knowledge personally relevant by employing "intuition and self-understanding" (Clewell et al., 1992, p. 8). They are not drawn to lecture approaches that reinforce drill and practice strategies, but rather hands-on activities that make knowledge transferable to their own lives. Laboratory experiences have been shown to improve female students' achievement in physical sciences due to the opportunity for females to apply the concepts to real-world examples (Burkam, Lee, & Smerdon, 1997).

When female students' learning styles are not met in the science classroom, the results can be disastrous. They often disassociate themselves with science viewing course work as task completion rather than knowledge attainment. Many females simply "go through the motions" rather than learning the concepts. Carlone and Johnson (2007) confirm that females' *student* identities are often high which allows them to get good grades. However, their science identities may not develop "because the nature of the tasks deemphasized scientific thinking, talking, and tool use" (p. 1190). Therefore, the problem with teachers using incompatible strategies is that females fail to acquire the required skill set to succeed in science courses. As a result, they are often tracked into general or remedial science courses that lack rigor and relevance, thus limiting female students' involvement in courses promoting high-order thinking skills (Malcom, 1984) that would encourage confidence building. Research into academic tracking of students has shown that highly differentiated courses tend to produce more outcome inequality for pupils from different classes (Buchmann & Park, 2009). The negative experiences associated with females being placed in general science classes and the limited relevance of the content to their own lives are major contributing factors to female students' avoidance of science coursework in high school, as well as science majors and career choices beyond secondary education.

Social barriers also present challenges to females negotiating science. Social barriers include interactions with people viewed as role models: parents, teachers, and peers. Parents tend to view science and mathematics less important for their daughters than their sons (Clewell et al., 1992). Parents are more likely to engage in discussions about science issues, purchase science toys and games, and support science-related extracurricular activities for their sons. A study by Crowley et al. (2001) showed that parents are three times more likely to explain and engage in discussions about science exhibits in museums with boys rather than girls. As a result, females are more likely to participate in play experiences that offer little understanding of the physical world and fewer opportunities to build spatial and physical concepts (Hensel, 1989). Although most parents support general academic performance, "they tend to discourage their daughters from entering quantitative fields in college" (Clewell et al., 1992, p. 11). Traditionally, parents perceive social and service oriented roles as more appropriate career choices for females. Research continues to show that females hold lower science self-efficacy levels than males on tasks that are viewed as masculine (Singh et al., 2007) making parents' stereotyping of science as a male domain a difficult barrier for females to overcome.

Science teachers exert their influence on female students in multiple ways. These influences include attitudes and behaviors, curriculum decisions, instructional strategies, and ability grouping. “Females tend to be influenced by what their teacher thinks of them and their ability in science” (Clewell et al., 1992, p. 7). Becker (1981) provided evidence that teachers view male and female abilities differently, thus teachers offer recognition and criticism differently. Most often in the science setting, boys are expected to perform better than females, and receive more praise than females (Eccles-Parson, 1984). However, in recognizing students’ abilities, teachers “show confidence in each student’s ability to learn” (Clewell et al. 1992, p. 27). Providing laboratory and hands-on experiences increases opportunities for students to make real-world connections to science concepts. Experiences designed to support physical science concepts have been shown to close the achievement gap between female and male students (Burkam et al., 1997) by giving females a “deeper conceptual knowledge of and more interest in science” (Hyde, 2007, p. 137).

Finally, students are strongly influenced by their peers. Due to the societal stereotype that science is male dominated, children also stereotype science as masculine. Steele’s (2003) study showed that girls rated adult men as more interested in and being better at science and math than women, although the girls rated boys and girls as equally achieving in these disciplines. Research shows that girls use peers to assess their own science achievement and career aspirations. This has been proven problematic as peers reinforce the gender stereotype in science and they punish non-conformity (Hannover & Kessels, 2004; Kessels, 2005). By middle school, female students are receiving less peer support for science activities than boys (Stake and Nickens, 2005).

Ultimately, females attribute their success in science to external social support. The lack of support from teachers, parents, and peers had led females to hold a lower science self-efficacy on tasks that are perceived as masculine. To better connect how these barriers affect middle school female students, I next examine literature that describes the middle school environment including the middle school science classroom and the female middle school students who occupy these classrooms.

Middle School

Clewell et al. (1992) note that the middle school years are a period when adolescents experience “great developmental change in the psychomotor, affective, social, and cognitive domains, dictating special educational needs” (p. 16). For decades, researchers and educators have examined how these changes affect students’ academic success. In order to establish effective strategies to help students, it is critical to identify the needs of middle school students. The Center for Early Adolescence (2008) compiled a list of seven students’ needs in which to consider along with their ongoing adolescent changes. First, middle school students need diversity in instruction or programs to support the wide range of abilities, interests, skills, and levels of maturity present in this population of students. Second, in order to allow students to develop a sense of identity that separates them from others, they need opportunities for self-exploration where they can develop “independence, self-esteem, and self-reliance” (Clewell, 1992, p. 19). Third, students need ways to engage in learning that is meaningful and relevant to their school and community in order for students to feel a sense of belonging in a group. Fourth, students need social interactions with both peers and adults to help them “learn social skills, control their behavior, and share their problems and feelings” (p. 20). Fifth, students need physical activity that compliments learning by sustaining their interests. Sixth, students need opportunities that promote competence and achievement where students are praised for good work, encouraged to work independently, and self-reflect on their own performances. Last, students need structure and clear limits that provide security as they continue to learn.

Research shows that when the needs of middle school students are met, the results include academically prepared, self-confident students who seek out answers to questions, utilize resources, and pursue their interests. However, when students' needs are not met, barriers emerge that cause students to question their abilities, interests, and goals. These barriers can magnify the issue of underrepresentation of females in the area of science. Research has shown that these barriers in females cause: 1) negative attitudes regarding science; 2) lower performance levels on standardized tests than their male counterparts; 3) limited exposure to science enrichment programs or failure to enroll in advanced science courses in high school; and 4) lack of information about and/or interests in science-related careers (Clewell, 1987; Clewell, Anderson, and Thorpe, 1988). For the purpose of this literature review, it is my goal to present a foundation of research examining the environmental influences that either encourage or discourage positive science identity construction in female middle school students. Next, I examine the middle school science classroom environment.

The Middle School Science Classroom

Early adolescence is a critical developmental time period as both positive and negative experiences can have lasting effects on students' lifelong learning, quality of life, and career aspirations and success (Csikszentamihalyi & Schneider, 2000; Sternberg, 2001). Due to the vulnerability of youth at this life stage, the context of the middle school classroom is at the heart of countless research studies examining students' identity construction. During middle school, students may start to question their abilities to succeed (Simmons & Blyth, 1987; Wigfield et al., 1991) and their intrinsic motivation to learn has been shown to decline (Anderman et al., 1999). A supportive school environment can slow the negative effects on self-efficacy and a desire to learn. Schaps, Battistich, and Solomon (1997) found that students are more likely to develop positive attitudes about themselves and prosocial attitudes and behaviors about others if students find their school environment to be caring, nurturing, and helpful. Supportive schools foster positive outcomes in students by promoting students' sense of "connectedness" (Resnick et al., 1997), "belongingness" (Baumeister & Leary, 1995), or "community" (Schaps, Battistich, & Solomon, 1997). In the end, Calabrese Barton et al. (2013) state that "what it means to be a good science student in the classroom is a product not only of standard achievement, but also of who one is allowed to be through the norms and routines that shape classroom life" (p. 44). In this section, I examine research that has been conducted to help educators understand the components of the middle school classroom as they affect female students' identity construction.

Ballard (2013) used a critical ethnographic case study approach to examine middle school girls' participation in OST programs. Informed by Lave and Wenger's (1991) concept of situated learning, Ballard's study viewed the science classroom as one type of learning community in which identity is constructed. Ballard (2013) states that the science classroom "has established norms, rules and expectations that structure how its inhabitants behave, interact and what roles they can take on" (p. 5). The study examined the various approaches to participation in the science classroom such as teacher-centered instruction, small group activities, or individualized projects or assignments. Ballard noted that these different forms of participation allow students to "author" and "reauthor" their science identities as they take on various roles and behave according to these roles.

The Ballard (2013) study allowed female participants to tell their story through a framework of narrative identity. Data was collected over two years from 17 middle school girls through interviews and small focus groups. Noteworthy findings from the study included the girls' tendency to be "consumers rather than producers of scientific knowledge" (p. 3) as the girls tend to take fewer risks and follow directions according to teacher instructions. This approach led to high achievement within the participants. As a result, the girls viewed themselves as being good science students, but negative experiences in the science classroom impacted their science self-efficacy. The girls also were most interested in participating in science activities that had personal interests or were beneficial to the community, but were not resistant to taking intellectual and social risks like leadership roles or acting as a scientist.

Ballard's (2013) study implications noted that the girls' science identities were most influences by "the social dimensions of their science education" (p. 2). To construct strong science identities, the girls required recognition as science thinkers from both teachers and peers. A lack of recognition resulted in negative experiences that the girls internalized as a weakness in their science abilities and achievement, thus negatively impacting how they identified with science.

Calabrese Barton et al. (2008) acknowledge the socially constructed environment of the science classroom. In doing so, the researchers discuss how middle school girls merge their social worlds with the world of school science. Calabrese Barton et al. state that "the science classroom is its own subculture, with particular ways of knowing, talking, and doing that do not always clearly align with the social worlds that [students] bring to learn science" (p. 72). Learning science is not simply learning the content presenting in class, but becoming a participant in the learning community of the science classroom (Aikenhead & Jegede, 1999; Seiler, Tobin, & Sokolic, 2003). Calabrese Barton et al. (2008) stress the value in establishing a hybrid learning community in the science classroom that integrates students' home experiences with the expectations of the classroom. The motivation to provide students with a hybrid environment is based on the view that "science instruction is at odds with students' worldviews"

(p. 73) causing students to abandon their way of thinking while reconstructing new ways of thinking. Calabrese Barton et al.'s study confirms the positive effects a hybrid environment would have on students' identity construction.

The science classroom offers a variety of opportunities for students to author their identities. Approaches to instruction include whole-group, small group, and individual tasks. Calabrese Barton et al. (2008) refer to the different instructional approaches as *science practices* arguing that students must not solely learn science content, but how to participate in these practices. The researchers align themselves with the idea that "identity is fluid and constructed socially within communities of practice" (p. 75). The science classroom is a community of practice in which the expectations of students impact the students' role identity as student and their social identity as a member of the class.

However, if instructional strategies and materials in science do not align or complement the learning styles of females, these students fail to identify with science (Beane, 1985). This happens when instructional strategies do not promote practice, causing females to develop a "poor self-concept as a 'doer' of science" (Clewell, 1992, p. 5). Furthermore, female students tend to have a negative perception of how science relates to their lives. When females fail to make the connections between science practice and instructional strategies, they struggle to transfer knowledge to higher order learning (Coles and Griffen, 1987). The failure of teachers to accommodate female learners can be disastrous. A majority of these students will enroll in more general and remedial science high school courses (Malcom, 1984). Often, these courses further perpetuate females' insecurities in science by failing to integrate the appropriate strategies and practices they need to be successful.

Ultimately, as children evolve into adolescence, research confirms that they begin to identify themselves as they believe others perceive them (Tarrant, North, & Hargreaves, 2001). Thus, the sense of self that a middle school student recognizes is not based on the student's uniqueness, attributes, or personal goals. Rather, the student's sense of self has been constructed to align with the perceptions of the student's peers and others in the school and community. The student's identity is a direct result of the social context in which he or she is immersed. For middle school students, the foremost social context is the classroom. As a result, the various academic contexts within the school influence the changing identities students will reveal.

The Middle School Female Student

Hill, Corbett, and St. Rose (2011) found that middle school is a time when science and engineering interests and participation drop quickly even when academic achievement remains high. Middle school students in a science classroom "encounter and become a part of powerful narratives, traditions, and histories that demarcate what is means to be a particular kind of person in science" (Calabrese Barton et al., 2013, p. 42). Regarding female populations, middle school is a critical time for educators to understand female students' formative experiences and career aspirations in order to better support their interest in science (Archer et al., 2010). Middle school female students are an especially vulnerable population as the socially constructed norms established in the classroom for "becoming in science" (Calabrese Barton, 2013, p. 42) present challenges. Calabrese Barton et al. (2008) note girls' choices about peer groups, mentors, grades, and afterschool programs in middle school are key to the high school courses they pursue and the resources they seek in order to become and/or to remain engaged in science. In this section of the literature review, I present studies that examine the how and why of females' interests and success in science. It is by presenting research that I seek to understand what factors contribute to the development of female students' science identities.

Calabrese Barton et al. (2013) used a longitudinal ethnographic case study approach to examine girls' identity trajectories from sixth to eighth grade. Two Midwestern schools were intentionally selected based on "historical relationships, allowing for depth of knowledge regarding schooling and science institutional and cultural narratives" (p. 46). In other words, the sites provided diversity in the female population of students. The diversity offered researchers a social context in which to examine a variety of variables, both culturally and ethically. The researchers in this study purposefully selected two case studies of girls who exhibited different kinds of science identity trajectories during middle school. Diane and Chantelle were chosen because "their contradictory natures help [the researchers] to describe the complicated process of authoring identity trajectories through the interaction between self and social contexts" (Calabrese Barton et al., 2013, p. 49). Ultimately, the goal of the study was to better understand how different science backgrounds and experiences in girls impact how they construct a science identity.

The first case, Diane, confirmed the notion that females' interest in science loses momentum during middle school. Diane enjoyed science throughout middle school; however, she failed to view herself as being good at science even when her science grades remained high. Over the course of three years, the researchers noted that Diane maintained consistent views about science. She engaged in science activities at home, relished in questioning the world around her, and remained openly aware of the importance of science in her life. By her eighth grade year, researchers had observed "a noticeable change in [her] interest, participation, and positioning in science" (Calabrese Barton, 2013, p. 49). Over time, Diane had changed from an active participant in the science classroom to someone who was “sleepy, talkative, and drew a lot” (p. 54). Ultimately, Diane renegotiated her role as a science student. The study revealed several factors that influenced Diane’s shifted in her sense of self.

Diane participated in a lunchtime science club during her seventh grade year. By the end of that year, Diane had stopped attending. When asked about her disengagement, Diane alluded to peer influences. Because none of her friends were in the club and she could only see them during lunch time, Diane said they had asked her to stay with them in the cafeteria. Diane’s choice confirms that peer influences are influential in determining the level of participation in science for girls.

Another significant influence was the teaching approaches of Diane’s science instructors. In seventh grade, Mrs. D proved to be dynamic and engaging. Students were constantly encouraged to question and explore science. In eighth grade, Mrs. E relied on a lecture approach to teaching. The researchers noted that in Mrs. E’s class Diane isolated herself from class activities by drawing pictures rather than attending to note-taking or asking questions. When asked about her pictures, Diane indicated that drawing gave her something to do when she was bored.

Calabrese Barton et al. (2013) observed Diane spending more time on finishing labs and assignments than most of her peers. They noted that this extra time was not due to difficulty with concepts, but Diane commitment to exhausting inquiry possibilities and providing in-depth responses to questions. The researchers found Diane to be focused, consistent, and thorough. Diane, on the other hand, viewed her methodical work as a lack of ability. She identified students to be “good at science” if they finished early even if these students received comparable grades to her grades.

Finally, Diane's socioeconomic status played a role with her trajectory shift. As a result of opting out of band due to her family's inability to pay fees, Diane was placed in an average track science course in the eighth grade. As a result of her placement, Diane was exposed to few opportunities to pursue science inquiry activities like projects, experiments, and class discussions. When Diane was able to voice her science curiosities, there was a significant lack of "recognition for her science interest or understanding by her peers and teacher" (Calabrese Barton et al., 2013, p. 53). This translated to Diane as not being good at science.

According to the researchers, Diane's case is not uncommon with middle school girls. Girls use the volatile years in middle school to establish their place in the social context of classroom and within the role of a student. The results of the study showed that Diane "maintained a strong science identity from one particular point of view (she still likes experiments), [but] did not think of herself as a good science student not did others view her that way" (Calabrese Barton et al., 2013, p. 54-55). Diane struggles impacted her science self-efficacy by disengaging her from the outward behaviors that reflect the social accepted "good science student." This issue remains at the forefront of science identity research in female students.

Contrarily, in the second case study, Chantelle's interest and success in science flourished during her three years in middle school. Chantelle was a reserved and well-behaved student. She always completed her work, but never volunteered to ask or answer questions in class. Calabrese Barton et al. (2013) claimed that Chantelle "often used good behavior and silence to create a safe place in the classroom for herself" (p. 59). However, Chantelle joined the Green Club at school as a result of her friends encouragement, and she found that the club offered her a place to integrate her love for dance with science. The researchers noted a situation when

Chantelle performed a dance for the club members as a suggestion for a club slogan. This example offered insight into Chantelle's desire to be a part of the social group and accept the role of a group member, thus contributing to her science identity. This situation merged a behavior Chantelle perceived herself at being good at (dance) with the focus of the club (science). As a result, she received recognition from club members, and an overall sense of success in her role as a science club member.

In a similar situation, the researchers found that Chantelle enjoyed telling stories "to engage in scientific talk" (Calabrese Barton et al., 2013, p. 60). During several science club meetings, Chantelle's vocabulary evolved from basic to more scientific. Therefore, the researchers noted an increase in her confidence to discuss science topics through her "performance" of stories in her own life. Through her involvement in the science club, Chantelle renegotiated her role as a science student by "developing [a] sense of self in the club as someone who can do science" (p. 61).

In three years, Chantelle's science identity had strengthened through her work in the Green Club. As a member of the club, she was afforded opportunities to organize and lead group activities, make suggestions about projects, and offering explanations regarding science issues. These behaviors were made possible by Chantelle's ability to incorporate her passion for dance and acting. Her increased science interests translated into the classroom as well. The quiet student who rarely participated was now raising her hand and contributing to scientific discussions.

In the end, Calabrese Barton et al. (2013) concluded that Chantelle developed a strong sense of self in science when given the opportunities to incorporate dance and acting in science. Her actions were positively recognized by her peers as playing a significant part of science work in the club and in the classroom. Chantelle was viewed by peers as being a "science expert" (p. 63), but most importantly, she established an interpersonal identity as a successful science student.

Calabrese Barton et al.'s (2013) study is an impactful example of how female middle school students' identity construction is ongoing and influenced by a multitude of social factors. The researchers work helped to open discussions regarding the "critical shifts in each girl's trajectories" by isolating the "mechanisms that foster those shifts" (p. 64). As educators, the responsibility of recognizing these mechanisms and promoting positive shifts in science trajectories lies in our hands. To reverse the waning science interests among middle school girls, researchers and educators must continue to examine the stories and experiences of our youth.

Out-of-School-Time Programs

For decades, studies on female students' interests in science has shown that more girls would consider science as a career if they received more encouragement from schools (Reis & Callahan, 1989) and had women in math and science as mentors in which to seek direction and advice (Rohrer & Welsch, 1998). The case studies described in the previous section support such results. Regardless of their trajectories in middle school, Diane and Chantelle both sought encouragement and reassurance from teachers and peers. However, research also shows that the learning community of the science classroom has barriers that have proven to dissuade some female students' from identifying with science. Whether the barriers align with gender, ethnicity, or socioeconomic, females have historically represented a disadvantaged population in science fields. As education reformers began to take notice, so did the efforts to enhance opportunities for females. In this section of the literature review, I examine studies and examples of out-of-school (OST) science programs that have helped to increase female interest in science and altered the trajectory of female participants to identify with science.

In 2001, the Bush Administration signed into legislation the No Child Left Behind (NCLB) Act. NCLB proposed the ambitious goal of closing the achievement gap between "more affluent U.S. families and our underclass" (Marx and Harris, 2006, p. 469). With this goal, the federal government turned its focus to ways of helping low achieving students reach proficiency in content areas. One piece of NCLB was to concentrate on children's OST activities. According to NCLB, OST services must occur after regular school hours and must consistently demonstrate an increase in students' achievement (No Child Left Behind Act of 2001, section 116[e]). At the time of the legislation's enactment, OST programs were developed to meet the needs of students' achievement in math and language arts; however, recently, renewed attention has been given to OST programs that aid in students' science learning.

OST refers to the hours in which school-age children are not in school (National Institute on Out-Of-School Time, 2003) and the related programs during that time include activities other than those mandated in the regular school day (Lauer et al., 2006). OST programs were originally instituted in the early 1900s to ensure the safety and well-being of children in unsafe neighborhoods and to provide childcare as women returned to the workforce (Halpern, 2002). Today, OST programs are found across the country and vary in goals and practices. Because OST programs service different age groups, the programs' practices must reflect developmentally appropriate enrichment activities. The various formats of OST programs across the U.S. can make research on the effects of program interventions a challenge.

Ultimately, the goal is for all OST programs to "deliver content that will facilitate developmental growth and promote positive well-being" (Green et al., 2013, p. 1558). Research suggests eight characteristics of high quality OST programs: physical and psychological safety, appropriate structure, supportive relationships, opportunities to belong, positive social norms, support for efficacy and mattering, opportunities for skill building, and integration of family, school, and community efforts (Eccles and Gootman, 2002). OST programs that maintain these characteristics have been found to impact long-term positive outcomes in youth by contributing to skill development, strengthening social relationships, and fostering identity construction (Mahoney et al., 2005).

Greene et al. (2013) used quantitative survey results from 435 low income middle and high school youths participating in one of 30 OST programs to examine their level of program engagement as it correlated with several factors. The factors tested were staff characteristics, program content, monetary incentives, and demographic characteristics of participants. The results indicated that the youths' engagement positively correlated to both staff characteristics and program content. Therefore, youth participants were most engaged in an OST program when the staff is caring, competent, and supportive, and the skills introduced through program activities are personal beneficial to the participants. For example, participants were more engaged when they were learning new skills that could help them find a job or make decisions about college. Interestingly, the youths' engagement was negatively correlated to incentives offered to participate such as gift cards, snacks, or field trips. Also, youth engagement was not related to demographic characteristics like ethnicity, gender, or age. The final two factors negatively correlated to youth engagement can be further supported by Akiva et al.'s (2013) study on youth belonging.

Akiva et al. (2013) studied how OST programs' social context fosters a sense of belonging in students. It is the researchers' findings that indicate students' cognitive engagement in a program's activities is the result of their emotional reaction to being accepted into a group. In their study, Akiva et al. administered surveys to 1160 youths representing 123 OST program offerings in four states. The survey assessed the program influences as they relate to youth engagement. The results indicated similar findings to the Greene et al. (2013) study in that youth are more engaged when a program's atmosphere is welcoming. A sense of belonging resulted when youth were more engaged. Additionally, youth indicated great cognitive engagement when they were active participants in their own learning.

Both the Akiva et al. (2013) and Greene et al. (2013) studies contribute to a growing body of literature examining factors that promote greater engagement of youth in OST programs. As noted in an OST STEM program evaluation report, DiLisi, McMillin, and Virostek (2011) state that increased OST engagement aids in the development of students' sense of self-efficacy in science. Research in education shows that the stronger an individual's self-efficacy, the more interest the individual has on the topic (DiLisi et al., 2011). In this program evaluation, the researchers developed a STEM program entitled *Project WISE: Working in Informal Science Education*. They employed both internal and external evaluation strategies to review the program's implementation process and impact on students, as well as pre- and post-survey feedback from participants. To bridge the informal and formal education communities, the program targeted two populations: 35 female high school juniors and seniors, and approximately 350 K-5 students. The results of the evaluation showed the program's strengths were impacting an appreciation and career interest in STEM among high school females, introducing peer mentorships between high school and undergraduate students, making contributions to the community, providing favorable incentives for participants, and accomplishing goals through a successful event day. The broader impacts of this program's evaluation is to provide a model for further OST program development especially programs that recruit female students and support female identity construction.

Adams et al. (2014) look at the long-term impacts of an OST museum program on female participants. In addition to being female, the study participants were ethnically diverse representing yet another population that is underrepresented in science fields. The focus of the research was a STEM program called *Lang Science* that was implemented through the Museum of American History. As Bell et al. (2009) note, museums have long played a role in supporting STEM education through informal settings. The researchers employed a narrative approach to the data analysis by inviting eight former *Lang Science* participants to reflect on their experiences through a focus group setting. In reflecting on their experiences, the female participants were asked to discuss their "post-graduation success and challenges with science-related experiences" (Adams et al., 2014, p. 18). The results of the study emphasized key factors in the OST program that promoted women's identity development and career aspirations.

First, the women in the study indicated that the OST program provided them with a safe environment in which to explore their science interests. They expressed a sense of isolation at school due to their science interests, so the OST program helped to build a collective identity among the participants. Adams et al. (2014) refer to collective identity as "a sense of group membership with like-minded peers" (p. 16). Similar to the findings in the Akiva et al. (2013) study, this study also gave the female participants a sense of belonging. They perceived the OST program as nurturing both interests in science and relationships with others that had interests in science.

Next, the females viewed the museum as a "community of science-minded people" (Adams et al., 2014, p. 17) in addition to a physical location. This community offered the women opportunities to engage in science discourse with science professionals. They were able to attend events that exposed them to others who enjoyed and pursued science issues. The participants were given access to all parts of the museum which further built their sense of belonging. People in the museum viewed the OST females as scientists, thus strengthen the females' identities through recognition.

Finally, *Lang Science* provided female participants with broader views of practicing science, which proved to encourage science career trajectories. The women reflected on their enlightened definition of *doing science* noting that science is not only lab experimentation and research. As the participants were given opportunities to communicate, writing, and analyze through the program, they found science career fields extended beyond their narrow understanding of the major fields. As Adams et al. (2014) state, the women "developed fluency in the culture of science" (p. 17). These experiences with various fields of science influenced several participants' decisions to consider STEM careers. In addition to changing career trajectories, others explained that long-term participation in the program helped them to persist in science fields.

OST programs offer unique opportunities to provide educational support for students. The high quality programs discussed in this literature review confirm that OST programs afford underrepresented groups, like females, an environment in which to engage in science activities without the barriers present in the science classroom. From self-efficacy to a sense of belonging, OST programs provide females with the essential skills, support, and encouragement to pursue science interests.

Theoretical Framework

As a constructivist, my view of the world and how it relates to the kind of knowledge being developed is evident through my study's research approach. My beliefs of assembling knowledge are guided by Piaget's cognitive model of constructivism. Like Piaget, I believe the "individual learner is an active constructor of knowledge; developmental processes must precede learning through instruction; and language is an epiphenomenon of thought and not constitutive of thought" (Dimitriadis & Kamberelis, 2006, p.169). In my research, I promote the idea that students construct their own knowledge and understanding of the world through experiences and reflection of those experiences. I have framed this study using the constructivism paradigm specifically focusing on a general identity theory. I believe identity is constructed once one gains knowledge about a particular role, group or community. Through worldly experiences, a person understands what behaviors align with a specific identity. The person will perform those behaviors to fit the parameters of an identity, and thus, will have constructed the identity within oneself. Throughout my study, I apply identity theory as the lens through which I understand the construction of science identity in middle school students. In doing so, I explicitly examine the role of OST programs in the development of science identities in female students.

The goal of my research is to study female science identities, how identity is developed or dissolved in middle grades, and how an OST program during middle school can contribute to the development of female science identity. By relying on the research of identity theorists, my study brings attention to students' science interests, equity in science education, and science self-efficacy. In the following sections, I will define identity, highlight the historical roots of identity theory, and connect identity theory to the goal of my study.

Identity Theory

In the last ten years, researchers have increased their focus on the construct of identity as a way for understanding how students learn science (Calabrese Barton et al., 2013). According to Burke and Stets (2009), identity is "a set of meanings that define who one is when one is an occupant of a particular role in society, a member of a particular group, or claims particular characteristics that identify him or her as a unique person" (p. 3). The problem faced by researchers of identity is that one's identity is always under construction. Social and environment conditions require one to continuously negotiate one's identity. When studying middle school students, I acknowledge outside influences in their home, their community, or in the media that have contributed to and continue to mold students' science identities. In addition to these influences, the science classroom and science teachers are major contributors of science ideas and knowledge. The scientific understandings that students acquire in the classroom will interact with outside influences to further construct the students' science identity. The science teacher's role in the classroom is most significant in that he or she develops, implements, and manages the methods of science instruction that will effectively deliver scientific content to students. When studying students' science identity construction, it is crucial to recognize that each middle school classroom exists as a social context in which students' identity construction, academic learning, and peer relations vary. Thus, each student in a science classroom has a unique perspective on learning, the classroom, and him or her self.

Historical Roots of Identity Theory

Social psychologists and sociologists introduced the concept of identity as a social construct during the twentieth century. Mead (1956) describes the identity, or self, as both a subject and an object that expresses and reflects the behaviors of the social groups to which the individual belongs. Noting that "selves can only exist in definite relationships to other selves," (p. 227). Mead suggests that an individual constructs identities in relation to the social context in which he or she inhabits. For middle school students, the school building depicts a primary social context in which identities emerge. According to Mead, scholars must examine the cultural contexts in which certain norms exist as the individual may express and reflect social norms or behaviors. "We divide ourselves up in all sorts of different selves with reference to our acquaintances" (Mead, 1956, p.207). Therefore, social interactions determine various identities, or selves, that we project toward others.

The Meadian concept of identity encompasses "social positions and other roles crucial to the conduct of social activities and relationships" (Holland & Lachicotte, 2007, p. 103). Associated with the field of social psychology, Mead's theory of identity allows for evolving, multiple identities that emerge in relation to group, or social, identities. Because my study focused on the construction of middle school students' science identity, specifically female students who participated in a science OST program, the Meadian notion of identity best aligned within my theoretical framework.

Vygotsky continued building on Mead's identity theory by transitioning from Mead's perspective of a fluid, ever-evolving "I" into a theory that allowed social groups to "author…new selves and new cultural worlds and try to realize them" (Holland & Lachicotte, 2007, p.116). Vygotsky's theory of identity adds that not only does the sociocultural context influence the individual, but the individual acts as an agent interacting with and shaping that context. In other words, the school building, teacher, and classroom contexts all exists before students arrive and sit at the desks. However, the classroom will not become a community of learners until the students enter and interact as part of the context. I found Vygotsky's views on sociocultural theories of identity to be beneficial in guiding my work with students' science identities.

Identity Theory in this Study

For the purposes of my study, I approached identity as a social construct merging the characteristics of the primary theories of identity: social identity theory (SIT) and identity theory (IT). Hogg, Terry, and White (1995) define identity as the "socially constructed self" (p.262). McCarthy (1999) supports this definition, stating that identity is constructed through social interactions and cultural constructions. In other words, a student's science identity is dependent on factors introduced to the student each day in the various social contexts: the classroom, their home, or in the community. The way a culture or community views the roles of a student, a scientist, or a female, plays a major part in students' identity construct within these roles. It is important to understand that a students' science identity originates before the student enters a classroom. Students are influenced by worldly experiences from birth that direct the construction of students' science identities. As previously mentioned, the construction of one's identity is always in the making due to factors influencing how one builds an understanding of who one is, how one fits into a group or community, and what role one plays in that setting. Often students are not presented with science as a standalone course until middle grades. By this time, students have been exposed to ideas and beliefs about science that have directed the construction of their science identities.

According to Dewey (1959), identity construction occurs "not in isolation but by interaction with the conditions which contain and carry subject-matter" (p.122). Dewey suggests that the school curriculum, including the context in which the curriculum exists as learned subject matter, influences non-curricular outcomes. In fact, a student learns to identify his or herself within the subject matter, as he or she simultaneously learns about the curriculum and about her or his emerging identity (Pope, 1999: Wortham, 2006). In the classroom, the teacher, science curriculum, and science school programs, play a significant role in guiding students' accurate interpretation of science understanding. It is my belief that the interaction of instructional methods and student understanding within the social context of the science classroom that will dictate the construction of students' science identities.

I believe that by using an identity theory framework, my study contributed to a growing collection of education research on students' identity construction as influenced by factors both in and out of the classroom. I narrowed my study to focus on identity construction within the context of science and middle school female students by examining several areas. In the end, this study offered results and findings about middle school female students' science identities, how female students' science identities influence their participation in an OST science program, and how an OST program helps to further construct female students' science identities.

Conclusion

In closing, the review of literature used to frame my study affirms the complexity of identity construction. The work of several identity theorists confirms that one's sense of self is always under negotiation. This negotiation is a result of the social context in which one is a participant. "Because identities are always in the making and are always socially negotiated, they are impossible to isolate or to name, raising questions about how to study them" (Calabrese Barton et al., 2013, p. 38). For the purpose of my research, I combine the theories of IT and SIT as I consider a general identity theory with the understanding that one occupies both a role and a group simultaneously. Identities constructed as a result of these theories are social constructed. In middle school students, science identity construction is influenced by various factors at school, home, and in the classroom. The literature describes that among these factors, females are especially susceptible to their environment. In an effort to support female science identities, OST programs have been developed across the country. Through continued research, educators and reformers are able to highlight the effective practices of OST programs to inform future development of programs. Ultimately, the goal of this study is to examine how OST programs encourage stronger science identities in females leading to trajectories that include career choices in science related fields.

CHAPTER III: METHODOLOGY

This study documents the impacts of a science OST program on the construction of middle school female students' science identities. The study also isolates the factors that influence the females' identities, which is critical for continued efforts in science education. From the research presented in Chapter II, identity development plays a significant role in the academic progress of middle school students and guides their career trajectories. More recently, focus has been placed on the lack of females pursuing science interests through high school course work and college majors. Therefore, data were collected in two phases. The first phase established the foundation of the study by examining the thoughts and beliefs of both male and female students at the study's middle school. Once a foundation was established, the second phase provided clarity as to the major influences molding the science identities of female students. Theories were generated to recognize factors contributing to or hindering the development of middle school females' science identities. Both quantitative and qualitative methods were used to analyze the data.

This chapter provides a detailed description of the data sources, the methods used to analyze the data, and the rationale behind these decisions. The first section of the chapter contains a description of the science OST program and the contributions of a pilot study conducted to identify stakeholders' satisfaction of the program. This section establishes the foundation for the current science identity study. The chapter continues with an explanation of the research design and a description of the population of students at the study's middle school. This is followed by a description of the data sources, the instrument used, and the data collection procedures. The final section details both the quantitative and qualitative data analysis procedures for the two-phase study.

The Science OST Program

Developed in the fall of 2007, the science OST program at the focus of this study has served over 470 students in one Southeastern suburban middle school. The target population for the program is 7th grade. Historically, 7th grade poses challenges for students as they gain independence, take on greater academic responsibilities, and explore more complex science concepts. Students interested in the OST program apply in mid-December, and if accepted, participate in monthly science-related activities during the spring semester. The OST program is defined by a five-day trip to the Outer Banks of North Carolina at the end of the school year. To better understand the components of the program, the program's objectives, application process, activities, and trip to North Carolina in are discussed in this section.

Science OST Program Mission

The science OST program's mission is to expose middle school students to an informal science environment based on student-centered approaches to learning. These approaches to learning have their origins in constructivist developmental theory (Fosnot & Perrry, 2005) because they promote the idea that students construct their own understanding and knowledge of the world. The program allows students to do this by using their own experiences and observations in science to build new scientific connections through team-based, cooperative learning activities (Felder & Brent, 1996). Student-centered learning also allows students to question and think critically (Holdzkom, 1984) about science concepts that are presented during instructional activities. Ultimately, the science OST program implements student-centered learning approaches so that students can simultaneously learn science, do science, and develop a science identity – that is, they learn not only to like science but also to view themselves as active participants in the scientific endeavor (Gray, 2013).

Application Process

In the fall, approximately 350 to 400 7th grade students at the middle school are invited to apply to the science OST program. The application requirements include an essay on a science related topic, two community recommendations, six current teacher recommendations, and a report card with students' cumulative grade point average. OST program applications are due in mid-December and students are informed of acceptance into the program in early January. On average, the program has 80 to 100 applicants each year, but accepts no more than 50 students to participate.

Trip to the Outer Banks

The program extends through the spring semester with the final experience for OST program participants being a 5-day trip to the Outer Banks of North Carolina during late April to early May. During the trip, students are involved in activities that support the science curriculum and supplement other subject areas like history, literature, math, technology, and the arts (Appendix A). Program activities that occur over a 3-month period in the spring to prepare students for program's trip to the Outer Banks are described below.

Program Activities

As part of the OST program requirements, students attend monthly work sessions and complete specific assignments. Most assignments are completed with peers encouraging group interaction and collaboration. The largest of those assignments requires students to select a science or math focus in which to design a lesson plan. Students are also required to incorporate a technology and engineering aspect to the lesson activities in support of current STEM-focused standards. The topic of the lesson must align with North Carolina elementary school science standards using a state designed lesson plan template. The 3-month project concludes with the

OST groups teaching their lesson at an elementary school during the program's trip to the Outer Banks.

Also during the program, students are involved in reading, interpreting, and discussing entries from David Stick's historical account of the Outer Banks entitled *The Outer Banks of North Carolina*. Assignments using the book include concept mapping of historical events, creating reenactments of events using iMovie, development of Wiki pages to share and collaborate about topics, research on geological processes, creation of online quizzes, and online discussion boards in which students reflect on the readings. The readings provide students with a lens through which to understand the culture of the people, the evolution of the landscape, and the impact of settlers on the Outer Banks. The readings have proven to be a significant bridge connecting students' experiences on the trip with the trip's setting.

Another project students are involved in is collecting food contributions for donation to the local Dare County *Food for Thought* charity. According to the 11th Annual report (2011) from the Dare County School District, 41.3% of students in the county were eligible for free or reduced lunch in 2011, an increase from twenty-three percent in 2006. This large percentage of students reflects the population at the elementary school with which the OST students work. The *Food for Thought* charity aims to provide weekend meals for students. The charity relies on donations to fill the shelves and volunteers to package and deliver meals to schools on Friday afternoons. Students benefiting from the charity stop by their school cafeterias to collect a meal bag before leaving for the weekend. As a result, Dare County has noted shorter breakfast lines and higher assessment scores on Mondays. The OST program students donate food items each year collected from their own community food drives. Students also visit the charity warehouse and assist in stocking the shelves with the donations. This community effort comes full circle as

OST program students teach their science lesson to the very students who benefit from the food donations. Traditionally, students' experiences in the OST program are enriched through this charitable activity.

Finally, OST students collect artifacts of their experiences in the Outer Banks. Following the trip, students present their experiences to their peers, parents, and school staff at an OST Program Night. While on the trip, students are engaged in multiple cross-curricular activities that support the 7th grade curriculum. Students are asked to research topics, collect data, and provide information that illustrates their learning experiences in the program. The Program Night allows students to share what they have learned, gives parents and the community an opportunity to hear about the program, and allows program coordinators an opportunity to assess the success of the program.

Contributions of the Pilot Study

A pilot study of the science OST program was conducted prior to this research. The pilot study was an internal evaluation focused on identifying the weaknesses and strengths of the program as viewed by the program's stakeholders. A 14-question survey consisting of Likert-scale and open-ended questions was administered to parents of last year's OST program's participants. Twenty-seven parents, representing 55% of the cohort's parents, completed the survey.

For the eight years in which the OST program has served students, parents have continued to provide positive feedback about the program. After analyzing the data from the stakeholder survey in this pilot study, two major conclusions were drawn. First, the program is successful and parent stakeholders are satisfied with the experiences provided for their children.

Parents noted that the program encouraged peer collaboration, allowed students autonomy in project planning and development, challenged students to think critically, and provided science experiences beyond the classroom walls. They overwhelmingly support the program's continuation at the school, but to better serve the student population, changes can be implemented.

Next, the stakeholders had valid suggestions about how to improve the program. Those changes included curriculum and content requirements. Parents mentioned struggles with reading assignments due to the difficultly and length of the requirements. Program journals required of students were considered time consuming and distracting to participants' experiences. Regarding content, parents expressed a need to expand the mission of the program to include content areas beyond STEM such as history and the arts. Finally, they shared concern about the timing and cost of the program trip.

Of the survey respondents, 18 were parents of female OST participants. Parents indicated strengths and weaknesses of the OST program that directly influenced the focus of this current identity study. Questioned remained about how the OST program's design and implementation impact students' beliefs about the importance of science, interests in science activities, self-perceptions of their science abilities, and desire to pursue science-related careers. As a result, a need for continued research in the area of female science identity construction advanced into the current study.

Mixed Method Research Design

In general, there are three approaches or methods to conducting educational research: qualitative methods, quantitative methods, and mixed methods (Creswell, 2003; Creswell & Clark, 2011; Tashakkori & Teddlie, 1998; Teddlie & Tashakkori, 2009). Proponents of qualitative research methods "contend that multiple-constructed realities abound, that time- and context-free generalizations are neither desirable nor possible, that research is value-bound, that it is impossible to differentiate fully cause and effects, that logic flows from specific to general" (Johnson & Onwuenbuzie, 2004, p.14). Qualitative researchers are focused on exploring social phenomenon as they occur in the natural setting. Therefore, these researchers seek to explain how individuals interact with the social environment. In doing so, qualitative researchers become the instrument of data collection generating rich descriptions of individual's thoughts and beliefs while seeking to focus on "why" a phenomenon occurs. Others note, "qualitative research is seen as deficient because of the personal interpretations made by the researcher, the ensuing bias created by this, and the difficulty in generalizing findings to a large group because of the limited number of participants studied" (Creswell & Clark, 2011, p. 9). Although qualitative research methods have become increasingly popular, the methods remain questionable and problematic for many researchers.

In contrast, quantitative research methods originated from work in natural and/or physical science. Researchers who use quantitative research methods do so because of the reliable and quantifiable data produced that help to establish relationships between variables within a study. Quantitative methods are viewed as objective allowing for a reduction in extraneous influences, specifically from the researcher. The precise measurements of quantitative methods support the potential for generalizability of large populations. However, like qualitative methods, quantitative methods also have disadvantages. Creswell and Clark (2011) state that quantitative research is "weak in understanding the context or setting in which people talk...the voices of participants are not directly heard in quantitative research. Further, quantitative researchers are in the background, and their own personal biases and interpretations are seldom discussed" (p. 9).

In this sense, quantitative research methods decontextualize the role of human behavior and fail to fully explain a phenomenon.

By combining qualitative and quantitative research methods, some social science researchers argue the convergence supports a broader range of perspectives providing fairness to the complexity of the phenomena studied (Foss & Ellefsen, 2002). Johnson and Onwuegbuzie (2004) describe mixed-method research as representing a third paradigm of educational research rather than singling out approaches from either qualitative or quantitative paradigms. Researchers who employ a mixed method paradigm view the need of research as using any methodological tool that best answers the research questions. A mixed method paradigm “rejects the either/or choices associated with the paradigm wars” (Teddlie & Tashakkori, 2009, p. 74) spotlighting the limitations of using a single methodological research approach. All the tools in the quantitative and qualitative paradigms exist harmoniously within the mix method research design.

More specifically, the mixed method approach in this study is an exploratory sequential design that describes the methods of using qualitative and quantitative strands. As defined by Creswell and Clark (2011) a strand is a “component of a study that encompasses the basic process of conducting quantitative and qualitative research: posing a question, collecting data, analyzing data, and interpreting results on that data” (p. 417). An exploratory sequential design employs a level of interaction when strands are mixed at any point during the study but prior to drawing conclusions. In this study, the strands were mixed during the data collection period to provide guidance for conducting focus groups. Priority was given to qualitative strand with quantitative results contributing to a qualitative approach. In this study, the strands were implemented sequentially so that “the collection and analysis of one type of data [occurs] after the collection and analysis of the other type" (Creswell & Clark, 2006, p. 66). First, quantitative survey data was collected and analyzed to answer research question 1. Survey results were used to refine the questions asked of focus group participants. Next, transcripts of the focus group interviews were analyzed using qualitative methods to answer research questions 2. Finally, research question 3 was answered using results from both the survey's open-ended questions and focus group transcripts. The exploratory sequential design applied a data analysis approach allowing quantitative data to guide the implementation of the qualitative method (Tashakkori & Teddlie, 2003). Figure 2 details the sequential exploratory design used during this study.

Population

This study targets a suburban middle school in the southeast United States with an enrollment of 1,392 students at the time of the study. The middle school houses sixth (*n*=445), seventh (*n*=489), and eighth (*n*=458) grades with an age range of 11 through 14. Of the students enrolled at the school, 85% are White, 3.5% African American, 3.42% Hispanic, and 0.23% Native American. Of the students enrolled at the school, 52.1% are male and 47.9% are female. Less than 15% of the student body is eligible for free and reduced lunch based on reported household income (Tennessee Department of Education, 2015).

Of the students who have participated in the OST program over the last eight years, 80% have been females. Currently, twenty-eight percent of the former female participants have graduated from high school, 42% are enrolled in one of two feeder high schools, and the remaining 11% are 8^{th} graders in the middle school.

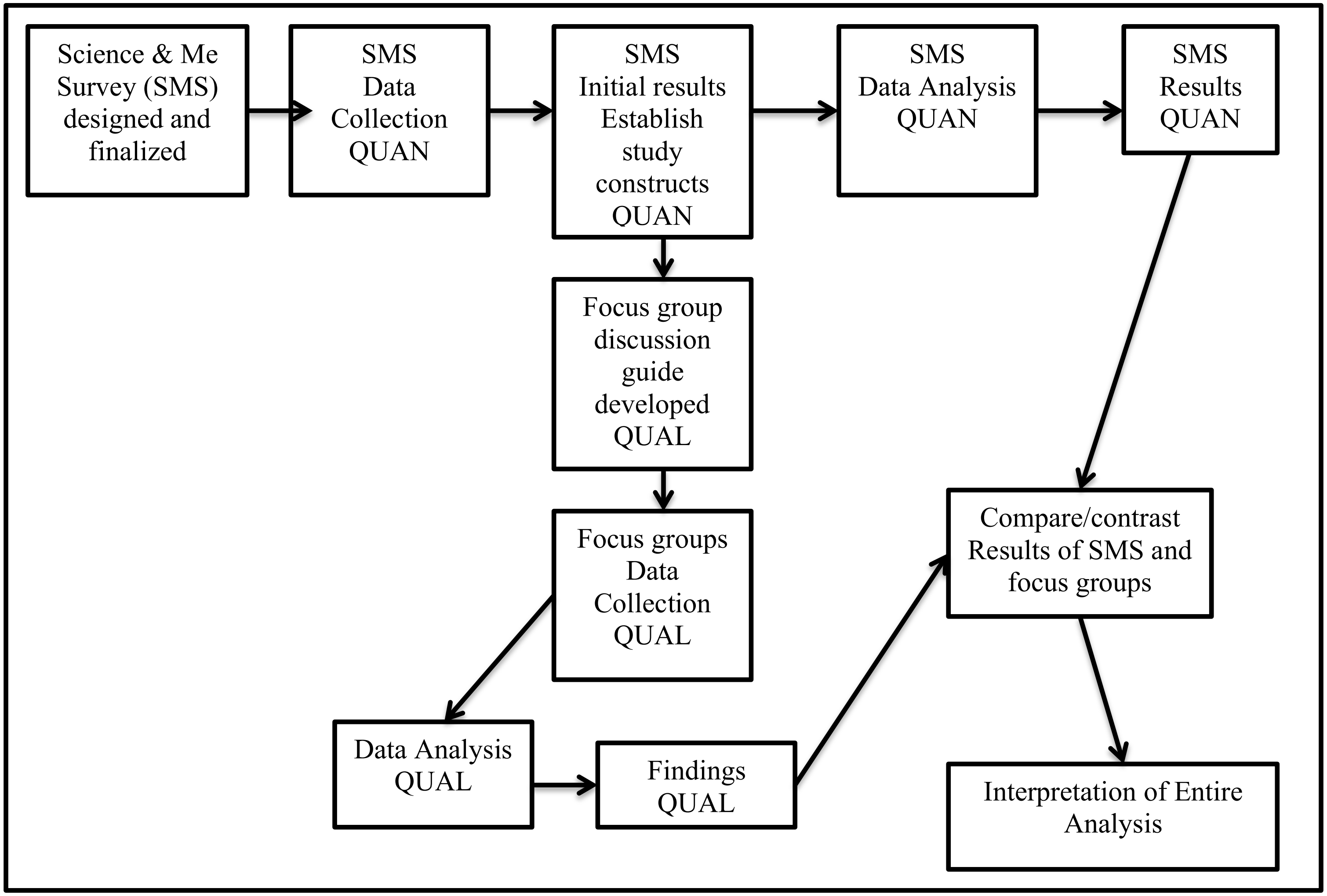

Figure 2 Sequential Exploratory Design (adapted from Creswell, 2003, p. 241)

Instrumentation

Science and Me Survey (SMS)

The SMS instrument used for this study consisted of 31 total questions. Of these, 10 questions were used to determine the demographic characteristics of the population, 18 questions were Likert-scale questions focused on the study's major constructs, and three open-ended questions asked students' likes and dislikes about science.

The SMS represents a modified instrument previously administered to eighth and ninth grade students in a study entitled, *Is Science Me? Exploring Middle School Students' STEM-M Career Aspirations* (Ashbacher, Ing, & Tsai, 2014). The study explored middle school students' aspirations in science, technology, engineering, and medical (STE-M) careers. The original survey instrument, "Is Science Me?", is based on various constructs including:

> childhood science activities; current extracurricular and school science activities; attitudes toward science, scientists, school science, and self in science; grades in science, math, and overall; perceptions of support for their science interest from teachers, family and friends; college and career aspirations; and student demographics. (p. 737)

Aschbacher et al. (2014) note that the survey questions were adapted from existing questions and surveys used in similar research studies. In the study's report, the researchers provided evidence that the survey constructs are "grounded in previous research on the role of self-perceptions" (p. 737). Aschbacher et al. piloted the survey to participating schools. They "debriefed students to maximize item comprehensibility and the sensitivity of item scales to the range of students responses" (p. 737). These measures taken by the researchers ensured construct validity of the instrument.

For the purpose of this middle school science identity study, permission was requested from Dr. Aschbacher to use, modify, and rename the "Is Science Me?" survey instrument. She granted permission to make changes to the original survey instrument. Modifications of the original survey instrument included removal of references to high school activities or specific courses, removal of demographic questions reflecting ethnicity, and the addition of questions requesting students' grade levels and participation in the OST program. Also, two open-ended questions were added at the end of the survey asking about students' science likes and dislikes. The modified survey instrument was renamed, "Science and Me" (SMS) (Appendix B). Next, the SMS was emailed to Dr. Aschbacher for approval. In addition to her approval, she provided detailed recommendations about each survey question based on her own data collection, analysis, and research experience. Several small modifications were made regarding the wording of questions based on her recommendations.

In her own study, Aschbacher et al. (2014) used a test-retest reliability approach because the same group of students in her their study took the survey in eighth grade and again in ninth grade. This approach ensured the stability of the instrument over time. Because of their extensive and thorough efforts to ensure the validity and reliability of the original survey instrument, I did not complete any validity and reliability tests. The modifications I made on the survey to fit the parameters of my study were considered minor, and along with Dr. Aschbacher's approval, did not pose a threat to the stability and consistency of the results nor what was being measured.

Aschbacher et al. (2014) named two central constructs of their study as self-perspective on science and career trajectories. As a result, I organized the survey questions into these two constructs as well as five others identified in the literature. The seven study constructs and the questions aligned within the constructs are shown in Table 2. The organization of each question into a construct allowed for streamlining of the survey data for analysis.

Table 2

Study construct alignment with survey questions

Study Constructs	Survey Questions
Students’ views of teachers and instructional practices	11
Support of science in the home	16, 17, 18, 19
Views of scientists/science-careers/media influences	7, 22
Involvement in science programs and activities	4, 6
Self-perspectives on science	8, 9, 10, 20, 27
Science interests and involvement	13
Career trajectories	5, 14, 15, 23, 24, 25, 29

Focus Group Discussion Guide

Whereas the quantitative survey determined and confirmed the factors that influence middle school students’ thoughts about science, the focus group discussions explored what factors female students feel are influential in constructing their science identities. Therefore, the qualitative research strand received priority in this study.

For this phase of the study, a focus group discussion guide was developed using the SMS questions. The purpose of the discussion guide was to provide the moderator with “a resource to maintain a balance between the [study’s] focus and the group’s discussion” (Morgan, 1997, p. 48). First, survey questions were divided into seven study constructs. Of the constructs, science self-perceptions and career trajectories, developed from the Aschbacher et al. (2014) study. The other five constructs materialized from the literature on identity theory and identity construction.

Next, focus guide discussion questions were designed to address each of the constructs. As noted by Hennink (2014), a discussion guide is not a static instrument. It can be "moderately refined during data collection" (p. 49) as the moderator may choose to probe participants or redirect the discussion using phrases or questions not originally outlined in the guide. Finally, the guide was used to facilitate the groups' discussions. The guide strengthened both the collection and analysis of the focus group data. It supported consistency in the data collected between the four focus groups in this study while allowing for comparison of similar issues across groups during data analysis (Hennink, 2014).

Focus group discussion guide structure

Research supports the development of a clear and logical discussion guide structure (Hennink, 2014). Organizing topics and/or questions appropriately promotes smooth transitions resulting in a more fluid discussion. The discussion guide structure used for this study's focus groups was the hourglass structure (Figure 3) (Hennink, 2014). Based on the work of Krueger and Casey (2009), this structure includes an introduction, opening questions, key topics with specific questions, and closing questions.

The hourglass structure begins with a broad introduction that allows the moderator to introduce himself, the participants, and attend to ethical issues related to the focus group discussion. Next, the moderator remains broad by asking simple questions that allow all participants to feel comfortable and begin to contribute to the discussion. These opening questions help the moderator build rapport with participants, as well as participants building rapport amongst each other (e.g. "Please share with me the daily activities in your science classroom.").

Like the shape of an hourglass, the focus group questions narrow to focus on key topics

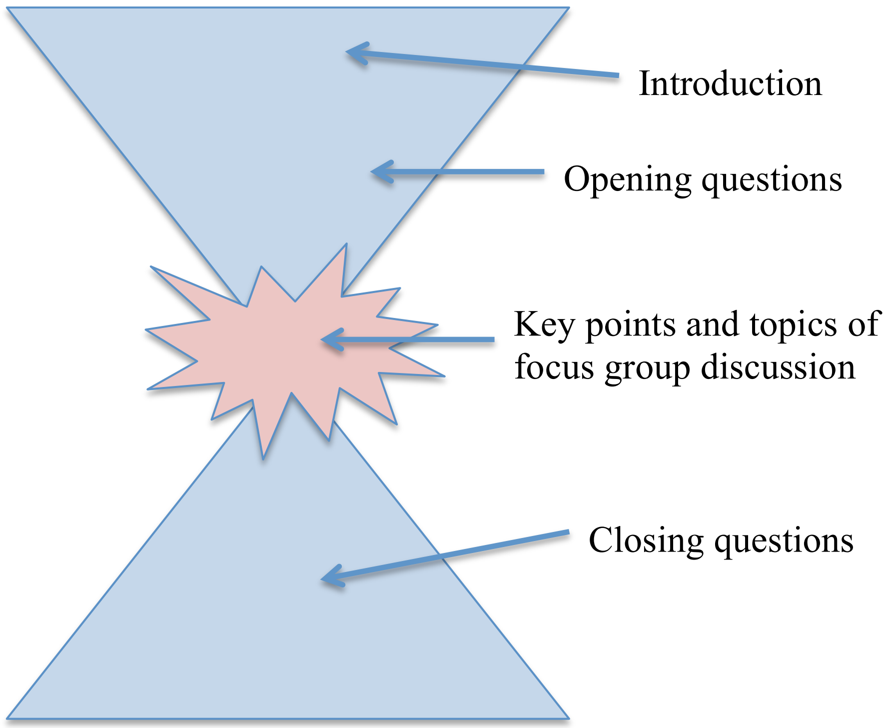

Figure 3 Hourglass Discussion Guide Structure

at the heart of the discussion. These questions are the most essential in generating data for the research study. Finally, the moderator designs closing questions that are used to signal the end of the discussion. Much like the broadening base of the hourglass, these questions represent a summary of the discussion. However, the questions can also contribute to data analysis as they allow participants to clarify statements and add final thoughts about the topics (e.g. "What types of careers do you wish to pursue? What has influenced your decision?").

Focus group discussion guide questions

For this study, the focus group discussion guide consisted of eight open-ended questions. Qualitative researchers recommend designing guides with "5 to 10 open-ended items" (Tashakkori & Teddlie, 2003, p. 308) as "a single question in a discussion guide may…lead to 5-

10 minutes of discussion or longer if the topic is controversial or participants have diverse views" (Hennink, 2014, p. 61). Due to the age of the participants and the after school focus group sessions, the eight questions were intended to keep the discussions within a period of one hour.

In addition to providing ample time for participants to talk, multiple considerations were made when designing the questions. The focus groups were used as a sequential exploratory phase of the research study to help the researcher better understand and interpret the information from the survey data. The questions were aligned with questions in the survey instrument. Also, the questions were developed to promote discussion. Being familiar with the age and research inexperience of the participants, it was key to avoid dichotomous questions. To fully answer the questions, participants were required to give detailed responses rather than yes or no. Finally, it was important to avoid direct personal questions that could make participants uncomfortable. The questions were designed to produce a broad perspective rather than personal narratives from the participants (Hennick, 2014). Table 3 provides an outline of the questions aligned with the study constructs.

Reliability and Validity

Several steps were taken to ensure the reliability and validity of the survey instrument by Dr. Aschbacher and her colleagues (α=0.82). They piloted the original survey, debriefed students, and eliminated items with poor reliability. The researchers conducted test retest reliability. Because of their efforts and the assistance Dr. Aschbacher provided me on the slight modifications to the survey, no further attempts were made to guarantee reliability. To strengthen validity of the new survey, three science teachers in the study's middle school were

Table 3

Focus group discussion guide questions and constructs

Study constructs	Focus group questions
Students' views of teachers and instructional practices	1. Please share with me the daily activities in your science classroom. a. What activities interest you? b. What activities do not interest you?
Support of science in the home	2. How is learning supported in your home? a. How is science learning supported in your home? b. How does that impact you and your performance in science?
Views of scientists/science-careers/media influences	3. What characteristics do you feel are essential for a scientists or other professional to be successful in a science-related field? 4. How do media outlets (TV, movies, internet, videos, etc.) perceive science?
Involvement in science programs and activities	5. Describe the science programs, projects, or extracurricular activities that you been involved?
Self-perspectives on science	6. How do you feel about your ability to be successful in science class?
Science interests and involvement	7. What things do you find easy, difficult, challenging, and rewarding in science?
Career trajectories	8. What types of careers do you wish to pursue? What has influenced your decision?

asked to review the survey questions. Minor modifications were recommended including small grammatical changes and ordering of statements within larger questions. These changes were made resulting in the final survey instrument used for the study.

To increase the reliability and validity of the focus group discussion guide, several steps were taken prior to the focus groups and upon conclusion of the focus groups. First, a pilot focus group was conducted to test the validity of the questions being asked of the focus group participants. The pilot focus group involved four female participants from the three academic levels targeted during the focus group discussions (honors, grade level, and basic). The result of the focus group resulted in minor modifications to the questions. The changes included the addition of two sub-questions to support question one as students in the pilot group initially failed to identify the instructional approaches they liked and disliked in the science classroom. Also, question five was added as the pilot group pointed out classroom instructional strategies incorporate media outlets as a means to teach science. Finally, participants were asked to identity the influences for their career trajectories rather than simply describe what they plan to pursue.

Another step taken to ensure the trustworthiness of the focus group data was to utilize member checking. Upon analyzing and interpreting the data from each focus group discussion, a summary of findings was emailed to each participate within the group. The female participants were asked to read the summary and provide feedback either verifying the information or clarifying misinformation. All participants in the four focus groups confirmed that the results positively corresponded with the discussions. As a result, no changes were made to the data analysis.

Collection of Data

As explained in the research design section, this study is divided into two strands, quantitative and qualitative, in which data was collected and analyzed to draw conclusions. Initial permission to conduct the study was requested by the school system through a written request. Once the school system approved the study, permission to recruit participants and conduct focus group sessions was requested from the school principal. Finally, an application to conduct the study was submitted to and approved by the University's Institutional Review Board. Upon the study's approval, the quantitative strand was implemented first. To better understand the steps taken to gather data, the strands are discussed below.

Quantitative Strand

In late October, seven science teachers from the study's middle school were asked via email to assist in recruiting students for both the quantitative and qualitative phases of the study. All the teachers agreed to participate. For the quantitative strand, teachers were provided paper copies of an official study letter (Appendix C), parent consent form (Appendix D), and student assent form (Appendix E) for each student in the selected classes. The teachers involved in recruitment were asked to select classes that represented various academic levels of students. In this middle school, students are grouped into classes by academic levels based on the individual's score on the science portion of the previous year's standardized test. Students placed in honors classes scored above the 93 percentile and students placed in grade level classes scored below the 93 percentile on the test. Table 4 provides an outline of the teachers and grade level taught, students' academic levels, number of students recruited, and the number of returned consent/assent forms per teacher.

Table 4

SMS recruiting information

Teacher	Grade Level Taught	Academic Level of Class	Number of Students in Class	Number of Consent/Assent Forms Returned
A	6^{th}	Honors	28	12
	6^{th}	Grade Level	21	7
B	6^{th}	Honors	29	16
	6^{th}	Grade Level	21	8
C	7^{th}	Honors	32	23
	7^{th}	Grade Level	33	10
D	7^{th}	Although initially agreeing to participate, this teacher did not send home recruitment packets.		
E	8^{th}	Honors	33	22
F	8^{th}	Grade Level	28	20
G	8^{th}	All the students enrolled in this teacher's class participated in the OBX program. Those students were recruited via email.		

Due to the large number of last year's OST program cohort enrolled in Teacher G's course, it was decided that the teacher would not participate in this phase of the study. OST program students were recruited via parents' emails. Attached to the email were the same consent and assent forms received by the non-OST program students. The official study letter was slightly modified to address the OST program specifically (Appendix F). Parents were given the option of printing the forms or their student could pick up paper copies in the school's front office. Of the forty-nine OST participants, seventeen students returned the forms needed to participate. Of those seventeen students, fifteen completed the survey.

Once collected, the consent/assent forms were labeled with the grade level, teacher's name, and academic level of the student's class. The email addresses provided on the consent forms were entered into a group email for easy dissemination of the survey link and future email notifications. When the email addresses had been entered, the first email with the SMS link was sent to parents. An initial two-week time limit was given to participants to complete the survey. Three email reminders were sent to parents during this time period. The first email reminder was at the close of the first week, the second email reminder was sent two days prior to the survey closing, and the final email reminder was sent the evening the survey was set to close. The final reminder informed parents that the survey would remain open for an additional week to allow students to complete the survey during the Thanksgiving holiday. This extension was offered as a means to increase the response rate.

At the close of the survey, 110 students started the SMS; 104 students completed it.. The initial survey results were then examined to identify seven study constraints that were used to develop the focus group discussion guide used during the qualitative phase of the study.

Qualitative Strand

A total of nineteen female students participated in four focus groups for this phase of the study. The four focus groups ranged from four participants to six participants. According to Hennink (2004), most focus groups contain no more than eight participants. Krueger and Casey (2000) further emphasize that this size allows the groups to be “small enough for everyone to have an opportunity to share insights and yet large enough to provide diversity of perceptions” (p. 10).

Students were recruited to participate in one of two ways. Of the nineteen female participants, ten were from last year’s OST program cohort. These students were recruited through an email to their parents. Interested students were given the choice of a Wednesday or Thursday focus group session and asked to submit the attached parent consent (Appendix G) and minor assent forms (Appendix H). To eliminate researcher bias, the first five females who submitted the forms to the school’s front office were selected to participate. Once selected, another email was sent to the parents of each female participant to confirm their participation and to provide a time and location of the session. One female requested to move from the Thursday focus group to the Wednesday focus group due to a scheduling conflict and her request was granted.

The remaining nine female participants were recruited based on feedback from the seven science teachers. The teachers were asked to select female students who represented various academic levels and would be open to participating in a group discussion. The teachers were asked to speak to female students in their classes who fit the requirements, and if the students showed interested, the teachers sent home the consent/assent form. Teachers collected returned forms and noted the order the forms were returned. Students were selected to participate in the order the forms were returned to avoid possible bias in selecting focus group participants. An email was sent to potential focus group females requesting confirmation of their attendance. Only one female volunteer did not show for her assigned focus group session resulting in the Tuesday session having four participants. Table 5 details information on the female participants for the study's focus groups.

Academic levels divided the non-OST student focus group sessions in an effort to aid in managing group dynamics. Krueger and Casey (2009) discuss that a range of personalities in a focus group can challenge the focus group moderator resulting in the need to utilize multiple strategies to avoid overshadowing by more dominant participants. To ensure that all participants were comfortable during their session, I felt it best to group participants according to their science academic levels. Although I did find that certain participants more dominating than others, I encouraged the quieter participants to remain involved in the conversation with "gentle probing…, open body language, and welcoming eye contact" (Hennink, 2014, p. 78). These approaches proved effective in managing successful and engaging focus group sessions.

The focus group sessions were held during the last week of November in the middle school library upon dismissal. The library was chosen for the sessions because as a room in the school it provides a natural setting that allows participants to be comfortable and "behave within their context" (Creswell, 2014, p. 185). Also, the library allowed for an uninterrupted environment as it was closed to students once the focus groups started. Finally, conducting the sessions on campus immediately upon dismissal helped avoid scheduling or transportation hurdles for parents, which encouraged female students to participate. When the female participants arrived for their assigned session, they were provided pizza, drinks, and cookies for participating the focus group sessions. All sessions started at 3:50pm.

Table 5

Focus group participants

Focus Group Session/Day of Week	Academic Level Represented	Number of Participants	Teachers Represented/Number of Participants per Teacher*/Grade Level
1/Monday	Honors Non-OST Program Students	5	A/1/6 B/1/6 C/1/7 D/1/7 G/1/8
2/Tuesday	Grade Level Non-OST Program Students	4	A/1/6 B/1/6 C/1/7 F/1/8
3/Wednesday	Honors OST Program Students	6	E/1/8 G/5/8
4/Thursday	Honors OST Program Students	4	G/4/8

**OST program students were not recruited by their teacher, but the teacher is noted to reflect a pattern in the OST program participants and their academic level of science course.*

The focus group sessions lasted a combined time of three hours, 37 minutes, and 9 seconds (55.13 minutes, 43.15 minutes, 69.52 minutes, and 48.59 minutes, respectively). Prior to the start of each session, participants were asked to sit with the researcher at a round table in the corner of the library. The participants were reminded that the thoughts and ideas they shared during the session would remain confidential in the written report of the data. They were also asked to keep other participants' contributions confidential. Participants were reminded that they could leave or decline to participate in the discussion at any time. All four focus group sessions were audio recorded. The same focus group discussion guide was used for all the sessions ensuring data collected were measuring the seven constructs.

During the focus group sessions, brief interview notes were taken. These notes aided in the analysis of the data as reminders of critical details and indicators of patterns. The focus group sessions were later transcribed and uploaded to a computer software program for analysis.

Data Analysis

Middle school students' interest in science is the focus of countless studies in science education research. Researchers continue to examine the correlation of attitudes toward science with achievement in science while noting the positive perceptions of science are lower in older female students (Neatherly, 1997). Many studies explore the equity issues present in science education. For this study, data were collected and analyzed from female students using both quantitative and qualitative methods.

It was critical to examine a sample of middle school students to identify any similarities and differences in how they view science. Because the study's focus is on influences that impact females' science identity construction, the survey results were analyzed and compared by gender to better separate female science perceptions from their male counterparts. In addition to providing a context for the study, the survey results were used to confirm the study constructs. Aschbacher et al's. study (2014) identified two study constructs, self-perceptions and career interests. These constructs carried over into this study and five additional constructs were identified through the literature surrounding students' identity development. The final seven constructs were used to guide the development of the focus group questions. Focus group sessions provided findings detailing the factors influencing the science identities of female middle school students and the impacts of the school's science OST programs on female middle school students. I found dividing the analysis section into the study's three research questions to be more straightforward. The following details each research question and the procedures employed to analyze data.

Research Question 1

The purpose of the first research question was to establish transparency regarding the middle school student population used for this study. This question was used to build the foundation for the study's primary goal of examining female identity construction as it relates to the schools' science OST program. By illustrating the science perceptions from a sample of the student population, my objective was to provide data to support or refute current science education literature on females' thoughts and views of science. This question was answered using the results of the Science and Me survey (SMS) instrument. The results are intended to provide the reader with a lens in which to view the findings of the qualitative focus group discussions on female identity construction.

The survey questions were entered into Qualtrics software to support easy dissemination of the survey link to participants. Once the survey was closed, the results were exported from Qualtrics to SPSS in order to analyze the data. Statistical tests were run in SPSS based on the data provided by the question. When analyzing the differences in how students' perceived their abilities in school versus their abilities in science, the results of the two questions were grouped and a paired samples t-test was conducted. A paired samples t-test is used when comparing two population means in the case of two samples that are correlated (Gravetter & Wallnau, 2011). These are the only survey questions in which students' responses between two categories (school and science) were compared during this study.

Most of the statistical tests run were multivariate analysis of variance (MANOVA). These tests allowed data to show whether there were differences in how male and female middle school students responded to the questions. If no significant differences were found, no further tests were conducted. If a significant difference was found, individual analysis of variance (ANOVA) tests were conducted. ANOVA tests allow for the evaluation of mean differences between two or more populations (Gravetter & Wallnau, 2011). In this study, ANOVA tests to identified the specific differences between male and female students. All results were embedded in tables and presented in the next chapter.

Research Question 2

Findings for the final two research questions emerged using a thematic analysis approach that emphasized examining data in order to identify specific patterns or themes. As themes were recognized, details were revealed about middle school females' science identities. The purpose of Question 2 was to explore female students' interests, perceptions, and beliefs about science both in and out of the science classroom. The data analyzed for Question 2 were provided through four focus group discussions with female middle school participants. The participants were asked eight questions addressing the seven study constructs.

Each focus group discussion was recorded. The audio of the four discussions was transcribed into MS Word documents which were uploaded to NVivo, a qualitative analysis software program. Next, seven nodes, or categories, were created within NVivo to represent the study constructs.

Data analysis began by coding data. The first phase required reading and assigning data from the transcripts to one or more of the NVivo nodes. Phase two of the analysis involved the creation of another set of nodes entitled *Academic Levels*. The data from phase one were coded into one of two academic levels: grade level and honors. The third phase involved creating a final set of nodes entitled *Attitudes*. The data from phase one were coded into one of two attitudes: positive and negative.

Once all data were coded, several queries, or tests, were conducted using NVivo. First, a word frequency was administered to determine the most common terms or concepts discussed by the participants. This helped to guide the analysis toward the major themes emerging from the discussions. Next, multiple coding queries were administered to identify intersecting data coded within the attitudes nodes and the study construct nodes. The purpose was to recognize positive comments related to each study construct and negative comments related to each study construct. Finally, a matrix-coding query was conducted. This query cross-tabulated and narrowed down data to determine the study constructs that were most influential regarding participants' science identities. The results of this query recognized four major influences: teachers and teaching approaches, parents and support at home, media, and peers.

Research Question 3

The final two focus groups consisted of former science OST program participants. When asked about their participation in science programs or clubs, the participants spend a considerable amount of time discussing their reasons for applying to the OST program, the program activities in which they were involved, and the impacts of the program. This portion of the focus group discussion was coded separately from the study constructs into a node entitled, *OST Program*. Next, the coded data in the OST Program node was coded into positive and negative impacts on participants. Additionally, the two open-ended questions results in the SMS were examined for differences between OST participants and non-OST participants.

Summary of Research Procedures

Two data sources were used in this study, the *Science and Me* survey (SMS) and focus group interviews. These data were analyzed both quantitatively and qualitatively. The SMS served as a quantitative measure of middle school students' science interests, perceptions, and school and career goals. Data were analyzed in SPSS using descriptive statistics. Data from male and female students were compared using MANOVA tests. If differences were significant, individual ANOVA tests were conducted to identify the specific differences. Focus group data served as a qualitative measure of middle school female students' science interests, perceptions, and future goals. Data were audio recorded and transcribed. The transcriptions were analyzed qualitatively using NVivo software. Multiple queries were run to determine the major influences on females' science identities. During the focus group discussions, data collected from former science OST program participants were analyzed for program impacts on females' science identities.

CHAPTER IV: RESULTS AND DISCUSSION

Science has played a critical role in the history of our country. More recently, the federal government has focused its attention on the union of science with technology, engineering and mathematics through the development of new K-12 curricula and programs. Presently, there is a consensus among science professionals that to be scientifically literate one must possess a foundation of skills and application of science to real-world experiences. For many, concern remains that American students are graduating high school lacking the fundamental skills to pursue or be successful in science-related careers (National Governors Association, 2007). Specifically, research pinpoints females as underrepresented in science related majors and career fields. The purpose of this study is to examine the science thoughts and beliefs of middle school students with emphasis on the influences that impact the construction of middle school females' science identities. Additionally, the study examines the impacts of an OST science program on its middle school female participants. By recognizing the influences that shape female students' science identities, education stakeholders can better support female students as navigate science in the middle school classroom and beyond.

This chapter is devoted to the study's results and a thorough discussion of the effect of those results on science education. The chapter begins with an explanation of the researcher's interests in the study and potential bias. Next, the chapter is divided into the three research questions to better organize the results. The results of each question are presented first, followed by a discussion on the meaning of the results.

Researcher Interest and Bias

In order for me to maintain quality research, it is critical to provide transparency in regards to my personal and professional interests as they apply to this study. The science OST program being examined is a program that I developed and coordinate each school year with the help of several teachers. The program mission and objectives were founded on valid science education literature, but molded to fit the parameters I desired for the program, as well as constraints placed by the school district and travel to the Outer Banks. As program director, I am continually seeking ways to improve the program. The aforementioned pilot study allowed stakeholders to communicate the strengths and weaknesses of the program. As a result, several changes were initiated to better serve the students. In maintaining a plan of improvement, it was important for me to also focus on the female population of the OST program. I wanted to ensure that the program was encouraging positive development in females. Thus, the purpose of this study was to identify how the program impacts female participants' science identities in the hopes of further modifying and designing objectives to fit the needs of these students, as well as improving recruitment tactics and incentives for female students.

Because the research priority is placed on the study's qualitative strand, it is essential to note the measures I have taken to avoid study treatments that are potentially harmful. In qualitative research, the investigator is the primary instrument for gathering and analyzing data (Creswell, 2003; Denzin & Lincoln, 2008). As the primary investigator for this study, I conducted all four focus groups involving the focus group discussion guide. As qualitative research is "interpretative research, with the inquirer typically involved in a sustained and intensive experience with participants" (Creswell, 2003, p. 184) there is a need for the primary investigator to "explicitly identify their biases, values, and personal interests about their research topic and process" (p. 184).

As the primary investigator, I brought certain biases to the study as an experienced science teacher for eleven years at the site where this study was conducted. My experiences as a science teacher have not only shaped my views on how middle school students think about science, but also expanded my own aptitude for recognizing, appreciating, developing, and understanding when students make scientific connections. The OST program is the result of my planning, designing, and implementation. I am undoubtedly vested in the success of the program and its sustainability at the school.

In addition, 10 of the 19 focus group participants were from last year's spring OST program cohort. Three of those students were in my 7th grade science class. In order to maintain objectivity during the data collection and analysis phases of the study, I avoided questions that pertained to my class or teaching approaches. I also asked participants to avoid using teachers' and peers' names. Not only did this protect these people, it allowed participants to speak freely about situations in their science classes without fear of harming someone. Also, I believe participants felt comfortable providing feedback on the OST program because of the safe environment promoted by the program. While in the program, students were often involved in discussions about how to improve or change program policies or requirements. Students were provided a sense of ownership into the direction of the program, as its goal is to foster student-centered learning. I believe this foundation allowed focus group participants to be more open about their views of the program and its impacts on their science identities.

During the data analysis process, I set aside my biases of the program by only asking questions from the discussion guide. I avoided additional probing questions that could make the participants uncomfortable or create opportunities for the analysis to be influenced by my own thoughts. Also, I did not allow my familiarity with the participants to cloud my interpretation by assigning pseudonyms to the number codes assigned by the NVivo software. In other words, I was not aware which participant contributed specific pieces of data that were used to construct the findings for the research questions.

Both in the classroom as a teacher and outside as a coach, club sponsor, and community member, I find my role in education to be one of supporting students' learning rather than dictating knowledge. My constructivist lens allows me to take great care in establishing a learning environment in which students feel welcome and comfortable to explore, make mistakes, and ask questions. I believe in building relationships of trust and respect with my students. I believe the rapport I have established with my former students contributed to the overall comfort level of students' involvement and openness during focus group sessions. As a science teacher of several participants, I inherently formed opinions and/or biases towards the students as individuals as well as groups. In an effort to address and minimize potential researcher bias and error, once data had been collected, participants' names were replaced by pseudonyms. Throughout the research process, I remained conscious of potential biases and attempted to minimize them.

Research Question 1

This section focuses on the results of the SMS that examined middle school students' thoughts and perceptions regarding science influences in their lives. Of the 118 consent forms submitted by students, 109 students completed the SMS. The high response rate met the target values ensuring high data quality. In presenting the data analysis, I have divided this section into an explanation of participant demographics and results of the survey as related to study constructs.

Participants

Participants attended a suburban middle school in the southeast United States and were selected from five science classes within the school. Of the participants, 49 (45%) were male and 60 (55%) were female. Of the male participants, 17 (35%) 6^{th} graders, 12 (24%) 7^{th} graders, and 20 (41%) 8^{th} graders. Of the female participants, 20 (33%) 6^{th} graders, 12 (20%) 7^{th} graders, and 28 (47%) 8^{th} graders. The participants were further divided according to science academic levels. Of the participants, 21 (19%) were enrolled in a standard grade level science course with the remaining 88 (81%) enrolled in an honors science course. Due to the substantially larger response rate from honors students, data analysis focused only on differences in responses of male and female students. The genders represented within the academic levels were reasonably equivalent with 78% of the male participants in an honors science class and 83% of the female participants in an honors science class. It should be noted that there were no 7^{th} graders from a grade level science class represented in this study.

Statement of Results

Study constructs developed from two sources: an earlier identity study by Aschbacher et al. (2014) and literature addressing the students' science identity development. The constructs that developed were a) students' self-perceptions, b) views of their science teacher and science practices, c) views of science and scientists, d) support at home, e) involvement in science tasks, f) involvement and experiences with science programs and activities, and g) career trajectories. These constructs guided the analysis of the SMS. SMS questions were placed into constructs most appropriately aligned with the content of the questions. Thus, the purpose of the survey was to identify students' science beliefs and thoughts as they related to the seven study constructs. The survey analysis for research question 1 is divided into the constructs below to streamline this results section.

Students' self-perceptions. Five survey questions (8, 9, 10, 20, and 27) were placed within the students' self-perceptions construct. This construct examined how students' viewed their academic success as related to their grades, as well as how they view their abilities to succeed in school as compared to the science classroom. Of the survey respondents, almost half (49%) reported they were earning mostly A's in all their classes. The remaining indicated 33% A's and B's, 2% mainly B's, 7% a mix of A's, B's and C's, 4% B's and C's, 6% mainly C's. None of the respondents indicated earning below C's.

Two survey questions further specified students' report of their grades in math in science. Math and science disciplines are commonly merged in STEM practices, so it was decided that examining both areas would provide a more substantial illustration of the students within the study. Regarding math, 49% of students indicated they were earning an A, 37% B, 13% C, and 2% below C. Science proved to be an area of greater success for the respondents as 87% indicated they were earning an A, 11% B, and 2% C. No respondents indicated earning less than a C in science.

The final two questions categorized within this construct looked at how students perceived their abilities in school and science. Although the questions about science abilities and school abilities were separate, the abilities were grouped together during the analysis to compare students' views of their abilities in these two areas. Cronbach's alphas for the five school and science items were .839 and .865, respectively. The results from school and science were averaged and a paired samples t-test was conducted to identify gender differences. There was no significant difference between the areas (t=-.329, df=104, p=.743). Table 6 contains the results of the t-test.

Table 6

Students perceived school abilities versus science abilities (n=105)

Students' Abilities	*M*	*SD*
school_ability	3.39	.501
science_ability	3.40	.479

Students' views of science teacher and instructional approaches. One survey question (11), using a 4-point Likert scale, indicated students' views of their science teachers and the instructional approaches their science teacher uses in class. Descriptive statistics provided the overall mean for the multiple aspects of the question. Additionally, multivariate analysis of variance test was conducted to detect difference between male and female students' views (Table 7). The results indicated no significance, $F(10, 95)=.853$, $p=.580$. Both male and female students agreed strongly that what they are learning in their science class is applicable to the real world, they enjoy science, felt that their science class was important to their future goals, and had a teacher who had high expectations and made science interesting. Also, both genders disagreed strongly that they had to have a special science talent to be successful in the class.

Students' views of science and scientists. Two survey questions (7 and 22) provided insight into this construct. Questions seven examined how students feel about the discipline of science, how they view the work of scientists, and whether or not they believe they fit their personal idea of a scientist. Descriptive statistics were run and an analysis of variance test was conducted to determine the difference in male and female views of science and scientists.

Table 7

Male and female students' views of science teachers and teaching approaches

	Male (*n*=48)		Female (*n*=58)		Total (*n*=106)	
	M	*SD*	*M*	*SD*	*M*	*SD*
My teacher thinks I could be a good scientist one day.	3.10	0.778	3.02	0.662	3.06	0.715
I enjoy learning science this year.	3.56	0.616	3.52	0.655	3.54	0.635
My teacher cares if I think science is interesting.	3.44	0.681	3.34	0.828	3.39	0.763
You need to have special talent in science to do well in this class.	1.81	0.673	1.71	0.726	1.75	0.701
It is important to me that my science teacher supports my views on science topics.	3.00	0.684	2.95	0.826	2.97	0.762
I know more about the content of this class than other students do.	2.69	0.689	2.60	0.793	2.64	0.746
My teacher has high expectations for me.	3.58	0.498	3.36	0.667	3.46	0.604
In this class, I am learning how science applies to real life.	3.73	0.449	3.50	0.682	3.60	0.596
Doing well in this class is important for my future career goals.	3.58	0.613	3.45	0.776	3.51	0.707
In this class, we talk about what everyday scientists do.	2.46	0.824	2.47	0.903	2.46	0.864

Note. agree strongly (4), agree somewhat (3), disagree somewhat (2), and disagree strongly (1).

As a result, no significant differences were found between genders, $F(13, 90)=1.402$, $p=.174$ (Table 8). Both male and female students' strongly agreed that science is interesting, scientists have a chance to make a difference in the world, scientists are respected by people in this country, and scientists have to go to school for many years. Respondents strong disagreed that scientists can't be religious.

For survey question 22, a multivariate analysis of variance showed that the difference between male and female students' view of the role of gender in the science-field was significant, $F(4,101)=3.437$, $p=.011$ (Table 9) and individual ANOVAs indicated jobs ($p=.003$) and likelihood of being a scientists ($p=.005$) were different. Female students believed females have more trouble getting jobs in science in this country than males. Also, females believed that females are less likely to become scientists than are males. Although statistically the female respondents showed differences from male respondents, the low mean results for the two statements (1.93 and 1.83, respectively) indicate that female respondents disagree somewhat that they have trouble getting jobs in science and are less likely to become scientists.

Support at home. Four survey questions (16, 17, 18, and 19) helped to provide results for the study construct indicating how students are academically supported at home. These results also offer insight into the education and expectations of students' family members. Of the respondents, 94% indicated their mothers/step mothers and 92% of their fathers/step fathers attended college. Additionally, 93% reported that one or more other adults in their family attended college. Twenty-two percent of respondents claimed to have an older brother or sister who attended college; however, 68% indicated either not having older siblings or not have siblings old enough to attend college.

Table 8

Male and female students' views of science and scientists

	Male (n=47)		Female (n=57)		Total (n=104)	
	M	*SD*	*M*	*SD*	*M*	*SD*
Science is interesting.	3.51	0.547	3.54	0.537	3.53	0.539
I could be a good scientist one day.	2.94	0.734	2.98	0.719	2.96	0.723
Scientists have a chance to make a difference in the world.	3.83	0.433	3.77	0.423	3.80	0.427
Scientists spend most of their time working by themselves.	2.19	0.798	2.05	0.766	2.12	0.780
Scientists spend most of their time working indoors.	2.11	0.787	2.21	0.818	2.16	0.802
Scientists' own opinions do not matter in their work.	1.96	0.859	2.14	0.99	2.06	0.933
Scientists have to work long hours at their job.	3.04	0.69	3.04	0.706	3.04	0.696
The beliefs and values in my home are different from the beliefs and values of science.	2.43	0.878	2.56	0.926	2.50	0.903
Scientists are respected by people in this country.	3.45	0.583	3.11	0.699	3.26	0.668
Scientists make a lot of money.	2.98	0.737	3.05	0.692	3.02	0.710
Scientists have to go to school for many years.	3.70	0.548	3.58	0.533	3.63	0.541
Scientists can't be religious.	1.51	0.748	1.28	0.620	1.38	0.687
The media (television, movies, etc.) makes science seem cool.	3.17	0.916	3.02	0.790	3.09	0.849

Note. agree strongly (4), agree somewhat (3), disagree somewhat (2), and disagree strongly (1).

Table 9

Male and female students' views on the role of gender in the science-field

	Male (n=48)		Female (n=58)		Total (n=106)		*Sig*
	M	*SD*	*M*	*SD*	*M*	*SD*	
It is important that my role model(s) or mentor(s) are the same gender as I am.	2.02	1.062	1.71	0.955	1.85	1.012	.112
Most of my friends are the same gender as I am.	2.90	0.951	3.07	0.896	2.99	0.921	.338
People who are the same gender as I am have trouble getting jobs in science in this country.	1.50	0.546	1.93	0.856	1.74	0.760	.003*
People who are the same gender as I am are less likely to become scientists than are people of the opposite gender.	1.42	0.577	1.83	0.841	1.64	0.758	.005*

Note. agree strongly (4), agree somewhat (3), disagree somewhat (2), and disagree strongly (1).
* $p < .05$.

Regarding careers, students reported that 37% of their mothers/step mothers had science-related careers, 57% did not, and 6% were not sure. Fifty-seven percent of fathers/step fathers had science-related careers, 38% did not, and 5% were not sure. Ten percent of siblings had science-related careers, but again, most respondents (70%) either do not have older siblings or their sibling is not older enough to have a career. Forty-nine percent of respondents indicated having one or more adults in the family with a science-related career, 20% did not, and 31% were not sure. Finally, 71% of respondents reported knowing an adult family friend who has a science-related career, 9% did not know of another adult who has a science related career, and 20% were not sure.

The respondents were asked about the expectations and beliefs of their family regarding interests and career choices. Most respondents (95%) agreed strongly that their family expected them to go to college, 4% agreed somewhat, 1% disagreed somewhat, and none disagreed strongly. The respondents agreed strongly (55%) and agreed somewhat (39%) that their family thinks it is important for them to learn science. No respondents indicated that their family disagreed strongly. Fifty-eight percent of students agreed strongly and 32% agreed somewhat that their family thinks science is interesting. Nine percent disagreed somewhat and 1% disagreed strongly that their family thinks science is interesting. Sixty-four percent of respondents agreed strongly, 28% agreed somewhat, 5% disagreed somewhat, and 2% disagreed strongly that their family would be happy if they pursued a career in science. Over half of the students (60%), indicated that their family does not expect them to pay for college with the remaining 40% indicating they would be expected to pay their own way to college.

Question 18 related to support at home reveals the frequency in which specific activities related to science, school, or students' futures occur at home. The results in Table 10 provide an understanding of the specific interactions students have with family members at regarding specific science related topics. A multivariate analysis of variance test was conducted to identify which items in the question differ by gender. The results indicated significant differences, $F(13,93)=3.246$, $p<.001$. Individual ANOVAs were run to determine the differences. At home, female students were more likely than their male counterparts to discuss issues related to the environment ($p=.013$), issues related to people's health ($p=.002$), books, art, and theater ($p=.008$), and their teachers (.041).

The final question (19) of this construct looked at how students view their family's academic and career expectations for them. A multivariate analysis of variance test was performed to identify gender differences present in parent expectations. There were no significant differences found, $F(5, 100)=.875$, $p=.501$ (Table 11).

Students' involvement in science tasks. Two survey questions (4 and 6) were used to provide data to indicate the involvement of students' with specific science tasks. For question four, students were asked about their use of electronic devices for science homework or research beyond the classroom. The results showed that all respondents have access to electronic devices. For science purposes, 29% of students used a device daily, 18% used two to three times a week, 18% once a week, 27% less than once a week, and 1% reported never using a device for science purposes.

The second survey question asked students to identify their involvement in science activities and tasks at both the elementary school and middle school levels. Table 12 shows the comparison of involvement. The middle school students in this study were more involved in using the Internet for science research and using special lab equipment in class than they were as

Table 10

Frequency of school and science related activities in the homes of male and female students

	Male (*n*=47)		Female (*n*=60)		Total (*n*=107)		*Sig*
	M	*SD*	*M*	*SD*	*M*	*SD*	
Current science news	2.96	1.197	3.37	1.025	3.19	1.117	.060
Issues related to the environment	2.96	1.103	3.48	1.049	3.25	1.100	.013*
Issues related to people's health	3.04	1.042	3.62	0.865	3.36	0.985	.002*
Politics	2.96	1.285	3.40	1.224	3.21	1.264	.072
Sports, television shows, movies	4.57	0.773	4.38	0.691	4.47	0.731	.181
Books, art, theater	3.36	1.223	3.93	0.954	3.68	1.113	.008*
My plans for college and/or a career	3.26	0.896	3.42	1.013	3.35	0.963	.392
Classes I should take in high school	2.83	1.167	3.17	1.251	3.02	1.221	.158
Things I am learning in my classes	4.53	0.654	4.60	0.718	4.57	0.688	.614
My grades	4.30	0.689	4.42	0.696	4.36	0.692	.381
My teachers	4.28	0.713	4.57	0.722	4.44	0.729	.041*
My friends	4.60	0.614	4.77	0.533	4.69	0.573	.126
Jobs or careers of my family members	3.72	1.077	3.67	1.145	3.69	1.111	.795

Note. everyday (4), once or twice a week (3), once or twice a month (2), once or twice a year (1), never (0).
* $p < .05$.

Table 11

Students' views of family's academic and career expectations for them

	Male (*n*=47)		Female (*n*=59)		Total	
	M	*SD*	*M*	*SD*	*M*	*SD*
They expect me to go to college.	3.96	0.204	3.93	0.314	3.94	0.270
They think it is important for me to learn science.	3.57	0.617	3.41	0.619	3.48	0.621
They think science is interesting.	3.47	0.687	3.46	0.727	3.46	0.706
They would be happy if I decided to pursue a career in science.	3.53	0.718	3.58	0.649	3.56	0.677
If I decide to go to college, they expect me to pay my own way.	2.34	0.867	2.17	0.894	2.25	0.882

Note. agree strongly (4), agree somewhat (3), disagree somewhat (2), and disagree strongly (1)

Table 12

Percentages of students involved in science activities in elementary and middle school (n=110)

	Middle		Elementary	
	%	*N*	*%*	*N*
Looked up science information in the library or on the Internet	68.2	75	52.7	58
Used special science equipment	65.5	72	47.3	52
Observed things in space	60.0	66	60.9	67
Spent time outdoors learning about nature	58.2	64	76.4	84
Used tools to build things with wood or metal	56.4	62	54.5	60
Read books about science or science fiction	56.4	62	71.8	79
Made models	53.6	59	59.1	65
Collected rocks, butterflies, bugs, or other things in nature	33.6	37	81.8	90
Taken apart things to see how they work	31.8	35	28.2	31
Written stories about science or science fiction	22.7	25	29.1	32
Learned a computer programming language	20.9	23	7.3	8

elementary school students. In elementary school, students spent more time outdoors exploring nature, reading stories about science, and collecting bugs and insects.

Involvement and experiences with science programs and activities. One survey question (13) was used to determine students' involvement and experiences with science programs and activities at both the elementary school and middle school level (Table 13). At both levels, a high percentage of students had a teacher who made learning science exciting. In elementary school, most students indicated participating in the science fair and attending a summer camp. Whereas, in middle school, a higher percentage of students noted visiting a college campus.

At both elementary and middle school levels, the highest percentage of respondents indicated they had a teacher that made learning science exciting. In middle school, a higher percentage visited a college campus and had a teacher who made them not like science. The remaining six programs and activities resulted in low percentages. Student involvement related to participating in the science fair, participating in a science club or team, and taking an extra science class being the lowest.

Career trajectories. Seven survey questions (5, 14, 15, 23, 24, 25, and 29) gave insight into the career interests and planning of the respondents. In question five, 72% percent of student participants indicated they have already taken or plan on taking a college entrance exam. Of the survey participants, 87% very much want to attend college (question 14) and 67% plan on pursuing a degree beyond a four-year Bachelor's degree (question 29). Also, none of the participants indicated a high school diploma as their final degree earned.

Questions 23 and 24 examined job-related activities and reasons for choosing a career. Respondents were asked to indicate how interested they were in having a job that involved

Table 13

Percentage of students involved in science experiences in elementary and middle school (n=107)

	Middle		Elementary	
	%	*N*	%	*N*
Had a teacher who made it exciting to learn science	86.4	95	75.5	83
Visited a college campus for any reason	66.4	73	31.8	35
Had a teacher who made you not like science	20.0	22	28.2	31
Attended a science camp or special science program	13.6	15	36.4	40
Received an award or special recognition for doing well in your science classes or other science-related activities (like science fair, competition, etc.)	10.9	12	30.0	33
Participated in a program specifically designed to prepare you for college (for example, Upward Bound)	10.0	11	6.4	7
Participated in a science fair	6.4	7	43.6	48
Participated in a science club or team	3.6	4	7.3	8
Taken an extra science class in the summer (not a make-up class)	1.8	2	7.3	8

specific activities. Descriptive statistics were run and an analysis of variance test was conducted to determine the difference in the level of interests between male and female students. As a result, no significant differences were found between genders, $F(7, 97)=1.833$, $p=.090$. Next, respondents were also asked about the reasons for choosing a career. A multivariate analysis of variance test was conducted to determine the difference between male and female students' responses. No significance differences were found between genders, $F(14, 90)=1.451$, $p=.147$. Students strongly agreed that they would choose a career that allowed time for family, would help people, and would make a difference in the world. They did not agree that their workplace had to be shared with people of their same ethnicity or gender. The results of the MANOVA tests are shown in Table 14 and 15, respectively.

Finally, questions 15 and 25 asked students about the college majors they wish to pursue. A multivariate analysis of variance was performed and results showed a significant difference between genders in a majority of the majors, $F(13, 91)=4.510$, $p<.001$ (Table 16). Individual ANOVAs were run to identify the differences. Female students were more interested than males in pursuing majors in pre-medicine and pre-dentistry ($p=.004$), pre-veterinary ($p=.005$), and nursing ($p=.001$). Male students were more interested than females in pursuing majors in physics ($p=.001$), earth and space science ($p=.046$), engineering ($p=<.001$), and computer science ($p=.001$).

Last, students were asked about the type of job they would like to have someday. To determine differences in the job choices of between males and females, a multivariate analysis of variance was conducted. Results showed a significant difference in 12 of the 19 career options, $F(19, 84)=4.529$, $p<.001$ (Table 17). Individual ANOVAs were run to identify the differences. Female students were more interested than males in pursuing jobs as a doctor, veterinarian, or

Table 14

Male and female students' interests in job-related activities

	Male (*n*=47)		Female (*n*=58)		Total (*n*=105)	
	M	*SD*	*M*	*SD*	*M*	*SD*
Design, invent, or develop new products or tools	3.28	0.800	2.93	0.876	3.09	0.856
Spend a lot of time and energy on a problem until you solve it	2.72	0.994	2.36	0.968	2.52	0.991
Discover new things that help the environment or people's health	2.77	1.068	2.95	0.981	2.87	1.020
Use computer, lab equipment, and other technology	3.09	0.996	2.83	0.958	2.94	0.979
Conduct investigations to understand how the world works	2.62	1.012	2.52	1.047	2.56	1.028
Analyze data to draw conclusions	2.30	0.998	2.19	1.051	2.24	1.024
Have your work reviewed and critiqued by others	2.72	0.902	2.31	1.079	2.50	1.020

Note. very interested (4), fairly interested (3), a little interested (2), not interested (1).

Table 15

Male and female students' reasons for choosing a career

	Male (n=47)		Female (n=58)		Total (n=105)	
	M	*SD*	*M*	*SD*	*M*	*SD*
To earn a lot of money	3.19	0.680	3.05	0.759	3.11	0.725
To make a difference in the world	3.49	0.688	3.53	0.627	3.51	0.652
To have time for a family	3.77	0.476	3.86	0.395	3.82	0.434
To be in a workplace with people who share my ethnic background	1.91	1.039	2.00	1.139	1.96	1.091
To be in a workplace with people who are the same gender as I am	1.47	0.776	1.28	0.555	1.36	0.667
To work outdoors	2.32	0.887	2.16	1.023	2.23	0.963
To work in a group with others instead of by myself	3.23	0.786	2.67	0.980	2.92	0.937
To have time for hobbies or other interests	3.55	0.653	3.57	0.624	3.56	0.634
To gain respect from others	3.64	0.529	3.43	0.775	3.52	0.681
To be my own boss	2.72	0.852	2.40	0.990	2.54	0.941
To help people	3.70	0.507	3.64	0.641	3.67	0.583
Whether I would have to go to school for a long time	2.45	1.080	2.33	0.980	2.38	1.023
Whether it conflicts with what's important to my family	3.19	1.056	3.09	1.014	3.13	1.029
The cost of the education and training	2.94	0.919	2.90	0.912	2.91	0.911

Note. very important (4), fairly important (3), a little important (2), not important (1).

Table 16

Male and female students' college major interests

	Male (*n*=47)		Female (*n*=58)		Total (*n*=105)		*Sig*
	M	*SD*	*M*	*SD*	*M*	*SD*	
Biology	2.51	0.997	2.78	1.077	2.66	1.045	.198
Chemistry	2.77	1.047	2.52	1.013	2.63	1.031	.221
Physics	2.66	1.048	2.05	0.826	2.32	0.976	.001*
Earth and Space Science	2.72	1.097	2.31	0.995	2.50	1.057	.046*
Environmental Studies	2.28	0.949	2.26	0.928	2.27	0.933	.922
Pre-Medicine, Pre-Dentistry	1.91	0.974	2.53	1.158	2.26	1.118	.004*
Pre-Veterinary Science	2.00	1.000	2.60	1.138	2.33	1.115	.005*
Nursing	1.62	0.795	2.31	1.111	2.00	1.038	.001*
Engineering	3.28	0.949	2.33	1.114	2.75	1.142	<.001*
Computer Science	2.74	1.113	2.00	1.124	2.33	1.174	.001*
Psychology	2.02	1.073	2.24	1.261	2.14	1.18	.344
Science Education	1.79	1.041	1.90	1.003	1.85	1.017	.586
Forensic Science	2.04	1.042	2.17	1.187	2.11	1.121	.557

Note. very interested (4), fairly interested (3), a little interested (2), not interested (1).
* $p < .05$.

Table 17

Male and female students' interests in future jobs

	Male (*n*=47)		Female (*n*=57)		Total (*n*=104)		*Sig*
	M	*SD*	*M*	*SD*	*M*	*SD*	
Life scientist	2.30	1.14	2.72	1.206	2.53	1.190	.072
Physical scientist	2.49	1.081	2.37	0.975	2.42	1.021	.550
Biotechnician	2.06	0.942	1.75	0.969	1.89	0.965	.104
Doctor, Veterinarian, Dentist	1.94	1.009	2.77	1.102	2.39	1.136	<.001*
Nurse	1.53	0.747	2.16	1.099	1.88	1.002	.001*
Physical Therapist	1.81	0.876	2.30	1.195	2.08	1.086	.021*
Dental Hygienist	1.45	0.717	1.77	0.945	1.63	0.861	.055
Lab Technician	2.26	0.988	1.84	0.902	2.03	0.960	.028*
Engineer	3.30	0.883	2.25	1.04	2.72	1.101	<.001*
Computer Programmer	2.43	1.078	1.91	1.138	2.14	1.136	.021*
Psychologist	1.74	0.871	2.21	1.176	2.00	1.070	.026*
Science teacher	1.55	0.855	1.96	0.981	1.78	0.945	.026*
Other teacher	1.62	0.848	2.07	1.083	1.87	1.005	.021*
Lawyer	1.96	0.977	2.00	1.102	1.98	1.043	.837
Businessperson	2.09	1.018	2.00	1.086	2.04	1.051	.683
Journalist	1.64	0.895	1.89	1.064	1.78	0.995	.192
Architect	2.30	0.998	2.16	1.049	2.22	1.024	.490
Artist, Musician, Actor, Dancer	2.02	1.113	2.77	1.086	2.43	1.156	.001*
Professional athlete	2.83	1.222	2.32	1.198	2.55	1.230	.033*

Note. very interested (4), fairly interested (3), a little interested (2), not interested (1).
* p < .05.

dentist ($p<.001$), nurse ($p=.001$), physical therapist ($p=.021$), psychologist ($p=.026$), teacher ($p=.021$) or science teacher ($p=.026$), artists, musician, actor, or dancer ($p=.001$). Males were more interested in becoming a lab technician ($p=.028$), engineer ($p<.001$), computer programmer ($p=.021$), or professional athlete ($p=.033$).

Research Question 2

The purpose of the second research question was to detect the factors that influence middle school female students' science identities. To answer this question, data was collected through four focus groups of female middle school students.

Participants

The focus group participants were 11 to 14 year old female students representing grades 6th through 8th at the study's middle school. The first focus group consisted of honors academic level non-OST participants that included two 6th graders, two 7th graders, and one 8th grader. The second focus group were standard academic level non-OST participants including two 6th graders, one 7th grader, and one 8th grader. The final two focus groups were 8th grade OST participants. The first group involved six participants and the last group involved four participants. A total of 19 female students participated in the four focus groups.

Statement of Findings

To isolate the major influences on female science identities that emerged from the focus group discussions, a matrix-coding query was performed in NVivo. This query allowed for coded content to be cross-tabulated and narrowed resulting in a relationship between four influences. Identified as teachers and teaching approaches, parents and support at home, media, and peers, these influences surfaced as themes used to answer Question 2. Each influence is discussed in this section.

Teachers and teaching approaches. Teachers and the approaches they use to present instruction content in the science classroom proved to be the most significant identity influence recognized by female participants. Participants shared countless examples of positive teaching approaches in the science classroom. Most preferred group work that encourages collaboration. They enjoy being engaged in scientific discussion. They like to talk and share ideas with other, as well as hear what other group members contribute to the discussion. Rachel (pseudonym used in place of participants' names) explained, "I like group work because it is, to me, easier to kind of…it makes…I guess it makes it easier to do it because you are working with a whole bunch of people and you guys can kind of all share your own ideas to figure it out as one big group instead of working it….working the problem out alone where it is sometimes harder." Beth added that group work helps to confirm her answers. "It is better to get a second opinion, like when you are working on a group activity and you are trying to figure something out, it is better to get a second opinion so you get the answer right."

Participants viewed activities that promote autonomy and creativity as positively influential to their thoughts about science. They communicated a desire to have a role in the direction and requirements of class assignments. Carolyn described an activity in which her teacher allowed students to explore their own ideas. The activity allowed "you to test creativity to see what you can make up, how you think it is supposed to happen. It is not so strict and basic. It is just you testing it so you can go outside of the box and think about other things you can do." Rachel describes a time when her science teacher asked students to design and write their own stories with illustrations about consumers and producers saying "I loved it because I got to use my imagination…I felt like I could see the science in my head instead of in a book."

Participants also value science tasks and activities that are applicable to the real world. Trish explained how she viewed the difference in social studies and science by explaining that "social studies it is just a date that you are learning and just having to remember a certain date and you are not really getting to experience what you are learning and be able to apply that into your life and with science you could do that." Beth mentioned how using a dichotomous key during the life science unit helped students "use real-life experiences to learn new things." In the final focus group, participants shared their dislike of defining key terms at the start of a unit. For the most part, the key terms were vocabulary words students were unfamiliar with, but necessary for understanding of the unit content. The participants described their struggles with making sense of foreign terms; however, they agreed that by completing the assignment, they were able to make quicker and more comprehensive connections with the content as it was being taught.

Labs and hands-on activities were the most preferred teaching approach discussed by the participants. A text search of the four focus group transcriptions within NVivo found the terms "lab(s)", "experiments", and "hands-on" were used 67 times by participants. Every student spoke favorably of this approach because the activities incorporate peer collaboration, creativity, and real-world applications and connections. From their descriptions, most lab activities incorporate peer collaboration and students found this allowed more authentic exploration, inquiry, and interaction of science concepts. Michelle explained her thoughts about labs: "To me…I guess the experiments or labs that we do makes science easier for me because you kind of get see how it is actually working and it is in front of you and that way you can actually see it, so when you are just writing it down, you might remember it but it is not going to…you sometimes might not have a clear understanding of what it is actually doing." Renee agreed by stating, "I like doing labs because you can see how it actually works rather than just listening about it and you are able to understand more and it is more fun to learn about it that way." Becca shared that her science teacher provided needed materials and a general procedure for experiments, but allowed students to design their own data tables and graphs. She stated that, "I learned more about the topic because I could put the ideas in my own words…it makes more sense to me." Additionally, participants revealed countless examples of labs in which they had been involved that made connections to personal, real-word experiences. Renee talked about a DNA lab: "We did one lab where…where we found our DNA and put in a necklace and it is like we just have a necklace of our own DNA. So it was really cool and that was something that was interesting."

Nearly all the participants mentioned that science-teaching approaches should promote creativity and encourage engagement, but they discussed several daily approaches that restricted these characteristics. For example, participants mentioned noting taking 31 times in reference to activities in science class that were considered boring, uninteresting, or not helpful. Noting taking was associated with teacher lectures, often corresponding with PowerPoints, and video presentations. Participants noted the limited interaction between peers and limited engagement in the content as reasons for the dislike surrounding taking notes. Kim described note taking in her science class: "We take a lot of notes, most of the time it is dark in our classroom because we are watching videos. The videos are okay…but sometimes the notes, like we just take so many of them and sometimes they do not even help." Rachel claimed her teacher lectures because "taking notes is the best way for her to get the information through to us," but she believes "there should be a more interesting way of taking notes." Jenna did not hesitate to share her thoughts about teaching approaches in her science class stating "it's the same thing repeating over and over again every day and the PowerPoints are awful but you also just have to take notes over and over and over."

Also, participants do not prefer teaching approaches involving worksheets, study guides, and assignments out of the book. Again, they found these activities did not fully engage students in learning the science content. They agreed they could learn about science from these activities, but failed to make genuine connections between the science concepts and applications of the concepts. Becca did not prefer study guides because "most of the time they are really thick and lengthy and there are 30 questions on it and some of the questions seem like they were not even relevant to what we talked about in class." Additionally, participants noted that such tasks are "time consuming" and are used as "busy work". They felt that most students are focused on finishing the assignment rather than understanding the concepts.

Finally, participants discussed teacher characteristics that support students' learning. There were three characteristics that materialized from the data. First, participants felt it was important that their teachers acknowledge the different learning styles present in the science classroom. As previously shared by Jenna, some teachers rely on the same methods to present content. The participants explained that repeated use of the same teaching approaches fails to reach students that do not learn best with those approaches. Kelly shared that "there are some teachers that kind of teach you like this one way but then if you do not understand…they just basically explain it the exact same way." She further explains that "there are some teachers…they will explain it but I kind of do not get it, so then they will do it in one or two or three more ways and then you really understand it because they are able to show you in so many different ways."

Parents and support at home. The support, or lack of support, students receive in their home environment proved substantial in the development of female students' science identities. The focus group participants shared ways their parents and other family members play a role in their daily academic lives. The data revealed that support was provided to students through help with assignments, modeling career interests, and daily discussions about school and/or science. Also, noted were ways in which parents limited students' self-perceptions of their science abilities. The most notable difference in female participants was the support received by honors academic level students versus the support received by standard academic level students.

Regarding science homework or projects completed outside the classroom, participants shared their parents' or family members' involvement in helping them understand the science content. Jennifer stated that, "my mom and dad, whenever I have questions about my homework, they always help me…they are both engineers, so if I ever have questions in science I can always go to them to ask them…" Kim spoke about how her parents encourage her and her sister to ask questions when they are confused or the material is difficult. She said, "and if we still do not understand it, our dad is really good at science and our mom is really good at math and so if one of us has trouble…we usually just sit down together and talk about it and then usually we both understand". Likewise, Joanna spoke about her dad's efforts to research topics even when he does not understand. "My dad…anytime that I am confused with anything…he will explain to me…even if he does not know it, he will just look it up and he will try to explain it to me in a way that I will understand it". Andrea mentioned that …"pretty much everyone in my family does support-like stuff and…because they want to make sure that we get to do what we want to do and get good grades and make sure that you have everything set up to be able to do well". Finally, Carolyn provided an example of how her mother supports her academic interests in science by searching out science opportunities outside the classroom. Carolyn shared: "my mom saw that I was enjoying science and she found this summer program and she asked me if I wanted to do it and I said I would."

Some participants lacked science homework support at home. Beth talked about how her dad "gets emails on all the tests because the teachers send them out"; however, he only asks her if she has studied, he never "offers to help because he doesn't know anything about science". Rachel has a similar situation when she asks her mother for help. She shared, "the thing with me, whenever I ask my mom to quiz me, she is like…go ask your sister…I'm not smart enough to do science". Kelly added: "I think my parents could have affected me because…I mean…I never learned anything about science from them."

Other means of support as characterized by the data include how participants' parents or family members project their views of science as a career. The data show parents can express their views in two ways. They model successes and challenges of science careers through their own work in the field. Also, they share their views of science through discussions with their children. Michelle informed the group that both her parents work at the local science laboratory and are "always involved in work that has to do with science". Trish shared that her uncle, a science teacher, shares his passion for plants with her. She talked about looking at plants with him: "when we are outside, he will point out interesting things about the plants to me". She added that his excitement about plants "makes me want to learn more about them". Helen revealed her grandfather's hobby of researching her family tree and how his work has made science applicable to her life. She stated, "he comes over a lot and he does genealogy online… he does a lot of research about genealogy and so he will talk to me about our origins a lot. Learning about my ancestors has made me love science." Finally, Sherry told the group that her "dad has a degree in biochemistry" and observing him work in the science field has made "science less intimidating" for her to pursue as a career.

However, some participants' parents did not have careers in science. Jenna stated that, "my was dad was a math and social studies person, so he does not know anything about science and neither does my mom. She is more of an executive real estate person. So, I tend to not like science as much." Kelly notes that her stepdad has been influential in her views of a science career. She shared that he works in retail and "views science as a less…not as good of a career to go into as another one, because apparently, if you are a female scientist you are paid a little less than men, so…and science does not really interest me that much." Becca's parents also discussed gender as it relates to science. She explained that her parents suggested she "not to go into science because it is too hard, especially for…they say it is harder for a girl". Rachel says that their suggestion has encouraged her to look into other careers like music and art.
Beth added that her dad believes "science probably is not the best career considering my IQ." Similarly, Rachel described a time when her dad said, "it [science] is probably not the best career for females, either, unless it is like teaching or something." Different from these participants, Carolyn expressed a desire to learn science even though her parents do not work in the field. "My mom is really a language arts person and my dad is a math person and I am kind of more of a science person." She continues to add that she wants to pursue a science career because "I like being different than other people in my family."

Media. Media emerged as another influence impacting females' science identities. Media outlets included in the discussion were the Internet, TV, and videos or documentaries accessed at home and/or school. Most of the participants noted that they accessed one of these media outlets daily. The Internet and TV were the girls' main source of scientific news. Jenna said, "most of the science that is on the news and stuff, it is trying to find cures and stuff." She adds that "there is not really any other science [on the news] except for like environmental like things…new ways…like solar panels." Kim added, "there are a lot of engineers working on the cars that drive themselves like solar-powered cars." Trish mentioned "the Mars stuff is really big right now and that is having a big impact on the social media."

Along with the examples of science news topics the participants spoke of, they also addressed their views on the gender divide present in the media. Olivia said, "sometimes I see the news and it is very surprising that a female scientist did this. I feel like it should not be that surprising if a male scientist did it than a female scientist." Renee agreed that male scientists make the news more frequently by sharing "whenever I see the news about science, it is a male scientist because they still think that the males can do it, like they can do that better than females can, because they think science is more of a…only men can do this not women." Michelle explained that she believes the way science is presented by media outlets causes females to be "treated differently" in the work place. Beth claimed the result is "less pay for doing the same job, so why would any girl want to work in science."

The same portrayal of science as a male dominated career field is evident in the way the participants discussed videos they watch in science class. Kim noted, "most of the videos we watch, there are not a lot of women on the video, it is more of the men doing the talking and the different experiments shown and I just think that the girls should be able to do some of that, just as much as the men do." Andrea agreed that females should be used as much as males in presenting scientific concepts through instructional videos. She stated, "most of the time it is male, not a female, so it would be different and may be a little better to see one of the videos with only a female doing the experiments." Helen remembered watching instructional videos in class with Bill Nye the Science Guy. She said, "I loved Bill Nye because he was funny and the experiments he did were very cool. But, even those…were hosted by a man…I would like to see a female Bill Nye one day." Jenna also added: "I do not think there has ever been a female scientist on the videos [in class]…I honestly do not think I have ever…if there is any scientific thing that they have shared…I do not think it has ever been a female."

From there, the discussion progressed to how the male dominated videos used in class impact the public's characterization of a scientist. Of the 19 participants, several terms were used multiple times to describe the intellectual characteristics of a scientist. "Smart/intelligent" was referenced 12 times, "creative" 5 times, and "team/group work" 3 times. Participants believed scientists have to be patient and determined. They need "to keep on trying and just stick with it and not keep on jumping to something else just because it fails to work one time." Scientists must "be able to work in groups and individually", as well as "be respectful of other scientists when they share their thoughts and ideas." Renee noted that scientists must be good writers in order for ideas to be "communicate[d] easily" to others.

Participants also focused on the stereotypes of scientists and how their own views of scientists have evolved. Andrea pointed out that her first image of a scientist is "someone with a white lab coat on and doing an experiment in a metal lab room." Jennifer recalled that her science teacher had them "draw a scientist and every single person in the class…I cannot think of one person that did not…drew a white man, in a lab coat, with crazy hair." Michelle mentioned she pictures "are a bunch of other scientist around…with microscopes and stuff." However, the participants also clearly noted an evolution of their views of scientists. Kim said, "I think my view has changed a lot too, because I used to think the white coat and the lab, but now I feel like I have been exposed to a lot more within the past two years [in middle school]." Jenna confirmed, stating "because now when I think of a scientist…it can be any gender…even though within the science world, when people think of it, it is a man and it has always been really dominated by men…and it can be, honestly like any race, any ethnicity, any sexual orientation, anything that anyone every really is…cause there is no set standard that you can be to be a scientist."

Contributing to their changing views of scientists, the participants revealed how network television shows and commercials portray science. Carolyn spoke of her favorite show, *Grey's Anatomy*. She shared, "I have always had an interest in like the medical field and becoming a doctor" and "half of the show's stars are successful females…this is encouraging." Helen added, "the *Big Bang Theory*…like half of them are girls and they are scientist, which I think helps girls also have interest in it [science]." Rachel referenced an Apple commercial using images of galaxies in space as "respark[ing] an interest in it [science]" for her. Others agreed that television exposes the public to aspects of science that may be unknown or misunderstood. Andrea confirmed with an example of a show she watched recently in which the characters played various scientific roles. She said, "there is this scientist, this scientist, this scientist…this engineer, that engineer, and it is…I did not even know half these things existed."

Peers. Peer relationships and interactions was the final theme that emerged from the data as impacting females' science identities. More specifically, the influence of peers surfaced within the discussion on participants' involvement in science clubs or programs. Specifically, the girls spoke about how their peers influenced their decisions to participate or not participante in the school's science enrichment program and the OST program. The OST program and the science enrichment program are limited to specific, but different, populations within the school. Because only 8th grade students are eligible for both programs, only 8th grade participants could speak to the peer theme during the focus groups; however, when questioned about their possible participation, 6th and 7th grade participants added to the discussions.

First, the science enrichment program is an elective course in its first year at the school. The purpose of the program is to further expose students to science as it relates to the disciplines of science, mathematics, engineering, and technology (STEM). At the end of their 7th grade year, eighth grade students were given the option to enroll in one 9-week section of the course. According to focus group participants, the course objectives aligned with the engineering design process and students were tasked with "building a Stirling engine out of steel wool wire and regular wire and Coke cans."

When asked if all the participants had taken, were currently enrolled, or planned on taking science enrichment, there were mixed reviews. Michelle initiated the conversation by explaining, "I have it next quarter but I am really excited but just from my experience of who is doing it, I have kind of talked with some of my friends and they are having fun." Trish agreed, "I am taking science enrichment [next semester] and I am excited to take it." In a different group, Jennifer shared her experiences in the class. "I'm taking the class now. It is like a class where you can do things that are more like lab and experiment related…you get to build things and do experiments and everything. It is really fun." However, not all participants signed up for the class. Kelly talked about a conversation about the class with a friend: "I said, 'Hey are you in science enrichment'…and a lot of the popular people have been just like…Oh no, I am not doing that…so I did not sign up either." Becca expressed, "I did not sign up. It's another science class…I am not an expert so why should I take two?" Sherry told the group, "I did not have any friends taking the class and I did not want to be by myself." Some of the participants who did not sign up for the class revealed their regret. "I did not want an extra science class…I heard from friends that it is not hard and a lot of fun, so I wish I would have taken it." When asked to describe the demographics of the course, the participants revealed it is "half girls and half boys" and most of the students are "also taking high school science classes like Biology and Physical Science."

Second, peer influences were also discusses in the two focus groups of OST participants as the influences related to the OST program. Participants were asked why they chose to apply for the program and a majority of responses involved the influence of peers. Jennifer said, "I heard a lot of good things about it…my neighbors said it was such a fun trip and once I got into it…I was…this is going to be a good educational thing." Carolyn added, "since some of my friends were thinking about doing it too…and that would be good to hang out with them a lot…I decided to apply. I just heard a lot of good things about it." Similarly, Michelle shared that "a lot of my friends were talking about doing it [OST program]…that was a pretty good reason to want to go." Emma talked about her older brother and his friends because they did not apply when they were in middle school. She said, "my older brother said…he did not go on a trip because his friends did not want to go because it is only for the honors kids…it is only for the kids who are really smart…and I was like…oh no, anyone can go…I wanted to prove him wrong so I applied." Casie explained she had "some friends that did not even really care about it, so they did not even acknowledge it." Most of the OST participants noted application requirements as the reason their peers did not apply. Kim said her friend "did not want to write the essay," whereas Jennifer's friend "did not want to bother with getting the teacher recommendations." Finally, Joanna revealed, "even though most of my friends were not interested in completing the requirements or doing the work involved in the program, I wanted to prove to myself that I could do this. I am very happy I succeeded."

Research Question 3

The purpose of the final research question was to examine the impacts of the science OST program on its female participants. To answer this question, data was collected from former OST female participants during the final two focus group discussions.

Participants

The study focused on last year's cohort of female participants. These female participants are currently 8th graders in the study's middle school. The females who volunteered (*n*=10) were given the option of participating in one of two focus group sessions. Six females participated in the first focus group and four participated in the second focus group.

Statement of the Findings

To isolate the major themes focus group participants discussed about the science OST program, a matrix-coding query was performed in NVivo. This query narrowed down coded data into three major themes about the program: reasons for applying, program experiences, and influences on career trajectories. Each of the themes is discussed in the following sections.

Reasons for applying. As the participants discussed their involvement in the OST program, they spent a considerable amount of time talking about the reasons they became interested in the program and decided to apply. Carolyn started by explaining, "I heard a lot of good things about it…everyone said it was such a fun trip and once I got into it…I was like…this is going to be a good educational thing." Kim concurred, "a lot of my friends were talking about doing it…so I applied." Renee said, "I just really was interested ever since people started talking about it." Trish spoke about her reason for seeking out more information on the program. "Well I had a friend whose older sibling had gone on it [the trip] and they had fun and so he was always asking about it and I was like…What is this trip? So I looked into it and decided I wanted to do it." Michelle mentioned the influence of her teacher, "Well I did not know anything about it until the teachers told me about it and in science I heard about it…and so some people where just saying how fun it is and everything and I just figured I will just apply and see if I get in and…I went on the trip and it was amazing."

However, not all the female participants mentioned a peer or teacher influence as their reason for applying to the program. Emma said, "I am interested in science, so it seemed like the obvious thing to apply for the program." Phyllis explained, "I knew there were requirements and I wanted to see if I could do it." Sarah said, "I made it my personal goal to get it the program. I felt like I work hard at school and could do this too."

Program experiences. The participants also discussed the impacts of the experiences from the program. These experiences were coded into several groups: cross-curricula connections, program tasks and activities, and "takeaways" or what students learned from the program. First, most of the girls addressed the blending of science with other subject areas. Michelle explained, "it [the program] is not just about science, you learn so much about history and all of the history of the Outer Banks. In our lesson design, we taught math to the kids…and we just learned so much stuff about different subjects." Kim said, "I learned how the Wright Brothers used the engineering design process to build the first plane. To do this, they had to study weather conditions and do math calculations. Their achievement is part of the science world but it mixes with other subjects too." Renee agreed, "it kind of got me interested in not just science but other academic courses…then I just felt like all of the stuff we learned was connected…like dissecting like the literature that we had to read…it just all really helped in like academically…it was just really fun." Trish was excited to make a connection with the program and her social studies class: "One of my group members was King George in our iMovie…then I was Giovanni da Verrazzano. A week later, we talked about it in social studies and I was like…I know this person!"

They also talked at length about program tasks and activities. Jennifer talked about the need to work cooperatively with her group members. "I had to learn to work with them really well even we had our conflicts…we had to talk and work them out." Andrea mentioned how her group members dealt with scheduling conflicts. "We were not really able to meet up that often or for that long because of all the different stuff that we were doing and then we would have to assign each person stuff to do over the next week or weekend and communicate by email and find Skype times to get it done." Helen agreed, "I learned a lot about time management." Two of the participants specifically made connections to their work in the program and the work of a scientist. Casie said, "…some things would not go as planned, like maybe we worked really hard on creating…a sort of product…and it did not work like we wanted…just like scientists make prototypes and it just does not work out how they thought it was going to and that could be frustrating…like the lessons we taught did not go how we thought it would go…" Joanna aligned her experience with the work of Rosalind Franklin by sharing, "there were times when the work in my group was not divided equally and people were getting more credit than they earned, like how Rosalind Franklin did not get all the credit for her contributions to DNA." Carolyn expressed her enjoyment of designing a STEM lesson by stating, "the lesson that we were planning was so much fun it did not even feel like hard work." Jennifer contributed by sharing the reward of teaching students new information: "We [her group members] asked them [elementary students] questions about the moon phases and they did not really know any of it because they had not really learned any of it yet. But, by the end of the lesson, I asked them questions and they were all like...it has eight phases that happens every so often and this is what this looks like. My whole group felt proud of our lesson and it was just really fun."

Career trajectories. Finally, the participants shared their thoughts about how the program has impacted their career choices. Andrea talked about how the program has supported her love of science. "I have always wanted to work in a science field…like a doctor…a pediatrician…now I know that science involves other areas that I like so I am more focused on this as a career." Jennifer agreed, "science is my favorite subject because I like working with groups of people and collaborating on projects. I felt like this program allowed me to do lots of cool things that have helped me realize this is what I want to do in the future." Kim said, "sometimes the assignments in my science class do not always let me be as creative as I want…but, this program let me plan using my own ideas…it showed me how fun science will be as a career." Joanna spoke about her hope to be an actress: "I like science but I don't want to do it as a job. I like acting in school plays and hope I can make a living doing it." Trish mentioned, "being a part of the program did not change my mind about my career…I like to write and I want to be a journalist…I am interested in science more as a hobby." Helen concurred, "I have always wanted to be a lawyer because I like to argue my opinions. I loved the program but I don't want to become a scientist because I was in it."

Discussion

The data analysis from the SMS provided a plethora of insight into middle school students' perceptions of their science abilities, interests, and career plans. Further, the focus groups' data allowed the study to narrow the focus to the major impacts on middle school females science identities. These areas of impact are seemingly interwoven in the lives of the girls and have proven in this study to either strengthen or weaken the critical aspects of science identity development. To better streamline the discussion, the results of the study are reviewed in relationship to three categories: gender divide, school science, and impact of peers.

Gender Divide

Overall, the survey results showed overwhelming similarities between how female and male students perceive science. There were a few areas in which the two genders views of science were different. One area was that of females pursuing science careers. Survey results confirmed females believe that they will have more trouble getting a job in a science-field and they will less likely become scientists than their male counterparts. During the focus group discussions, these beliefs were reinforced by participants who shared that their parents discouraged them from pursuing science careers due to the difficulty women had in getting those jobs and that women make less money than men in science fields. One participant even shared that her step-father discouraged her because her IQ would not allow her to work in a science field. Additionally, the survey and discussion group results established that these beliefs about females and science are more prevalent in female students who are enrolled in grade level rather than honors science classes. Although some honors students do not plan to pursue a science career, they did not indicate the reasons for their career choice was based on the influences of family members. These results confirm the impact of stereotype threat in middle school female students. The threat is perpetuated by the beliefs of influential people, or role models, in the females' lives. As a result, females' science self-efficacy is lowered because science has been perceived as masculine (Singh, Allen, Schedckler, & Darlington, 2007). Stereotype threat poses as a significant challenge for female students as they construct their science identities. As science identities are negatively constructed, female students tend to underperform in a way that reinforces the stereotype (Aronson & Steele, 2005; Miyake et al., 2010; Ong, Wright, Espinoza,

& Orfield, 2011). This helps explain the reason why many female students in grade level science classes find their way into those classes and typically have more negative perceptions of their science abilities.

Another survey area that proved different between female and male students was career trajectories. Female students preferred pre-medicine, pre-veterinary, pre-dentistry, and nursing careers than their male counterparts. The careers preferences of these female respondents confirm research that states females are drawn toward science fields that have been historically categorized as domestic sciences. The domestic science rhetoric of the early 20th century established a gendered outlook on career paths for females, most notably opening doors to careers like medicine that extended the role of females as caregivers in the home into caregivers in the workplace (Watts, 2007).

Focus group participants also indicated the influences of media outlets on their views of science. They noted the lack of gender equity present in news stories and announcements about scientific discoveries. Additionally, the females spoke to their own experiences of watching science videos that only use male narrators or male scientists to discuss science concepts. They believed that the media's methods maintain that science is male dominated field leaving female students questioning their abilities in science. During the focus group sessions, it was also clear that the media's gender bias portrayal of science continues to support the scientist stereotype of being a white male in a lab coat working on an experiment in isolation. Although some of the participants acknowledged that the image of the scientist is evolving to incorporate societal change, many participants seemed satisfied in allowing the scientist stereotype to cloud their own abilities to do science.

School Science

The focus group participants were open to sharing their thoughts and beliefs about their science experiences. They were very articulate and knowledgeable about how they learn best. They were aware of teaching approaches that stifle their enjoyment or interest in science. The focus group discussions provided exceedingly insightful findings that distinguished the major influences that shape the science identities of middle school girls.

The participants overwhelmingly preferred instructional approaches in the science classroom that include group work. The participants acknowledged feeling less interested in science assignments that limited their interaction with peers. They did not enjoy lectures about science concepts, but preferred to be involved in hands-on learning that allowed them to see science in action. They believed that activities that parallel real-word experiences are most effective in their understanding of science concepts and increasing interest in science. It was clear that a lack of interest in instructional approaches resulted in students' failure to take ownership in their learning and distanced the relevance of the class to their own lives. Ultimately, the data revealed that science instructional approaches perceived as uninteresting disengaged students' with the science content, and furthermore, disassociated students' identities with science.

The data provided by the focus group interviews established a lens into the world of the academically diverse science students present in this middle school. Honors students were more understanding of the need for teachers to lecture or assign bookwork in order to share information with students. They noted that these approaches addressed the various learning styles of other students. Additionally, honors science students viewed challenging assignments differently than grade level science students. The honors students all expressed a sense of accomplishment when they completed a difficult assignment; whereas, grade level students focused more on the frustration caused by the assignment. For example, several honors science students discussed the "key terms" assignment. They acknowledged the difficultly of defining and interpreting unfamiliar terms prior to the science lesson. However, they understood the purpose was to expose them to the terms early so that they could make seamless connections when the science concepts are being taught. The data from the various focus groups identified that honors science students possess more effective coping skills to manage challenges. Those skills are the result of a plethora of influences including support at home, success at school, and a stronger sense of self-confidence and self-efficacy in science.

There was also a distinct difference in the ways the two academic levels viewed group work. The honors science participants looked at group work as a change in routine. These students used group work to confirm the validity of their personal thoughts about the science content. They approach group work having established their own ideas and enjoy discussing ideas with their peers as a means to broaden their thinking on a topic. On the other hand, grade level science students view group work as an opportunity to understand the content. Most of the participants noted that group work gave them the means to get help from their peers and alleviate their own frustration with the content. It was obvious that grade level students often entered into group work without establishing their own ideas on a science topic, but rather, relied on their peers to help them shape ideas. In the end, group work helps grade level students build self-confidence in their abilities to engage in scientific discussions that they otherwise lack when required to work independently.

The survey results also showed the differences in science activities at the elementary and middle school levels. As students move into middle school, there is less emphasis on the outdoors in science. Students are no longer assigned tasks that take place outdoors. More activities take place in the classroom using special equipment and research. This transition has narrowed students' perspectives on the study of science by limited what they view as "doing science". In addition, middle school students attend fewer science camps and programs; fewer students participate in science projects or fairs, and fewer students are recognized for their science achievements than their elementary school counterparts. The decreasing frequency of these science-related activities and events has proven to distance students' interests in science. As confirmed by the focus group students, middle school females enjoy being involved and interacting with their peers. They want their role models – teachers, parents, and peers – to acknowledge their successes and support their abilities in science. In doing such, female students gain a sounder science self-efficacy that in turn reinforces their science identities.

As an extension of their school science experiences, science OST participants indicated that the program supported the development of their science identities. The program provided female participants with a sense of belonging to a group composed of others with similar interests. This sense of belonging established a safe environment in which students had autonomy in how they approached learning and interacting with program assignments. The culture of the program promoted students to research concepts, design plans, and modify as new ideas or thoughts emerged. Female students revealed they did not fear making mistakes or encountering problems. They felt their ideas were accepted and they were trusted to seek out alternatives if needed. Students noted that frustration levels remained low while self-confidence increased.

Impacts of Peers

As discussed, peers are the preferred method of interaction in science class. In addition, peers are also a major factor in influencing middle school females' decision making in the classes in which they enroll and the career paths they seek. While state mandated test results are the key factor in placing students in courses, the survey respondent indicate they have a choice when selecting their science classes. Further, focus group participants added that they chose classes based on the friends enrolled in the class or recommendations of their peers about the class. An example described by all four focus groups was the science enrichment class offered at the middle school. All eligible 8th grade honors science participants had enrolled, wanted to enroll, or taken the course. The two that wanted to enroll were not able because of scheduling conflicts with another course. They shared that two factors influenced their decision to take the class. The course was science content focused and their friends were taking the class. Of the grade level participants, none had enrolled or taken the class; however, several indicated they had heard from a friend that the class was fun and they wished they had taken the class.

Similarly, science OST participants shared that they chose to apply because a friend or family member had encouraged them or peaked there interests in the program by sharing their own thoughts. Although a few OST participants noted that their participation in the program was a personal goal, most of them indicated that they applied because a friend was applying or had encouraged them to take part. In the end, the data clearly shows the substantial impact of peers on decision-making. Grade level students are not as likely to seek out information from other sources to make decisions. They rely on their peers to inform their decision-making. While honor students are more likely to have personal interest and goal in mind, they maintain that peers are a significant part of their decisions about science courses and program involvement.

Summary of Results and Findings

Middle school female students are a population vulnerable to societal influences causing them to either embrace or withdraw from science. As presented in this chapter, these influences are part of the everyday lives of female students. Daily, female students are faced with the challenges of interpreting how these influences fit into their role as an individual and as a member of society. The data collected and analyzed during this study proves that the influences have a substantial impact on middle school females' construction of their science identifies. Survey results found female students' failed to recognize their abilities to pursue and secure a science-related career. Further, focus group participants confirmed that most females perceive their science abilities as inferior to males.

In addition to the gender divide, middle school females acknowledged other factors inhibiting their ability to construct positive science identities. Instructional approaches used by science teachers, academic support from parents and family, media outlets portrayal of science, and peer interactions were recognized as restricting females' science self-efficacy and self-confidence. The next chapter will present how this study contributes to current literature, impacts science education, and offers recommendations for further research on female science identity construction.

CHAPTER V: CONCLUSIONS AND RECOMMENDATIONS

For decades the underrepresentation of female students in science majors and female graduates in science careers was explained as females having a lesser aptitude in science; however, as more research in this area has emerged, it is clear there is not empirical evidence to support this claim. Recently, studies have shown the female students' science achievement is equal to their male counterparts, and in some cases females feel equally as capable of learning science. However, there is an obvious disconnect in the number of females versus males pursuing science careers. The purpose of this study was to examine the science perceptions and thoughts of a population of middle school students to recognize the areas in which males and females differed. Next, the study established the major influences that contribute to or negate the positive construction of females' science identities. Finally, as science Out of School Time (OST) programs become more prevalent in schools, it is critical to examine how these programs contribute to females' science identities. This final chapter connects the literature to this study's findings, examines how this study contributes to science education reform measures, and pinpoints ideas for future research that will continue to support female students' science identity construction.

Research Contributions to the Literature

Throughout my study, a multitude of findings emerged illustrating a picture of how females view science and their place within the science world. In an effort to summarize the findings, I presented three research questions. The survey results of the first question provided a baseline for differences in how middle school females and males viewed various areas of science. These results led to the design of the focus group discussion guide used to secure findings about females' science identities and the impact of an OST program on their identities.

In providing closure to this study, I present how the results and findings of each research question connects to the literature.

Research Question 1

The results of the SMS found that three of the seven study constructs indicated a significant difference between middle school females and males. First, they differed in the their views of science and scientists. Female respondents reported it would be more difficult for them to get jobs in science and they would be less likely to be scientists than their male counterparts. This result aligns with Steele's (2003) study in which girls viewed their academic achievements equal to their male counterparts, but believed adult males to be better at science than adult females. This result allowed for an understanding throughout the study that female students hold a lower science self-efficacy than male students because females perceive science as masculine (Singh et al., 2007).

Next, females indicated that they discussed issues related to the environment, healthcare, the arts, and their teachers more so than their male counterparts. This result confirms that females tend to be more oriented into social and service roles (Singh et al., 2007) that address issues and concerns with people. Also, history has shown that females are steered toward science areas that align with domestic responsibilities like caring for other members of the household (Watts, 2014).

Finally, the results of career trajectories differed greatly between females and males. Female respondents indicated pre-medicine, pre-dentistry, pre-veterinarian, teaching, and nursing as possible career paths; whereas, males chose computer science, engineering, and physical sciences as their trajectories. The careers selected by female respondents have traditionally been identified as female fields. In choosing these careers, female students' are connecting with their core identity, which has shown to be profoundly influenced by gender and gender roles (Yazilitas et al., 2013). Although efforts have been made to lessen the inequalities between females and males in our education system and the workplace, these efforts have not yet been successful in promoting equal representation of females in male-dominated fields. As a result, female students often perceive these fields as unattainable as indicated by the responses of female students on the SMS (Yazilitas et al., 2013).

Research Question 2

The four focus group sessions allowed females to discuss their perceptions of science within the seven study constructs. The findings narrowed the science thoughts and beliefs of female students to four major influences impacting the construction of their science identities. Females recognized teachers and teaching approaches, parental and home support, media outlets, and peers as the being most influential to the development of their identity as a science person.

The female participants acknowledged science teachers with dynamic and energetic personalities that are enthusiastic about their craft as more influential in building their science self-confidence (Calabrese Barton et al., 2008). Also, the participants preferred science teachers who incorporate their personal interests into instruction much like Chantelle using her love of dance to contribute to the school's science club in the Calabrese Barton et al. (2013) study. The female participants stressed the importance of their participation in science rather than just learning concepts (Ballard, 2013; Calabrese Barton et al., 2008). Additionally, the participants wanted teachers who recognized their various learning styles (Beane, 1985). They enjoy interacting with peers and collaborating on projects (Taylor et al., 2001). They want to engage in inquiry confidently without fear of criticism (Taylor et al., 2001). Supporting the Burkam et al. study (1997), the participants preferred hands-on science experiences that align with real-world problems. These experiences help to support their understanding of more challenging concepts. It is evident from these findings that it is impossible for females to construct a science identity when the practices of the social community (classroom) are in conflict with the females' learning styles (Calabrese Barton et al., 2008).

In examining the difference in honors and grade level female participants, it was clear that grade level females lacked the science self-efficacy of the more advanced group of participants. These females often questioned their abilities to be successful in the science classroom. This self-doubt frequently led to their disassociation with science. These findings confirm Malcom's (1984) research on academic tracking of students that found that students placed in general or remedial classes are not provided rigorous instruction. They often continue to distance themselves from an identity associated with the discipline. Females will identify with the "person" as others perceive them and they perceive themselves (Ballard, 2013; Calbrese Barton et al., 2013; Tarrant, North, & Hargreaves, 2001). In other words, if others view a female student as lacking the competence to engage effectively in science tasks, she takes on that role and fails to develop a science identity.

Next, parental and home support was a major influence in the science identity construction of female middle school students. Again, I found that the participants were academically divided based on the amount and type of support they received at home. Honors students indicated their parents or other family members played an active role in their science work at home. This included being available to help study, complete homework, or offer advice. The honors females felt they were able to rely on their parents as a knowledgeable resource and a role model for academic success (Clewell et al., 1992). The grade level science participants indicated a range of support or non-support efforts in their homes. While none of the girls indicated their parents did not want them to be successful, most were discouraged from identifying with science due to the limited or absence of support their parents provided them. A few believed their parents wanted to help, but lack the skills or abilities. These parents questioned their daughters about homework or tests, but never offered to help them study. Some participants described their parents' discouragement of a science career due to science being a masculine field (Yazilitas et al., 2013). These findings show the continued effect of stereotype threat in not only these girls' lives, but their parents as well. Aligned with Yazilitas et al.'s (2013) study, the participants shared that they were encouraged to pursue female friendlier careers like nursing, teaching, or the arts.

Third, the media influenced the way in which female participants identified with science. The participants stated that a majority of scientists spotlighted for scientific discoveries by new outlets were males. Additionally, the females noted that most of the narrators and scientists in science videos viewed at school were male. They admitted to relying heavily on media sources like the Internet and television to provide them with information on science. As it turns out, these sources only perpetuate the stereotype of science as a male dominated discipline (Watts, 2014). The inequity of science news and information is reinforcing the idea that science is not meant for girls (Watts, 2014). As a result, girls internalize this aspect of their identity and they detach themselves from an interest in and ability to engage in science tasks (Yazilitas et al., 2013).

Finally, female participants noted their peers as influential in the construction of their science identities. The participants shared that they relied on their peers to recommend the classes in which they enroll, as well as the activities in which they participate. This response aligns with Calabrese Barton et al.'s study (2013) in which a student, Diane, stopped attending the lunchtime science club because her friends encouraged her to eat lunch with them instead. During the focus group discussions, the participants shared that their peers' encouragement or discouragement to take a class or join a club were often founded on what they had heard from others rather than through their own experiences. The participants made little indication that they would seek out information about science programs or classes from adults. A few fameless admitted to feeling regret for not enrolling in the school science enrichment course after hearing positive feedback about the course from their friends. Their low science self-efficacy led to many of their initial decisions to not enroll in the course (Clewell et al., 1992), therefore preventing the participants from constructing a science identity.

Additionally, the findings indicated how peers play a significant role in how the female participants viewed their own science abilities. If the participants received recognition from peers as being "smart" or "good" in science, the participants shared that they felt more confident to pursue science tasks, classes, or programs (Calabrese Barton et al., 2013). Likewise, participants who did not seek out opportunities to participate in science rarely received recognition, awards, or encouragement. As confirmed by Carlone and Johnson (2007), these females failed to hold strong beliefs in their own science competence and performance because others were not recognizing them as "science people."

Research Question 3

Findings from the final two focus groups of former OST female participants provided details about why the girls applied to the program and the impacts of the program experiences on their science identities with specific interest in their career trajectories. To begin, most females applied for the OST program as a result of encouragement from their peers (Calebrese Barton et al., 2013). A few participants shared that program's acceptance was a personal goal. It was through this part of the focus group discussions that problems with the application process related to female science identity construction were illuminated. As Carlone and Johnson (2007) discovered, positive recognition strongly supports self-confidence in female students. When females applied and were accepted to the program, an aspect of their roles within the social community of science was sparked leading them to develop a more positive science identity. However, it can be assumed through this same research that female students who applied and were not accepted to the program faced challenges as they negotiated their identities. Presumably, the failure of their acceptance to the program compounded their already vulnerable science identities (Calabrese Barton et al., 2013) causing them to question their science interests and abilities. This problem detects a facet of the program that conflicts with the purpose of an OST program, thus making it the most alarming finding of this study. The exclusive nature of the OST program ignores a large population of females who would benefit from the positive recognition provided by the experiences in the program. In other words, the females not accepted or participating in the program fail to shape their own self-recognition as science people because they failed to receive external recognition reinforcing their science abilities (Carlone and Johnson 2007).

Next, the females talked about how the experiences of the OST program supported their science identity development. The findings indicated that the OST program fostered female participants' sense of belonging (Wenger, 1998). The OST participants were provided with role models (teachers, scientists, and peers) that increased their exposure to other people tied to strong science identities (Stets and Burke, 2000). The program gave female participants opportunities to explore science, develop self-confidence through independent and group work, and build self-esteem surrounding their abilities to successfully complete science tasks (Clewell et al., 1992). The females shared that their experiences in the program allowed them to engage in learning that is meaningful and relevant to their lives (Greene et al., 2013). They believed they had a role in evoking positive change in communities and at school. As part of the program, the female students highlighted the importance of the recognition and praise they received from completing or participating in program activities (Carlone & Johnson, 2007).

As a result of the engagement aspects of the program, the female participants described program activities that aligned with that of a scientists although never explicitly connect the activities to one's of scientists. As Wenger (1998) explained, the female participants' actions and energies were aligned with others in the science world. This alignment reinforced and complemented their role as a science person with their social role in a science community (Stets & Burke, 2000). Female participants were associated with high quality characteristics of a scientists resulting in a stronger sense of self as a science person. The program allowed females to build self-confidence and self-efficacy concerning science.

According to Wenger (1998), belonging also includes one imaging herself fitting into a specific community or thought or practice. For the female OST participants, their engagement in science activities allowed them to align their self-perceptions with that of the science community. From engaging in science activities in the program, they developed a strong science self-efficacy that supported more interest in science (DiLisi et al., 2011). As students developed more interest in science, their science identities were triggered (Stets & Burke, 2000). As a group, there was a collective science identity among female participants (Adams et al., 2014). Their performance of science tasks reinforced their competency in science. As a result, they were often recognized for their progress and success (Carlone & Johnson, 2007). Consequently, as Carlone and Johnson (2007) had found, the OST females viewed themselves as science people because others viewed them as science people.

Finally, the female participants shared that their appreciation for science careers had been strengthen (DiLisi et al., 2011) although none indicated a change of career plans as a result of participation in the program. The program provided participants with a broader understanding of science careers whereas before, their idea of a science career was limited to medicine, engineering, and biologists. They discussed how working with different science fields during the program educated them on the purpose and goals of each field. Most importantly, the participants internalized a belief that they were capable of pursing any of the science fields regardless of being female. The program allowed the female participants to remove societal blinders and remain unconstrained by stereotypical gender roles in science (Taylor et al., 2001).

Impact of Study on Science Education

This study provides a case for the need of countless interventions in science education. Female science identities are in flux and this is a concern for our field. In an effort to encourage more females to pursue science majors and careers, it is critical that we address the barriers that stand in their way. Those efforts should include, but not limited to, increased focus on science teacher professional development on identity construction and the implementation of OST programs earlier in students' schooling. First, science teachers must be made aware that the instructional strategies they use in class need to align with the learning styles of all students. Teachers need to be provided with resources that help support these learning styles rather than be left to locate or develop them on their own. Also, teachers need to be aware that the resources they use to discuss science content should support equity. Videos, textbooks, ancillary materials, and guest speakers should provide students with a rich diversity of ethnicities, genders, and fields of science.

Although the social influences of parents and peers are difficult to negotiate, science teachers and reformers need to educate communities that a lack of social and academic support for female students impedes their academic and career aspirations. This can be done by providing female students with opportunities to engage in enrichment programs early in their schooling. Although this study focused on middle school participants, it was apparent that earlier exposure to science would have presented a clearer understanding of science courses, programs, and careers available as they moved into middle school and high school. Additionally, earlier interventions may help females disassociate with the gender stereotypes present in science and math. As described in this study, the long-standing stereotype that males are stronger than females in science harms female students. It is critical that female students be provided with the support, encouragement, and reinforcement to construct a robust science identity in order to eliminate the equity gap in science.

Future Research Studies

As stated in the National Academies report (2007), a large body of evidence exists claiming most people hold implicit biases. These biases contribute to the ongoing struggle for females who are provided fewer opportunities to participate in science. Beyond seeking answers to three research questions, the purpose of this study is to encourage continued action that will better support our female students' science identity development. Science education reform measures must focus on approaches to disengage female students' from the influences that inhibit or extinguish their abilities to succeed in science fields. This study clearly presents the case that female students may have the interest and desire, but are continually barred from science careers due to social barriers in their daily lives. As a result of my study's findings, there are several future studies that need to be conducted to help close the gap in the area science identities as it relates to female students. First, education reform efforts need to ensure science teachers hold strong science efficacy. While it is easy to assume a teacher in a science classroom is confident in their ability to effectively instruct science concepts that may not be the case. In some schools and at different grade levels, teachers are teaching science because of a need to fill a position or like with some elementary teachers, science was not the focus of their pre-service studies. Most likely, these teachers lack a background in science and science education courses. Our goal should be to identify struggling science teachers and provide them with training to recognize and combat the negative influences faced by female science students. Supporting science teachers will help to alleviate the formation of additional barriers in the science classroom.

Second, a deeper focus on the impact of academic tracking with female students needs to be addressed. As seen from this study, there were several aspects of the participants' science experiences that proved different for females enrolled in grade level classes as compared to females in honors science classes. The grade level participants faced more challenges at home, at school, and with their peers. Typically, these participants held low self-confidence and self-efficacy, which impacted their decisions to join clubs, programs, or pursue science enrichment classes. The females indicated their science classes failed to provide them with hands-on activities but rather teachers dictated concepts through lectures. Placing these females in less rigorous classes with fewer opportunities to develop science identities, schools are creating barriers that many females are unable to overcome.

Finally, more research needs to be conducted on OST programs. OST programs are in the early stages. There remains much to learn from how these programs benefit students. One area that needs to be studied is the overlap of OST program and the science classroom. Researchers need to identify the impacts of OST programs on students' academic performance in science classes. In researching the academic impacts of OST programs, science teachers, parents, and administrators can begin to develop a blueprint for programs to be used across the country to build stronger, more efficient programs for our students – underrepresented or not.

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Appendix

Appendix A

OBX Trip Locations and Associated Activities

Locations	Associated Activities	Content Areas Met
Carowinds Amusement Park	Calculations of speed, velocity, and acceleration based on park rides	math, science, technology
Festival Park	Tours and discussions about the ship replica of Elizabeth II, Indian settlement, colonists settlements, hands-on museum	history, geography, science
The Wright Brothers Memorial	Museum and monument tour, discussion of history of the work of the Wright Brothers by park rangers	history, science, math, technology
Cape Hatteras Lighthouse	Park ranger talk about geography and geology of the land and movement of lighthouse; climb to the top of the lighthouse	science, history, technology
Ocracoke Island	1-hr ferry ride to Ocracoke examine the inlets and changes in water movement through the inlets	science, history
North Carolina Aquarium	Tour of wildlife indigenous to the area, shark tank talk with divers, sea life rehabilitation center	science, technology, math
Ft. Raleigh National Historic Site	Discussion with park ranger about the history of the area, visit to site of first English colony, video presentation about colonists, museum	science, history, technology
Elizabethan Gardens	Tour of the gardens examining foliage, artifacts, and greenhouses; discussion of gardens with local educator	science, history
Jockey's Ridge State Park	Hike across the sand dunes, identifying vegetation, animal prints, and noting movement of sand due to wind	science
North Carolina Museum of Natural Sciences	An in-depth look at NC geographic regions; state of the art lab facilities for scientists that welcome students to participate and observe, specimen lab to examine organisms' skeletons, furs, etc., IMAX movie, hands-on tools and computers to explore science concepts	science, math, history, technology, research
Blackbeard the Pirate, Mr. Ben Cherry (guest speaker at the hotel)	Presentation of the history of the Outer Banks including the impact of piracy on coastal settlements	history, science
Jeanette's Pier	Hands-on classes on clean energy; students create wind turbines, test ocean water acidity, examine beach erosion as related to weather events	science, math, technology

Appendix B

Science and Me Survey (SMS)

Science and Me

The Science and Me survey includes 31 questions based on your beliefs and thoughts about science and other school-related experiences. The survey will take you approximately 25 to 30 minutes to complete. The survey will be accessible until Sunday, November 22nd at midnight. Your answers are anonymous. You may stop the survey at any time and return within one week to complete the questions. Your participation is voluntary which means you may skip questions or end your participation at any time. Please read the questions carefully including the information in parentheses. Some questions allow for multiple answers while others require one answer per statement or row. Thank you for your time and commitment to research in science education.

Q1 Please select your current grade level.
- ❍ 6 (1)
- ❍ 7 (2)
- ❍ 8 (3)

Q2 Please select your gender.
- ❍ Male (1)
- ❍ Female (2)

Q3 Have you ever done the following activities on your own time (NOT for a class or in a class)? (Mark as many as apply in each row).

	Yes, I did this in elementary school. (1)	Yes, I did this in middle school. (2)	No, I've never done this. (3)
Read books about science or science fiction. (1)	❑	❑	❑
Spent time outdoors learning about nature. (2)	❑	❑	❑
Looked up science information in the library or on the Internet. (3)	❑	❑	❑
Used special science equipment (like microscopes, telescopes, chemistry set, etc). (4)	❑	❑	❑
Made models (like airplanes, dinosaurs, houses, etc.) (5)	❑	❑	❑
Learned a computer programming language (like Java, HTML, etc.) (6)	❑	❑	❑
Used tools to build things with wood or metal. (7)	❑	❑	❑
Collected rocks, butterflies, bugs, or other things in nature. (8)	❑	❑	❑
Taken apart things (like motors, computer, toasters, etc.) to see how they work. (9)	❑	❑	❑
Observed things in space (like planets, the moon, starts, etc.) (10)	❑	❑	❑
Written stories about science or science fiction. (11)	❑	❑	❑

Q4 Have you taken or do you plan to take the PSAT, SAT, or ACT (college entrance) exam? (Mark one).

- ❍ Yes (1)
- ❍ No (2)
- ❍ Not sure (3)

Q5 On average, how often do you use your personal computer, laptop, iPad, or mobile device for science (homework, research, viewing documentaries, etc.) when you are NOT at school?

- ❍ Never (1)
- ❍ Less than once per week (2)
- ❍ Once a week (3)
- ❍ 2-3 Times a week (4)
- ❍ More than 3 times a week (5)
- ❍ Daily (6)
- ❍ I do not have access to these electronic devices. (7)

Q6 In your opinion, how much do you agree or disagree with the following statements about science in general? (Mark one in each row.)

	Agree strongly (1)	Agree somewhat (2)	Disagree somewhat (3)	Disagree strongly (4)
Science is interesting. (1)	❍	❍	❍	❍
I could be a good scientist one day. (2)	❍	❍	❍	❍
Scientists have a chance to make a difference in the world. (3)	❍	❍	❍	❍
Scientists spend most of their time working by themselves. (4)	❍	❍	❍	❍
Scientists spend most of their time working indoors. (5)	❍	❍	❍	❍
Scientists' own opinions do not matter in their work. (6)	❍	❍	❍	❍
Scientists have to work long hours at their job. (7)	❍	❍	❍	❍
The beliefs and values in my home are different from the beliefs and values of science. (8)	❍	❍	❍	❍
Scientists are respected by people in this country. (9)	❍	❍	❍	❍
Scientists make a lot of money. (10)	❍	❍	❍	❍
Scientists have to go to school for many years. (11)	❍	❍	❍	❍
Scientists can't be religious. (12)	❍	❍	❍	❍
The media (television, movies, etc.) makes science seem cool. (13)	❍	❍	❍	❍

Q7 What is your BEST GUESS as to how you are doing in ALL of your classes so far this school year? (Mark one.)

- ❍ Mostly A's (1)
- ❍ Mostly A's and B's (2)
- ❍ Mostly B's (3)
- ❍ A mix of A's, B's, and C's (4)
- ❍ Mostly B's and C's (5)
- ❍ Mostly C's (6)
- ❍ Mostly below C's (7)

Q8 What is your BEST GUESS as to your grade so far in your MATH class this year? (Mark one.)

- ❍ A (1)
- ❍ B (2)
- ❍ C (3)
- ❍ Below C (4)

Q9 What is your BEST GUESS as to your grade so far in your SCIENCE class this year? (Mark one.)

- ❍ A (1)
- ❍ B (2)
- ❍ C (3)
- ❍ Below C (4)

Q10 For your science class this year, how often do you: (Mark one in each row.)

	Always (1)	Most of the time (2)	Sometimes (3)	Never (4)	No opportunity to do this (5)
Do the homework for this class (1)	❍	❍	❍	❍	❍
Do work for extra credit (2)	❍	❍	❍	❍	❍
Participate in class discussions (3)	❍	❍	❍	❍	❍
Ask questions in class (4)	❍	❍	❍	❍	❍
Make up work when you miss class (5)	❍	❍	❍	❍	❍
Feel bored in class (6)	❍	❍	❍	❍	❍

Q11 For your science class this year, how much do you agree or disagree with the following statements? If you are not sure, mark your BEST GUESS. (Mark one in each row.)

	Agree strongly (1)	Agree somewhat (2)	Disagree somewhat (3)	Disagree strongly (4)
My teacher thinks I could be a good scientist one day. (1)	❍	❍	❍	❍
I enjoy learning science this year. (2)	❍	❍	❍	❍
My teacher cares if I think science is interesting. (3)	❍	❍	❍	❍
You need to have special talent in science to do well in this class. (4)	❍	❍	❍	❍
It is important to me that my science teacher supports my views on science topics. (5)	❍	❍	❍	❍
I know more about the content of this class than other students do. (6)	❍	❍	❍	❍
My teacher has high expectations for me. (7)	❍	❍	❍	❍
In this class, I am learning how science applies to real life. (8)	❍	❍	❍	❍
Doing well in this class is important for my future career goals. (9)	❍	❍	❍	❍
In this class, we talk about what everyday scientists do. (10)	❍	❍	❍	❍

Q12 Have you ever: (Mark as many as apply in each row.)

	Yes, I did this in elementary school. (1)	Yes, I did this in middle school. (2)	No, I've never done this. (3)
Attended a science camp or special science program? (1)	❑	❑	❑
Taken an extra science class in the summer (not a make-up class)? (2)	❑	❑	❑
Participated in a science fair? (3)	❑	❑	❑
Participated in a science club or team? (4)	❑	❑	❑
Received an award or special recognition for doing well in your science classes or other science-related activities (like science fair, competition, etc.)? (5)	❑	❑	❑
Had a teacher who made it exciting to learn science? (6)	❑	❑	❑
Had a teacher who made you not like science? (7)	❑	❑	❑
Visited a college campus for any reason? (8)	❑	❑	❑
Participated in a program specifically designed to prepare you for college (for example, Upward Bound)? (9)	❑	❑	❑

Q13 How much do you want to go to college? (Mark one.)

- ❍ Very much (1)
- ❍ Somewhat (2)
- ❍ Only a little (3)
- ❍ Not at all (4)
- ❍ I don't know (5)

Q14 If you go to college, how interested would you be in majoring in any of the following fields? (Mark one in each row.)

	Very interested (1)	Fairly interested (2)	A little interested (3)	Not interested (4)
Biology (Marine, Plant, Biotech, etc.) (1)	❍	❍	❍	❍
Chemistry (2)	❍	❍	❍	❍
Physics (3)	❍	❍	❍	❍
Earth and Space Science (Geology, Astronomy, etc.) (4)	❍	❍	❍	❍
Environmental Studies (5)	❍	❍	❍	❍
Pre-Medicine, Pre-Dentistry (6)	❍	❍	❍	❍
Pre-Veterinary Science (7)	❍	❍	❍	❍
Nursing (8)	❍	❍	❍	❍
Engineering (Aeronautical, Electrical, Mechanical, etc.) (9)	❍	❍	❍	❍
Computer Science (10)	❍	❍	❍	❍
Psychology (11)	❍	❍	❍	❍
Science Education (to teach science in middle/high school) (12)	❍	❍	❍	❍
Forensic Science (13)	❍	❍	❍	❍

Q15 Have the following people in your family attended college? (Mark one in each row.)

	Yes (1)	No (2)	I'm not sure (3)	Don't have (or none old enough to go) (4)
Mother or stepmother (1)	❍	❍	❍	❍
Father or stepfather (2)	❍	❍	❍	❍
One or more older brother(s) or sister(s) (3)	❍	❍	❍	❍
One or more other adults in my family (legal guardian, grandparent, aunt, uncle, etc.) (4)	❍	❍	❍	❍

Q16 Have the following people ever had a science-related job? (Mark one in each row.)

	Yes (1)	No (2)	I'm not sure (3)	Don't have (or none old enough to have one) (4)
Mother or stepmother (1)	❍	❍	❍	❍
Father or stepfather (2)	❍	❍	❍	❍
One or more older brother(s) or sister(s) (3)	❍	❍	❍	❍
One or more other adults in your family (legal guardian, grandparent, aunt, uncle, etc.) (4)	❍	❍	❍	❍
Other adults who are friends with you or your family (5)	❍	❍	❍	❍

Q17 How often do you talk with at least one of your family members about each of the following things? (Mark one in each row.)

	Everyday (1)	Once or twice a week (2)	Once or twice a month (3)	Once or twice a year (4)	Never (5)
Current science news (1)	❍	❍	❍	❍	❍
Issues related to the environment (2)	❍	❍	❍	❍	❍
Issues related to people's health (3)	❍	❍	❍	❍	❍
Politics (4)	❍	❍	❍	❍	❍
Sports, television shows, movies (5)	❍	❍	❍	❍	❍
Books, art, theater (6)	❍	❍	❍	❍	❍
My plans for college and/or a career (7)	❍	❍	❍	❍	❍
Classes I should take in high school (8)	❍	❍	❍	❍	❍
Things I am learning in my classes (9)	❍	❍	❍	❍	❍
My grades (10)	❍	❍	❍	❍	❍
My teachers (11)	❍	❍	❍	❍	❍
My friends (12)	❍	❍	❍	❍	❍
Jobs or careers of my family members (13)	❍	❍	❍	❍	❍

Q18 How much do you agree or disagree with the following statements about your family (or legal guardians)? (Mark one in each row.)

	Agree strongly (1)	Agree somewhat (2)	Disagree somewhat (3)	Disagree strongly (4)
They expect me to go to college. (1)	❍	❍	❍	❍
They think it is important for me to learn science. (2)	❍	❍	❍	❍
They think science is interesting. (3)	❍	❍	❍	❍
They would be happy if I decided to pursue a career in science. (4)	❍	❍	❍	❍
If I decide to go to college, they expect me to pay my own way. (5)	❍	❍	❍	❍

Q19 How much do you agree or disagree with the following statements about yourself? (Mark one in each row.)

	Agree strongly (1)	Agree somewhat (2)	Disagree somewhat (3)	Disagree strongly (4)
I can learn new ideas quickly in school. (1)	❍	❍	❍	❍
School is easy for me. (2)	❍	❍	❍	❍
I can understand difficult ideas in school. (3)	❍	❍	❍	❍
I am capable of getting straight A's. (4)	❍	❍	❍	❍
I am good at learning new things in school. (5)	❍	❍	❍	❍

Q20 How much do you agree or disagree with the following statements about your experiences at this school so far? (Mark one in each row.)

	Agree strongly (1)	Agree somewhat (2)	Disagree somewhat (3)	Disagree strongly (4)
I like classes that are easy for me more than classes that challenge me. (1)	❍	❍	❍	❍
When an assignment turns out to be harder than I expected, I usually don't complete it. (2)	❍	❍	❍	❍
I feel comfortable asking my teachers to explain ideas that are unclear. (3)	❍	❍	❍	❍
I can take the science classes that I want to take. (4)	❍	❍	❍	❍

Q21 How much do you agree or disagree with the following statements about your gender (male or female)?

	Agree strongly (1)	Agree somewhat (2)	Disagree somewhat (3)	Disagree strongly (4)
It is important that my role model(s) or mentor(s) are the same gender as I am. (1)	❍	❍	❍	❍
Most of my friends are the same gender as I am. (2)	❍	❍	❍	❍
People who are the same gender as I am have trouble getting jobs in science in this country. (3)	❍	❍	❍	❍
People who are the same gender as I am are less likely to become scientists than are people of the opposite gender. (4)	❍	❍	❍	❍

Q22 How interested would you be in having jobs where you would do the following activities? (Mark one in each row.)

	Very interested (1)	Fairly interested (2)	A little interested (3)	Not interested (4)
Design, invent, or develop new products or tools (1)	❍	❍	❍	❍
Spend a lot of time and energy on a problem until you solve it (2)	❍	❍	❍	❍
Discover new things that help the environment or people's health (3)	❍	❍	❍	❍
Use computer, lab equipment, and other technology (4)	❍	❍	❍	❍
Conduct investigations to understand how the world works (5)	❍	❍	❍	❍
Analyze data to draw conclusions (6)	❍	❍	❍	❍
Have your work reviewed and critiqued by others (7)	❍	❍	❍	❍

Q23 Below are some reasons for choosing a particular career. How important is each reason to you? (Mark one in each row.)

	Very important (1)	Fairly important (2)	A little important (3)	Not important (4)
To earn a lot of money (1)	❍	❍	❍	❍
To make a difference in the world (2)	❍	❍	❍	❍
To have time for a family (3)	❍	❍	❍	❍
To be in a workplace with people who share my ethnic background (4)	❍	❍	❍	❍
To be in a workplace with people who are the same gender as I am (5)	❍	❍	❍	❍
To work outdoors (6)	❍	❍	❍	❍
To work in a group with others instead of by myself (7)	❍	❍	❍	❍
To have time for hobbies or other interests (8)	❍	❍	❍	❍
To gain respect from others (9)	❍	❍	❍	❍
To be my own boss (10)	❍	❍	❍	❍
To help people (11)	❍	❍	❍	❍
Whether I would have to go to school for a long time (12)	❍	❍	❍	❍
Whether it conflicts with what's important to my family (13)	❍	❍	❍	❍
The cost of the education and training (14)	❍	❍	❍	❍

Q24 How interested are YOU in having a job like these someday? (Mark one in each row.)

	Very interested (1)	Fairly interested (2)	A little interested (3)	Not interested (4)
Life scientist (Biologist, Zoologist) (1)	❍	❍	❍	❍
Physical scientist (Chemist, Physicist, Astronomer) (2)	❍	❍	❍	❍
Biotechnician (3)	❍	❍	❍	❍
Doctor, Veterinarian, Dentist (4)	❍	❍	❍	❍
Nurse (5)	❍	❍	❍	❍
Physical Therapist (6)	❍	❍	❍	❍
Dental Hygienist (7)	❍	❍	❍	❍
Lab Technician (8)	❍	❍	❍	❍
Engineer (9)	❍	❍	❍	❍
Computer Programmer (10)	❍	❍	❍	❍
Psychologist (11)	❍	❍	❍	❍
Science teacher (12)	❍	❍	❍	❍
Other teacher (Elementary or any subject that is not science) (13)	❍	❍	❍	❍
Lawyer (14)	❍	❍	❍	❍
Buisnessperson (15)	❍	❍	❍	❍
Journalist (16)	❍	❍	❍	❍
Architect (17)	❍	❍	❍	❍
Artist, Musician, Actor, Dancer (18)	❍	❍	❍	❍
Professional athlete (19)	❍	❍	❍	❍

Q25 In the box below, please any other jobs you are very interested in. If none, please leave blank.

Q26 How much do you agree or disagree with the following statements about yourself? (Mark one in each row.)

	Agree strongly (1)	Agree somewhat (2)	Disagree somewhat (3)	Disagree strongly (4)
I can learn new ideas quickly in science. (1)	❍	❍	❍	❍
Science is easy for me. (2)	❍	❍	❍	❍
I can understand difficult ideas in science. (3)	❍	❍	❍	❍
I am capable of getting straight A's in science. (4)	❍	❍	❍	❍
I am good at learning new things in science. (5)	❍	❍	❍	❍

Q27 The state of Tennessee requires students take three high school science courses to graduate with an academic diploma (Biology, Chemistry or Physics, and one additional lab course). What other courses would you take if you had the opportunity during your 11th or 12th grade year? (Mark as many answers as apply.)

- ❑ Physical science (1)
- ❑ Environmental science (2)
- ❑ Human Anatomy & Physiology (3)
- ❑ Earth Science (4)
- ❑ Geology (5)
- ❑ Ecology (6)
- ❑ Scientific research (7)
- ❑ Biology II (8)
- ❑ Chemistry II (9)
- ❑ AP courses (10)
- ❑ I would only take the required courses (11)

Q28 How far do you think you will go in school? (Mark one.)
- Will not finish high school (1)
- Certificate of completion of course work without a high school diploma (2)
- High school diploma (3)
- 2-year college degree (Associate's degree) (4)
- 4-year college degree (Bachelor's degree) (5)
- Master's degree (6)
- Ph.D. or other advanced professional degree (medicine, law, dentistry, etc.) (7)
- Don't know (8)

Q29 Did you participate in the 2015 Outer Banks STEM program during the spring of your 7th grade year?
- Yes (1)
- No (2)
- I am a 6th or 7th grader this year. (3)

Q30 In the box below, please explain what about science that you do not enjoy.

Q31 In the box below, please explain what about science that you do enjoy.

Appendix C

October 30, 2015

Dear Farragut students and parents,

As a science teacher at Farragut Middle, I am thrilled to be completing my dissertation research by examining how middle school students identify with science. Students construct an understanding of science through experiences both inside and outside the school. My goal is to examine how these collective experiences set the stage for students' success in the classroom and interests in pursuing science as a career. I am hopeful that the findings of this research study will allow me to further advocate for science reform measures in our school and county by providing our students will the most effective instructional approaches in the science classroom setting.

I am requesting your permission to allow your child to participate in my research study. The first phase of the study involves the administration of a brief survey, *Science and Me.* Although the title of the study indicates an examination of female students, the initial survey phase of the study involves both female and male students.

If you and your child choose to participate, please review, sign, and return the attached **two** forms (Informed Consent and Minor Assent) to your child's science teacher <u>no later than Monday, November 9th</u>. A survey link will be sent to the parent's email address provided on the Informed Consent form by the middle of next week. Your child will have two weeks to complete the survey from home using a computer or mobile device. There are 31 questions and it will take approximately 25 minutes to complete.

I appreciate your consideration to participate and continued support of my research. Please feel free to contact me with any questions or concerns.

Sincerely,

Elizabeth R. MacTavish
elizabeth.mactavish@knoxschools.org
Farragut Middle School science teacher
Ph.D. Candidate in Science Education
University of Tennessee, Knoxville

Appendix D

Informed Consent Form

Out of School Time Science Programs: Examining a Program's Long-Term Impacts on the Science Identities of Middle School Female Participants

Introduction

The purpose of this form is to invite students at Farragut Middle School to participate in a research study examining the science identity of middle school students. The study objective is to administer an identity survey to participating middle school students to determine the level of science identity based on student experiences and future goals. Current research in the field of middle school science education is focused on the lack of science interest in underrepresented populations such as females. Understanding the reasons for a lack of interest in science contributes to instructional approaches that may keep females engaged and confident in science-related fields through high school and beyond.

Participants' Involvement in the Study

A science identity survey will be administered to participating students at Farragut Middle School. The survey being administered was developed based on a reliable and valid survey instrument entitled Is Science Me? (Aschbacher, Ing, & Tsai, 2014). The survey has been used in multiple science and STEM identity research studies with middle and high school students to assess the students' level of science interest, confidence, and plans to pursue a science-related field as a career.

The survey will be administered electronically. Once, consent is received from the parent and assent received from the student, the survey link will be shared via the parent's email. The survey takes approximately 25-30 minutes to complete. It is composed of 31 questions.

Risks

Surveys are anonymous with no identifiers to connect students with survey data. As a result, students' names will not appear in written reports of the study. These measures eliminate risks to students. Also, students are volunteers in this research study and may choose not to participate at any time with no ramifications.

Benefits

The benefits of this study include continued support of science education reform measures including curriculum development, teacher professional development, and classroom resources. The data will allow teachers to further strengthen science pedagogy by focusing on the needs of underrepresented groups.

Confidentiality

All data collected during this study will be kept confidential. Data will be stored securely and will be made available only to the study investigator unless participants (and parents) specifically give permission in writing to do otherwise. No reference will be made in oral or written reports which could link participants to the study.

Contact Information

If you have any questions about the study or the procedures involved in the study, you may contact the researcher, Elizabeth MacTavish, at emactav@vols.utk.edu. If you have questions about your rights as a participant, contact the University of Tennessee, Knoxville Office of Research Compliance Officer at (865) 974-7697.

Please keep the above information for your records and only return the consent portion below to your child's science teacher.

Survey Parental Consent

I have read the above information. I have received a copy of this form. I agree to participate in this study.

Student participant's name___________________________________ Date ___________________

Parent's name ____ Date ___________________

Parent's signature ____

Parent's email address for administering of survey link:

____

Appendix E

Assent Form for Minors

Project Title: Out of School Time Science Programs: Examining a Program's Long-Term Impacts on the Science Identities of Middle School Female Participants

Researcher: Mrs. Elizabeth MacTavish

Hello! As a science teacher, I am conducting a research study about how middle school students identify with science. I have asked permission from your parent(s)/guardian(s) to gather information about your experiences with science both inside and outside the classroom. I will be administering a 25-30 minute survey about your science experiences.

There are no right or wrong answers for the survey. Also, your responses will be kept confidential as I will be the only one who reads how you answered each question.

I hope that the data I collect from the survey will help answer some very important questions about how science is taught in the classroom, as well as, how you have grown to understand science. The data will help to identify areas where students need more help, so we can make those positive changes. When all the survey data have been reviewed, I will write a report about what was learned. The report will not include your name or that you were in the study.

If at any time, you do not wish to participate, you do not have to take the survey or you may stop during the administering of the survey. You will not be penalized if you chose not to participate.

If you sign this paper, it means you have read this form and that you want to be in this research study. If you do not want to participate, please do not sign the form. Please return the bottom portion of this form to your science teacher.

Student's signature ____ Date ________________

Student's printed name ____ Date ________________

Appendix F

November 16, 2015

Dear Farragut students and parents,

As a science teacher at Farragut Middle, I am thrilled to be involved in a research opportunity examining how female middle school students identify with doing science. Current research shows that females are more likely to become disengaged in science during middle school. My goal is to examine the experiences that contribute to females' engagement or disengagement in science. I am hopeful that the findings of this research study will help to implement more effective opportunities for female students to gain interest in science over the course of their schooling.

I am requesting your permission to allow your child to participate in a small focus group discussion about her experiences in science. This is the second phase of my research study. The first phase of the study involved the administration of a brief survey to middle school science students. The focus group phase will allow females to discuss their thoughts, feeling, and goals as they relate to science. Your child has been randomly selected to participate by her science teacher. As the researcher, I do not know the names of the students being invited to participate in the focus groups until I receive the attached consent and assent forms.

In selecting your child, her science teacher will consider her academic science level based on last year's state TCAP test. If you and your child choose to participate, her academic level will be disclosed to me to best place her in an academically appropriate focus group.

If you and your child agree to participate, please review, sign, and return the attached two forms (Informed Consent and Minor Assent) to your child's science teacher. Focus groups sessions will take place after school (3:45-5pm) during the week of November 30th at Farragut Middle School. You will receive an email over Thanksgiving Break with the date and location of the focus group session your child has been assigned. Due to the after school time, I will be providing pizza, drinks, and dessert for the female participants during the focus group sessions.

I appreciate your consideration to participate in my research study. Please feel free to contact me with any questions or concerns.

Elizabeth R. MacTavish
elizabeth.mactavish@knoxschools.org

Appendix G

Informed Consent

Out of School Time Science Programs: Examining a Program's Long-Term Impacts on the Science Identities of Middle School Female Participants

Introduction

The purpose of this form is to invite your child to participate in a research study on the science identity of middle school female students. Your child is asked to participate in a small focus group discussion about her experiences in the science classroom, science groups/clubs, and science outside the classroom.

Participants' Involvement in the Study

Female students will participate in a small (6-8) member focus group for no more than one hour. The researcher has specific questions to ask the group and participants may contribute her own thoughts about science. If you and your child agree to participate in the focus group, I will contact you via email about a date, time and location of the focus group.

The focus group will be audio recorded and the data will be transcribed for data analysis.

Risks

Students' names will not be used in the transcription process to eliminate risks to the participants. Pseudonyms will be used in all written reports about the study. Participation will not affect your child's grade in any course at Farragut Middle. Also, participants are volunteers and may choose to withdraw or leave the focus group at any time without ramifications.

Benefits

The benefits of this study are continued support of science education reform measures including curriculum development, teacher professional development, and classroom resources. The data will allow teachers to further strengthen science pedagogy by focusing on the needs of underrepresented groups like females.

Confidentiality

All data collected during this study will be kept confidential. Data will be stored securely and will be made available only to the study investigator unless participants (and parents) specifically give permission in writing to do otherwise. No reference will be made in oral or written reports which could link participants to the study.

___________ Participant's initials ____________ Parent's initials

Compensation

All focus group participants will be provided with pizza, drinks, and cookies at the time of the focus group session.

Contact Information

If you have any questions about the study or the procedures involved in the study, you may contact the researcher, Elizabeth MacTavish, at emactav@vols.utk.edu. If you have questions about your rights as a participant, contact the University of Tennessee, Knoxville Office of Research Compliance Officer at (865) 974-3466.

Please keep the above information for your records and only return the consent portion below to your child's science teacher.

Focus Group Parental Consent

I have read the above information. I have received a copy of this form. I agree to participate in this study.

Student participant's name ____ Date _______________

Parent's name ____ Date _______________

Parent's signature ____

Parent's email contact ____

Appendix H

Assent Form for Minors

Project Title: Out of School Time Science Programs: Examining a Program's Long-Term Impacts on the Science Identities of Middle School Female Participants

Researcher: Mrs. Elizabeth MacTavish

Hello! As a science teacher, I am conducting a research study about how middle school female students identify with science. I have asked permission from your parent(s)/guardian(s) to gather information about your experiences with science both inside and outside the classroom. I am asking that you participate in a small group discussion after school to talk about your experiences with science growing up at home, school, and in the community.

Your responses will be audio recorded during the session. I will take the recordings and write out the dialog so that I can identify patterns and trends in our discussion. Your responses will be kept confidential as I will be the only one who listens to the recording.

I hope that the data I collect from the group's discussion will help to shed light on how females view their role in the science classroom. I would like to identify females' thoughts and beliefs about their capabilities to understand science and perform scientific tasks successfully. When the group data have been reviewed, I will write a report about what was learned. The report will not include your name or that you were in the study.

During our focus group session, I will provide pizza, drinks, and cookies for us to enjoy and a thank you for your time and input to the discussion.

If at any time, you do not wish to participate, you do not have to attend the group session or you may withdraw and/or leave at any time during the group discussion. You will not be penalized if you chose not to participate. Your participation does not have any effect on your grade in any of your classes.

If you sign this paper, it means you have read this form and that you want to be in this research study. If you do not want to participate, please do not sign the form. Please return this portion to your science teacher.

Student's signature ____ Date ________________

Student's printed name ____ Date ________________

Vita

Elizabeth Ripley MacTavish has taught middle school science for 15 years. Upon receiving her Masters degree in Science Education in 2001, she moved to Orlando, Florida to follow her passion of the space program by applying for the Teacher in Space Program.

In 2004, she returned to Knoxville, Tennessee and has since taught 7th grade science at Farragut Middle School. During her time at Farragut, Elizabeth has been involved in countless efforts to support science education including her STEM program and travels to the Outer Banks. In its eight years, her STEM program has served over 470 students.

Elizabeth returned to the University of Tennessee in 2013 to complete work on her Ph.D. She continues to play an active role in science education within her middle school and the area systems. Elizabeth lives with her husband of 12 years, Chris, and their two children, Emma, 10, and Carson, 9.