Girls' Construction of Mathematical Discourse in Single-Sex and Coeducational Classroom Environments

McKenzie Hoxit Brittain
_Clemson University_, mhoxit@clemson.edu

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GIRLS’ CONSTRUCTION OF MATHEMATICAL DISCOURSE IN SINGLE-SEX
AND COEDUCATIONAL CLASSROOM ENVIRONMENTS

A Dissertation
Presented to
the Graduate School of
Clemson University

In Partial Fulfillment
of the Requirements for the Degree
Doctor of Philosophy
Curriculum and Instruction

by
McKenzie Hoxit Brittain
May 2020

Accepted by:
Dr. S. Megan Che, Committee Chair
Dr. Carlos Nicolas Gomez
Dr. Andrew Tyminski
Dr. Susan Cridland-Hughes
Dr. William Bridges
ABSTRACT

This study seeks to examine and illuminate the ways in which girls in middle grades single-sex and coeducation mathematics classrooms construct mathematical Discourse. I implement a holistic case study design by providing an in-depth description of how girls engage in constructing mathematical Discourse both with other students and their teacher. There are two bounded settings within this study: an all-girls sixth grade mathematics classroom and a coeducational sixth grade mathematics classroom. The four individual cases for this study are Maria and Leah (Single-Gender) and Nautica and Jordan (Coeducation). The findings from this study suggest girls in middle grades mathematics single-gender and coeducation classrooms construct mathematical Discourse (Moschkovich, 2003) through engaging in written, spoken, acted, listening, and interacted (Gee, 1999) mathematical Discourse (Moschkovich, 2003). Additionally, I found very similar types of mathematical Discourse (Moschkovich, 2003) and positionings in the single-gender and coeducational mathematics classroom.
DEDICATION

This dissertation is dedicated to the three most influential people in my life.

To my parents, Chester and Cecilia, thank you for your endless support and encouragement. You have always been role models in my life. Thank you for the many sacrifices you have both made to support me over the years. I am so grateful for your unconditional love.

To my husband, Drew, thank you for your unwavering love and support. Words cannot express how grateful I am for you. Thank you for your daily encouragement and the sacrifices you have made to support this endeavor. Thank you for being by my side on the tough days, the good days, and the great days.

Mom, Dad, and Drew there is one thing for sure, there is no way I could have done this without you.
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I would also like to acknowledge Dr. Megan Che. Dr. Che you inspire me in so many ways. Dr. Che you have encouraged me to think critically, you have encouraged me to take risks, and you have supported me throughout this entire process. Thank you for the extended time and effort you have poured into working with me. There is no way I could have completed this dissertation without your guidance and support.
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CHAPTER ONE
INTRODUCTION

Study Rationale

My interest in how girls construct mathematical discourses—discussing mathematical ideas, explaining a mathematical process, writing and thinking about a mathematical task—is connected to several aspects of my lived experiences: (1) being a female in a K-12 mathematics classroom, (2) being a female in a STEM focused major, (3) being a female secondary mathematics teacher, (4) and being a female graduate student. Prior to these experiences, I already loved mathematics at a very young age. I remember coming home from school, sitting on the kitchen island, and practicing various mathematics skills with my dad. For instance, he would change the time on a two-handed clock and ask me to read the time, and often he would lay out various amounts of coins and ask me to count the total amount of money. I remember my mom and dad taking me to a local store to buy mathematics books to practice basic operations. I always enjoyed this time and it helped make mathematics exciting. I recall always enjoying mathematics in my everyday life, which sparked my interest and joy for mathematics once entering a K-12 mathematics classroom.

As a female student in K-12 mathematics classrooms, I remember having a strong interest and joy in both attending and engaging in all of my mathematics courses. The content was interesting, I was eager to learn, and over the years, mathematics became the subject I was most passionate about learning and understanding. For instance, I remember being excited to attend my sixth grade mathematics class where often we had
opportunities to work in small groups and engage in mathematical conversations. I was curious about how what we were learning built on what we previously learned. The experiences of joy I felt at a young age for mathematics continued through elementary into my middle and high school years.

I believe a big factor of my joy for mathematics began from my parents showing an interest in me learning mathematics at a young age. I carried that interest with me into the classroom, and in being eager to learn, I was successful. In eighth grade, I transitioned out of college prep classes into honors after the first weeks of school because I placed high enough on a standardized test in mathematics. The transition increased my confidence as a student and I became more motivated to learn mathematics. I attribute my joy for mathematics to the success I experienced in mathematics.

Although I thoroughly enjoyed mathematics and was successful in my mathematics classes, I remember being intimidated to speak up and to share my ideas in the learning process. Often I would solve a problem on my own and learn I did solve it correctly, but I never shared my answers out loud with the class. I was extremely shy and fearful of saying something wrong. I noticed I had more confidence in small group settings, but I was reserved in expressing my ideas and how I thought about the mathematics. My intimidation and fear of speaking out loud stayed with me as I began my undergraduate studies.

As an undergraduate, I felt very different in education courses than I did in my mathematics content courses. My education courses only had a few students in attendance, while my mathematics courses had a large number of students in attendance.
All education mathematics majors took the same courses, so we were very comfortable in class together. In my education courses, the majority of students were female, white, and came from a middle class background. Quite honestly, everyone looked just like me.

While in my mathematics courses, the room was full of males who were earning degrees in engineering, architect, and sciences. In my mathematics courses, I assumed everyone was smarter because they were earning a mathematics degree, which made me think they had a more thorough understanding of the material. This made me feel intimidated to speak up in class and to group with students of other majors. Similar to my perspective in K-12, I was fearful of saying something incorrect and lacked confidence in my own abilities. The small group of education majors in the mathematics classes grouped and worked together. This was our comfort zone. As graduation neared and I accepted my first teaching position I remembered those feelings of being intimidated to speak up and to share my ideas. I recognized while I was more confident in my own abilities, I would teach students who felt very similar to me in my classroom.

I taught high school mathematics for five years in public schools which implemented a coeducational model of schooling. Over my years of teaching, I taught a variety of students and courses, from freshman in Intermediate Algebra and Algebra 2 Honors to seniors in Probability and Statistics and in Pre-Calculus. I had the opportunity to work with many students from various backgrounds and levels of mathematical abilities. Teaching allowed me to observe my students on a daily basis and have a more thorough understanding of how they engaged in the classroom. Although I never
conducted research in those courses, I still had the opportunity to build relationships with students and interact with them mathematically on a daily basis.

I taught students who were just like me: reserved, less willing to interact with other students, and shy when asked to speak out about their learning process. For instance, I remember a girl in my Geometry Honors course who rarely spoke unless called on. She was very shy and did not engage in conversation with me or her peers unless someone spoke to her first. She did, however, engage in her work and always seemed motivated to think through the tasks and activities assigned. Her handwritten work was detailed and she was very thorough in writing out all her thoughts about how to solve given tasks. Although she was reserved in her willingness to engage with others, she was exceptionally smart and always performed at a high level.

I also taught students who were more vocal, interactive with classmates, but less hands-on when engaging in classroom mathematics. As an example, I taught a boy in Algebra 2 CP who was always excited and willing to share his thoughts. When the class had opportunities to share their thinking, he always volunteered. He often was the first to walk in the classroom and ask what we were learning that day, and was genuinely excited to engage in classroom activities and discussions. Unlike the girl in Geometry Honors, this student was not thorough in his handwritten work. He often put only an answer on his paper, but did not provide detail in how he thought through the task. Although he was vocal and eager to interact in the classroom, he was less willing to engage in work that was written.
The two examples demonstrate how students engage in and construct mathematical discourses differently. My curiosity of why students engage differently with peers, their teacher, and with their work stems from teaching different students in different classroom spaces. I found myself wondering why some students hold-back and are reserved, while others actively participate and engage in mathematics. The opportunities to observe and work with students of different engagement levels stuck with me as I began my graduate studies.

My specific interest in understanding how girls experience single-sex versus coeducational classrooms stemmed from my opportunity to conduct research during a research assistantship. I conducted interviews with middle grades students in both single-sex and coeducational classrooms. Specifically, the stories of two girls who were experiencing single-sex education sparked my curiosity and interest in further understanding how girls experience single-sex classrooms as compared to coeducational classrooms.

One student, a sixth-grade girl, was experiencing single-sex classrooms for the first time. She enjoyed her classroom setting and seemed very happy being a student in her all girls classroom. Reflecting on my experiences in school, I immediately identified with the girl in sixth grade. Although I did not personally experience single-sex classrooms as a student, I imagined I would have a very similar experience as the student in sixth grade.

The sixth grade student aligned with the gendered norms vivid in her all girls’ class. According to Butler (2004), “A norm operates within social practices as the
implicit standard of *normalization*…. For gender to be a norm suggests that it is always and only tenuously embodied by any particular social actor” (p. 41, emphasis in original). The student described how girls in her all girls class wore colorful clothing, carried floral backpacks, and put on makeup. She talked about how their teacher decorated the classroom with girly decor and gave assignments focused on pageants. She enjoyed talking about her locker decorations, the bright colors of clothing she and her friends wore to school, and her floral backpack. She seemed very content in her all girls class, to her, everyone dressed and acted in a similar way.

Another student, an eight-grade girl, was experiencing a coeducational classroom for the first time after spending two years in single-sex classrooms. She shared she was more comfortable in the coeducation classroom, and she could be herself when she left single-sex classrooms and went back into coeducation classrooms. She spoke of feeling freedom to be more creative in a coeducation classroom. Her experiences were opposite of the sixth grade girl.

The eighth grade student did not align with the norms present during her sixth and seventh grade years within single-sex classrooms. She pushed back on the norms of being girly. She shared how girls had messier notebooks than boys. She talked of how she felt frustrated by the drama that took place in single-sex classrooms. She did not wear floral clothing and her backpack was plain. To her, not everyone had to dress the same or have the same interest.

As I learned of her experiences over the course of the year, I quickly realized not all students experience single-sex education the same way. Some students wanted to push
back against what they were experiencing in single-sex education, and their stories and descriptions of what they experienced are the guiding reasons for what sparked my interest in this study. Over the year spent interviewing and listening to stories of students in those settings, I became eager to continue exploring how those classroom settings contribute to student learning.

After learning of the experiences of the students mentioned and other students I interviewed, I began looking at scholarship related to single-sex education and student experiences. As my curiosity of student engagement in these classroom spaces sparked, I wanted to better understand why these classroom spaces were originally constructed. Through my understanding of single-sex education, I became more eager to explore how these spaces impact girls, specifically in mathematics classrooms.

**Broader Trends**

Single-sex schooling was initially the only formal education available in the United States. Females were educated at home and formal education was only for white males (Bracey, 2006). Girls began attending school for girls only in the 1800s (Bracey, 2006). According to the Bureau of Education (1883), towards the end of the nineteenth century and beginning of the twentieth century, coeducation became the norm for public schools (as cited in Datnow & Hubbard, 2002). Coeducation in public schools emerged for economic efficiency and not for educational benefits (Riordan et al., 2008).

Legislators passed Title IX in 1972 to promote gender equity and to prohibit discrimination on the basis of sex, which prohibited single-sex public schools and classrooms (Bracey, 2006). Efforts to implement single-sex education in the public sector
faced opposition through the 1990s (Riordan et al., 2008). The No Child Left Behind Act of 2001, authorized school districts to use “local or innovative program funds to offer single-sex schools and classrooms consistent with applicable laws” (Riordan et al., 2008, p. ix). In 2006, following the No Child Left Behind Act of 2001, the Department of Education Office for Civil Rights asserted:

The purpose of these amendments would be to support efforts of school districts to improve educational outcomes for children and to provide public school parents with a diverse array of educational options that respond to the educational needs of their children, while at the same time ensuring appropriate safeguards against discrimination (Guidelines regarding Single Sex Classes and Schools, p. 2)

The amendments to Title IX allowed public schools in the United States to offer single-sex education (Federal Register, 2006).

These changes in regulations made it possible for thousands of schools to implement single-sex education. Therefore, in the U.S., single-sex public education options only recently emerged (Carter, Kombe, & Che, 2014). Because of this recency, research on single-sex public classroom spaces in the U.S. is limited (Bracey, 2006), and we do not fully understand the impacts these classroom environments have on students. Recognizing the importance of developing our understandings about how students learn in these spaces, scholars in the field of education have begun to explore impacts of single-sex education in the U.S.
Scholars in the field of education examined a variety of research questions exploring single-sex education. Bowe et al. (2015) explored student, teacher, and administrator beliefs about single-sex and coeducational mathematics. Carter et al. (2014) examined questions about student academic self-concept and perception of classroom environments. Further, scholars explored research questions specific to content areas, classroom environment, attitude, achievement, and confidence. For instance, Che, Wiegert, and Threlkeld (2012) examined strategies girls and boys use for solving non-routine mathematical tasks. Shapa and Keating (2003) explored experiences of girls in ninth and tenth grade, specifically looking at achievement rate, attitude, and likelihood of enrolling in advanced mathematics and science classes. Clark (2001) explored research questions focused on girls’ confidence in single-sex classroom spaces. These questions allow researchers to further understand student perceptions about experiences in single-sex classrooms, students experience in specific content courses, and provide more detail on students’ attitudes and confidence in single-sex environments. The need for further understanding how students experience and learn in single-sex educational environments is demonstrated through the research questions explored by scholars of education. Through research it is important we understand what is happening and taking place in these settings.

**Problem Statement**

Educational researchers contributed to our understanding of single-sex education by exploring the impacts single-sex education has on student self-concept (Sullivan, 2009), attitude (Lee & Bryk, 1986; Norton & Rennie, 1998), perspective (Rennie &
Parker, 1997), experiences (Blair, 2013), environment (Schneider & Coutts, 1982),
achievement in mathematics (Clark, 2001; Van de gaer et al., 2004; Lee & Lockheed,
1990), benefits of single-sex education (Shah, 2009), and academic performance
(Jimenez & Lockheed, 1989; Smithers & Robinson, 2006).

Some studies suggest advantages to single-sex education (e.g. Schneider &
Coutts, 1982; Rennie & Parker, 1997; Shah, 2009; Sullivan, 2009; Jimenez & Lockheed,
1989; Norton & Rennie, 1998; Van de gaer et al., 2004; Lee & Bryk, 1986; Shapka &
Keating, 2003; Bowe et al., 2015), while others suggest no sound evidence to support
single-sex or the need for further exploration (e.g. Bracey, 2006; Smithers & Robinson,
2006; Blair, 2013; Che et al., 2012; Carter et al., 2014; Kombe et al., 2016). Mael et al.
(2004) discussed how single-sex schooling is still largely debated, and limited studies
have provided sound evidence for or against single-sex education. Additionally, Bracey
(2006) asserted:

Some were taken aback that a U.S. Department of Education that emphasizes the
importance of supporting programs with scientifically based research would
permit single-sex schools ‘even though the Department of Education concluded a
year ago that there was not enough evidence to definitively evaluate single-sex
classes.’ (p. 15).

Research findings are varied and provide inconclusive understandings of the affordances
and drawbacks of single-sex education.

Single-sex education offerings increased since the change in regulations to Title
IX in the United States (Federal Register, 2006), and research on ways girls experience
mathematics in these academic spaces are limited. Ryve (2011) calls attention to reform documents (NCTM, 2000) stressing communication and development of discourse in mathematics classrooms. Although mathematical discourse studies are prevalent in education, according to Herbel-Eisenmann and Otten (2011), “there is still a looming concern that studies of mathematics classroom discourse need to attend further to the mathematics being construed in the discourse” (p. 452). Discourse research in mathematics education increased according to Ryve (2011), from three sources:

First mathematical classroom communication and the development of discourse communities in classrooms are stressed in reform documents (e.g., NCTM, 2000). Second, discourse research in other scientific disciplines has developed theoretical perspectives and analytical constructs to conceptualize and analyze phenomena of relevance in mathematics education, such as interaction, agency, identify, positioning, and gender. Third, scholars have conceptualized mathematics as a discourse (e.g., Moschkovich, 2002; Sfard, 2008). (p. 168)

To expand on current research in single-sex education and mathematics discourse, this study seeks to examine and illuminate ways girls in middle grades mathematics classrooms construct mathematical discourse in single-sex and coeducational classrooms. Specifically, I implement a holistic multiple-case study design by providing an in-depth description of how girls engage in constructing mathematical discourses with their teacher and peers.

**Theoretical Framework**
This study is framed by Discourse, more specifically, I use positioning theory as a lens to guide the entirety of this study. Yin (2014) discusses how the “role of theory development, prior to the conduct of any data collection” (p. 12) is one of the pieces which sets case study research apart from other qualitative designs. A thorough description of Discourse, mathematical discourse, and positioning theory and how the frameworks guide this study are provided in the following subsections.

**Discourse**

Gee (1999) introduces and establishes a distinction between discourse and Discourse with a capital D, focusing on language-in-use as the domain for investigation. Researchers interested in “how language is used ‘on site’ to enact activities and identities” relates to Gee’s “discourse” (Gee, 1999, p. 7). Gee asserts, however, how activities and identities of interest to researchers are rarely presented through language alone, and therefore, Gee provides a definition which encompasses more than just language. Gee (1999) defines Discourse as:

I use the term “Discourse,” with a capital “D,” for ways of combining and integrating language, action, interactions, ways of thinking, believing, valuing, and using various symbols tools, and objects to enact a particular sort of socially recognizable identity. Thinking about the different Discourses a piece of language is part of is another tool for engaging in discourse analysis (p. 21).

We continuously build and rebuild our world through language; however, building takes place with language used alongside “…actions, interactions, non-linguistic symbol
systems, objects, tools, technologies, and distinctive ways of thinking, valuing, feeling, and believing” (Gee, 1999, p. 10).

Recognition is a key element of Discourse and Gee (1999) states:

The key to Discourses is “recognition.” If you put language, action, interaction, values, beliefs, symbols, objects, tools, and places together in such a way that others recognize you as a particular type of who (identity) engaged in a particular type of what (activity), here-and-now, then you have pulled off a Discourse (and thereby continued it through history, if only for a while longer). (p. 27)

Discourses are important to consider when looking at student interactions with their peers and teacher. Recognition work occurs when people try to recognize others for who they are, within interactions, and when they reflect on those interactions at a later point (Gee, 1999).

Discourse encompasses language plus actions, interactions, values, beliefs, symbols, objects, tools, and places. For this study, I focus on how girls construct Discourses (Gee, 1999); therefore, “d” discourse will not be used because language alone will not be sufficient to fully understand how mathematical Discourses are constructed. In the following section I define mathematical Discourse.

**Mathematical Discourse**

use experiences from within school and outside of school during discussions of mathematics (Moschkovich, 2003). Moschkovich (2003) discussed the importance of considering what is included and excluded in how “student talk as everyday or mathematical” (p. 3-325) is labeled. It is possible we miss the mathematical capabilities of student talk if we only assume mathematical discourse encompasses textbook definitions and the ways mathematicians practice in formal settings (Moschkovich, 2003).

Moschkovich (2003) points to Gee’s definition of Discourse (Gee, 1999) and builds on the definition to define mathematical Discourse. According to Moschkovich (2003), mathematical Discourse is defined as follows:

Mathematical Discourse includes not only ways of talking, acting, interacting, thinking, believing, reading, writing but also mathematical values, beliefs, and points of view. Participating in mathematical discourse practices can be understood in general as talking and acting in the ways that mathematically competent people talk and act when talking about mathematics. (Moschkovich, 2003, p. 3-326)

This definition implies simply knowing a list of mathematical terms is not adequate enough for engaging in mathematical Discourse (Moschkovich, 1999). To learn mathematics, one must shift from everyday language to a mathematical use of language (Moschkovich, 2003).

Participating in mathematical discussion is an important aspect of mathematical Discourse in the classroom (Moschkovich, 1999), and can occur in small groups or as an
entire class. Pirie (1991) defines mathematical discussion as “purposeful talk on a mathematical subject in which there are genuine pupil contributions and interactions (p. 143)” (as cited in Moschkovich, 1999, p. 12). Although students might engage in discussions which include “standard or canonical mathematical discourse” (p. 12), students participate in mathematical discussions, according to Brenner (1994), by “making conjectures, presenting explanations, constructing arguments, etc. about mathematical objects, with mathematical content, and towards a mathematical point” (as cited in Moschkovich, 1999, p. 12). Further, it is important to recognize that the ways we construct characteristics of Discourse and how we look for Discourse are almost certainly influenced by a white-centered and white-privileged perspective. According to Shah (2017), “Rather, what is needed is a theoretical perspective robust enough to simultaneously conceptualize the positionalities of all racial groups in terms of dynamic set of relations among those groups” (p. 11). How we recognize and construct characteristics of Discourse needs further consideration and research; however, for the purposes of this study I focus on gender. To better understand how girls construct mathematical Discourse (Moschkovich, 2003) in mathematics classrooms, I use positioning theory as a lens to guide this study, which is discussed in the next section.

**Theory of Discourse: Positioning Theory**

My study focuses on ways girls construct mathematical Discourses with their teacher and peers in the classroom; therefore, I use positioning theory to guide this study as a way to narrow on interactions and relationships that occur in both single-sex and coeducational classrooms.
Smith (1988; xxxv) first introduced the concept of positioning where a person was distinguished between an agent and subject (as cited in Davies & Harré, 1990). Davies and Harré (1990) claim their development of positioning contributes to further understanding personhood. In this study, positioning correlates to discursive processes where individuals are in conversations “as observably and subjectively coherent participants in jointly produced story-lines” (Davies & Harré, 1990, p. 48) and positioning as a metaphor represents relationships (Harré & van Langenhove 1999) (as cited in Herbel-Eisenmann & Wagner, 2010). Discursive processes represent when students are constructing Discourses and when students are being constructed by those Discourses. Positioning can occur interactively where what one person says positions another person, or positioning can occur reflexively where one person positions oneself (Davies & Harré, 1990). Observable Discourses represent Discourses which are spoken, written, acted, or interacted with others. Subjectively coherent participants are participants who speak clearly and logically based on or influenced by personal feelings or opinions.

According to Harré and van Langenhove (1991), “Conversations have story-lines and the positions people take in conversation will be linked to these story-lines” (p. 396). Positioning focuses on two aspects: how discursive practices (1) situate participants of a conversation in certain ways, and (2) is a support for participants within the conversation to negotiate new positions (Davies & Harré, 1990). Within a conversation, a position is a figurative concept in which a person’s ethical and individual characteristics as speaker are comprehensively brought together (Harré & van Langenhove, 1991). Conversations
have a tri-polar structure which are composed of “positions, story-lines and relatively
determinate speech acts” (Harré & van Langenhove, 1991, p. 396).

There are distinctions in the forms of positioning which include: first and second
order positioning, performative and accountive positioning, moral and personal
positioning, self and other positioning, and tacit and intentional positioning (Harré & van
Langenhove, 1991). For this study, I focus on first and second order positioning. First
order positioning occurs when a person locates both themselves and other people in a
space, using story-lines (Harré & van Langenhove, 1991) and is the initial act in the
positioning. Once first order positioning occurs, the other person(s) involved question
and negotiate the first order positioning within that conversation, which is considered
second order positioning.

Harré and van Langenhove (1991) state the concept of positioning as a theoretical
framework brings together various aspects of social life.

First, people will differ in their capacity to position themselves and others, their
mastery of the techniques so to speak. Secondly, they will differ in their
willingness or intention to position and be positioned. Thirdly, they will also
differ in their power to achieve positioning acts. While the first two variations are
individual attributes, the latter is social: powers are derived from specific
locations in social orders and networks. (Harré & van Langenhove, 19991, p. 406)

People are continuously engaged in positioning. Positioning others occurs when one
person takes on a storyline expounding on a cultural stereotype, and the other person is
required to conform to participate in conversation with the person’s storyline (Davies &
Harré, 1990). More specifically, “In speaking and acting from a position people are bringing to the particular situation their history as a subjective being, that is the history of one who has been in multiple positions and engaged in different forms of discourse” (Davies & Harré, 1990, p. 48). Positioning theory focuses on interaction in the moment, acknowledging that multiple storylines can occur at the same time (Wagner & Herbel-Eisenmann, 2009). I use positioning theory as a lens to guide this entire study.

In the following section I provide an overview of how positioning theory is used by mathematics education researchers, and specifically discuss suggestions made by Herbel-Eisnemann, Wagner, Johnson, Suh, and Figueras (2015) for operationalizing positioning theory as a mathematics education researcher.

**Positioning Theory in Mathematics Education Research**

Positioning theory as a theoretical framework is used by mathematics education researchers to understand how students position themselves based on outside experiences (Wagner & Herbel-Eisenmann, 2009), students’ learning and construction of identity (Anderson, 2009; Yamakawa et al., 2009), teacher and student relationships (Herbel-Eisenmann & Wagner, 2010), mathematical discussion and classroom interaction (Esmonde & Langer-Osuna, 2013), and positioning of teacher and student (Tait-McCutcheon & Loveridge, 2016). A general overview and description each study is provided below, specifically understanding how each study framed by positioning theory contributes to the field of mathematics education.

Wagner and Herbel-Eisenmann (2009) focused on conceptualization of positioning discussed by Harré and van Langenhove, connecting the ideas to “relevant
mathematics education and education literatures” (Wagner & Herbel-Eisenmann, 2009, p. 2). Wagner and Herbel-Eisenmann discussed how students differ in abilities to start storylines that work in a classroom because students learn different effective ways of positioning themselves based on various experiences outside of school (Wagner & Herbel-Eisenmann, 2009). Additionally, Anderson (2009) used positioning theory to explore “ways to be a student (e.g., competent, a failure) and local acts that contribute to students being positioned according to such notions (e.g., what counts as success or failure here)” (p. 292). Anderson mentioned how classroom life is extremely complex and many factors correlate to a students’ learning and construction of identity.

Yamakawa, Forman, and Ansell (2009) used positioning theory as a way to examine students’ construction of identity in a third grade mathematics classroom. Their findings suggested the teacher positioned students differently within the mathematics classroom, and those “differential interactions construed different identities” (Herbel-Eisenmann et al., 2015, p. 195). Further, Tait-McCutcheon and Loveridge (2016) examined teachers’ implementation of a mathematics lesson, and they analyzed the positioning of the teacher and students, developing storylines, and social acts. Their findings suggested the ways teachers positioned themselves and students had greater impact than the resources implemented in the lesson (Tait-McCutcheon & Loveridge, 2016).

Herbel-Eisenmann and Wagner (2010) assert the importance of positioning, specifically how it provides focus on issues of control, authority, and power in relationships such as teacher and student and how those relationships are negotiable.
Herbel-Eisenmann and Wagner (2010) looked at transcripts from secondary mathematics classrooms, and identified patterns of speech coded as *interpersonal positioning*. Herbel-Eisenmann and Wagner (2010) suggest “some of the language forms and storylines in terms of students’ obligations to structuring influences (i.e., the teacher and the ‘discipline’) they seem to encode” (p. 45). The possibility for power and authority is intensified in the mathematics classroom due to “the importance of justification and truth in the teaching and learning of mathematics” (Herbel-Eisenmann & Wagner, 2010, p. 45). Additionally, Esmonde and Langer-Osuna (2013) looked at classroom interactions, focusing on a group of high school students and how they navigated mathematical discussions. The researchers considered storylines and elaborated on those storylines (as cited in Herbel-Eisenmann et al., 2015). Esmonde and Langer-Osuna (2013) focused on “multiple figured worlds” examining how students’ experiences on a larger scale inform their interactions in the classroom setting (as cited in Herbel-Eisenmann et al., 2015, p. 198).

Although positioning theory is implemented in the work of many mathematics education researchers, ambiguities are still present in the conceptualization of the framework. Herbel-Eisenmann, Wagner, Johnson, Suh, and Figueras (2015) point to a revisioning of the framework for mathematics education researchers, focusing on position/positioning, storylines, and scales. Herbel-Eisenmann et al. (2015) provide a definition for positioning theory which is adapted from Harré and van Langenhove (1999) and Harré (2012):
Positioning theory is the “study of local moral orders” based on ongoing shifting patterns of “mutual and contestable rights and obligations of speaking and acting” (Harré & van Langenhove, 1999b, p.1). It does not assume, however, that everyone in an interaction has equal access to rights and duties to perform any action (Harré, 2012). (as cited in Herbel-Eisenmann et al., 2015, p. 187)

Herbel-Eisenmann et al. (2015) discussed two important components of positioning theory which are position/positioning and storylines. Herbel-Eisenmann et al. (2015) use the definition of position provided by Harré and van Langenhove (1991):

A complex cluster of generic personal attributes, structured in various ways, which impinges on the possibilities of interpersonal, intergroup and even intrapersonal action through some assignment of such rights, duties and obligations to an individual as are sustained by the cluster. (p. 188)

Positioning is used for describing how people experience interactions with others (Herbel-Eisenmann et al., 2015). Storylines are defined as “the ongoing repertoires that are already shared culturally or they can be invented as participants interact” (Herbel-Eisenmann et al., 2015, p. 188). Their discussion of these components stem from how unclear the operationalization of position/positioning and storylines are in mathematics education research.

In revisioning positioning theory, Herbel-Eisenmann et al. (2015) mention timescales/scales (Table 1) adapted from Lemke (2000) to maintain focus on the moment, and to “provide greater clarity regarding what people bring forth into current interactions from past conversations” (p. 194). Herbel-Eisenmann et al. (2015) argued classroom
participants “bring into the moment previous experiences with school interaction patterns and other discourses that may seem relevant to them” (p. 192).

Table 1

<table>
<thead>
<tr>
<th>Typical process</th>
<th>Timescale (and duration)</th>
<th>Reference events</th>
</tr>
</thead>
<tbody>
<tr>
<td>Utterance</td>
<td>$10^0$-$10^1$ s</td>
<td>Word, holophrase, short monologue; in context</td>
</tr>
<tr>
<td>Exchange</td>
<td>$10^2$ s (seconds to minutes)</td>
<td>Dialogue; interpersonal relations; developing situation</td>
</tr>
<tr>
<td>Episode</td>
<td>$10^3$ s (~15 min)</td>
<td>Thematic, functional unit; speech genre, educative</td>
</tr>
<tr>
<td>Lesson</td>
<td>$10^3$-$10^4$ (hour)</td>
<td>Curriculum genre</td>
</tr>
<tr>
<td>Lesson sequence</td>
<td>$10^4$ s (~2.75 h)</td>
<td>Macro curriculum genre</td>
</tr>
<tr>
<td>School day</td>
<td>$10^5$ (day)</td>
<td>[“seamless day”]</td>
</tr>
<tr>
<td>Unit</td>
<td>$10^6$ s (11.5 days)</td>
<td>Thematic, functional unit</td>
</tr>
<tr>
<td>Semester/year</td>
<td>$10^7$ s (4 months)</td>
<td>Organizational level; unit in next scale</td>
</tr>
<tr>
<td>curriculum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multilayer</td>
<td>$10^8$ (~3.2 years)</td>
<td>Organizational level; limit of instructional planning</td>
</tr>
<tr>
<td>Lifespan</td>
<td>$10^9$ s (~32 years)</td>
<td>Biographical timescale; identity change</td>
</tr>
<tr>
<td>Educational system</td>
<td>$10^{10}$ (~320 years)</td>
<td>Historical timescale; new institutions</td>
</tr>
<tr>
<td>change</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Worldsystem</td>
<td>$10^{11}$ (3200 years)</td>
<td>New cultures, languages; limit of historical records</td>
</tr>
<tr>
<td>change</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ecosystem, climate</td>
<td>$10^{12}$-$10^{13}$ (32,000-320,000 years)</td>
<td>Last ice age</td>
</tr>
<tr>
<td>change</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. The timescales are excerpts from Lemke’s (2000, p. 277) timescales for education and related processes and was adapted by Herbel-Eisenmann et al. (2015, p. 193).

Scales are useful in operationalizing positioning theory for mathematics education researchers and “for clarifying the identification of levels of positionings and storylines” (Herbel-Eisenmann et al., 2015, p. 193).

Herbel-Eisenmann et al. (2015) reconfigured the triangle (Figure 1) related to positioning theory, replacing speech acts with communication acts. Communication acts encompass gestures, physical positions, stances, and speech (Herbel-Eisenmann et al., 2015). Herbel-Eisenmann et al. (2015) “draw on Lemke’s timescales to conceptualize
multiple levels of narrative enacted simultaneously, each in its own storyline, in order to make the naming of storylines sharper” (p. 193).

*Figure* 1. The triangle on the left represents the positioning triangle (Tait-McCutcheon & Loveridge, 2016) and the diagram on the right represented the reconfigured triangle by Herbel-Eisenmann et al. (2015).

The goal for reconfiguring the triangle is to display the continuing and dynamic character of positioning in connection to communication acts. In describing the reconfiguration, Herbel-Eisenmann et al. (2015) state:

The arrows indicate that communication acts within any discourse both influence how people identify positionings (either researchers, explicitly in analysis, and participants, either implicitly or explicitly) and are influenced by such identifications. We describe these acts as discourse choices because, as Kress (1993) pointed out, whenever speakers speak, they are making choices (not necessarily consciously) amongst alternative structure or content. The fluid nature of positioning relates to the reality that actors in an interaction may have different perspectives on relevant storylines and thus constantly negotiate positioning either implicitly or explicitly (pp. 193-194).
Herbel-Eisenmann et al. (2015) provided suggestions to better operationalize positioning theory in mathematics education research. The first suggestion is to identify scales at which positions occur. Doing so helps to clarify the construct of positioning, provide clarity on how scales of positioning may be similar or different from storylines, understand what people bring from past conversations when positioning, and make claims warranted in relation to implications of findings (Herbel-Eisenmann et al., 2015). The second suggestion is to observe different positions or storylines in an interaction. The third suggestion is to represent storylines and communication acts which inform positionings, not focusing only on positioning (Herbel-Eisenmann et al., 2015). The fourth suggestion is to label and identify types of positions, and doing so would “draw attention to the reciprocal first-order positionings assumed by the speakers and can be used to identify the storylines teachers and students draw on in their re-tellings” (Herbel-Eisenmann et al., 2015, p. 202). The importance of these suggestions lies in the hypothesis by Herbel-Eisenmann et al.’s (2015) which states:

We hypothesize, however, that additional attention to storylines and communication acts (in combination with the attention to positions) would provide the field with richer depictions of classroom interactions and how those interactions are shaped by participants in them. (p. 199)

I follow Herbel-Eisenmann et al. (2015) suggestions to operationalize positioning theory in this study.

Drawing on these theoretical frames that inform my research questions, I recognize classrooms are spaces which encompass students and teachers of all
backgrounds, a variety of Discourses (Gee, 1999), and numerous forms of positioning. I am interested in how students learn and engage in these classroom spaces, specifically focusing on construction of mathematical Discourse. Mathematical Discourse (Moschkovich, 2003) and Positioning Theory guide and inform my research questions. To explore and further understand these classroom spaces, I employ the following research question and secondary questions:

How do girls in middle grades mathematics classes engage in constructing mathematical Discourses in both coeducational and single-sex environments? Specifically:

a. How do girls construct mathematical Discourses with other students in their classroom?
   i. What forms of positioning do girls utilize as they construct mathematical Discourses with other students in their classroom?

b. How do girls construct mathematical Discourses with their teacher in their classroom?
   i. What forms of positioning do girls utilize as they construct mathematical Discourses with their teacher in their classroom?

c. How do these methods or approaches of constructing these mathematical Discourses compare across coeducational or single-sex environments?

Overview of Chapters

The literature review is coordinated in Chapter Two, and provides an outline of how I think about and consider gender in mathematics education, how girls have been
and are viewed in the mathematics classroom, and the background of single-sex education. Chapter Three describes the holistic multiple-case study methodology implemented for this study. Included within Chapter Three is a discussion of how I collected data, the included protocols for case-study design, and a description of how each case was constructed and analyzed. Chapter Four provides an analysis of each individual case, and a cross-case analysis. Chapter Five includes a comprehensive summary of the study’s findings, a discussion of results, and implications for future research.
CHAPTER TWO

REVIEW OF RELATED LITERATURE

My Understandings of Sex and Gender in Mathematics Education

Sex and gender are terms used in education focused on single-sex or single-gender type schools and classrooms; however, following the latest guidelines from advocacy groups and scholars, I operationalize these two words with different meanings. For this study, I follow the GLAAD Media Reference Guide (2016) definition of sex:

The classification of a person as male or female. At birth, infants are assigned a sex, usually based on the appearance of their external anatomy. (That is what is written on the birth certificate.) A person’s sex, however, is actually a combination of bodily characteristics including: chromosomes, hormones, internal and external reproductive organs, and secondary sex characteristics (GLAAD Media Reference Guide, 2016).

Based on the definition provided by the GLAAD Media Reference Guide, I view sex as biological and binary. I follow the GLAAD Media Reference Guide to define gender identity, which is “A person’s internal, deeply held sense of their gender” (GLAAD Media Reference Guide, 2016). Additionally, I follow the GLAAD Media Reference Guide to define gender expression, which is “External manifestations of gender, expressed through a person’s name, pronouns, clothing, haircut, behavior, voice, and/or body characteristics. Society identifies these cues as masculine or feminine, although what is considered masculine or feminine changes over time and varies by culture” (GLAAD Media Reference Guide, 2016). I view gender expression as socially
constructed and a continuum. For example, the eighth grade girl I discussed from my research assistantship experiences gender expression did not always align with the rigid social gendered norms. Her gender identity, however, was female because she identified as a girl.

Focusing on difference of sex and gender expression, Paechter (2006) asserts “The traditional conception of the difference between sex and gender is that sex pertains to the body, and is therefore given, and gender is socially constructed” (p. 125). The use of the terms sex and gender, in some cases within education, are used interchangeably to represent the same meaning. Paechter (2006) claims:

In recent years, however, our conceptions of gender have once again become problematic, particularly given gradual slippage regarding the sex/gender distinction and the increasing use of ‘gender’ to refer to matters of biology as well as those pertaining to the social (p. 121).

Interchangeably using the terms gender and sex is unjust. For instance, when students’ gender identity does not align with their assigned sex, using the terms gender and sex interchangeably obscures that reality. According to the GLAAD Media Reference Guide, for transgender people “their own internal gender identity does not match the sex they were assigned at birth.” As described in Chapter 1, some students’ gender expressions do not always align with gendered norms which are often constructed in an all-girls’ or all-boys’ classroom. Thus, we must understand both the affordances and drawbacks of these classroom spaces for all students.
As one partial contribution to this understanding, in this particular study, I am focusing on mathematical Discourse (Moschkovich, 2003) construction processes in single-gender and coeducational spaces for students whose gender identity aligns with their biological sex (i.e., these students are cisgender) and who are female. For this study, when I use girl or all-girls, I am referring to gender identity based on the context of how the particular school for which I am collecting data determines how students are placed in each classroom space. Although I will address the specific context of the school for this study in Chapter Three, it is important to understand the processes for which students are placed in all-girls’ classrooms at this particular school. After speaking with the principal of the school, I was informed students have the option to be placed in a single-gender or coeducational classroom. The principal sends home a document during the spring of the upcoming school year, and parents and students have the option to place themselves in a single-gender or coeducational classroom. The parent and student have a choice for their placement and when choosing, the form labels their options as single-gender or coeducational. Additionally, I asked the principal if the school has ever had a transgender or gay student, and if so, how would that student be placed. The principal assumed, if the district was in agreement, the student would be placed based on how the student identified. Therefore, given the circumstances of this particular school, I am referring to gender identity when I am discussing an all-girls’ classroom for my study and I refer to these classroom spaces as single-gender.

The limitations for referring to single-gender in my study is using the term gender could reinforce the notion that gender is dichotomous. Additional limitations could be
that a person who identifies as non-binary would not put themselves into these spaces. There could be a student who identifies as a girl and puts themselves in this space and another student who identifies as a girl who also puts themselves in this space, but those spaces have different meanings for each girl. The different meanings could be based on their gender expression, provided different spectrums of the continuum. Gender expression can vary, but gender identity is often self-selected. Using the term gender to identify these classroom spaces does have limitations; however, gender is the term used by the school and aligns with the processes for placing students in these spaces. Therefore, I use the term gender to refer to all-girls’ classrooms in this study. It is important to note the U.S. Department of Education uses the term single-sex when girls are in homogeneous classroom environments; however, they do not have a process for a student who identifies as female but was assigned male at birth to opt into these classroom environments. Thus, when referring to these educational spaces and without understanding the processes for which students are placed, I too view these spaces as single-sex. Thus, to limit confusion, I will continue to use the term single-sex when referencing single-sex education in the United States or internationally, but single-gender when referring to my particular study.

In South Carolina, the term gender is often used to discuss single-gender educational environments during discussions about single-gender education (Chadwell, 2008; Rex & Chadwell, 2009; South Carolina Department of Education, 2015). For instance, in an article titled Single-Gender Education: An Option for Meeting Diverse Student Needs, Chadwell (2008) asserted:
As of October 2008, South Carolina was the nation’s leader in single-gender education, with classes in 78 elementary schools, 100 middle schools, and 20 high schools. If every school that has expressed interest in single-gender classes were to implement a program, one-third of all the state’s schools (and three-fourths of its middle schools) would offer this option (p. 1).

Previously, the state of South Carolina’s Department of Education established a single-gender initiatives and Chadwell was the coordinator.

**Girls in the Mathematics Classroom**

As a partial contribution to further understanding the affordances and drawbacks of single-sex classroom spaces, I focus my work on processes in which girls construct mathematical Discourse (Moschkovich, 2003) in single-sex and coeducational mathematics spaces. Mathematics teaching and learning is gendered regardless of whether the classroom environment is coeducational or single-sex. The groundbreaking work on girls and mathematics is essential for further understanding how girls learn in mathematics classrooms today. The first influential work on girls in mathematics was conducted by Fennema (1974, 1977, 1979), and her work sets the stage for why research on girls and mathematics is imperative and provides focus to continue critically examining the notion of sex-related differences in mathematics.

Fennema’s (1974) influential work began with the question “Are there really sex differences in mathematics achievement?” (p. 126). Prior to Fennema’s work, some scholars viewed mathematics as a male domain and “...some authors believe the sex difference in mathematical achievement has not always appeared, most authors feel that
when it does appear, it is in favor of boys” (Fennema, 1974, p. 126). From the conclusions of studies reviewed by Fennema (1974), more questions were raised by Fennema (1974) which include: “What sex-related factors influence mathematics achievement? Are these factors inherent or environmental?”, “Can learning environments be structured so as to enable boys and girls to achieve at similar levels in mathematics after puberty begins?”, “Is there ‘sexism’ in mathematics-education research and its reporting?”, “Is there ‘sexism’ in mathematics education?” (p. 137). Fennema’s work brings light to the problematic notion of sex-related differences in mathematics; and the questions posed by Fennema (1974) suggest if such sex-related differences did exist, then there would be a need to further explore learning environments and to find ways to help girls achieve at similar levels as boys. Fennema’s work demonstrates that students, both girls and boys, all have the ability to be successful in mathematics.

Fennema and Sherman (1977) investigated mathematics achievement, and relationships to and the notion of sex-related differences in mathematics achievement. Their findings suggest females have the same potential as males in mathematics, and their data did not support the notion females could not do well in mathematics (Fennema & Sherman, 1977). Further, Fennema (1979) reviewed studies published after 1974 and found the notion of male dominance in mathematics lessened and “is no longer accepted as valid in all situations” (p. 390). The reason for change is due to: (1) females learning mathematics at a level similar to males and (2) before 1974 the studies reported used random samples of males and females in secondary schools but females had studied less mathematics as compared to males at that time (Fennema, 1979). After 1974, studies
controlled for the amount of mathematics studied and found few significant differences between males and females in mathematics achievement.

Additionally, Fennema (1979) referred to different variables for exploring the notion of sex-differences in mathematics. When pointing to educational variables, Fennema (1979) brings light to the fact many advocate for female-only classes as a means to encourage equitable mathematics education. Fennema (1979) states the following about female-only classes:

The argument for this type of school organization goes something like this: because peer pressure against female competitiveness is too strong a force, females will not compete against males in mixed-sex classrooms. Female leadership (in problem-solving in this case) is only able to emerge when competition with males is eliminated. Teachers will not have different sex-related expectations and behaviors if only one sex is present (p. 398).

Fennema (1979) claimed single-sex classrooms seem like a simple solution to a very convoluted problem. Fennema’s (1974;1979) and Fennema and Sherman’s (1977) work regarding the notion of sex-differences in mathematics achievement is groundbreaking, and is the first influential work to bring light to the problematic notion of sex-differences in mathematics.

Following the influential work of Fennema (1974; 1979) and Fennema and Sherman (1977), the notion of sex-differences in mathematics achievement, student performance, and relationships between gender and the achievement gap have all been investigated by many researchers over the years (Burton, 1990; Walden & Walkerdine,
1985; Frenzel & Goetz, 2007; Mubeen et al., 2013). For instance, Burton (1990) notes some studies suggest “boys are significantly superior to girls in both their mathematical performance and their attitude towards mathematics (Backman, 1972; Maccoby and Jacklin, 1974; Mullis, 1975; Aiken, 1976; Benbow and Stanley, 1980)” (Burton, 1990). Mubeen et al. (2013), however, examined secondary boys’ and girls’ attitudes towards mathematics and academic achievement, and their findings suggest that there were differences in the mathematical achievement of boys and girls, specifically that girls achieved better results as compared to boys. Attitude towards and achievement in mathematics, however, did not align (Mubeen et al., 2013).

Literature regarding the notion of sex-differences has “considered the possibility that male mathematics superiority is due to psychosocial processes such as stereotyped sex-role identifications (Aiken, 1976; Becker, 1981; Burton, 1986; Walden and Walkerdine, 1985) and social reinforcement contingencies (Fox et al., 1979)” (Burton, 1990, pp. 87-88). Further, Frenzel and Goetz (2007) examined gender differences in mathematics, specifically looking at achievement emotions, examining emotions of enjoyment, pride, anxiety, hopelessness, and shame. Their findings suggest girls and boys had similar grades in mathematics; however, “...girls reported significantly less enjoyment and pride than boys, but more anxiety, hopelessness and shame” (Frenzel & Goetz, 2007, p. 497). Additionally, Walden and Walkerdine (1985) described and examined how students performed as they moved from primary to secondary school, and their findings suggested differences in “the ways teachers judged and valued the contribution of boys and girls in their mathematics classes, but they also found
differences in the ways boys and girls described themselves as learners of mathematics” (as cited in Burton, 1990, p. 10). These studies suggest further examining how girls experience and learn in mathematics classroom spaces.

According to Frenzel and Goetz (2007), progress towards gender equity in regards to cognitive performance has been made; however, “the gender gap still remains substantial in terms of attitudes and affect relating to mathematics” (p. 509). Although our understandings have grown since the work of Fennema, and because of her influential work scholars have continued to examine the notion of sex-differences in mathematics, there is still work to be done. It is imperative we facilitate success for all students in mathematics. All students have the ability to be successful in mathematics and it is our job to facilitate mathematics learning that allows students to be successful, whatever that success means for each and every student. Thus, my study seeks to contribute to our understandings of the affordances and drawbacks of single-sex classroom spaces, by examining the processes in which girls construct mathematical Discourse (Moschkovich, 2003) in single-sex and coeducational mathematics spaces.

**Single-Sex Education Internationally**

Single-sex education is a historical phenomenon (Shah, 2009) and is still prevalent in many countries outside of the United States (Rennie & Parker, 1997; Cocklin & Battersby, 1987). For instance, studies conducted in England (Sutherland, 1985; Sullivan, 2009), Australia (Feather, 1974; Rennie & Parker, 1997), Nigeria (Lee & Lockheed, 1990), Thailand (Jimenez & Lockheed, 1989), New Zealand (Cocklin & Battersby, 1987), Trinidad and Tobago (Blair, 2013), and Canada (Schneider & Coutts,
1982) contribute to our understandings of single-sex education and the influence of these settings on academic self-concept, perspectives of learning, school environment, and other factors which impact students in these classroom spaces. An overview of single-sex studies from various countries and their findings are provided below.

**Research Findings within International Context of Single-Sex Education**

Many countries, including Australia, New Zealand, and Ireland still have a large number of single-sex schools, and other countries, such as the United States and Britain, increased single-sex school offerings (Smyth, 2010). Although single-sex offerings increased, reviews conducted in Australia, Canada, Ireland, New Zealand, United States, and the United Kingdom claim limited evidence of consistent advantages in single-sex or coeducational settings (Smither & Robinson, 2006). An overview of findings from different countries and the different ways countries implement single-sex education (i.e., single-sex schools, single-sex classrooms within coeducational schools, and private schools) are discussed below.

Internationally, private or independent schools are often single-sex, but changes are occurring in some countries. For instance, in Australia, single-sex education occurs mostly in the private or independent sector (Australian Bureau of Statistics, 1997). In England, however, schools were originally for boys only and girls were taught at home. Towards the end of the nineteenth century education for girls became prominent; however, girls and boys attended single-sex schools rather than coeducational schools. Single-sex education was the norm through the 1960s and coeducational schools were only established as progressive experiments (Smithers & Robinson, 2006). “By 2004
(DfES, 2004) only about one in eight of the secondary schools in England were single-
sex - 226 for girls only and 184 for boys only - out of a total of 3,409 (including middle
deemed secondary)” (Smithers & Robinson, 2006, p. 1). A shift in coeducation within the
independent sector of education occurred. Smithers and Robinson (2006) wrote:

By 2005, of the 598 independent schools covering the secondary age range in
England just under half - 215 girls’ and 81 boys’ - were single-sex, including
those taking students of the other sex in the sixth form (Smithers and Robinson,
2005). Single-sex education which was once taken for granted in the sector now
feel threatened. Girls’ schools, in particular, have felt vulnerable, as boys’ schools
have opened their doors to girls (p. 1).

Although single-sex education has shifted to the private sector for many countries, in
many Middle Eastern countries, private schools are coeducational while public schools
are separated by sex.

Single-sex class offerings within coeducational schools are increasing in many
countries internationally. According to Van de gaer et al. (2004), “the establishment of
single-sex classes for core subjects like English and mathematics in co-educational
schools in countries like the United States, Australia and the United Kingdom is growing
faster than the evidence to support it (Rowe, 1988; Gillibrand et al., 1999; Robinson &
Smithers, 1999)” (p. 308). Specifically, Gillibrand, Robinson, Brawn, and Osborn (1999)
claimed “research findings are far from conclusive as to whether arranging classes in
mixed schools by gender has any beneficial effects on girls’ interest, confidence level,
and academic performance” (p. 350). Gillibrand et al. (1999) suggested further research
in regards to establishment of single-sex classes in coeducational schools due to a lack of consensus found in previous results.

Limited studies suggest advantages for girls in single-sex education based on school environment (Schneider & Coutts, 1982), perspectives of learning (Rennie & Parker, 1997), values and beliefs (Shah, 2009), academic self-concept (Shah, 2009; Sullivan, 2009), and parent perspectives (Leder & Forgasz, 1997). In Canada, Schneider and Coutts (1982) focused on school environment comparing coeducational schools, all-male schools, and all-female schools. Their findings suggested “Coeducational schools are perceived by most students as having more pleasant atmospheres—both in terms of attending to the social-emotional desires of their students and minimizing the necessity of control and discipline” (Schneider & Coutts, 1982, p. 898). Although Schneider and Coutts (1982) found coeducational schools had more pleasant atmosphere as perceived by students, Rennie and Parker (1997) found single-sex classrooms provided a more supportive learning environment for girls, and a less supportive learning environment for boys. Additionally, Leder and Forgasz (1997) investigated parent perspectives of single-sex mathematics classes at a coeducational high school, and found parents were more in support of the single-sex program than opposed in both years of data collection (Leder & Forgasz, 1997). These three studies leave us still wondering which classroom environment is more conducive to learning for students and a need for further exploration.

Further, Shah (2009) argued single-sex education should be explored and analyzed with a focus on values and beliefs of school community. In examining
educational, social, cultural, and religious concerns in regards to single-sex schooling, Shah (2009) discussed major themes from participants which included:

The two major themes that emerge from this study are first, a perceived link between educational achievement and single-sex schooling, especially among male respondents; and second, impact of culture/faith in demanding single-sex schools specifically for girls. (p. 16)

Additionally, Sullivan (2009) assessed a cohort of students born in 1958, seeking to understand if single-sex or coeducational schools affected students’ academic self-concept. Findings from the study show academic self-concept was highly gendered, and boys had higher self-concepts in mathematics and science while girls had higher self-concepts in English (Sullivan, 2009). According to Sullivan (2009), “Single-sex schooling reduced the gender gap in self-concept, while selective schooling was linked to lower academic self-concept overall” (p. 2). Both studies demonstrate the notion of a higher academic self-concept for boys in these spaces, but limited understanding for girls. These studies leave me wondering why girls did not have a higher self-concept in mathematics and a need to further explore these classroom spaces.

Additional studies examine the advantages of single-sex education focusing specifically on mathematics (Jimenez & Lockheed, 1989; Lee & Lockheed, 1990; Norton & Rennie, 1998; Van de gaer et al., 2004). Jimenez and Lockheed (1989) analyzed coeducational and single-sex education in Thailand; looking at how the educational settings enhance eighth grade boys and girls scores on mathematics standardized test. Lee and Lockheed (1990), however, investigated the effects of coeducational and single-sex
schooling for students in Nigerian public schools, focusing on effects of types of schooling on academic achievement and stereotype views of mathematics for students. Both studies found single-sex schooling was more effective in improving student performance in mathematics for female students and coeducational schooling was more effective for male students (Jimenez & Lockheed, 1989), and single-sex schools affect Nigerian girls positively, but have a less positive effect on adolescent males (Lee & Lockheed, 1990). Lee and Lockheed (1990) claimed single-sex schools are not more beneficial than coeducational schools for all students; however, single-sex schools were effective for girls. Specifically, the study suggested “single-sex schools affect Nigerian girls positively in both increasing mathematics achievement and in engendering less stereotypic views of mathematics” (Lee & Lockheed, 1990, p. 227). Findings from both studies suggest girls enrolled in single-sex schools had higher achievement in mathematics than girls in coeducational schools.

Similar to the findings from Jimenez and Lockheed (1989) and Lee and Lockheed (1990), scholars explored attitude and progress of language in mathematics (Norton & Rennie, 1998; Van de gaer et al., 2004). For instance, Norton and Rennie (1998) examined students’ attitudes towards mathematics at the secondary level (single-sex girls’ private school, single-sex boys’ private school, and state and private coeducational school) in Australia. The study findings suggested:

Clear differences between boys and girls on the Mathematics as a Male Domain scale, with girls being less stereotyped in their perceptions than boys. Except for this scale, effects related to the sex of the student were small, and effects relating
to grade level and school type on all variables were also small (Norton & Rennie, 1998, p. 16).

Additionally, Van de gaer et al. (2004) investigated effects of single-sex versus coeducational classes and schools; focusing on progress in language and mathematics for students in secondary education. The results indicate:

For boys, the gender composition of the class seems more important than the gender composition of the school. For girls, on the other hand, the gender composition of the school has more impact on their mathematics achievement than the gender composition of the class (Van de gaer et al., 2004, p. 319).

Findings suggest boys make more progress for language in coeducational classes, while girls make more progress for mathematics in single-sex (Van de gaer et al., 2004). These studies demonstrate some advantages for girls in these classroom spaces, but limited advantages for boys.

Although some studies suggest advantages for single-sex education, others discuss inconclusive evidence regarding support for single-sex education or coeducation (Smithers & Robinson, 2006; Smyth, 2010). In England, Smithers and Robinson (2006) point to efforts to make sense of the contradictory information regarding single-sex education, and offer a detailed review of literature from multiple countries. Smithers and Robinson (2006) examined main claims regarding single-sex and coeducation, and assert “Our assessment of the balance of the evidence overall is that research on single-sex and co-education has failed to demonstrate unequivocally that one approach is superior to the
other” (p. 29). Specifically, Smithers and Robinson (2006) list four possible reasons for why there is no evidence to support one approach being better than the other:

- there really are no differences to speak of;
- there are effects, but they are very small compared to other factors;
- there are effects, but they interact with other factors and show up in some situations but not others;
- the methods of gathering evidence are inadequate to show any differences that do exist (p. 29).

In regards to single-sex classrooms, there are no consistent findings about performance, attitude, or teachers’ reactions (Smithers & Robinson, 2006). They believe this is due to difficulty of controlling for effects of few single-sex classrooms within a coeducational school. Similar to the findings of Smithers and Robinson (2006), Smyth (2010) stated the following on impacts of single-sex education and student outcomes:

> It points to considerable variation between and within countries in the conclusions reached, depending on the research methods and analytical techniques employed, and outcomes considered. There appears to be very little consensus on whether single-sex education is advantageous to girls’ or boys’ academic achievement (p. 52).

Smyth (2010) mentioned broader issues regarding studying single-sex education, both the societal context in which coeducation and single-sex education take place and how difficult it is to compare single-sex and coeducational schools and classes (Smyth, 2010). Smyth (2010) states:
In particular, there appears to be considerable potential for the future in exploring the potential relationship between the broader “gender regime” (Connell 2002) and way in which gender is constructed (and reconstructed) within single-sex and coeducational schools (p. 53).

These broader issues make research difficult and lead to limited research on the comparisons of school types.

Additional studies were conducted to explore attitude, performance (Smithers & Robinson, 2006), and experiences (Blair, 2013) regarding single-sex education. For instance, in Australia, two schools shifted from single-sex to coeducational schools, and teachers believed all students preferred a coeducational environment (Smithers & Robinson, 2006). The paradox asserted by Smithers and Robinson (2006) is no conclusive evidence to support single-sex education or coeducation; “people ‘know’ one or the other is better but cannot prove it” (p. iii). Additionally, Blair (2013) explored single-sex schooling in Trinidad and Tobago where one fourth of the state secondary schools are single-sex. Blair (2013) focused on experiences of students in single-sex schools, stating “it was found that to merely segregate children based on their sex is naive and does not necessarily address the problems as they are perceived” (p. 139). Blair (2013) suggests before developing single-sex schooling in education, policy-makers should “read the literature; consider the facts and likely outcomes, and undertake a thorough examination of the curriculum in relation to the complex needs of all the individuals who make up that society” (p. 139). Both studies provide examples of inconclusive results in relation to single-sex education.
As evidenced above, many international studies provide inconclusive results about single-sex education or only provide evidence of advantages for one sex of student but not the other. In the following section I discuss single-sex education and provide an overview of the studies conducted in the United States.

**Single-Sex Education in the United States**

In the United States, formal education was initially only single-sex (Bracey, 2006). Riordan, Faddis, Beam, Seager, Tanney, and DiBiase (2008) define single-sex schooling as “education at the elementary, secondary, or postsecondary level in which males and females attend school exclusively with members of their own sex” (p. 1). This definition of single-sex schooling also encompassed “dual academies” in which males and females attend the same school with classes separated by sex, but not coeducational schools separated by selected subjects (Riordan et al., 2008). Although formal education in the United States was originally for white males only, in the 1800s girls began attending single-sex schools, but by the beginning of the twentieth century coeducational schools emerged (Bracey, 2006).

Coeducation in public schools emerged in the early twentieth century for economic efficiency and not for educational benefits (Riordan et al., 2008); leaving single-sex education to the private sector. According to Bracey (2006), “As coeducation became dominant, single-sex schools existed almost solely in the private sector as either church-affiliated schools or independent secular schools” (p. 1). According to the Bureau of Education (1883), towards the end of the nineteenth century and beginning of the twentieth century, coeducation became the norm for public schools (as cited in Datnow &
For more than a century, in the U.S., single-sex education was predominantly implemented in the private sector (Protheroe, 2009).

Legislators passed Title IX in 1972, promoting gender equity; therefore, single-sex public schools and classrooms became illegal to open (Bracey, 2006). Efforts to implement single-sex schools in the public sector faced opposition throughout the 1990’s from fear of violating Title IX requirements (Riordan et al., 2008).

Beginning in the 1980s, leaders in education implemented single-sex classes as a way to reduce problems in inner city schools (Riordan et al., 2008). For instance, in a New York elementary school, parents had an option of enrolling their student in single-sex or coeducational classrooms at every grade level. The principal faced many criticisms; however, “In the following years, students in the single-sex classrooms showed greater gains on reading and mathematics tests, higher attendance rates, lower suspension rates, and higher parental participation rates than students in the coed classes” (Riordan et al., 2008, p. 2). Although few attempts were made to open single-sex schools or classrooms, many attempts and efforts failed due to push back from opposition groups and Title IX violations (Riordan et al., 2008).

Several attempts were made in the 1990s to permit single-sex schools but failed (Bracey, 2006). According to Bracey (2006), “Sections 5131(a)(23) of the 2001 reauthorization of the Elementary and Secondary Education Act of 1965 (No Child Left Behind), however, authorizes the use of funds to establish single-sex schools and single-sex classes within coeducational schools” (p. 2). The U.S. Department of Education published regulations regarding single-sex classes which claimed:
Single-sex *schools*, however, would not have to provide any rationale or conduct periodic reviews. Although charter schools would be exempt from all three regulations, the district implementing a single-sex school would have to provide ‘substantially equal’ courses, services, and facilities at some other school or schools within the same district. (Bracey, 2006, p. 2).

Sadker and Zittleman (2004) addressed the change in regulations, pointing to how the Bush administration skipped evidence and failed to consider different factors which occur from private to public schools. Additionally, Sadker and Zittleman (2004) suggested an examination of diverse single-sex schools already in existence to carefully look at what did and did not work.

In the U.S., legislators amended regulations under Title IX of the Education Amendments of 1972, which prohibited sex discrimination in federally assisted education programs and activities, and allowed public schools to offer single-sex education (Federal Register, 2006). Specifically, the Department of Education Office for Civil Rights asserted:

The purpose of these amendments would be to support efforts of school districts to improve educational outcomes for children and to provide public school parents with a diverse array of educational options that respond to the educational needs of their children, while at the same time ensuring appropriate safeguards against discrimination (Guidelines regarding Single Sex Classes and Schools, p. 2).
Single-sex school openings increased since 1996 and according to Riordan et al. (2008), “By fall 2003 the number of single-sex public schools had grown to 20, and by fall 2007 over 80 single-sex public schools were in existence in a number of states” (p. 3). The increase in single-sex offerings correlates to the change in legislation regarding single-sex education in 2006. Thus, single-sex public education offerings have become a recent phenomenon in United States public schools (Carter, Kombe, & Che, 2014).

According to Mael et al. (2005), “A related though different phenomenon is single-sex classes, whereby schools that are otherwise coeducational provide separate classes for males and females in selected subjects for one or more years” (p. 1). The U.S. Department of Education published draft regulations in 2004 on single-sex classes and according to Bracey (2006):

These regulations held that: 1. Coeducational schools operating single-sex classes must provide a rationale for the classes, such as historic failure of girls to enroll in certain classes offered for both sexes (for example, physics or computer science). 2. They must provide either a single-sex class for the other gender or a coeducational class in the same subject at the same schools. 3. They must conduct periodic reviews to determine if conditions still render the single-sex class necessary. (p. 2)

In addition, all enrollment in single-sex classes are voluntary and an equal coeducational class in the same subject has to be provided (Bracey, 2006). Single-sex offerings increased in the U.S. public sector based on changes in regulation.
An overview of single-sex studies from the United States and findings are provided below.

**Research Findings within the United States Context of Single-Sex Education**

Similar to international single-sex education studies, the U.S. has positive and inconclusive evidence regarding affordances and drawbacks of single-sex education. For instance, Lee and Bryk (1986) investigated single-sex secondary education in the private sector, finding positive effects on: attitude, behavior, course enrollment, academic achievement, educational aspirations, locus of control, self-concept, and sex role attitudes (Lee & Bryk, 1986). However, Lee and Bryk (1986) suggested results from their study should encourage more careful inspection of life in regards to secondary single-sex schools, and focus more on practices within these schools. According to Smithers and Robinson (2006), in the U.S., single-sex schooling has shown to benefit disadvantaged children because it represents pro-academic choice. These studies show some positive evidence to support single-sex education; however, the studies are limited and encourage further research in these classroom spaces.

While a few studies suggested positive evidence of single-sex education, other studies suggested inconclusive evidence. According to Blair (2013):

In a meta-analysis of single-sex vs. coeducational schooling in the USA, Mael, Alonzo, Gibson, Rogers, and Smith (2005, p. 39) report that there is little evidence to suggest that single-sex schooling is better for developing a child’s self-esteem with 17% of the studies they examined reporting results in favour of
single-sex schooling, 50% reporting null results and 33% reporting results in favour of coeducation schooling. (p. 133)

Mael et al. (2004) points to how single-sex schooling as compared to coeducational schooling is still largely debated. According to Mael et. al (2004), “As a result of the obstacles to conducting true randomized experiments, few or no studies have provided definitive evidence for or against SS schooling” (p. i). Further, Bracey (2006) claims single-sex schools are schools of choice, and therefore extremely difficult to conduct “scientifically acceptable research on single-sex schools” (p. 16). Single-sex schools that do exist in the public sector are new; therefore, research is limited (Bracey, 2006). These studies demonstrate both limited evidence to support single-sex education and a need for further research to truly understand the impacts of these classroom spaces.

To provide focus for my study, I discuss single-sex studies and their findings specific to the mathematics classroom below.

**Single-Sex Education in the Mathematics Classroom**

Similar to both international and national studies regarding single-sex education, there are both positive and inconclusive results for single-sex education specific to mathematics. Some studies suggest single-sex education has a positive impact on mathematics achievement for girls in single-sex classrooms (Clark, 2001; Shapka & Keating, 2003; Bowe et al., 2015; Smithers & Robinson, 2006). While other studies suggest further exploration and in some cases, no differences in evidence to support single-sex education versus coeducation (Che et al., 2012; Carter et al., 2014; Kombe et al., 2016).
Clark (2001) examined short-term and long-term achievement effects of single-sex mathematics classes within a coeducational private middle school, and found single-sex mathematics classes are good for girls, and single-sex mathematics within coeducational schools may be fine for boys (Clark, 2001). Further, Shapka and Keating (2003) investigated the benefits of all girls classroom instruction for mathematics and science at a public coeducational high school. Their findings suggest being taught in at least one mathematics or science single-sex class in ninth and tenth grade has a significant positive effect on performance and persistence in mathematics and science. Although positive effects on performance and persistence were found, there were no positive influences on attitude towards mathematics (Shapka & Keating, 2003). Both studies suggest positive impacts for single-sex education for girls in mathematics; however, these studies still leave us with uncertainty regarding attitude towards mathematics and a limited understanding of how these classroom spaces impact all students.

Similar to the findings from Shapa and Keating (2003) and Clark (2001), Bowe, Desjardins, Convington Clarkson, and Lawrenz (2015) examined single-sex and coeducational urban elementary mathematics classes and their findings suggest “African American girls made more math achievement gains in single-sex classrooms; single-sex classrooms might mitigate math academic stereotypes for students and teachers; and that important conceptual factors play a role in these outcomes” (p. 1). Although this study suggested positive impacts for African American girls, this study pointed to further exploration of factors such as:
…teacher buy-in, congruency in students’ perceptions about their learning environment, teacher’s role in fostering positive academic identities, and exacerbated social identities are important contextual within these environments that go beyond the mere separation of the sexes. (Bowe et al., 2015, p. 23)

Exploring these factors would be a step toward understanding if single-sex education achieves equity for minority students in an urban elementary school (Bowe et al., 2015). Supporting the previous takeaways, we are still left with a limited understanding of how these classroom spaces impact and affect all students.

In addition to our limited understanding of how students experience and learn in these classroom spaces in the moment, Clark (2001) questioned what happens to girls once they return to a coeducation setting after experiencing single-sex education. According to Clark (2001) “…the literature on single-sex math classes for girls is silent on the question of what happens once girls, who apparently benefit from single-sex classes, are exposed again to classrooms where boys may again tease them when they ask and answer questions, where they may be tempted to adopt one-on-one roles, where boys may do much of the asking and answering and where teachers may, consequently, give the girls less attention” (p. 149). Although some studies suggest a positive impact for girls in single-sex mathematics education, these studies demonstrate a need for further exploration of these classroom spaces.

Studies suggest further exploration and in some cases, no differences in evidence to support single-sex education versus coeducation (Che et al., 2012; Carter et al., 2014; Kombe et al., 2016). For instance, Carter, Kombe, and Che (2014) examined student
mathematics self-concept and student perception of classroom environment; looking specifically at all-girls’ classes, all-boys’ classes, and coeducational classes. Their findings suggest students mathematics self-concept and student perception of classroom environment were the same no matter classroom environment (Carter, Kombe, & Che, 2014). Kombe, Che, Carter, and Bridges (2016) investigated student mathematics self-concept and student perception of classroom environment (e.g., all-girls, all-boys, and coeducation classes), and their findings also suggested students’ mathematics self-concept and perception of classroom environment were similar no matter the class environment. These studies both contribute to our understanding of student perception and student mathematics self-concept.

Further, Che, Wiegert, and Threlkeld (2012) examined problem solving strategies of girls and boys in single-sex mathematics classrooms. Their findings claim “From our results, the possibility is raised that, prior to formal instruction on solving proportions, sixth-grade boys may be more likely to approach a proportional problem using non-additive strategies than sixth-grade girls” (p. 325). According to Che et al. (2012):

If these indications are supported by further studies, it may raise concern among stakeholders considering the affordances and drawbacks of public, single-sex educational environments because learning opportunities from students sharing strategies may be perceived to be inhibited if the preponderance of students in the class approaches the problem the same way (p. 325).

Based on these findings, and findings of studies mentioned in this section, there are still many gaps in our understanding of the affordances and drawbacks of these classroom
spaces. Although we have a better understanding of student mathematics self-concept, student perception of the classroom environment, and problem solving strategies, there are still gaps in our understanding of the ways in which students learn and communicate in these classroom spaces.

**Limitations of Our Understandings**

Scholars across the world demonstrate, through research, the lack of evidence to support single-sex education. For instance, Smithers and Robinson (2006) reviewed literature from multiple countries and found overall one form of education was not superior to the other. Smyth (2010) asserted there was little consensus on “whether single-sex education is advantageous to girls’ or boys’ academic achievement” (p. 52). Blair (2013) suggested policy-makers should “read the literature; consider the facts and likely outcomes, and undertake a thorough examination of the curriculum in relation to the complex needs of all the individuals who make up that society” (p. 139). Scholars internationally and in the United States have demonstrated the need for further research or suggested limited evidence for or against single-sex education.

In the United States, many scholars demonstrate lack of evidence for or against the implementation of single-sex education. Blair (2013) points to Mael et al. (2005) meta-analysis of single-sex versus coeducational schooling, suggesting little evidence that single-sex education is positive for developing self-esteem in a child. Mael et al. (2004) suggested that few or no studies provide evidence for or against single-sex schooling. Additionally, Lee and Bryk (1986) encouraged more careful inspection of life and more focus on practices within secondary single-sex schools based off their results.
These studies suggest limited evidence to support single-sex education across all content areas.

In mathematics, scholars in the United States demonstrate lack of evidence for or against single-sex education. For instance, Carter et al. (2014) and Kombe et al. (2016) claim students mathematics self-concept and student perception of classroom environment were the same no matter classroom environment. Che et al. (2012) suggested that if further research supports similar findings, then stakeholders should consider the affordances and drawbacks of single-sex educational environments.

There are gaps in our understandings of the affordances and drawbacks of these classroom spaces. We do not fully understand how students learn in these classroom spaces, how students interact and communicate in these classroom spaces, and the impacts these classroom spaces have on students once they return to coeducation. Because of our limited understanding in how students experience and learn in these classroom spaces, it is imperative we research how these classroom spaces impact and affect student learning. I provide an in-depth description of how students construct mathematical Discourse (Mosckovich, 2003) in these classroom spaces.

**Summary**

In providing a literature review, this chapter examined applicable scholarly work focused on single-sex education internationally and in the United States. This chapter looked at single-sex schooling, single-sex classrooms within coeducational schools, and single-sex private schools. This chapter presented findings based on each context of the single-sex environment, and discussed my understandings of sex and gender in the
mathematics classroom and how girls are discussed in mathematics. Based on findings from relevant scholarly works, there are gaps in literature of our understandings of how students experience and learn in single-sex education. This study implements a holistic multiple-case study approach to explore both single-sex and coeducational environments. Specific details of the research method, data collection, and data analysis procedures are presented in the following chapter.
CHAPTER THREE

METHODOLOGY

Introduction

In this study, I investigated mathematical Discourses (Moschkovich, 2003) girls constructed in middle grades mathematics coeducational and single-gender classrooms. I implemented a multiple case study design to deeply understand and examine how girls’ construct mathematical Discourses in these distinct classroom spaces. In this chapter, I describe the methods and procedures used to conduct a holistic multiple case study. The following research question and secondary questions guide this study:

How do girls in middle grades mathematics classes engage in constructing mathematical Discourses in both coeducational and single-sex environments?

Specifically:

a. How do girls construct mathematical Discourses with other students in their classroom?

   i. What forms of positioning do girls utilize as they construct mathematical Discourses with other students in their classroom?

b. How do girls construct mathematical Discourses with their teacher in their classroom?

   i. What forms of positioning do girls utilize as they construct mathematical Discourses with their teacher in their classroom?

c. How do these methods or approaches of constructing these mathematical Discourses compare across coeducational or single-sex environments?
Rationale for Method

Two predominant paradigms in educational research are quantitative and qualitative traditions. Following Howe (1988), I distinguish between the two paradigms based on what I am attempting to investigate and what assumptions I make. When a researcher is assuming little and seeking to keep an investigation open-ended, they are conducting qualitative research. The nature of the study is quantitative when a researcher identifies variables and the variables of interest are measurable (Howe, 1988). According to Howe (1988):

At the level of data, the distinction between a “measurement” and an “ontological” sense is ambiguous. At the level of design and analysis, as well as interpretation, “qualitative” means “nonmechanistic” and “quantitative” means “mechanistic.” At the second two levels, it is impossible to imagine a study that could avoid having “qualitative” elements. (This suggests that all research ultimately has a “qualitative grounding,” Campbell, 1974) (p. 12).

Additionally, Merriam (1998) claims “Qualitative research is an umbrella concept covering several forms of inquiry that help us understand and explain the meaning of social phenomena with as little disruption of the natural setting as possible” (p. 5).

I observed and reported on how girls engaged in constructing mathematical Discourses (Moschkovich, 2003) in their natural setting. The data were not measurable; the design, analysis, and interpretation were open-ended, and I assumed little when entering the field of study. I was “acutely sensitive to the particulars of the context, especially the descriptions and explanations of events supplied by actors involved”
(Howe, 1988, p.12). I was interested in the construction of mathematical Discourse by girl students within the single-gender and coeducational classroom. Thus, the questions of interest posed by me, the data, design and analysis, and interpretation discussed were qualitative in nature.

Types of qualitative research common to education include: basic or generic, ethnography, phenomenology, grounded theory, case study, and emergent design (Patton, 2002; Merriam, 1998). A basic or generic qualitative study provide description, interpretation, understanding, and focus on patterns which take the form of themes or categories (Merriam, 1998). Ethnography is used when studying human society or culture (Merriam, 1998). To collect data and implement an ethnography, the researcher must complete extensive fieldwork, specifically immersing oneself into the culture of study (Patton, 2002). Further, phenomenology is a widely used method of qualitative research and has been approached in various ways which are “...a focus on exploring how human beings make sense of experience and transform experience into consciousness, both individually and as shared meaning” (Patton, 2002, p. 104). As defined by Merriam (1998), “In the conduct of a phenomenological study, the focus would be on the essence or structure of an experience (phenomenon)” (p. 15). To conduct and gather data for a phenomenology, the researcher must conduct in-depth interviews with people who have directly experienced the phenomenon being studied (Patton, 2002).

The qualitative methodologies discussed are guided by a theoretical framework, directing the researcher to aspects of the human experience (Patton, 2002). However, grounded theory, another form of qualitative methods “focuses on the process of
generating theory rather than a particular theoretical content” (Patton, 2002, p. 125). Grounded theory “...emphasizes steps and procedures for connecting induction and deduction through the constant comparative method, comparing research sites, doing theoretical sampling, and testing emergent concepts with additional fieldwork” (Patton, 2002, p. 125). Additionally, emergent design is centered on the flexibility to adapt inquiry as understandings deepen or situations change (Patton, 2002). Emergent design allows the researcher to have an initial focus and plan; however, “A naturalistic design unfolds or emerges as fieldwork unfolds” (Patton, 2002, p. 44).

According to Merriam (1998), “Case studies are differentiated from other types of qualitative research because they are intensive descriptions and analyses of a single-unit or bounded system (Smith, 1978) such as an individual, program, event, group, intervention, or community” (p. 19). Case studies are particularistic, descriptive, and heuristic (Merriam, 2002). Merriam (1998) discussed how “qualitative case studies in education are often framed with the concepts, models, and theories from anthropology, history, sociology, psychology, and educational psychology” (p. 19). A case study design is used to “gain an in-depth understanding of the situation and meaning for those involved. The interest is in the process rather than outcomes...” (Merriam, 1998, p. 19). Merriam (2002) claimed that case study is a suitable design when the researcher is interested in the process, monitoring and describing the context. More specifically, Patton (2002) asserts the following:

The case study approach to qualitative analysis constitutes a specific way of collecting, organizing, and analyzing data; in that sense it represents an analysis
process. The purpose is to gather comprehensive, systematic and in-depth information about each case of interest. The analysis process results in a product: a case study. Thus, the term case study can refer to either the process of analysis or the product of analysis, or both (p. 447).

According to Creswell (2007), multiple case study design is implemented when “the one issue or concern is again selected, but the inquirer selects multiple case studies to illustrate the issue” (p. 74). Yin (2014) states, “you may want to settle for two or three literal replications when your theory is straightforward and the issue at hand does not demand an excessive degree of certainty” (p. 61).

I use case study design to provide an in-depth description and comparison (Patton, 2002) of how girls engage in constructing mathematical Discourses (Moschkovich, 2003) within different classroom environments. To gain comprehensive and different perspectives (Creswell, 2007) of how girls construct mathematical Discourses (Moschkovich, 2003), a holistic multiple-case study (Yin, 2014) design was implemented. I provide intensive descriptions about each case, within each classroom setting, based on the data collected and analyzed. My research questions motivate a case study design. Specifically, I am interested in how students construct mathematical Discourse (Moschkovich, 2003), so participants are the case. There were four total cases, two participants from the single-gender classroom and two participants from the coeducation classroom setting. The bounded setting is the classroom type and the unit of analysis (Patton, 2002) is mathematical Discourse (Moschkovich, 2003). Mathematical Discourse (Moschkovich, 2003) was selected as the unit of analysis rather than students
or the classroom because I examined how mathematical Discourses (Moschkovich, 2003) were constructed, specifically I focused on interactions and relationships centered on mathematics which took place in each classroom setting.

I collected and analyzed data based on interactions (Gee, 1999) and mathematical Discourses (Moschkovich, 2003) which took place in each classroom setting. According to Creswell (2007), “Yin (2003) suggests that the multiple case study design uses the logic of replication, in which the inquirer replicates the procedures for each case” (p. 74). Literal replication of data collection was implemented for each case (Yin, 2014). Each case included all data gathered that involved mathematical Discourses (Moschkovich, 2003) constructed in the middle grades single-gender classroom for each participant.

A more thorough description of the design and specific details regarding this study are provided in the methodologies section below.

Methodologies

Multiple-Case Study Design Framework

Creswell (2007) suggested the development of a data collection matrix, including all information collected around each case. A data collection matrix (Figure 2) is provided to illustrate the layout of each case and collected data for this study. The data collection matrix is separated into four cases based on boundaries established in this study.
Boundaries for each case were based on the environment of the middle grades classroom, single-gender and coeducational.

Patton (2002) asserts the following:

Qualitative data describe. They take us, as readers, into the time and place of the observation so that we know what it was like to have been there. They capture and communicate someone else’s experience of the world in his or her own words. Qualitative data tells a story (p. 47).

The data collected for this study took place in the natural setting, and I provided a descriptive view of what it would be like to be part of the single-gender or coeducation middle grades mathematics classroom. I interviewed students and the teacher to provide an opportunity for them to communicate their experiences in their own words. Data collection for each case included classroom observations, audio-visual recordings of classroom observations, documents of all lesson plan materials for the student used.
during observations, documents regarding participant information, an individual student interview, and a teacher interview. The goal of the collected data was to provide a descriptive view of the classroom space and student experiences. A more thorough description of the methodologies implemented within this study are discussed in the following sections.

**Procedures**

After gaining IRB approval, I began the recruitment process. As previously mentioned, I already gained approval to collect data at a public middle school in the Southeast of the United States. I recruited one teacher who taught both single-gender and coeducation mathematics. After recruitment, I discussed timing of observations, interviews, and collection of documents with the teacher. A timeline (Appendix E) is provided. I gave the teacher a copy of the Parent Permission Form-Parent Letter for all students in the classroom (Appendix F). Each parent and student had through August 23, 2019 to let me know if they would prefer for their child to not be part of the study. The Parent Permission Form-Parent Letter provided an overview of the study and discussed potential risks students may encounter. The Parent Permission Form-Parent Letter did not require a signature or collection, and after August 23, 2019 data collection began. No students opted to not participate in the study. I observed both classrooms twice on two different days. Following the two observations, I recruited two girls who represented the recruitment criteria from each classroom type and the criteria for recruitment is discussed below. Once I determined which two girls from each classroom type I would like to recruit, I gave each student a copy of the Parent Permission Form for Each Participant
(Appendix G) and a Child Participant Release Form (Appendix I). All four students agreed to participate in the study and returned signed copies of both forms. I gave the teacher a Teacher Consent to Be in a Research Study Form (Appendix H) which did not have to be signed, and an Adult Release Form (Appendix J) which did have to be signed. Once I received signed copies of both forms from all four participants and the signed form from the teacher, data collection began. I collected data over three units of instruction. To allow students and the teacher time to settle into their daily routines for the school year, I began data collection after the first two weeks of school.

Overall planning of each case study followed Yin’s (2014) suggestion of creating a case study protocol. A case study protocol was developed and implemented during data collection for each case (Yin, 2014). The case study protocol (Appendix A) included an overview of the case study, data collection procedures, data collection questions, and a guide for the case study report (Yin, 2014). I followed Yin’s (2014, Figure 2.5, p. 60) template as a guide for enacting the multiple case-study design procedures. For defining and designing: I began by developing theory, then I selected cases and designed data collection protocol. In regards to preparing, collecting, and analyzing: I conducted the case studies and wrote individual case study reports.

Data collection included multiple sources of evidence for each case, which took place over the course of three mathematics units. During the data collection period, I observed and audio-visually recorded one lesson per unit for a total of three units for each classroom type. The first observation took place on the first day of Unit 3 and the unit topic was fractions, the second observation took place on the first day of Unit 4 and the
unit topic was decimals, and the third observation took place on the first day of Unit 5 and the unit topic was ratios. Each unit was approximately three to four weeks apart, so I typically had about three weeks between each observation. On the last day of observations, I conducted student and teacher interviews. Collection of documents took place over the entirety of data collection.

Throughout the data collection portion of the study, I added to and organized the case study database. The database provided a space for all collected data to be organized and stored for on-going analysis. Analysis of data were on-going and occurred throughout the entirety of data collection. Once individual cases were analyzed, I drew cross-case conclusions. I used all analyzed data and emergent storylines from each case to compare and contrast types of mathematical Discourse (Moschkovich, 2003), positionings, and storylines which emerged within each classroom setting. I then compared across settings, comparing and contrasting the types of mathematical Discourse (Moschkovich, 2003), positionings, and storylines which emerged across participants who were similar in their level of engagement, Maria and Nautica, and Leah and Jordan. Specific details on data analysis are included later in this chapter.

**Multiple-Case Study Selection and Recruitment**

Single-sex classrooms are prevalent in schools today both internationally and within the United States as mentioned in Chapter Two. In regards to case selection, I first obtained a list from the South Carolina Department of Education (SCDE) website of schools which implement single-gender education. The most recent version of single-gender schools for the State of South Carolina was from the 2014-2015 academic school
year. According to the SCDE list, the majority of schools which implement single-gender education are elementary and middle grades. Based on the 2014-2015 report, there was only one high school, specifically ninth grade, in the state of South Carolina which implements single-gender for mathematics. This study examines mathematical Discourses (Moschkovich, 2003) within classroom settings; therefore, I selected middle grades classrooms as a boundary criterion. The boundaries for each case were based on classroom type, single-gender or coeducation, within middle grades classrooms. I recruited from schools in the surrounding area within the state of South Carolina by emailing principals of schools which implemented single-gender education. Once I received approval to conduct my study at a school, I began the next level of recruitment.

I purposefully selected cases to show different perspectives (Creswell, 2007). Purposeful selection allowed me to discover, understand, and gain insight (Merriam, 2002) from a selection that had the most to offer in regards to learning. According to Patton (2002), “The logic and power of purposeful sampling derive from the emphasis on in-depth understanding. This leads to selecting information-rich cases for study in depth” (p. 46). The purpose of this study was to gain an in-depth understanding of how girls construct mathematical Discourses (Moschkovich, 2003) with their peers and teacher in single-gender and coeducational classrooms; therefore, I purposefully chose cases which “illuminate the questions under study” (Patton, 2002, p. 230).

After recruiting and gaining access to a middle school, I recruited a teacher who was willing to participate under the study criteria. I recruited one teacher who taught coeducation and single-gender mathematics classes. The criteria for participating in this
study included: willingness to let me observe and record one lesson per unit for three units, collect unit documents given to students, conduct individual student and teacher interviews, and collect documents relating to participant information.

Next, I recruited two girls within each classroom type for observation and individual student interviews, representing each case within the study. Merriam (2002) suggested sampling until a point of saturation, thus my goal was to recruit a minimum of two girls from each class type. Patton (1990) suggested the researcher provide a minimum sample size, “based on expected reasonable coverage of the phenomenon given the purpose of the study” (p. 186). I recruited the minimum per classroom type to allow for a more in-depth analysis of collected data. Ongoing analysis, however, occurred throughout the study and no additional students were selected. I recruited student participants after observing two different lessons for each classroom type. I observed each classroom type twice to provide myself an opportunity to observe which students should be selected based on a set criteria, which is discussed below.

According to Merriam (2002), “To begin purposive sampling, you must first determine what selection criteria are essential in choosing the people or sites to be studied” (p. 61). I had a set criteria for participant selection. I did not pre-select students for observation and interviews because I wanted to observe girls in their classroom environment. Then I selected who to observe more in-depth and interview based off specified criteria. A detailed description of the student recruitment criteria is discussed below.
**Student Recruitment Criteria.** A general overview of criteria for all student participants include: enrollment in a middle grades mathematics class, identify as female, and willingness to participate in the study. Participation in the study included observation of three lessons and an individual interview. During classroom observations, I looked for girls who actively participated in mathematical Discourse (Moschkovich, 2003) and for girls who were very shy or reserved when they engaged in mathematical Discourse (Moschkovich, 2003). Students participate in mathematical discussions differently as discussed by Brenner (1994) by “making conjectures, presenting explanations, constructing arguments, etc. about mathematical objects, with mathematical content, and towards a mathematical point” (as cited by Moschkovich, 1999, p. 12). Thus, I looked for students who interacted (Gee, 1999) with other students, engaged in conversation with their teacher and peers, and wrote (Gee, 1999) and participated in their mathematics work. My goal was to recruit girls who represented both ends of a participation spectrum.

Gee (1999) points to how “discourse analysts often look at two contrasting groups not to set up a binary contrast, but in order to get ideas about what the poles of a continuum may look like. We can get ideas that can then inform the collection of new data out of which emerges a much more nuanced and complex picture” (p. 138). From each classroom type, I recruited one girl who was active when engaging in mathematical Discourse (Moschkovich, 2003) during classroom observations. I also recruited one girl who held-back and seemed very reserved when engaging in mathematical Discourse (Moschkovich, 2003). I recruited two girls for participation in the study that represented extreme differences of engagement when constructing mathematical Discourse.
(Moschkovich, 2003) within the same classroom environment, as a way to provide a broad range of perspectives from the students.

**Context**


> In South Carolina, as in many states, there are gender-based performance gaps. We see it most clearly in the percentages of boys and girls in grades 3 through 8 who have scored below basic competency in English language arts and mathematics on our annual state assessment over the last four years (p. 1).

The South Carolina Department of Education last updated a list of 17 public school districts which implement single-gender education in 2014-2015. After contacting the South Carolina Department of Education for the 2018-2019 school year, I was informed data of schools which implement single-gender education are no longer collected at the state level. Schools in South Carolina, however, still implement single-gender education today.

**Middle School Specific to this Study.** The school I collected data at is situated in South Carolina. The public elementary and middle school provides PK through eighth grade education, with a total enrollment of 788 students as of 2017. As of 2017, 72% of students who attend this school are in poverty. The school offers the option for single-gender classes during sixth and seventh grade.
**Teacher and Classroom Specific to this Study.** Ms. Taylor, a white female, has taught mathematics for 14 years. For the purposes of this study, all names are pseudonyms. Ms. Taylor teaches the same group of all-girls for mathematics, science, and ELA each day; she also teaches the coeducation sixth grade mathematics class. The classroom was colorful and student work was displayed around the room. There were bookshelves full of books for students to read, mathematics posters on the walls, and many supplies for students to use as needed.

**Single-Gender Classroom.** In the single-gender classroom there were 25 students, 6 girls were Black and 19 girls were White. The girls enrolled in Ms. Taylor’s all-girls class had Ms. Taylor for language arts, science, and mathematics. During my first two visits, students sat in two large rows which wrapped around the classroom. In the single-gender classroom, students sat beside each other and one student was selected each day to sit on a yellow cushion at the back of the classroom. On my last visit, Ms. Taylor received large circle tables and students sat in groups at those table.

Ms. Taylor started each mathematics lesson with a set of five mathematics problems called Morning Work. Students were able to view the problems displayed on the SmartBoard or they could use personal computers to view the Morning Work. Students had about ten minutes to complete the problems and then they spent the remaining fifteen minutes going over the problems. Ms. Taylor drew names out of a cup to randomly select students to demonstrate their work at the board. During my first visits students could opt out of demonstrating their mathematics work; however, after a few weeks into school students had to demonstrate their work if their name was selected.
After twenty-five minutes of Morning Work students left and went to Specials (Art, Music, Physical Education, etc.). When students returned from Specials, there were forty-three minutes remaining for mathematics. Ms. Taylor taught a new lesson each day when students returned from Specials. Ms. Taylor displayed notes on the SmartBoard and worked through the notes and mathematics problems. She asked students to watch as she taught or she asked students to take notes. Ms. Taylor typically solved problems on the SmartBoard and posed questions throughout for students to respond in chorus. Occasionally, Ms. Taylor asked students to try a problem on their own and then they would go over the problem as a class. Ms. Taylor provided very limited opportunities for students to engage in conversation about mathematics with peers. Often, Ms. Taylor engaged students in whole class discussion or they watched as she wrote and discussed mathematics.

**Coeducation Classroom.** In the coeducation classroom there were 18 students, 7 girls and 11 boys. Of the girls, 3 were Black and 4 were White. All students enrolled in coeducation had Ms. Taylor for mathematics and science. During my first two visits, students sat in two large rows which wrapped around the classroom. In the coeducation classroom, for the most part, students sat by a student of the opposite sex. On my last visit, Ms. Taylor received large circle tables and students sat in groups with both boys and girls at each table.

Ms. Taylor’s instruction in the coeducation classroom was mostly identical to the all-girls instruction. The class time, however, was not split by Specials. Ms. Taylor taught mathematics to the coeducation class for the last fifty-five minutes of the school day. She
began each class with twenty to twenty-five minutes of Morning Work and spent the remaining class time teaching a new lesson. Although Ms. Taylor intended to teach the exact same lesson each day, she did make adjustments if needed. For instance, during one visit the students were not understanding a concept so Ms. Taylor stopped and reviewed before moving into the new lesson. Ms. Taylor drew names to randomly select students to share work just as in the single-gender classroom and generally posed questions throughout each lesson for students to respond in chorus. Similar to the single-gender classroom, Ms. Taylor engaged students in whole class discussion or they watched as she wrote and discussed mathematics.

**Student Recruitment in Each Classroom Setting.** In each classroom type, single-gender and coeducation, I observed for two days prior to recruiting two participants from each classroom. During single-gender observation, I observed for two girls who represented one end of a participation spectrum and two girls who represented the other end of a participation spectrum. During coeducation observation, I observed for two girls who represented one end of a participation spectrum and two girls who represented the other end of a participation spectrum. I observed and took field notes on eight students, four from single-gender and four from coeducation. After taking field notes and re-watching videos, I narrowed my participant selection to two girls per classroom type based on the student recruitment criteria described in the previous section.

**Single-Gender.** In the single-gender classroom I observed and took field notes on four girls and then narrowed my selection to focus on two girls. I identified two girls who were more engaged in constructing a mathematical Discourse (Moschkovich, 2003)
which were Candice and Maria. Candice and Maria were both White females and were very vocal in their all-girls classroom. Candice was very active in constructing mathematical Discourse on the first day of observation; however, on the second day she got out a book and read during the lesson rather than continuing to be engaged in mathematics. Maria, who I describe in more detail below, was selected because she continuously engaged in constructing a mathematical Discourse (Moschkovich, 2003) during both days of observation.

I identified two girls who were less engaged in constructing a mathematical Discourse (Moschkovich, 2003) which were Sam and Leah. Sam was a White female and Leah was a Black female. Sam and Leah did not interact with their teacher and both opted out of participating in their mathematics when selected to do so by Ms. Taylor. Sam was not selected because on the second day of observation she began responding to questions in chorus posed by Ms. Taylor, while Leah did not respond or share out. Leah, who I describe in more detail below, was selected because she rarely engaged in constructing a mathematical Discourse (Moschkovich, 2003) during both days of observation.

Coeducation. In the coeducation classroom I observed and took field notes on four students and narrowed my selection to focus on two girls. I identified two girls who were more engaged in constructing a mathematical Discourse (Moschkovich, 2003) which were Kim and Nautica. Kim was a Black female and Nautica was a white female. Both girls were very vocal in their coeducation classroom. Kim was very active in constructing mathematical Discourse on both days of observation. Kim sometimes talked
to Ms. Taylor and always completed her mathematics work. Nautica, however, was extremely vocal and often yelled out over all the other students to respond to questions posed by Ms. Taylor and to share her work. Additionally, Nautica asked for Ms. Taylor’s help on mathematics multiple times. Nautica, who I describe in more detail below, was extremely engaged in constructing a mathematical Discourse (Moschkovich, 2003) in comparison to her peers which was the importance for her selection.

I identified two girls who were less engaged in constructing a mathematical Discourse (Moschkovich, 2003) which were Kirstin and Jordan. Kirstin was a White female and Jordan was a Black female. Kirstin and Jordan did not interact with their teacher and both opted out of participating in their mathematics when selected to do so by Ms. Taylor. Although Kirstin and Jordan were both limited in their engagement in mathematical Discourse (Moschkovich, 2003), I selected Jordan because I observed her drawing and doodling on the side of her notebook rather than doing her mathematics work. Jordan, who I describe in more detail below, was selected because she rarely engaged in constructing a mathematical Discourse (Moschkovich, 2003) during both days of observation.

I now describe the four participants who were recruited for this study.

**Maria.** I recruited Maria, a white female in the all-girls sixth grade mathematics class, because she represented one end of a participation spectrum. I recruited students who were willing to interact with other students, engage in conversation with their teacher and peers, and to write (Gee, 1999) and participate in their mathematics work. I had a goal to recruit girls who represented both ends of the participation spectrum, and
Maria represented one end of the participation spectrum. During my first two observations, I observed Maria talking (Gee, 1999) to and interacting (Gee, 1999) with her peers. Maria responded chorally with the class during mathematical discussion (Moschkovich, 1999). Maria engaged in conversation with Ms. Taylor often, asked many questions throughout the lesson, raised her hand to ask questions, and responded to questions posed by Ms. Taylor.

During my first two visits, Ms. Taylor used popsicle sticks as a way to select students to demonstrate Morning Work at the board. If students did not feel comfortable demonstrating their work, they could opt out during that specific week. Ms. Taylor drew Maria’s name two days in a row and Maria happily participated both days. Maria talked (Gee, 1999) through her Morning Work problems and responded to questions posed by Ms. Taylor. Additionally, I observed Maria writing (Gee, 1999) and participating in her mathematics work, though this was the norm for this particular classroom.

Maria’s engagement in all forms of mathematical Discourse (Moschkovich, 2003) throughout the entirety of the two-day observation was the importance for her selection. Maria participated in mathematical discussion (Moschkovich, 1999). Maria was an active participant in the classroom and engaged in written, spoken, acted, listening, and interacted (Gee, 1999) mathematical Discourse (Moschkovich, 2003).

Leah. I recruited Leah, a black female in the all-girls sixth grade mathematics class, because she represented one end of a participation spectrum. During my first two observations, Leah had opportunities to interact with other students during Morning Work and to discuss mathematics problems during class time; however, Leah never
spoke (Gee, 1999) to her peers. Leah rarely responded chorally with the class during mathematical discussion (Moschkovich, 1999). Leah never answered questions posed by Ms. Taylor and never raised her hand to ask her own questions. Leah did not engage in conversation with Ms. Taylor and did not ask questions throughout the lesson. I rarely observed Leah talking (Gee, 1999) to or interacting (Gee, 1999) with her peers or Ms. Taylor. Similar to Maria, Leah’s name was selected on a popsicle stick to demonstrate her mathematics problem at the board. Ms. Taylor drew Leah’s name during one of the observations and Leah opted not to demonstrate her work for the class to observe.

Although Leah did not engage in mathematical conversation with her peers and Ms. Taylor, Leah often engaged in written (Gee, 1999) mathematics. I observed Leah writing in her mathematics notebook and she often scrolled her computer to view the Morning Work in Google Classroom. Leah appeared very reserved verbally during lessons and did not engage in conversation with Ms. Taylor, and Leah only engaged in written (Gee, 1999) mathematical Discourse (Moschkovich, 2003). Leah demonstrated limited engagement in spoken (Gee, 1999) and interacted (Gee, 1999) mathematical Discourse (Moschkovich, 2003) throughout the entirety of the lesson, thus the importance for Leah’s selection. This particular class was built on mathematical discussion (Moschkovich, 1999) and Leah did not publicly contribute to the mathematical conversation.

**Nautica.** I recruited Nautica, a white female in the coeducation sixth grade mathematics class, because she represented one end of a participation spectrum. During my first two observations, I observed Nautica talking (Gee, 1999) occasionally to
students next to her about mathematics. Nautica responded chorally with the class during mathematical discussion (Moschkovich, 1999), often shouting her answers. Nautica frequently engaged in conversation with Ms. Taylor and asked many questions throughout the lesson. Nautica not only engaged in conversation when called on by Ms. Taylor, but also raised her hand to ask questions and responded to questions posed by Ms. Taylor.

During my first two visits, Ms. Taylor used popsicle sticks to randomly select students. As previously mentioned, students were allowed to opt out. Ms. Taylor drew Nautica’s name two days in a row and Nautica participated both days. Nautica talked through her problem and responded to questions posed by Ms. Taylor. I observed Nautica writing (Gee, 1999) and participating in her mathematics work, though this was the norm for this particular classroom.

Nautica’s engagement in all forms of mathematical Discourse (Moschkovich, 2003) throughout each lesson was the importance for why I selected Nautica. Nautica participated in mathematical discussion (Moschkovich, 1999). Nautica was an active participant in the class and engaged in written, spoken, acted, listening, and interacted (Gee, 1999) mathematical Discourse (Moschkovich, 2003).

**Jordan.** I recruited Jordan, a black female in the coeducation sixth grade mathematics class, because she represented one end of a participation spectrum. During my first two observations, Jordan had opportunities to interact with her peers during Morning Work and to discuss mathematics problems during class time; however, Jordan never spoke (Gee, 1999) to students sitting near her. Jordan rarely responded chorally
with the class during mathematical discussion (Moschkovich, 1999). Additionally, Jordan never answered questions posed by Ms. Taylor and never raised her hand to ask her own questions. Jordan did not engage in conversation with Ms. Taylor and did not ask questions throughout the lesson. I rarely observed Jordan talking (Gee, 1999) to or interacting (Gee, 1999) with her peers or teacher. Similar to Nautica, Jordan’s name was selected on a popsicle stick to demonstrate her mathematics problem. Ms. Taylor drew Jordan’s name during both days of observations and Jordan opted not to demonstrate her work both days.

Although Jordan did not engage in mathematical conversation with her peers and Ms. Taylor, Jordan sometimes engaged in written (Gee, 1999) mathematics. On the second day of observation, I observed Jordan doodling in her notebook rather than completing her mathematics work. When Ms. Taylor talked about problems, Jordan would then write (Gee, 1999) in her notebook. It is important to note that engagement in written mathematics was the norm for all students in this particular classroom.

Jordan appeared very reserved verbally during lessons and did not engage in conversation with Ms. Taylor and only engaged in written (Gee, 1999) mathematical Discourse (Moschkovich, 2003). During the second day, I observed Jordan talking very quietly to a student next to her. Ms. Taylor, however, was talking during this time and Jordan was off task. Jordan demonstrated limited engagement in spoken (Gee, 1999) and interacted (Gee, 1999) mathematical Discourse (Moschkovich, 2003) throughout the entirety of each lesson, thus the importance for Jordan’s selection. This particular class
was built on mathematical discussion (Moschkovich, 1999) and Jordan did not publicly contribute to the conversation.

**Data Sources**

I follow Yin’s (2014) four principles for data collection. A detailed overview of each principle is provided below.

**Principle 1: Use Multiple Sources of Evidence.** Evidence in case study research can come from multiple sources including: “documentation, archival records, interviews, direct observation, participant-observation, and physical artifacts” (Yin, 2014, p. 103). I collected data for each case, which included audio-visual recordings of classroom observations, individual student interviews, teacher interviews, and documentation.

**Principle 2: Create a Case Study Database.** In order to preserve the collected data in an easily accessible form (Yin, 2014), I organized all collected data on a locking hard drive. The database is organized by date collected and type of collected data. I used an observation protocol (Appendix B) and took field notes in a notebook during classroom observations based on the observation protocol. I expanded the field notes after each observation. Field notes were typed and saved in a locking hard drive for ongoing analysis. The observation protocol was a space for me to note specific instances of interest for me to go back and analyze in the audio-visual footage. All documents collected during data collection were scanned and saved electronically to the locking hard drive. All materials created by me were stored in the database on a locking hard drive. Additionally, all transcripts from audio-visual recordings and interviews were stored in the database for ongoing analysis.
**Principle 3: Maintain a Chain of Evidence.** I maintained a chain of evidence throughout the entirety of the study. I moved from one part of the case study to the next, citing sources of evidence with a clear report of date and time in which the evidence was collected. I insured sources of evidence cited contained evidence highlighted in the documents. A detailed description of time and date for each source of evidence is included in the observation protocol, semi-structured interview protocol for students (Appendix C) and teacher (Appendix D), and overall timeline for the study. The protocol questions and original study questions are linked (Yin, 2014).

**Principle 4: Exercise Care When Using Data from Electronic Sources.** For the purposes of this study, no internet based electronic devices were used as sources of evidence. Data collection methods include the use of Google Drive and QuickTime player; however, all collected data were stored on my computer and a locking hard-drive, and deleted from the electronic source.

In the subsections below, I provide a detailed discussion of each source of data.

**Classroom Observations.** Case studies take place in the real-world setting (Yin, 2014); therefore, I conducted classroom observations to observe how mathematical Discourses (Moschkovich, 2003) were constructed in the actual classroom settings, as they occurred. My observations included one lesson per unit over three units, I observed three lessons per classroom type. It was possible some students may not align with the content of a single unit or be as engaged in that unit as they may typically be; therefore, I observed three units instead of one. I expected to be nearing saturation with types of mathematical Discourses (Moschkovich, 2003) constructed over the course of three units.
I did near saturation after collecting data for the third unit and did not continue collecting data for a fourth unit.

Additionally, I set up an audio-visual recording device to record the entire classroom observation. I took field notes during direct observations using an observation protocol, and expanded on those notes directly after the observation occurred. All audio-visual recordings were transcribed and used for purposes of ongoing analysis. The purpose of direct observation and recording observations was to observe interactions (Gee, 1999), actions (Gee, 1999), and conversations in which mathematical Discourses (Moschkovich, 2003) were constructed. Additionally, each participant used an Echo or Livescribe pen and took notes in a notebook. The data collected in the notebooks were included in analysis. The theoretical framework guided data collection, which allowed me to focus only on mathematical Discourses (Moschkovich, 2003) and interactions (Gee, 1999) which took place in the classroom spaces.

**Individual Student and Teacher Interviews.** Interviews are an important source of evidence for case study research (Yin, 2014); therefore, I conducted individual student and teacher interviews within each case. Specifically, I conducted shorter case study interviews (Yin, 2014) to follow-up on findings from direct classroom observation. Interviews were open-ended, assumed a conversational manner (Yin, 2014), and guided by a semi-structured interview protocol (Appendix C & D). I audio-recorded student and teacher interviews and transcribed for ongoing analysis.

**Student Interviews.** Interviewing purposefully selected students based on the established criteria allowed me to further understand the actual experiences of
participants in their own words. More specifically, I gained insight on how the participants thought they constructed mathematical Discourse (Moschkovich, 2003) in the classroom. For instance, if I observed a student working on a mathematical task at the board for the class to observe, I may not have fully grasped what the student was thinking from observation alone. Posing questions that allowed the student to share their thinking provided deeper insight on the constructed mathematical Discourse (Moschkovich, 2003). Conducting interviews allowed me to gain insight from the participant perspective, adding to the description of constructed mathematical Discourse (Moschkovich, 2003) of the actual experiences of participants in their own words. Examples of interview questions based on the student recruitment criteria is discussed below.

Through interviews, I better understood how and why students engaged differently in constructing mathematical Discourse (Moschkovich, 2003). As I observed, I looked for girls who represented opposite ends of the spectrum in how they constructed mathematical Discourse (Moschkovich, 2003). I observed for verbal and nonverbal cues. Examples of nonverbal cues relate to the communication acts as discussed by Herbel-Eisenmann et al. (2015), which include “not only speech but also gestures, physical positions, and stances” (p. 193). I looked for girls who were vocal in communicating with Ms. Taylor and peers, who interacted (Gee, 1999) with Ms. Taylor and peers, and who engaged in mathematical work. Additionally, I looked for girls who were quiet and reserved from communicating with Ms. Taylor and peers, who seemed shy and less
willing to interact (Gee, 1999) with Ms. Taylor and peers, and who held-back or seem disengaged from mathematical work.

I interviewed the purposefully selected students to gain a better understanding of how mathematical Discourses (Moschkovich, 2003) were constructed. For instance, I started by asking broad and general questions similar to the following: Tell me how you feel about being in this class? How do you feel about being in other classes? How do you contribute to the ideas in class? How do you contribute to the understandings y'all are developing? Talk to me about your favorite class. Why is that class your favorite? Broader and more general questions gave the student an opportunity to freely share how they felt and gave space for a less directed answer. I then asked questions focused on specific instances I observed during data collection. I asked more specific and tailored questions similar to the following: How do you feel about speaking up in class? How do you decide when to speak up in class and why? How do you feel about volunteering to demonstrate your work at the board and why? How do you feel about demonstrating your work at the board when you are selected by Ms. Taylor? These questions allowed me to understand how students thought about constructing mathematical Discourse (Moschkovich, 2003), and I was able to gain a deeper understanding than observation alone.

Teacher Interview. I interviewed Ms. Taylor to gain a better understanding of how mathematical Discourses (Moschkovich, 2003) were constructed by students on a regular basis. I started by asking broad and general questions similar to the following: Talk to me about teaching your classes. What is that like for you? How do you feel about
that? How do you provide opportunities for students to contribute to ideas in class? Do you think that is important? Think about your favorite class you have taught. Why was that class your favorite to teach? Broader and more general questions gave Ms. Taylor an opportunity to freely share how she taught the class, and it also gave Ms. Taylor space to share her perspective of how she provided students opportunities to contribute to mathematical thinking and learning. Based on classroom observations, I tailored questions to focus on specific instances I observed during data collection. I asked more specific and tailored questions similar to the following: Are discussion and collaboration around mathematical tasks and activities a norm in your classroom? Explain. How often do students have the opportunity to share their ideas? How do you decide when to select students to demonstrate their work for the class to observe? How do you decide when to select students to describe or share their work verbally? How do you decide when to allow students to share responses in chorus? If students do not seem as engaged in their work or with peers, how do you know they are grasping the ideas you are teaching? Tailored questions allowed me to understand how Ms. Taylor observed students constructing mathematical Discourse (Moschkovich, 2003), and how Ms. Taylor gave opportunities for students to construct mathematical Discourse (Moschkovich, 2003).

Interviews allowed me to paint a richer picture, including specific insight from participants, of how mathematical Discourse (Moschkovich, 2003) was constructed in single-gender and coeducational classrooms.

Documents. According to Yin (2014), “For case study research, the most important use of documents is to corroborate and augment evidence from other sources”
(p. 107). I asked Ms. Taylor for copies of all lesson activities, worksheets, assignments, etc., that were incorporated and aligned with each direct observation of data collection. I requested a copy of participant schedules and general information about each participant. I collected documents throughout the entirety of data collection and stored them in the database.

The following section discusses on-going analysis throughout the data collection process and how I analyzed the data.

**Analysis of Data**

According to Gee (1999), Discourse analysis focuses on:

(a) illuminating and gaining evidence of our theory of the domain, a theory that helps to explain how and why language works the way it does when it is put into action; and (b) contributing, in terms of understanding and intervention, to important issues and problems in some “applied” area (e.g., education) that interests and motivates the researcher (p. 8).

The analysis of discourse is a constant movement from “context to language and from language to context” (Gee, 1999, p. 14). More specifically, Merriam (2002) claims “That is, our analysis and interpretation -- our study’s findings -- will reflect the constructs, concepts, language, models, and theories that structured the study in the first place” (p. 48). This study illuminates how language-in-use, or mathematical Discourse (Moschkovich, 2003) in the mathematics classroom, is constructed by girls in middle grades. Using the definition and discussion of mathematical Discourse (Moschkovich, 2003) in Chapter One, I narrowed my data collection and analysis focusing only on
mathematical Discourses (Moschkovich, 2003) constructed by girls, and the interactions (Gee, 1999) and actions (Gee, 1999) which occurred around the construction of those mathematical Discourses (Moschkovich, 2003).

Although students might have discussions which include “standard or canonical mathematical discourse” (p. 12), students will participate in mathematical discussions as discussed by Brenner (1994) by “making conjectures, presenting explanations, constructing arguments, etc. about mathematical objects, with mathematical content, and towards a mathematical point” (as cited by Moschkovich, 1999, p. 12). I observed and recorded classroom types, single-gender and coeducational, over multiple units as a way to reach saturation of the mathematical Discourses (Moschkovich, 2003) constructed in each case. According to Gee (1999), “Our confidence in these hypotheses will rise if we look through more and more talk from this same group of people in this and subsequent meetings and we gain more and more evidence for our hypotheses - more and more examples that appear to be best explained by our hypotheses” (p. 18). To more narrowly focus the framework for this study, I specifically collected and analyzed data that pertained to mathematical Discourses (Moschkovich, 2003) in the classroom which were observable. Observable Discourses represent Discourses which are spoken, written, acted, or interacted with others (Gee, 1999).

In analyzing the constructed Discourses, I focused on mathematical Discourses (Moschkovich, 2003) constructed by girls and the interactions and actions (Gee, 1999) which occurred around the construction of those mathematical Discourses (Moschkovich, 2003). I looked for different positions and/or storylines occurring in interactions. I
labeled and identified the types of positionings, storylines, and/or communication acts that occurred (Herbel-Eisenmann et al., 2015). I observed and collected video recordings of three different lessons over three different units of content which were transcribed to include the participants’ interactions, actions, gestures, writing, and talk with other students and the teacher.

To operationalize positioning theory in the analysis of data, I followed suggestions made by Herbel-Eisenmann et al. (2015). I focused on timescales of positioning (Table 1) at which they occurred, helping to clarify the construct of positioning and provide coherence on how timescales of positioning may be similar or different from storylines. Doing so allowed me to understand what the participants brought from past conversations when positioning. I looked for different positions or storylines that occurred in an interaction. I considered storylines and positions when analyzing student communication in regards to positioning theory. Additionally, I represented the storylines and communication acts which informed the positionings that occurred, not focusing solely on positioning (Herbel-Eisenmann et al., 2015). I labeled and identified the types of positionings that occurred, as mentioned by Herbel-Eisenmann et al. (2015), “doing so would ‘draw attention to the reciprocal first-order positionings assumed by the speakers and can be used to identify the storylines teachers and students draw on in their re-tellings’ (Herbel-Eisenmann et al., 2015, p. 202)”. The specific forms of positioning used for this study, as defined in Chapter One, are first order and second order positioning.
During classroom observation, I used an observation protocol to organize all gathered information. As I audio-visually recorded the classroom, I walked around the classroom for direct observation focusing on the recruited participants. During direct observation, I observed for storylines, student positions, teacher positions, communication acts, mathematical Discourses of interest, and additional notes that aligned with the observation. I listened and observed for classroom discussion, group discussion, partner discussion, and communication between teacher and individual recruited participants. I observed for students working individually to see what they were doing, and I observed for students working with a partner or group. I observed students’ written work to see how or whether they were constructing mathematical Discourse (Moschkovich, 2003). I took note of communications acts by observing students’ gestures, physical positions, stances, and speech (Herbel-Eisenmann et al., 2015). The observation protocol was a space for me to note specific instances of interest for me to go back and analyze audio-visual footage. The observation protocol helped me to organize all mathematical Discourse (Moschkovich, 2003) and positionings that I observed, and helped to narrow my focus on exactly what I needed to observe during classroom observation. Following the classroom observation, I expanded my direct observation notes in my notebook. Taking field notes and expanding on them directly after observation allowed me to focus on very specific moments during observation; however, audio-visually recording allowed me to go back and narrow in on specific moments that I was not able to catch during observation. For instance, I reviewed instances where participants interacted with their teacher, instances where participants interacted with
their peers, or instances where participants worked on their mathematics. I reviewed such instances after each classroom observation and after expanding my field notes. I was the only researcher collecting data for this study; therefore, multiple forms of observation allowed me to go back and take note of instances and interactions that I was not able to directly observe. Having both notes and recordings allowed me to go back and forth between the two forms of data to make comparisons and further understand how mathematical Discourses (Moschkovich, 2003) were constructed in each classroom setting.

Following Merriam’s (2002) data analysis strategies, I implemented the constant comparative method. According to Merriam (2002), “The researcher begins with a particular incident from an interview, field notes, or document and compares it with another incident in the same set of data or in another set. These comparisons lead to tentative categories that are then compared to each other and to other instances” (p. 159). Following the step-by-step process from Merriam (2002), I began “category construction or data analysis” during data collection. While building the case study database, I took notes and commented on data I found interesting or relevant to my study (Merriam, 2002). This process occurred after every observation and interview. Going through all notes and comments, I began to group notes and comments that were similar. This process occurred for each set of data. The overall goal for this process was to construct a list of categories which were ongoing throughout both the data collection and analysis process. All forms of collected evidence were included in the constant comparative method as a means to accurately demonstrate the constructed themes.
Ongoing data analysis occurred throughout the entirety of this study; however, because the study was a multiple-case study design, two stages of analysis occurred (Merriam, 2002). The first stage was within-case analysis, where each case was analyzed comprehensively, and the second stage was cross-case analysis of cases (Merriam, 2002). According to Merriam (2002), “Without ongoing analysis, the data can be unfocused, repetitious, and overwhelming in the sheer volume of material that needs to be processed. Data that have been analyzed while being collected are both parsimonious and illuminating” (p. 162). I analyzed data throughout the entirety of data collection and after data collection. Cross-case analysis occurred, comparing cases to one another, seeking to understand how the methods or approaches of constructing mathematical Discourses (Moschkovich, 2003) compared across coeducational or single-gender environments.

In the single-gender setting, I coded all transcriptions for Maria and developed a list of codes. I coded all transcriptions for Leah using the codes from Maria, adding to the list of codes as they emerged. In grouping the codes into themes, I considered my research questions. I grouped codes that correlated to the student interacting with peers, I grouped codes that correlated to the student interacting with Ms. Taylor, and I grouped codes that correlated to the student working independently. I looked at the established group of codes and considered which codes focused on spoken (Gee, 1999) or non-verbal interactions (Gee, 1999) with peers and Ms. Taylor, and which codes focused on written (Gee, 1999), acted (Gee, 1999), physical positions, or gestures. All forms of collected evidence for Maria and Leah were included in the case analysis. As I grouped the codes together, I looked for emergent storylines or “the ongoing repertories that are already
shared culturally or they can be invented as participants interact” (Herbel-Eisenmann et al., 2015, p. 188). In looking for emergent storylines, I considered the actual talk of the participants from both classroom observation and interviews to understand and establish the storylines.

Additionally, I transcribed all talk (Gee, 1999), actions (Gee, 1999), interactions (Gee, 1999), and gestures of Ms. Taylor in each lesson. I only focused on Ms. Taylor, however, when she was interacting, talking, or gesturing towards the specific participants in the study. After analyzing data for Maria and Leah, I looked for common storylines that emerged from the single-gender data. Through Maria and Leah’s talk, writing, gestures, actions, and interactions (Gee, 1999), I looked for different positions and/or storylines that occurred in the single-gender classroom.

I followed the same exact process for analyzing data in the coeducation setting. I did, however, start over with the list of codes. I first coded all transcriptions for Nautica and developed a list of codes, and then I used that list to code all transcriptions for Jordan. The process for group codes, considering my research questions, and looking for emergent storylines was the exact same in the coeducation setting as the single-gender setting. Through Nautica and Jordan’s talk, writing, gestures, actions, and interactions (Gee, 1999) I looked for different positions and/or storylines that occurred in the coeducation classroom.

After analyzing each case individually, I analyzed across cases. I used all data collected and analyzed, as well as the emergent storylines from each case to compare and contrast types of mathematical Discourses (Moschkovich, 2003), positionings, and
storylines which emerged within the single-gender and coeducation classroom setting. I then compared across settings, specifically comparing and contrasting types of mathematical Discourses (Moschkovich, 2003), positionings, and storylines which emerged across Maria and Nautica, and Leah and Jordan. I analyzed across cases of the participants who were similar in their level of engagement as a way to show differences in constructed mathematical Discourse (Moschkovich, 2003) across classroom settings.

**Construct Validity**

Yin (2014) defines construct validity as “identifying correct operational measures for the concepts being studied” (p. 46). According to Gee (1999), “the validity of an analysis is not a matter of how detailed one’s transcript is. It is a matter of how the transcript works together with all the other elements of the analysis to create a “trustworthy” analysis” (p. 106). Construct validity is addressed in this study because there are multiple sources of evidence (Yin, 2014) collected. Data collection included: classroom observations, student and teacher interviews, and collection of documents. To ensure construct validity, I maintained a chain of evidence throughout the entirety of the study. I cited sources of evidence with a clear report of date and time of collection, making sure sources of evidence cited contained evidence highlighted in the documents. Additionally, the protocol questions and original study questions are linked (Yin, 2014).

**External Validity**

Yin (2004) defines external validity as “defining the domain to which a study’s findings can be generalized” (p. 46). Yin (2014) claims statistical generalization is not possible when conducting case study; however, analytic generalization is characterized
through the role of theory. In this study, external validity was addressed through the use of replication logic (Yin, 2014) in implementing a multiple-case study design.

**Reliability**

Yin (2004) defines reliability as “demonstrating that the operations of a study -- such as the data collection procedures-- can be repeated, with the same results” (p. 46). To increase reliability, a case study protocol for each case was developed and implemented. I used the case study protocol to guide me as I collected data for each case. Additionally, I developed a case study database for all data collected. Data was organized in a locking hard drive and organized by date collected and type of collected data.

**Limitations**

Limitations which occur in case-study research can relate to both time and money (Merriam, 2002). Time and money put a constraint on this study and data were only collected in South Carolina. I only had a single semester for data collection, thus a smaller number of cases were conducted. Additionally, I was the only researcher involved with designing, implementing, and analyzing all data. According to Merriam (2002), “Qualitative case studies are limited, too, by the sensitivity and integrity of the investigator…The investigator is left to rely on his or her own instincts and abilities throughout most of the research effort” (p. 42). Herbel-Eisenmann et al. (2015) point to the researcher’s privileged storylines which can affect which data become important. Specifically, Herbel-Eisenmann et al. (2015) assert the following:

At least three possibilities might help address this issue: (a) articulating the nature of the methodological and interpretive decisions, (b) being clear about the
potential storylines at play and a rationale for the ones that were highlighted, and
(c) making clear the positionality of the researcher. (p. 197)

To address this limitation, I implemented protocols for each form of data collection for
transparency. Biases are another limitation that I, as the researcher, needed to be aware of
in collecting and analyzing data. To address my biases, I provided a personal rationale in
Chapter One, which addresses my previous history and relation to being a female and in
previously working with students in single-sex classrooms. To eliminate biases I used
collected data to describe what I observed in both single-gender and coeducation
classrooms, and I followed the suggestions made by Herbel-Eisenmann et al. (2015). I
also addressed issues of reliability, validity, and generalizability.
CHAPTER FOUR

CASE STUDY FINDINGS

In this chapter, I discuss findings from each case for Maria, Leah, Nautica, and Jordan. I discuss each case separately, and then compare and contrast emergent storylines from cases of the same classroom setting. I discuss findings across-cases and compare participants whose level of engagement aligned, Maria and Nautica, and Leah and Jordan. Specifically, I look at how the results hold across single-gender and coeducation settings. In this chapter, I provide emphasis on findings for each research question.

Case 1: Maria

Introduction

Maria, a sixth-grade student in the all-girls mathematics class, is a white female. Maria is enrolled in all-girls classes with Ms. Taylor for mathematics, science, and ELA. Maria is also enrolled in all-girls classes for Art, Christian Learning Center, PE, and Health. Maria is enrolled in coeducation classes for Science and Writing. Maria enjoys being in her all-girls mathematics class. In her interview, Maria talked about not liking mathematics class prior to Ms. Taylor’s class. Maria feels very comfortable in her all-girls class, especially when speaking up because she feels the people in her all-girls class will not judge her. Maria spoke very positively about her all-girls mathematics class, how she likes the people in her mathematics class, and how it is her favorite class.

Maria’s Findings

Maria occupied multiple storylines while in the all-girls mathematics classroom. Maria frequently positioned herself as a “I love doing that stuff” student towards
participating in mathematics, a “Can I Teach You?” mathematics student, an on task mathematics student, and a “Get Up There and Talk” participant in the mathematics classroom. Maria occupied these storylines through her gestures, talk, listening, actions, interactions, and writing (Gee, 1999).

I now provide examples of each of the enacted positionings and storylines occupied by Maria with examples from my observations.

“I Love Doing that Stuff” student towards participating in mathematics.

Maria was eager to share her mathematical work and to contribute to mathematical discussions (Moschkovich, 1999) publicly with Ms. Taylor. For instance, Ms. Taylor randomly selected Maria to work a division problem and the following interaction (Gee, 1999) occurred:

Ms. Taylor: Yep, two people can do it at the same time. Erasing on the dry erase board. Alright for division, Maria. For multiplication, Student J.

Maria: Woo hoo! When Maria’s name is called she immediately starts clapping. Maria stands up and goes to the board. Can I go ahead and start Ms. Taylor?

Ms. Taylor: You may.

Maria: Looks towards her classmates and smiles really big, puts her hands up in a motion of excitement and says Yes! Then turns and begins writing the problem on the dry erase board.

Through Maria’s talk and actions (Gee, 1999) towards being selected to demonstrate her work at the board, Maria positions herself as a “I Love Doing that Stuff” student towards participating in mathematics.
During morning work on day two, Ms. Taylor was working through a mathematics problem on the board and posed questions for students to respond in chorus. Maria interacted with Ms. Taylor and acted in the following way:

Ms. Taylor: 33. And now my step is to do what? Asking the whole class and students answer in chorus.

Maria: Add. Then as Ms. Taylor continues to talk Maria looks at her notebook and nods her head as Ms. Taylor calls out the numbers, puts her hand in and somewhat nods it along while Ms. Taylor calls out the numbers. Maria then puts her arm straight in the air with a face of excitement. Then pumps her hand back and forth and then puts her hand down and writes in her notebook. Ms. Taylor I got it right. Says this across the classroom to Ms. Taylor. Sits her pen down and then quietly claps for herself.

Through Maria’s actions (Gee, 1999) towards getting her mathematics problem correct, Maria positions herself as a “I Love Doing that Stuff” student towards participating in mathematics.

During our interview I asked Maria how she felt about speaking up in mathematics class and she responded “Oh I love it”. Additionally, I asked Maria how she felt about demonstrating her work at the board for the class to observe and Maria responded:

Maria: ...whenever I got up and showed Ms. Taylor the box method, I love doing that stuff.
Maria often spoke of her love for participating in mathematics, occupying the role of a “I Love Doing that Stuff” student towards participating in mathematics.

“Can I Teach You?” mathematics student. Following the previous in-class interaction, Maria spends a few minutes working the division problem at the board. Maria asks Ms. Taylor a question about the problem and Ms. Taylor quickly responds, telling Maria not to ask a question because she doesn’t know what Maria is doing. Ms. Taylor says this sarcastically because Maria is demonstrating her work in a method not familiar to Ms. Taylor. The following interaction (Gee, 1999) took place between Ms. Taylor and Maria:

Ms. Taylor: I’ll wait for you to teach me.

Maria: Okay, can I teach you?! *Smiles and turns back to the dry erase board and erases. Turns back to look at Ms. Taylor.*

Ms. Taylor: Where’s your 873? *Talking specifically to Maria but for the whole class to hear.*

Maria: *Listening to Ms. Taylor, then turns and uses her marker to point to the 8, 7, and 3 on the board in her work.* I’ll show you in a second. *Then points to Ms. Taylor and smiles.* Okay. * Turns to face the board.* So, 5 goes into 8 how many times? *Turns and faces the class and asking Ms. Taylor.*

Ms. Taylor: But you are not, okay yeah you are dividing. Okay keep going mm hmm.
Maria: *Nods her head to say yes, I am dividing. Turns back to face the dry erase board and using her marker to point at the board.* 8 goes into, 5 goes into 8, 1 time. 5 times, *writes on the dry erase board.* 8 minus 5 is 3.

Ms. Taylor: Okay. *Affirming what Maria is saying.*

Maria: So I carry this 3 up here. *Uses the marker to show she carries the 3 up.*

Okay, 5 goes into 37 how many times? *Looks at class and teacher to answer.*

Ms. Taylor: 7. *Responding to Maria’s question for her and the class.*

Maria: 7. *Underlines her 7 on the board.* Okay, and then that 5, *drawing on the dry erase board while talking for everyone to hear.* Times 7 is 35.

Ms. Taylor: Right. *Affirming what Maria is saying.* You’re left with 2.

Maria: Subtract that, do that, here.

Ms. Taylor: And you move that up. Okay. *Speaking of the work Maria is doing.*

Maria: Now 5 times, or 5 times, or 5 goes into 23, 4 times. *Using a pen to point to her work as she is talking.*

Ms. Taylor: 4 times. Okay. *Affirming what Maria is saying.*

Maria: 4. *Uses hand to suggest yes that’s right towards Ms. Taylor.* So it makes it 20, and then this time and this is how many are left over. *Circles the 3 on the board. Then turns to face the class and Ms. Taylor.*

Ms. Taylor: So 3 is my remainder? *Asking just Maria but for the whole class to hear.*

Maria: Yes. *Nods her head in agreement with Ms. Taylor.*

Ms. Taylor: So behind that 4, put R 3 for me.
Maria: *Writes R 3 on the board like Ms. Taylor asks her to do.*

Following this interaction, Ms. Taylor goes to the board and compares her method to Maria’s method. Maria stands beside Ms. Taylor as Ms. Taylor talks through her method. Ms. Taylor often points to Maria’s work as she talks through her method of solving and asks Maria “but do you see how this is really not that much different?”. Ms. Taylor asked Maria to teach her method to the class, positioning Maria as a “Can I Teach You?” mathematics student. Maria’s spoken, acted, listening, and interacted (Gee, 1999) mathematical Discourse (Moschkovich, 2003) made apparent she was actively willing to share her mathematical work and to engage in mathematical conversation with Ms. Taylor. Maria positions herself as a “Get Up There and Talk” participant in the mathematics classroom while occupying the role of a “Can I Teach You?” mathematics student.

During our interview, Maria discussed this interaction with Ms. Taylor. I asked Maria how she felt about volunteering to demonstrate her work at the board and why:

Maria: I like doing that because um a lot of the times I feel like my brain works completely differently than other people. And I like trying to explain it to them. And I love it whenever they have questions about how I do it because then I get to explain it even more. So I’m pretty sure it was the last time you were here maybe two times ago, whenever I got up and showed Ms. Taylor the box method, I love doing that stuff. Um, again because other people in here didn’t understand it and I was able to show them and explain it to Ms. Taylor at the same time.
Through both Maria and Ms. Taylor’s discourses, positions, and storylines, Maria is occupying a role of a “Can I Teach You?” mathematics student in this classroom.

**On task mathematics student.** Maria asked her own questions when she needed clarification or when she was curious about mathematics:

Maria: Ms. Taylor. *Looks up from notebook and says Ms. Taylor’s name who is walking by/near where Maria is sitting.*

Ms. Taylor: What now? * Watches Maria as she stands up and walks over to her, then grabs Maria’s notebook as Maria hands the notebook over to her.*

Maria: *Stands up with notebook and walks over to Ms. Taylor. Is that right? Holds notebook out for Ms. Taylor to see.*

Ms. Taylor: *Looks at Maria’s notebook. Yep, no, no, no, no, no it does not say 51 minus, it says 51 is less than. Uses her finger to demonstrate as she talks to Maria. If it less than where does it go? In the back.*

Maria: *Looking at Ms. Taylor, grabs notebook back from Ms. Taylor. Less than. Nods head slightly and is smiling as if she understands and then takes her notebook and goes back to sit at the yellow cushion.*

Maria often clarified her understanding of the mathematics as she needed it throughout the lessons, positioning herself as a student who was on task.

I often observed Maria writing (Gee, 1999) in her notebook, looking to the board where mathematics problems were located, counting on her fingers while working problems, and talking (Gee, 1999) quietly to herself while working through her
mathematics problems. For instance, while working on Morning Work, Maria said the following as she wrote.

Maria: *Sits up and looks towards the SmartBoard where Morning Work is displayed. Looks over at Ms. Taylor who is talking to another student and then looks down at her notebook to write. Looks up at the SmartBoard and then looks back down at her notebook and continues writing. Maria talks quietly to herself as she writes in her notebook. 10 this is 10 times, 10 minus 1 is 9, 8 is 1, 0, 16 okay. So it’s 16 point 019.*

Figure 3. Maria’s Morning Work Day 1.

*Figure 3. The figure displays Maria’s work for the 5 problems on the Morning Work for day 1 of observation. The action discussed focuses on her work for the problem labeled number 4 in the figure.*
I often observed Maria writing (Gee, 1999) in her notebook and occasionally talking (Gee, 1999) through her mathematics problems to herself as she wrote (Gee, 1999). Through Maria’s talk (Gee, 1999) and writing (Gee, 1999), she positions herself as an on task mathematics student.

“Get Up There and Talk” participant in the mathematics classroom. Maria responded both chorally and individually to questions posed by Ms. Taylor throughout each lesson. Maria was very comfortable asking Ms. Taylor questions whether publicly, from across the classroom, or directly beside Ms. Taylor. Ms. Taylor often posed questions that allowed students to respond in chorus. Often, I observed Maria responding in chorus to Ms. Taylor’s questions. There were instances when Maria appeared to be thinking about a response or looking ahead at Ms. Taylor, but did not respond to every question asked by Ms. Taylor:

Ms. Taylor: Okay so what is 6 times 3? Asking all students to answer in chorus.

Maria: 18. Says this in chorus with other students.

Ms. Taylor: Thank you. I put my 8, carry my 1. What is 6 times 4? Asking all students to answer in chorus.

Maria: Maria sits looking ahead but does not respond.

Ms. Taylor: Plus 1? Asking all students to answer in chorus.

Maria: Maria sits looking ahead but does not respond.

Ms. Taylor: Put my 5, carry my 2. What is 6 times 8? Asking all students to answer in chorus.

Maria: Looks up slightly as if thinking, then says 48.
There are many instances throughout all observations where Maria positions herself as a “Get Up There and Talk” participant in the mathematics classroom by responding in chorus to Ms. Taylor’s mathematical questions. During our interview, I asked Maria how she felt she contributed to what they were learning in class:

Maria: I do put in my input on a lot of things. I have a very talkative mouth so whenever it comes to the time where I can put in my input, I do it. And I say a lot.

Further in our interview I asked Maria how she felt about speaking up in class and Maria discusses her comfort of speaking up in her all-girls classroom as compared to other classes:

Maria: Whenever I get up there and talk they aren’t going to be surprised.

Maria frequently occupied the role of a “Can I Teach You?” mathematics student, while also positioning herself as a “Get Up There and Talk” participant.

Maria often gestured her attentiveness to Ms. Taylor throughout each lesson. Maria took notes and looked at the board when Ms. Taylor talked and wrote about mathematics. Maria demonstrated her attentiveness to Ms. Taylor by nodding in agreement or disagreement when Ms. Taylor posed mathematical questions. When Ms. Taylor asked students to raise their hand if they agreed with a classmate or if they remembered a certain idea from a previous mathematics lesson, Maria often raised her hand. Maria positioned herself as a “Get Up There and Talk” participant in the mathematics classroom in a variety of interactions (Gee, 1999) with Ms. Taylor and frequently engaged in constructing a mathematical Discourse (Moschkovich, 2003).
There were limited opportunities for students to work together on mathematics in Ms. Taylor’s class. Often students worked independently on Morning Work and then Ms. Taylor moved into the lesson which frequently included whole class discussion. During Morning Work, however, minimal conversations occurred about mathematics problems. Maria occasionally talked (Gee, 1999) to students sitting near her during this time. For instance, Maria exchanged the following few words about mathematics problems during Morning Work:

   Student: When you subtract do the decimals have to line up?

   Maria: Yes.

   and

   Student: 3 goes into 9, 3 times.

   Maria: But it’s 27.

Although conversations with peers about mathematics were limited, Maria expressed her willingness to work with students during the interview. I asked Maria how she interacts and communicates with peers in mathematics class:

   Maria: I think I communicate well with other people. Other than by myself… In math because I am able to sit there and relook everything as I am talking about it…. other than whenever I am by myself I am overlooking it, I am not saying it out loud. And same with them towards me, or I might catch something they did or they might catch something I did wrong.

Given the opportunity, Maria enjoyed talking (Gee, 1999) to classmates about mathematics and positioning herself as a “Get Up There and Talk” participant in the
mathematics classroom. Maria also occupied the role of a “Can I Teach You?” mathematics student because she viewed herself as someone who “I might catch something they did wrong”, referring to her classmates mathematical work.

Maria often gestured she was attentive to her classmates by watching students as they demonstrated their work at the board and listening (Gee, 1999) as students talked about mathematics. For instance, Ms. Taylor selected a student to demonstrate their Morning Work problem at the SmartBoard and the following talk and actions (Gee, 1999) took place by Maria:

Ms. Taylor: Remember 18 is a whole number and all whole numbers have a decimal where? *Gives students a moment to respond.* Behind them. *Talking while Student J is writing her Morning Work problem on the SmartBoard for the class to observe.*

Maria: *Looking down at notebook and then up to the SmartBoard where the student is demonstrating their Morning Work. Then puts hand down and says What?* *Watching the student at the SmartBoard.*

Ms. Taylor: Okay, wait, stop. Erase what you got. That number cannot go on top. You got to keep it in order it is on the board. 18 has got to on top. *Talking directly to the student at the SmartBoard but for the whole class to hear.*

Maria: Oh snap I just realized what I did wrong. *Then looks down at her notebook and continues to write. Looks up at the SmartBoard and then writes in her notebook. Looks up at the student at the SmartBoard and watches the student while she demonstrates her mathematics problem.*

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I often observed Maria watching her classmates as they talked or demonstrated their work for the class to observe. Maria’s actions (Gee, 1999) and talk (Gee, 1999) demonstrated her attentiveness to her classmates, positioning herself as a “Get Up There and Talk” participant in the mathematics classroom.

Although conversations with peers were limited, Maria discussed during her interview that she really enjoyed helping her peers with mathematics and learning mathematics from her peers, once again positioning herself as a “Can I Teach You?” mathematics student who is also on task in her mathematics classroom. I asked Maria how she felt about being in her mathematics class and she responded:

Maria: I like the people in the class. Because they, there are some people that if I don’t understand they will easily help me whenever other people don’t know how to explain it. And then there are also times where I can help people. I like doing that too.

Further, I asked Maria how she feels like she contributes to what they are learning in mathematics, and Maria said “I am very open to help others. So if they don’t understand it, I think that is a way I contribute to it because I help others understand it.” Maria views herself as someone who can share what she learns with her classmates. Maria frequently occupied the role of a “Get Up There and Talk” participant in the mathematics classroom, while also positioning herself as a “Can I Teach You?” mathematics student.

**Maria’s Perspective of the Single-Gender Classroom Environment**
During our interview, Maria talked about how she loved teaching Ms. Taylor the box method for the class to observe. Following her response, I asked Maria if she would feel comfortable doing the same in a different class:

Maria: …my mind doesn’t go straight to the students, it also goes to the teacher. So in here I would easily be able to do that because I know Ms. Taylor is actually listening... it depends on the class. And the teacher and the people and that I would be in there…

Maria often positioned herself as a “Can I Teach You?” mathematics student and she discusses how students in her class and Ms. Taylor had an impact on her role in occupying this particular storyline. Ms. Taylor, and the students who were in her classroom, helped her to feel comfortable and safe in this classroom environment, which impacted her role in this storyline.

Additionally, Maria discussed how Ms. Taylor and the students in her mathematics classroom had an impact on her engagement in being a “Get Up There and Talk” participant. I asked Maria how she felt about speaking up in class:

Maria: Oh I love it. But, if I were to go try to do that in ART class, with other people, wouldn’t be able to do it. Or adults, can’t do it. I have so much stage fright and then I get to this class, I don’t know if it is because it’s all-girls or I am very used to the people in this class, but I could, if everybody was in here I could stand up and write a whole speech.

I asked Maria to discuss this further and she responded:
Maria: I feel like I am able to do that because I know everybody in here won’t judge me…if I were in a class with other people, let’s say if I was in a class with boys I wouldn’t be able to do that because I would think they were judging me the whole time…Or just other people in general. Maybe if it was other girls or if like I went to a new school and they didn’t know me. As well, as the people here do…Maria feels very comfortable occupying the role of a “Get Up There and Talk” participant in her all-girls classroom. In this particular classroom, Maria is willing to speak (Gee, 1999) publicly and to share her mathematical thinking and work because she knows the people in this particular classroom will not judge her. The people in her all girls-classroom has an impact on Maria’s role in this storyline.

Maria discussed in our interview that mathematics was her favorite class because it was very easy for her to understand things:

Maria: My favorite class is definitely math. Because I think that, again it is very easy for me to understand things. And I like the people in my math class and I like the way they word things, same with Ms. Taylor. And again if I don’t understand anything the people in here will easily help me.

Through this conversation, Maria discusses how it is easy for her to understand things, positioning herself as a “Can I Teach You?” mathematics student; however, if she does not understand something the people in this particular class would easily help her. Maria frequently occupies multiple storylines and although she often positions herself as a “Can I Teach You?” mathematics student, Ms. Taylor and the students in this classroom support her role in occupying multiple storylines. Maria’s engagement in multiple
storylines in this particular classroom occurs because she feels safe and comfortable around Ms. Taylor and the other students in her mathematics classroom.

**Summary of Maria**

Maria occupied multiple storylines while in the all-girls mathematics classroom; specifically, multiple storylines were at play by Maria throughout the course of each lesson (Herbel-Eisenmann et al., 2015). Maria frequently positioned herself as a “Can I Teach You?” mathematics student through her talk, gestures, actions, interactions, and writing (Gee, 1999). Throughout all three lessons, Maria shared her mathematical understanding and contributed to mathematical discussion (Moschkovich, 1999). Maria’s dominant storyline was that of a “Can I Teach You?” mathematics student.

Additionally, Maria reflexively positioned herself as a “Get Up There and Talk” participant in the mathematics classroom, a student who was on task in the mathematics classroom, and a “I Love Doing that Stuff” student towards participating in mathematics. Maria engaged in spoken, acted, listening, written, and interacted (Gee, 1999) mathematical Discourse (Moschkovich, 2003) when positioning herself in the mathematics classroom and occupying multiple storylines.

**Case 2: Leah**

**Introduction**

Leah, a sixth-grade student in the all-girls mathematics class, is a black female. Leah is enrolled in all-girls classes with Ms. Taylor for mathematics, science, and ELA. Leah is also enrolled in all-girls classes for Art, Christian Learning Center, PE, and Health. Leah is enrolled in coeducation classes for Science and Writing. Leah moved to
this school in third grade and mentioned in our interview that she was just starting to feel more comfortable at the school because she was starting to meet people. Although I often observed Leah being very quiet during mathematics, Leah would talk between classes to students who sat near her. I often observed Leah smiling and laughing, and during our interview she mentioned Ms. Taylor’s class was her favorite and she thought the girls in her mathematics class were very funny. Leah frequently occupied a role of a “One-on-One” mathematics student and she seemed happy while in Ms. Taylor’s classroom.

**Leah’s Findings**

Leah occupied multiple storylines in the all-girls mathematics classroom. Leah frequently positioned herself as a student who was “Nervous” about participating in mathematics, a “One-on-One” mathematics student, and was often an on task mathematics student. Leah occupied these storylines through her gestures, listening, actions, and writing (Gee, 1999); however, Leah rarely engaged in spoken or interacted (Gee, 1999) mathematical Discourse (Moschkovich, 2003).

I now provide examples of each of the enacted positionings and storylines occupied by Leah with examples from my observations.

**“Nervous” about participating in mathematics.** Leah often appeared nervous if an opportunity arose that she might have to share her mathematical work and to contribute to mathematical discussions (Moschkovich, 1999) publicly with Ms. Taylor. This was especially true when Ms. Taylor used popsicle sticks to randomly select students to demonstrate their work at the board or to publicly respond to mathematical
questions. For instance, Leah acted (Gee, 1999) in the following way when Ms. Taylor randomly selected a student:

Leah: *Looking at Ms. Taylor as she talks. Does not respond to Ms. Taylor’s question.*

Ms. Taylor: I need 10 groups, again multiplication facts. *Drawing a popsicle stick out of her cup while she talks.*

Leah: *Sits watching Ms. Taylor while she talks. Puts hands over her face and shakes her head.*

Ms. Taylor: Student C.

Leah: *When Ms. Taylor selects a different student’s name, Leah smiles and puts her hand down. Leah looks back at her notebook.*

Leah’s reaction to Ms. Taylor randomly selecting students occurred multiple times. Leah positioned herself as a student who was “Nervous” about participating in mathematics through her actions (Gee, 1999) of covering her face with her hand, shaking her head, or making a worried face and then showing a sigh of relief for not having her name selected. During our interview, I asked Leah how she felt she contributed to the ideas they were learning in class:

Leah: Um, I think that I do well in class. But I don’t really like talking in front of big groups and stuff like that.

Researcher: Okay so you, it’s just more when it’s like a lot of people you don’t really like to speak up is that right?

Leah: Yeah.
Leah made clear through her actions (Gee, 1999) and talk (Gee, 1999) she did not enjoy talking publicly about her mathematics work. During our interview, I asked Leah how she decided when to speak up:

Researcher: How do you decide when to speak up? So in class and why, so let’s say for example if Ms. Taylor asks you to write, you get called on, right to do something at the board, or you get called on to share out, are you willing to speak up then when you have been asked to?

Leah: Nods head.

Researcher: Yeah? Is there anything else you would like to say about that?

Leah: I do go to the board, it’s like speaking up we do, like when she takes names out of the cup. I do that.

Researcher: How do you feel when you are asked to do that?

Leah: I get anxious and nervous.

Researcher: How do you feel about volunteering to demonstrate your work at the board and why?

Leah: I will go up there and do it. But I, like I won’t talk about it. Just do it and go back to my seat.

Researcher: Okay, so you would be willing to show your work, you just don’t want to verbally talk about it? Is that right?

Leah: Nods head.
Leah was not a defiant student and she engaged in request made by Ms. Taylor. Through Leah’s actions (Gee, 1999) and gestures, she often positioned herself as a student who was “Nervous” about participating in mathematics.

As previously mentioned, there were limited opportunities for students to work together on mathematics problems in Ms. Taylor’s class. Students frequently worked independently on Morning Work and then Ms. Taylor moved into the lesson. During Morning Work, minimal conversation took place about Morning Work problems. Leah rarely talked (Gee, 1999) about mathematics to students sitting near her during this time. Although there were limited opportunities for Leah and her peers to have one-on-one mathematical conversations, Leah provided the following response during our interview:

Researcher: Is there anything else you would like to say about how you interact and communicate with your peers in this class? And again, we will just think about math for right now, okay?

Leah: I communicate with math a little bit. Because I don’t really talk during math.

_During member-checking, Leah mentioned she was starting to talk a little more. She still did not like getting called up because she didn’t like showing her work in front of other people because she did not want them to judge her if she was wrong. But she was progressing on that and she was starting to show her work more, and she works her problems out on a piece of paper before she goes up to the board. She felt a little more comfortable._
Researcher: Okay, so you feel you don’t talk much during math?

Leah: Nods her head.

Researcher: What about when you are given the opportunity to talk, are you more willing to talk then? If you have the chance?

Leah: Shakes head no. Like if it is in front of the class.

Researcher: Okay, so it is more about in front of the class. What if like in your circle here, with a group of girls, would you be willing to talk in those spaces?

Leah: Nods her head.

Researcher: What about that makes you feel more comfortable?

Leah: Um because like I don’t really like talking in front of like the whole because I get nervous.

It’s important to note, Leah did talk to students at her table occasionally, but often the conversation was on non-mathematical topics. Leah said during our interview “I do talk to my classmates. But I don’t like standing in front of them”. During member-checking Leah said she moved to this particular school in 3rd grade and is starting to feel more comfortable. Leah further mentioned in our interview she did not like to share her work because “when my classmates work look different and I feel like I got it wrong”. Leah often occupied multiple storylines, a “One-on-One” mathematics student and a student who is “Nervous” about participating in mathematics. During member-checking, Leah said she was beginning to depend on her own work now and she was starting to talk a little bit more during mathematics class. Leah viewed herself as someone that is timid of her own mathematical abilities and does not like to share her work with her classmates;
however, after member-checking with Leah later in the semester, it seemed she was making progress in her own mathematical work and depending on herself as someone who is capable of doing and learning mathematics.

“One-on-One” mathematics student. The few conversations and interactions which took place between Leah and Ms. Taylor were often “One-on-One” and not public. Leah rarely responded in chorus to questions posed by Ms. Taylor; however, Leah sometimes repeated numbers or read numbers aloud if Ms. Taylor asked students to say a number with her. For instance, the following verbal and non-verbal interactions and actions took place between Leah and Ms. Taylor:

Ms. Taylor: So you have 4/10ths and 7/10ths, which one is bigger? *Asking the whole class.*

Leah: *Does not respond in chorus when Ms. Taylor asks which number is bigger.*

Ms. Taylor: *Listens as students share out responses.* And how would you read that? If you had to read the whole thing. *Asking the whole class.*

Leah: *When Ms. Taylor asks how to read the whole thing, Leah looks up and says the following in chorus with her classmates.* 4 tenths is less than 7 tenths.

Ms. Taylor: *Listens as students respond.* Okay so 4/10ths is less than 7/10ths. The less than symbol, remind me how it goes. The alligator does, some people think of Pac-Man.

Leah: *Leah uses her hands to show the less than symbol immediately when Ms. Taylor asks how the symbol goes.* Leah looks up as if thinking for a moment and then continues to use her fingers to show the less than symbol.
If Ms. Taylor specifically asked students to read a number aloud or to repeat a number, often Leah would repeat or say the number. Leah, however, often did not respond in chorus to mathematics questions where students were asked to say the next step in a problem, the solution to a problem, or what one number multiplied by another number equaled. Through Leah’s actions (Gee, 1999) and gestures she frequently positioned herself as a “One-on-One” mathematics student.

Although Leah did not share her mathematics publicly, there was an instance where Leah wanted to share her mathematics work with Ms. Taylor:

Leah: *Raises hand to get Ms. Taylor’s attention. Puts hand down and holds her notebook up and says Ms. Taylor very quietly. Then as Ms. Taylor walks near to Leah’s desk, Leah turns back and holds her notebook up high to show Ms. Taylor and smiles.*

Ms. Taylor: *Holds her hand up to give Leah a high-five. You like the box method, okay girl if that works for you I am good with it.*

Leah: *Nods her head when Ms. Taylor says she likes the box method. Then puts her hand up and gives Ms. Taylor a high-five. She smiles and then sits her notebook down.*

The limited conversations and interactions between Leah and Ms. Taylor were often “One-on-One”. Leah engaged in multiple storylines in the all-girls classroom, positioning herself as “One-on-One”, “Nervous”, and on task participant in the mathematics classroom.
**On task mathematics student.** In one instance, Leah was writing (Gee, 1999) in her notebook when she stopped and asked Ms. Taylor who was standing near to her a question, “Ms. Taylor, what does absolute value mean?” in which Ms. Taylor responded “Absolute value means how far the number is away from zero, whether you are going positive or negative it’s still counting numbers. It’s a positive number that counts in either direction.” Leah completed column I and O in example 2 (Figure 4), and then stopped and asked Ms. Taylor about column 3. After talking with Ms. Taylor “One-on-One”, Leah moved to problem 4 and left the absolute value column blank. Once Ms. Taylor talked about problem 2 and provided an example, Leah then filled in the absolute value column.

*Figure 4. Leah’s Morning Work Day 2, Problem 2.*

Leah often positioned herself as an on task student in her mathematics class, while also occupying the role of a “One-on-One” student. During the interview, I asked Leah how she interacted or communicated with Ms. Taylor in mathematics, and Leah responded “I talk to Ms. Taylor a lot about like learning and stuff like that”. I then asked Leah if she was willing to talk to Ms. Taylor publicly, where her classmates could hear their
conversation, or if she preferred talking to Ms. Taylor one-on-one, and Leah responded “One-on-One”. Leah mentioned she talked to Ms. Taylor a lot. Although I observed Leah in limited verbal interactions (Gee, 1999) with Ms. Taylor, Leah was willing to engage in conversations with Ms. Taylor that were “One-on-One”. Leah did not respond to many opportunities to actively engage in public mathematical Discourses (Moschkovich, 2003), positioning herself as a “One-on-One” mathematics student. Leah was willing to engage in “One-on-One” conversations about mathematics with Ms. Taylor, and in doing so she positioned herself as a student who was on task.

Leah’s gestures and actions (Gee, 1999) demonstrated she was on task throughout each lesson. During our interview, I asked Leah how she felt she contributed to the understandings they were developing:

Leah: Um, at first it gets like hard. After a lot of practice. I think I get better at it.

Researcher: …when you say practice, is that like when you are writing things or when you are watching Ms. Taylor go over it or when you are able to talk about it? What helps you to understand it better?

Leah: Writing and watching Ms. Taylor do it on the board.

I frequently observed Leah watching Ms. Taylor as Ms. Taylor talked and wrote mathematics on the board, and then Leah wrote (Gee, 1999) her own notes in her notebook. Leah demonstrated she was on task by nodding in agreement or disagreement when Ms. Taylor posed mathematical questions. When Ms. Taylor asked students to raise their hand if they agreed with a classmate or if they remembered a certain idea from a previous mathematics lesson, Leah sometimes raised her hand. For instance, when Ms.
Taylor asked students who remembered benchmark fractions, Leah did not raise her hand. However, when Ms. Taylor asked students if they agreed with another student's response to a mathematical problem, Leah typically raised her hand in agreement. Although Leah rarely spoke publicly in her mathematics class, Leah was active in a variety of non-verbal interactions (Gee, 1999) with Ms. Taylor. Leah was often on task while also positioning herself as a “One-on-One” mathematics student.

I often observed Leah writing (Gee, 1999) in her notebook, looking at her personal computer to view Morning Work, looking up to the board where mathematics problems were located, counting on her fingers while working problems, and using her pen as a guide on her paper while working through problems. For instance, during Morning Work, Leah acted (Gee, 1999) in the following way while completing mathematics problems (Figure 4 of Leah’s Work):

Leah: *Looking at her computer at the Morning Work and then writes in her notebook. Sits pen down. Counts on her fingers, then writes in her notebook.*

*Using her pen as a guide on her paper and then writes in her notebook. Sits up and looks at her notebook.*

Leah worked through her Morning Work problems in her notebook during the time students were asked to complete Morning Work. In Figure 5, Leah wrote the following:
Figure 5. Leah’s Morning Work Day 3.

1. Part + Part = 6 + 3
   Part + Whole = 6 + 9
   Whole + Part = 9 + 3

2.  

3. BT - 6

4.  

I observed Leah frequently writing (Gee, 1999) in her notebook and looking to her computer screen for Morning Work or the SmartBoard for the lesson. During our interview, I asked Leah how she engaged in her classwork, and Leah responded “I do like write down a lot.” Leah always started her Morning Work as soon as class began and I observed Leah writing (Gee, 1999) and looking at her computer throughout the entire Morning Work time. During lessons, I observed Leah writing (Gee, 1999) problems in
her notebook and trying problems when asked to do so by Ms. Taylor. Leah frequently positioned herself as an on task student.

**Leah’s Perspective of the Single-Gender Classroom Environment**

Leah often did not share her mathematical thinking and was limited in her classroom engagement. During our interview, I asked Leah which class was her favorite and why:

Leah: Ms. Taylor’s class…the girls that are in here are like funny. And talk a lot. Further in our interview, I asked Leah if there was anything she would like to say about how she interacted or communicated with her teacher in the class:

Leah: I talk to Ms. Taylor a lot about like learning and stuff like that. Leah did not like talking publicly in any of her classes; however, Leah felt very comfortable talking to Ms. Taylor and Leah was willing to talk to the girls that sat at her table group. Although Leah frequently positioned herself as a “One-on-One” mathematics student and “Nervous” about participating in mathematics student, she felt comfortable having one-on-one conversations with students in her class and Ms. Taylor.

**Summary of Leah**

Leah occupied multiple storylines while in the all-girls mathematics classroom; specifically, multiple storylines were at play by Leah throughout the course of each lesson (Herbel-Eisenmann et al., 2015). Leah frequently positioned herself as a “One-on-One” mathematics student through her gestures, actions, and interactions (Gee, 1999). Throughout all three lessons, Leah rarely shared her mathematical understanding and minimally contributed to mathematical discussion (Moschkovich, 1999). Leah’s
dominant storyline was that of a “One-on-One” mathematics student. Leah frequently occupied the role of a student who was “Nervous” about participating in mathematics through her limited talk, actions, and limited interactions (Gee, 1999). Leah often engaged in both storylines of being a “One-on-One” mathematics student who was “Nervous” about participating in mathematics.

Although Leah engaged in these particular storylines, she coincidingly enacted a storyline in which she was on task. Leah often engaged in written (Gee, 1999) and listening (Gee, 1999) mathematical Discourse (Moschkovich, 2003). Leah sometimes engaged in spoken (Gee, 1999) and interacted (Gee, 1999) mathematical Discourse (Moschkovich, 2003) with Ms. Taylor when she was unsure or needed clarification. Leah positioned herself as a student who was on task, while also occupying the role of a “One-on-One” student who was “Nervous” about participating in mathematics.

Comparing and Connecting mathematical Discourse, Storylines, and Positionings Across Cases in the Single-Gender Setting

Introduction

During analysis of single-gender data, several storylines emerged which correlated to both the theoretical framework and research questions which guide this study. Maria and Leah occupied multiple storylines in the all-girls mathematics classroom. Maria frequently occupied the role of a “Can I Teach You?” mathematics student, while also positioning herself as a “Get Up There and Talk” participant, who was on task, and who was a “I Love Doing that Stuff” student towards participating in mathematics. Leah frequently occupied the role of a “One-on-One” mathematics student,
who was often “Nervous” about participating in mathematics, and who was on task. Just as in any mathematics classroom, mathematical Discourses (Moschkovich, 2003) varied and were constructed in different ways. Maria and Leah occupied these storylines through their gestures, listening, actions, writing, talk, and interactions (Gee, 1999). I now provide a description of each emergent storyline and how the single-gender classroom setting impacted the storylines of each participant.

**Single-Gender Storylines**

**“Can I Teach You?” mathematics student.** A participant positioned oneself as a “Can I Teach You?” mathematics student if they were willing to talk (Gee, 1999) about their mathematical thinking or demonstrate their mathematics for Ms. Taylor or classmates. A participant positioned oneself as a “Can I Teach You?” mathematics student if they responded to mathematical questions posed by Ms. Taylor or students, or if they taught a new method for solving mathematics for Ms. Taylor and students to observe. For instance, during our interview, Maria said the following:

Researcher: Tell me how you feel about being in this class and by this class I mean the math part of this class, okay?

Maria: I like the people in this class….Because they, there are some people that if I don’t understand they will easily help me whenever other people don’t know how to explain it. And then there are also times where I can help people. I like doing that too.

This classroom environment supported Maria’s engagement in both the “Can I Teach You?” mathematics student storyline and the “Get Up There and Talk” storyline. Maria
likes the people in her all-girls classroom and feels the students in this classroom will help her if she needs it and in turn she can help others, positioning herself as both a “Can I Teach You?” and a “Get Up There and Talk” mathematics student.

“Get Up There and Talk” participant in the mathematics classroom. A participant positioned oneself as a “Get Up There and Talk” participant in the mathematics classroom if they responded chorally to questions posed by Ms. Taylor. A participant positioned oneself as a “Get Up There and Talk” participant if they watched, listened (Gee, 1999), and responded to Ms. Taylor or peers. If a student was willing to help other students with mathematics or shared their own mathematical understanding with students, then they positioned themselves as a “Get Up There and Talk” participant.

In some instances, a student occupied multiple storylines. This included a “Get Up There and Talk” participant and a “Can I Teach You?” mathematics student if the participant shared their own mathematical understanding. For instance, Maria discussed how the single-gender classroom environment had an impact on her engagement in being a “Get Up There and Talk” participant. I asked Maria how she felt about speaking up in class and she responded:

Maria: Oh I love it. But, if I were to go try to do that in ART class, with other people, wouldn’t be able to do it. Or adults, can’t do it. I have so much stage fright and then I get to this class, I don’t know if it is because it’s all-girls or I am very used to the people in this class, but I could, if everybody was in here I could stand up and write a whole speech.

Researcher: Okay, so talk to me a little bit more about that, I am interested.
Maria: Um, because I feel like I am able to do that because I know everybody in here won’t judge me. As in, I meant, other than if I were in a class with other people, let’s say if I was in a class with boys I wouldn’t be able to do that because I would think they were judging me the whole time, if that makes sense? Or just other people in general. Maybe if it was other girls or if like I went to a new school and they didn’t know me. As well, as the people here do. And it’s easy to do that whenever I know everybody in here has been around me and know how I act. Whenever I get up there and talk they aren’t going to be surprised. As if I feel like adults would be because they don’t know how I act. If that makes any sense.

Maria feels very comfortable occupying the role of a “Get Up There and Talk” participant in her all-girls classroom. In this particular classroom, Maria is willing to speak (Gee, 1999) publicly and to share her mathematical thinking and work. The all-girls classroom environment has an impact on Maria’s role in this storyline.

**On task mathematics student.** A participant positioned oneself as on task when they engaged in written (Gee, 1999) mathematics or when they talked (Gee, 1999) through mathematics independently. When a participant used their fingers to count, sought answers to their own mathematical questions, spoke (Gee, 1999) up when unsure, or engaged in conversation with Ms. Taylor and peers about mathematics they positioned themselves as someone who was on task. For instance, I asked Maria how she decides when to speak up in class and why:

Maria: Well, normally if I have something to say that’s, mostly I try to keep my mouth closed, unless it’s something either very important, or something that I
really feel like everybody else needs to know, or she asks a question. But, for
math normally if she stops and I have something to ask, I will ask.

Maria feels comfortable asking questions in her all-girls mathematics classroom. In
mathematics, Maria waits until her teacher provides opportunities for students to ask
questions and she asks her own questions if needed. This classroom supports Maria’s
engagement in this particular storyline.

“I Love Doing that Stuff” student towards participating in mathematics. A
participant positioned oneself as “I Love Doing that Stuff” towards participating in
mathematics if they talked (Gee, 1999) about their joy and excitement for mathematics.
Additionally, when a student clapped when their name was selected to demonstrate their
work or shouted their excitement towards being able to share their work, they positioned
themselves as a “I Love Doing that Stuff” student towards participating in mathematics.

“One-on-One” mathematics student. A participant positioned oneself as a
“One-on-One” mathematics student if they were unwilling to share their mathematical
thinking with the class or unwilling to demonstrate their mathematics for the class to
observe. A participant positioned themselves as “One-on-One” if they were unwilling to
share mathematics publicly and only engaged in “One-on-One” conversations with their
teacher and peers. If a participant was willing to watch and listen (Gee, 1999) to their
classmates and Ms. Taylor, but not respond verbally, they positioned themselves as a
“One-on-One” mathematics student. Additionally, if a participant looked to the
SmartBoard for the lesson, wrote (Gee, 1999) in their mathematics notebook, and used
their fingers to count but did not share their mathematics with other students or Ms.
Taylor, they positioned themselves as a “One-on-One” mathematics student. For instance, Leah discussed in our interview how class size is what made her “Nervous” about speaking publicly:

Leah: Um because like I don’t really like talking in front of like the whole because I get nervous.

Researcher: Do you get nervous because of the con.. Like because of math itself, like just the subject or would that be the case in any class just the size like how many people are in there?

Leah: The size of it.

*During member-checking Leah mentioned she was progressing more in every class about talking publicly. In health class she had to read a paragraph in front of the class and didn’t want to.*

Leah often occupied the role of a “One-on-One” mathematics student; however, through our interview conversation it seems this particular classroom environment did not impact her role in this storyline and Leah would occupy this storyline in any classroom with a large number of students. This particular instance also correlates to the next storyline of “Nervous” about participating in mathematics.

If a participant was willing to watch and listen (Gee, 1999) to their classmates and Ms. Taylor, but not respond verbally, they positioned themselves as a “One-on-One” mathematics student. Additionally, if a participant looked to the SmartBoard for the lesson, wrote (Gee, 1999) in their mathematics notebook, and used their fingers to count
but did not share their mathematics with other students or Ms. Taylor, they positioned themselves as a “One-on-One” mathematics student.

“Nervous” about participating in mathematics. A participant positioned themselves as “Nervous” about participating in mathematics if they covered their face, shook their head, or put their head on their desk when the teacher used popsicle sticks to randomly select students. If a participant spoke (Gee, 1999) about feeling like their work was wrong in comparison to other students, spoke (Gee, 1999) about being anxious and nervous when demonstrating or sharing their work, or would not share their mathematical work with others they positioned themselves as being “Nervous” about participating in mathematics.

Although Leah sometimes engaged in a storyline of being “Nervous” about participating in mathematics, this positioning was not directly correlated to the classroom environment and Leah mentioned in the previous example how she would be nervous in any classroom with a large number of students. During our interview, Leah discusses how Ms. Taylor’s class is her favorite class:

Researcher: Can you talk to me about your favorite class and why it is your favorite class?
Leah: Ms. Taylor’s class.
Researcher: Can you talk to me about why it is your favorite class?
Leah: Um the girls that are in here are like funny. And talk a lot. It has one of my favorite subjects, ELA.
Although Leah specifically liked ELA, the students and teacher during the ELA session were the exact same as the mathematics session. Leah enjoyed being in the all-girls classroom and the environment did not impact her engagement in this particular storyline.

**Summary of Single-Gender Storylines**

Maria and Leah occupied different roles and engaged in different mathematical Discourses (Moschkovich, 2003) while in the same all-girls mathematics classroom. For instance, Maria occupied the role of a “Can I Teach You?” mathematics student, while also positioning herself as a “Get Up There and Talk” participant throughout each lesson. Maria occupied the role of a “I Love Doing that Stuff” student towards participating in mathematics. Leah, however, frequently occupied the role of a “One-on-One” mathematics student who was “Nervous” about participating in mathematics. Maria and Leah were both participants in the single-gender mathematics classroom but the storylines in which they engaged were often different. Maria engaged in constructing a mathematical Discourse (Moschkovich, 2003) through written, spoken, acted, listening, and interacted (Gee, 1999) mathematical Discourse (Moschkovich, 2003). Leah rarely engaged in spoken or interacted (Gee, 1999) mathematical Discourse (Moschkovich, 2003); however, Leah did engage in listening and written (Gee, 1999) mathematical Discourse (Moschkovich, 2003). The one storyline in which Maria and Leah both engaged, was the role of students who were on task. Both participants occupied this storyline through their engagement of listening, written, and interacted (Gee, 1999) mathematical Discourse (Mosckovich, 2003).
Maria and Leah were both participants in the single-gender classroom, and through their mathematical Discourse (Moschkovich, 2003), positions, and storylines, each participant occupied different roles within the single-gender classroom. The mathematical Discourses (Moschkovich, 2003) in the single-gender classroom were varied and constructed in different ways by participants who represented opposite ends of a continuum.

**Case 3: Nautica**

**Introduction**

Nautica, a sixth-grade student in the coeducation mathematics class, is a white female. Nautica is enrolled in coeducation classes with Ms. Taylor for mathematics and science. Nautica is also enrolled in coeducation classes for ELA, Writing, Art, Health, Music, PE, and Social Studies. Nautica does not take any all-girls classes. In her interview, Nautica spoke about hanging out with her teachers at lunch rather than going to recess because of drama. Nautica felt she interacted with Ms. Taylor better than she did with other students. Although Nautica’s favorite class was Social Studies, she did say in her interview that she liked being in her mathematics class because Ms. Taylor was very supportive.

**Nautica’s Findings**

Nautica occupied multiple storylines in the coeducation mathematics classroom. Nautica frequently positioned herself as a “I Love Doing that Stuff” student towards participating in mathematics, a student who was on task, a “I Just Talk Freely” student, a “Get Up There and Talk” participant in the mathematics classroom, and a “Can I Teach
You?” mathematics student. Nautica occupied these storylines through her talk, gestures, listening, actions, interactions, and writing (Gee, 1999).

I now provide examples of each of the enacted positionings and storylines occupied by Nautica with examples from my observations.

“I Love Doing That Stuff” student towards participating in mathematics.

Nautica was eager to share her mathematical work and contribute to mathematical discussions (Moschkovich, 1999) publicly with Ms. Taylor. Nautica often responded to questions posed by Ms. Taylor and shouted out her mathematical thoughts throughout each lesson. For instance, during lesson one and two, Ms. Taylor used popsicle sticks to randomly select students. Nautica was not selected to demonstrate her work at the board either day; however, during lesson two, when Ms. Taylor drew a popsicle stick Nautica shouted “I love them sticks”. During the interview, I asked Nautica how she felt about speaking up in class and Nautica said “I think it’s fun” and nodded her head when asked if she enjoyed going to the board. Further in our interview, I asked Nautica how she felt about volunteering to demonstrate her work at the board and she responded “Um, I like doing it because I like to like I just like going up there and doing them”. Although Nautica was never selected during the three observed lessons to demonstrate her mathematics work at the board, she happily shared her work during the original two observations when selected. Nautica positioned herself as a “I Love Doing That Stuff” student towards participating in mathematics, while also occupying a role of a “Can I Teach You?” mathematics student.
On task mathematics student. Nautica was an active participant in her mathematics class during every lesson. I observed Nautica raising her hand when she had questions, and often Nautica shouted out what she was thinking randomly during each lesson. For instance, during Morning Work, the following conversation took place publicly between Nautica and Ms. Taylor:

Nautica: *Looking at personal computer. Leans over on yellow cushion, props computer on a chair in front of her and lays over the yellow cushion to work.*

Nautica: *Reading out loud from her computer. Holding pen in her hand and ready to write.* What’s the ratio of the three different ways, part to whole. For every point I score, Dana scores 5. For every point. Ms. Taylor I don’t get number 1.

Ms. Taylor: Okay. So look at it, look what it says, it says for every point I earn, Dana earns 5. So you need to write a part to whole relationship or ratio. *Still erasing the dry erase board but talking out loud to Nautica.*

Nautica: *Looking at her computer while Ms. Taylor talks.* Ohhh I gotcha. I gotcha.

Nautica: *And then writes the following* (Figure 6) *in her notebook. Continues to talk while she writes.* 1 to 5.
Figure 6. Nautica’s Morning Work Day 1.

Figure 6. The figure displays Nautica’s work for the Morning Work for the first day of observation. The action discussed above focuses on Nautica’s work for the problem labeled number 1 in the figure.

Interactions (Gee, 1999) like the example above took place often between Nautica and Ms. Taylor. Nautica often asked or shouted out questions when she was unsure of the mathematics. During our interview, I asked Nautica how she engaged in her classwork:

Nautica: I guess like I do it and if I have a question I sit right there and I instead of having my chair right there I move it between that table and Ms. Taylor’s table and I usually just talk to Ms. Taylor right there and she helps me if I have a problem with the like if I have a problem with the problem.
Nautica physically positioned herself to sit right next to Ms. Taylor’s desk area while she worked so she could ask Ms. Taylor questions if she needed assistance. Nautica frequently positioned herself as a student who was on task.

Additionally, I often observed Nautica writing (Gee, 1999) in and looking at her notebook, and looking up to the board or personal computer for mathematics problems. I observed Nautica counting on her fingers while working problems, talking (Gee, 1999) quietly to herself while working through her mathematics problems, and reading out loud from the problems located on her personal computer:

Nautica: Sits up and begins counting on her fingers. Counting with both her fingers and whispering the numbers out loud. Scratches her head and then leans back over slightly and continues writing in her notebook. Sits up and looks at the SmartBoard and then looks at her notebook. Looks back over at the SmartBoard. Then looks back down at her notebook and continues to write.

Nautica often wrote (Gee, 1999) in her notebook and occasionally talked (Gee, 1999) through her mathematics problems to herself as she wrote (Gee, 1999). Nautica was attentive to her work as she consistently looked at the SmartBoard or personal computer to view the mathematics problems and looked back to her personal notebook to write. Nautica often positioned herself as a student who was on task.

“I Just Talk Freely.” Although many interactions resembled the example above, there were times when Nautica shouted out of turn and answered questions Ms. Taylor posed for other students, or spoke (Gee, 1999) over Ms. Taylor:
Ms. Taylor: Alright. So I need everybody to pay attention up there please. If Eva had, if Eva purchases enough variety boxes to have 6 cranberry scented candles, how many scented candles will she have… Talking to the whole class.

Nautica: So you got to do. Looking at the SmartBoard and starts answering the question though she wasn’t asked to.

Ms. Taylor: Hold on. Looking at the SmartBoard and says this in response to Nautica talking about the problem. How many (saying this very quietly as fidgeting with the SmartBoard).

Nautica: Leaning to look at the board. Cranberry. Begins counting out loud on fingers. 2, 4, 6, 7, 18, 19 times 3. Talks and counts while Ms. Taylor is talking.

Ms. Taylor: …Alright, so hold on Nautica, I love that you are thinking and I love that you are thinking out loud but let’s hold on for just a second, okay? Talking just to Nautica but out loud where the whole class can hear.

Nautica: Continues counting on her fingers even after Ms. Taylor asks Nautica to hold on. Continues thinking out loud but quietly to herself.

Nautica was very eager to contribute to the mathematical discussion (Moschkovich, 1999) which took place in the coeducation classroom; however, some of those contributions were out of turn or before Ms. Taylor was ready for Nautica to share. During our interview, I asked Nautica if there was anything else she could think of about how she interacted or communicated with her peers and Ms. Taylor during mathematics and she responded “Um, I guess I just talk freely. It’s probably bad.” Through Nautica’s actions (Gee, 1999) and talk (Gee, 1999), she positions herself as a “Can I Teach You?”
mathematics student who is trying to be a “Get Up There and Talk” participant in the mathematics classroom. However, because Nautica shouts out of turn and begins answering the question loudly without permission from the teacher, she occupies the role of a “I Just Talk Freely” student.

Nautica also verbally read problems from the SmartBoard with Ms. Taylor or said parts of problems along with Ms. Taylor, often without Ms. Taylor asking Nautica to contribute. For example, during one lesson Ms. Taylor said “We have to line the decimals up” and Nautica says along with Ms. Taylor “the decimals up”. Another example is when Ms. Taylor said “You can’t take 3 from 2 so you have to borrow” and Nautica said “Borrow” along with Ms. Taylor. Nautica would watch Ms. Taylor closely and join in on verbally stating parts of numbers or the end of a sentence. Nautica enjoyed speaking (Gee, 1999) out and reading the problems from the SmartBoard:

Ms. Taylor: Alright. What if then Nautica starts reading the problem out loud while Ms. Taylor is trying to get the problem ready on the board.

Nautica: In a basket 3 out of 4 eggs are cracked. How many eggs are cracked I can’t see Leaning and trying to see the SmartBoard. Reading the problem on the SmartBoard out loud even though she was not asked to by Ms. Taylor.

Ms. Taylor: Ah darn. Looks at Nautica and walks back to the right side of the classroom while Nautica continues to read the problem out loud.

Nautica: If there are a total of 28 eggs in the basket. Continues to read problem on the SmartBoard out loud even though she was not asked to by Ms. Taylor.
In this particular instance, Nautica began reading the problem loudly without waiting for Ms. Taylor to present the problem to the class, thus through her actions (Gee, 1999) Nautica positions herself as a “I Just Talk Freely” student. Ms. Taylor frequently supported Nautica’s engagement in this particular storyline and only if Nautica got completely out of line Ms. Taylor would ask Nautica to wait or be quiet based on the situation. There are many instances throughout all lessons where Nautica verbally interacts (Gee, 1999) with Ms. Taylor and takes part in mathematical conversations, occupying a role of a “Can I Teach You?” mathematics student who is also a “I Just Talk Freely” student.

During the interview, I asked Nautica when she decided to speak up in class and she responded “I guess I just talk. I talk too much.” Further in our interview Nautica said, “Ms. Taylor lets me yell out sometimes, and she yells at me laughs”. Followed by, “Like I just say the answer when I get it” and nodded her head when I asked “Okay so you are able to share or speak up when you understand something”. Nautica was very comfortable speaking up and sharing out in her mathematics class. Nautica shared her mathematical thinking and responded to questions often, positioning herself as a “Can I Teach You?” mathematics student who often occupied the role as a “I Just Talk Freely” student in the classroom. Nautica often occupied multiple storylines while in the coeducation mathematics classroom.

“Get Up There and Talk” participant in the mathematics classroom. Nautica frequently responded in chorus to questions posed by Ms. Taylor:
Ms. Taylor: Okay. You identified that this and this are different, right? This is 1 out of? *Asking the whole class.*

Nautica: Yes! 1000. *Responds to both of Ms. Taylor’s questions in chorus.*

Ms. Taylor: Okay. And how would I write that as a decimal? *Asking the class.*

Nautica: Zero decimal zero zero one. *Says in chorus while watching Ms. Taylor.*

Ms. Taylor typically worked through mathematics problems on the SmartBoard and posed questions throughout demonstrating how to solve the problems. In most instances, Nautica responded to Ms. Taylor’s questions, positioning herself as a “Get Up There and Talk” participant.

Nautica often gestured she was attentive to Ms. Taylor throughout each lesson. Nautica took notes and looked up to the board when Ms. Taylor talked about or wrote mathematics problems. Nautica demonstrated her attentiveness to Ms. Taylor by nodding in agreement or disagreement when Ms. Taylor posed mathematical questions. Nautica was active in a variety of non-verbal interactions (Gee, 1999) with Ms. Taylor and frequently engaged in constructing a mathematical Discourse (Moschkovich, 2003). Nautica frequently positioned herself as a “Get Up There and Talk” participant in the mathematics classroom.

There were limited opportunities for students to work together on mathematics during the coeducation class. Students worked independently on Morning Work, though they were not discouraged from talking quietly to students near to them. Students had opportunities to participate in whole class mathematical discussion (Moschkovich, 1999) during lessons. Nautica rarely spoke to students sitting near her during class; however,
she did shout out during whole class discussions. During our interview, I asked Nautica how she interacted and communicated with her peers in mathematics class and Nautica responded “They yell at me a lot.” She then followed with “I think it’s funny”. I asked Nautica to talk to me a little more about this and she followed with “Like, I yell at them cause I can’t, they always yell out before I can say something but then I do it because of them, I do it say they can’t talk and then they yell at me so I am like okay well then”. Further in the interview Nautica mentioned she interacted (Gee, 1999) better with her teacher than she did with most kids because Ms. Taylor was more understanding and was not as dramatic as most kids.

“Can I Teach You?” mathematics student. Although Nautica shouted out responses often and talked over Ms. Taylor, it was evident students viewed Nautica as a “Can I Teach You?” mathematics student:

Ms. Taylor: Okay, Student A said 4 hundredths, Student E says zero and 4 hundredths. Who would agree with, Student J? *Listens for student responses.*

Okay, Student C who would you agree with? *The two students who raised their hand and responded both said Student E.*

Nautica: *Raises her hand. Keeps her hand up until Ms. Taylor calls on her.*

Ms. Taylor: Nautica who would you agree with?

Nautica: *Puts hand down. Student A.*

Students in the class: Oh never mind! Oh never mind. Yeah, Student A.

Many students in the class agreed with Student E’s solution; however, when Nautica said she believed Student A was correct many students changed their responses to Student A.
Nautica was willing to raise her hand and share a different response than her classmates, positioning herself as a “Can I Teach You?” mathematics student. Nautica, however, was also positioned by her peers as a “Can I Teach You?” mathematics student when they switched their responses because of Nautica’s response. Following Nautica’s response, Ms. Taylor pushed the class to think further and asked “Why would Student A be right?” Other students shared their response but were not asked why, but when Nautica shared her response Ms. Taylor pushed her and the other students to think further as to why Student A was correct.

**Nautica’s Perspective of the Coeducation Classroom Environment**

Nautica frequently shared her mathematical thinking and was very engaged in the mathematics classroom. During our interview I asked Nautica how she felt about being in mathematics class:

Nautica: I like being in it because Ms. Taylor is very supportive and stuff. Nautica mentioned multiple times that she frequently talked to Ms. Taylor and she often shouted out responses and talked freely. Nautica was very comfortable in her mathematics classroom, allowing her to engage in multiple storylines, and that was largely in part because of Ms. Taylor’s support.

**Summary of Nautica**

Nautica engaged in multiple storylines in the coeducation mathematics classroom. Nautica occupied two dominant storylines which were a “Can I Teach You?” mathematics student and a “I Just Talk Freely” student through her talk, gestures, actions, interactions, and writing (Gee, 1999). During each lesson, Nautica shared her
mathematical understanding and contributed to mathematical discussion (Moschkovich, 1999) in the coeducation classroom; however, often these contributions were out of turn or over the talk of Ms. Taylor or peers.

Nautica also positioned herself as a “Get Up There and Talk” participant in the mathematics classroom, a student who was on task, and a “I Love Doing That Stuff” student towards participating in mathematics. Nautica engaged in spoken, acted, listening, written, and interacted (Gee, 1999) mathematical Discourse (Moschkovich, 2003) when positioning herself in the coeducation mathematics classroom and occupying multiple storylines.

Case 4: Jordan

Introduction

Jordan, a sixth-grade student in the coeducation mathematics class, is a black female. Jordan is enrolled in coeducation classes with Ms. Taylor for mathematics and science. Jordan is enrolled in coeducation classes for ELA, Writing, Health, Music, PE, Social Studies, and Christian Learning Center. Jordan does not take any all-girls classes. Jordan was held back in the first grade and mentioned during our interview she should be in seventh grade. Jordan told me she felt sad and upset when her friends moved to the next grade, but now realizes it was helpful for her to be held back. Jordan mentioned being in mathematics class with Ms. Taylor is really helpful because she struggled a lot at her old school in mathematics and her former teachers were mean. Jordan often occupied the role of a “One-on-One” student and she spoke positively about being in her coeducation mathematics class.
Jordan’s Findings

Jordan occupied different storylines in the coeducation mathematics classroom. Jordan often positioned herself as a “One-on-One” mathematics student, who was also “Nervous” about participating in mathematics. Jordan occupied these storylines through listening, actions, writing (Gee, 1999), and gestures. Jordan rarely engaged in spoken (Gee, 1999) or interacted (Gee, 1999) mathematical Discourse (Moschkovich, 2003).

I now provide examples of each of the enacted positionings and storylines occupied by Jordan with examples from my observations.

“Nervous” about participating in mathematics. Jordan rarely contributed publicly to mathematical conversations which took place in the coeducation classroom, and appeared nervous if an opportunity arose that she might have to share her mathematical work publicly. For instance, Ms. Taylor randomly selected Jordan to demonstrate her work at the board and the following interaction (Gee, 1999) and actions (Gee, 1999) took place between Jordan, Ms. Taylor, and her peers:

Ms. Taylor: Alright, number 4, subtraction. Draws a popsicle stick to select a student. Umm, Jordan. You’ve got this girlfriend. I will help you if you need it okay? You are good, I know you can do it. Sitting in the back of the classroom on a stool near the dry erase board as she talks out loud and watches Jordan as she works her problem on the SmartBoard.

Jordan: When Jordan’s name is called she immediately makes a face that she does not want to do the problem. She is slightly smiling, but also scrunches her nose and mouth to show she doesn’t want to solve the problem. She sits looking
straight ahead not looking at anyone. Sits her pen down, makes a face that she really doesn’t want to go, and then stands up slumping her shoulders over and walks to the SmartBoard.

Ms. Taylor: Alright. Jordan, as you are going up there, all whole numbers have a decimal behind them. So behind that 18 is an imaginary decimal. So what I would like you to do is write 18 point. Talking to Jordan but out loud for the class to hear.

Jordan: Standing at the SmartBoard. Arms down beside her and holding her hands together. Still has her face almost in a frown showing that she really doesn’t want to be up there. When Ms. Taylor says write 18 point, Jordan then turns and writes on the SmartBoard. She writes 18.

Ms. Taylor: Okay, now underneath that Jordan, 8 is where I want you to start your number so you are going to put 2.981 where your decimals are in line with each other so the 2 goes under the 8. Talking to Jordan but out loud for the whole class to hear. The phone ring and Ms. Taylor talks to someone on the phone.

Jordan: Turns back to face Ms. Taylor and slumps her body over holding her hands down and smiles. When Ms. Taylor tells Jordan the next thing to write on the board, Jordan then turns and writes exactly what Ms. Taylor asks her to write. She writes 2.981 underneath 18 on the SmartBoard. Once Ms. Taylor says it goes under the 8, she then writes under the 8. Seeming lost at first until Ms. Taylor guides her. The phone rings and when Jordan finishes writing she turns to face the direction of the phone ringing and stands there.
Following the phone conversation, the interaction (Gee, 1999) between Ms. Taylor and Jordan continued. Ms. Taylor positioned Jordan as a “Can I Teach You?” mathematics student when she said “you got this” and “I know you can do it”; however, Ms. Taylor then walked Jordan through every step without giving her a chance to do the problems on her own. Through Jordan’s gestures and actions (Gee, 1999) she positions herself as a student who is “Nervous” about participating in mathematics. Jordan slumped her body over, held her head and arms down, and continued to shrug her shoulders and make an upset face. Jordan continues to listen (Gee, 1999) to Ms. Taylor as she gives her directions and then Jordan followed the directions of Ms. Taylor step-by-step as she wrote on the board. During our interview, I asked Jordan how she felt about speaking up in class:

   Jordan: I am like a nervous person, like I remember when she used to make us like, not make us, but um do like, we had morning work so you’d go up there and like you got to answer, kind like I had to answer the question. And I used to be so nervous.

She also mentioned that she was a really shy person and she didn’t really like to talk in any of her classes. Jordan reacted nervously each time Ms. Taylor drew popsicle sticks to randomly select students. Once Jordan even said “Oh no” and then leaned over and put her head on her desk until a student was selected. Jordan often positioned herself as a student who was “Nervous” about participating in mathematics.

   During our interview, I asked Jordan about her willingness to talk publicly in class:
Researcher: Are you willing to talk out loud, so maybe not going up to the board, but talking out loud in front of the class or more one-on-one with Ms. Taylor?

Jordan: Um, ons or offs, like yes and like no.

Researcher: Okay, so talk to me about that, what do you mean?

Jordan: …I mean like, you taught yourself like every day, but like in front of like other people it’s like no. But I am okay with like doing it though now cause you like know, I can read like a passage. Something like that. And I’ll be okay.

Researcher: Okay. What about in math?

Jordan: Math? Um, cause like some people in my class are like oh math is so easy, so it’s kind of like, I don’t want to go up there cause people like “you don’t know that?” like “oh you should know that”

Jordan talks about how some students in her class view mathematics as easy and this causes Jordan not to feel comfortable demonstrating her work at the board. Jordan often occupies the role of a student who is “Nervous” about participating in mathematics.

“One-on-One” mathematics student. Jordan sometimes gestured she was attentive to Ms. Taylor throughout each lesson. Jordan sometimes wrote (Gee, 1999) in her notebook and sometimes looked up to the board when Ms. Taylor talked and wrote about mathematics. Jordan demonstrated her attentiveness to Ms. Taylor by sometimes nodding in agreement or disagreement when Ms. Taylor posed mathematical questions. For instance, the following non-verbal interaction (Gee, 1999) took place between Jordan and Ms. Taylor:
Ms. Taylor: Okay, but not even that. Have you ever gone anywhere and paid a bill, where they say, even if like you are buying candy do they, but let me just ask you this, let’s say the piece of candy or the candy bar was 50 cents, does the store ask you for 0 dollars and 50 cents? Asking the entire class.

Jordan: Shakes her head no but does not say anything out loud in chorus. Then sits looking ahead at Ms. Taylor.

Jordan sometimes showed her attentiveness to Ms. Taylor through her gestures and watching Ms. Taylor as she spoke; however, she rarely verbally contributed to the conversation. During our interview, I asked Jordan how she interacted and communicated with Ms. Taylor:

Jordan: Um, normal, just good. Really good, like she is a really very funny person. Really funny.

During member-checking Jordan said she needed to get to know the person. In her opinion she did not like to talk to people that much but when she talks to people in her group she gets ways they help her more.

Researcher: Okay, and so you feel like you interact and communicate

Jordan: Mmm hmm

Researcher: With your teacher in here?

Jordan: At first, I was like you know I am not going to get this, like I can’t do this, and then they say you know, she kind of like you know, like say it’s okay, it’s just like and then so my grades got good and I am like ohhh I got this. I can do this.
Jordan said she and Ms. Taylor had normal or good communication, though I did not observe many verbal interactions (Gee, 1999) between Jordan and Ms. Taylor. Jordan’s limited participation in all forms of engagement in the classroom positioned her as a “One-on-One” mathematics student.

I observed Jordan writing (Gee, 1999) in her notebook, looking at the computer to view Morning Work, using her finger to count across the computer screen, counting on her fingers, and looking up to the board where mathematics problems were located. For instance, during a lesson, Jordan took the following notes:

Figure 7. Jordan’s Notes from the Lesson on Day 2.

Jordan wrote (Gee, 1999) her Morning Work and lesson notes each day in her notebook. During the interview, I asked Jordan how she engages in her classwork and
Jordan responded “Um, like I focus a lot. But sometimes like you know I just want to goof off”. She mentioned further in the interview that it was important to mind her business and to be quiet.

There were limited opportunities for students to work together on mathematics during the coeducation classes. Students worked independently on Morning Work, though they were not discouraged if they talked quietly to someone near to them. Students had opportunities to participate in whole class discussion during lessons. Jordan rarely spoke (Gee, 1999) to students sitting near her during class. There were a few instances where Jordan whispered to the student near to her, but they never engaged in full mathematical conversations. During our interview, I asked Jordan how she interacts and communicates with her peers specifically about mathematics:

Jordan: They really do help you but it helps like you can take it like ‘oh she’s not going to help me like she’s just so perfect’. You really like, you can open, you can talk to them more, like you’re like oh like she is like smart, she can like help you and good, you can make good grades.

Jordan also mentioned during our interview she was more willing to interact with people she already knew.

Although Jordan did not talk often to her peers during my observations, the following interaction (Gee, 1999) took place during the previous example where Jordan demonstrated her mathematics work on the board between her and her peers (Note: this interaction took place while Ms. Taylor was on the phone):

Jordan: She makes a face towards a friend near her.
Student: Jordan write decimal and then 9 and 10.

Jordan: She writes the decimal.

Student: Alright then put 9, 8, and 1

Jordan: Jordan then writes 9, 8, and then 1 on the board.

Student: The student continues to talk but it is not audible.

Jordan: Jordan slouches over again, looking up at the SmartBoard, turns back and smiles at the students in the class, slouches over again and then stands up and looks at the SmartBoard. Fidgets with the pen and then looks back at Ms. Taylor when she gets off the phone and starts to talk to Jordan again.

Jordan listened (Gee, 1999) as students in the room told her what to write on the board and then she turned and wrote (Gee, 1999) exactly what the students told her to write. Students in the class positioned Jordan as a student who was not a “Can I Teach You?” mathematics student and Jordan in turn positioned herself as a “One-on-One” mathematics student who was “Nervous” about participating in mathematics. Jordan slumped her shoulders over and gestured she was unsure of how to solve the problem. She turned to her classmates throughout working on the problem while Ms. Taylor was on the phone.

**Jordan’s Perspective of the Coeducation Classroom Environment**

Jordan often did not share her mathematical thinking and was limited in her classroom engagement. However, during our interview, Jordan discussed how she felt about Ms. Taylor:
Jordan: Like, say what you want, like it’s okay, cause when I first saw Ms. Taylor I thought she was going to be like mean like all my other teachers at my old school. But you know, when you get to know her like she is really like a calm person and very funny.

*During member-checking Jordan said Ms. Taylor is really helpful.*

Although Jordan frequently positioned herself as “One-on-One” mathematics student and “Nervous” about participating in mathematics, she felt comfortable having one-on-one conversations with Ms. Taylor and she thought Ms. Taylor was really helpful.

**Summary of Jordan**

Jordan occupied multiple storylines in the coeducation mathematics classroom. Jordan often positioned herself as a “One-on-One” mathematics student through her talk, gestures, actions, and interactions (Gee, 1999). Throughout all three lessons, Jordan only shared her mathematical understanding when selected by Ms. Taylor and rarely contributed to mathematical discussion (Moschkovich, 1999). Jordan’s dominant storyline was that of a “One-on-One” mathematics student. Although Jordan often positioned herself as a “One-on-One” mathematics student, she still engaged in written (Gee, 1999) and listening (Gee, 1999) mathematical Discourse (Moschkovich, 1999).

Jordan often occupied the role of a student who was “Nervous” about participating in mathematics through her limited talk, actions, and limited interactions (Gee, 1999). Jordan frequently engaged in both storylines of being a “One-on-One” mathematics student who was “Nervous” about participating in mathematics.
Comparing and Connecting mathematical Discourse, Storylines, and Positionings
Across Cases in the Coeducation Setting

Introduction

During analysis of coeducation data, several storylines emerged which correlated to both the theoretical framework and research questions which guide this study. Nautica and Jordan occupied multiple storylines in the coeducation mathematics classroom. Nautica frequently occupied the role of a “Can I Teach You?” mathematics student who was also a “I Just Talk Freely” student. Nautica also positioned herself as a “Get Up There and Talk” participant in the mathematics classroom, a student who was on task, and a “I Love Doing that Stuff” student towards participating in mathematics. Jordan frequently occupied the role of a “One-on-One” mathematics student, who was often “Nervous” about participating in mathematics. Just as in any mathematics classroom, mathematical Discourses (Moschkovich, 2003) varied and were constructed in different ways. Nautica and Jordan occupied these storylines through their gestures, listening, actions, writing, talk, and interactions (Gee, 1999). I now provide a description of each emergent storyline and how the coeducation classroom setting impacted the storylines of each participant.

Coeducation Storylines

“Can I Teach You?” mathematics student. A participant positioned oneself as a “Can I Teach You?” mathematics student if they talked (Gee, 1999) about their mathematical thinking or demonstrated mathematics for their teacher or classmates. A participant positioned oneself as a “Can I Teach You?” mathematics student if they
responded to mathematical questions posed by the teacher or other students. I provide an example within the next emergent storyline which represents Nautica’s engagement in both storylines of a “Can I Teach You?” mathematics student who was also a “I Love Doing that Stuff” student towards participating in mathematics.

“I Love Doing that Stuff” student towards participating in mathematics. A participant positioned oneself as “I Love Doing that Stuff” towards participating in mathematics if they talked (Gee, 1999) about their joy and excitement for mathematics. If a student shouted their excitement towards being selected to demonstrate their work then they positioned themselves as a “I Love Doing that Stuff” student towards participating in mathematics. Nautica engaged in this storyline while coincidingly engaging in other storylines. For example, Nautica discussed how she enjoyed being in her coeducation course during our interview:

Researcher: So Nautica tell me how you feel about being in this class and specifically just the math part of it.

Nautica: Okay. I think it is fun….What’s fun is we get a little bit more freedom.

To like help with problems and stuff.

Nautica liked to help with problems in her mathematics class and often contributed her mathematical understanding, positioning herself as a “Can I Teach You?” mathematics student. Nautica discusses how this particular classroom is fun because she is able to help and contribute with problems which has an impact on her role in occupying this particular storyline of a “I Love Doing that Stuff” student towards participating in mathematics.
“Get Up There and Talk” participant in the mathematics classroom. A participant positioned oneself as a “Get Up There and Talk” participant in the mathematics classroom if they responded in chorus to questions posed by Ms. Taylor. A participant positioned oneself as a “Get Up There and Talk” participant if they watched, listened (Gee, 1999), and responded to Ms. Taylor or peers. If a student helped others with mathematics or shared their mathematical understanding they positioned themselves as a “Get Up There and Talk” participant in the mathematics classroom. For example, I often observed Nautica occupying the role of a “Get Up There and Talk” participant in her mathematics classroom. During our interview I asked Nautica how she contributed to the ideas they were learning in their mathematics class and she responded, “Like, I guess like say the answers and stuff”. Nautica felt very comfortable participating in her coeducation mathematics classroom. Further, during our interview I asked Nautica how she felt about being in math class:

Nautica: I like being in it because Ms. Taylor is very supportive and stuff.

Nautica feels very comfortable occupying the role of a “Get Up There and Talk” participant in her coeducation classroom. Ms. Taylor’s support is part of why Nautica likes being in her mathematics classroom and why she engages in this storyline.

On task mathematics student. A participant positioned oneself as on task if they engaged in written (Gee, 1999) mathematics or if they talked (Gee, 1999) through their mathematics independently. When a participant counted on their fingers, sought answers to their mathematical questions, spoke (Gee, 1999) up when unsure, or engaged in conversation with their teacher and peers about mathematics they positioned themselves
as on task. Nautica frequently positioned herself as a “Can I Teach You?” mathematics student; however, there were instances when she asked questions or sought answers when unsure of her mathematics with Ms. Taylor:

Researcher: …do you like learning math, maybe not like learning math? Things like that.

Nautica: I like learning math but it is difficult sometimes.

Nautica enjoyed learning mathematics even though at times it was difficult for her. As previously mentioned, Nautica said Ms. Taylor was very supportive and she enjoyed being in the coeducation mathematics class. Although Nautica often positioned herself as a “Can I Teach You?” mathematics student, who was on task, there were times when mathematics was still difficult for her. This classroom environment supported Nautica’s engagement in multiple storylines.

“I Just Talk Freely”. A participant positioned oneself as a “I Just Talk Freely” student if they shouted out responses when not requested, answered questions posed by Ms. Taylor for other students, or shouted out responses when other students were thinking. Additionally, if a participant read problems aloud meant for Ms. Taylor to read then the student positioned themselves as a “I Just Talk Freely” student. During our interview, I asked Nautica when she decides to speak up in this particular class and why and she responded:

Nautica: I guess I just talk. I talk too much.

Researcher: …and Ms. Taylor is teaching or y’all are working on something, how do you decide when you want to share or whether that is independently share
something or when the class is responding to things, how do you decide when you are going to speak up?

Nautica: Guess it just happens like I just talk.

Nautica is very aware that she talks a lot in this mathematics classroom and she talks freely when things come to her mind. Nautica engaged in this storyline often while also engaging in other storylines in this particular coeducation mathematics classroom.

“One-on-One” mathematics student. A participant positioned oneself as a “One-on-One” mathematics student if they were unwilling to share their mathematical thinking with the class. If a student was unwilling to demonstrate or share mathematics publicly, and only engaged in “One-on-One” conversations with Ms. Taylor or their peers they positioned themselves as a “One-on-One” mathematics student. For instance, Jordan often occupied the role of a “One-on-One” student in her mathematics class and during our interview Jordan said the following:

Researcher: Would you say you feel more comfortable now speaking up in class?

Jordan: nooo

Researcher: No. Okay, is that just in math or how do you feel about speaking up in other classes?

Jordan: Um, really just every class cause like, I am like a shy person. I don’t really like to talk.

Jordan mentions she is a shy person and does not like to speak (Gee, 1999) up in any of her classes. Jordan engages in this storyline because she is a shy person and her role in this storyline would occur in all of her classes.
Additionally, if a participant was willing to watch and listen (Gee, 1999) to their classmates and Ms. Taylor, but not respond verbally they positioned themselves as a “One-on-One” mathematics student. If a participant looked to the SmartBoard for the lesson, wrote (Gee, 1999) in their mathematics notebook, and used their fingers to count but did not share their mathematics with other students or Ms. Taylor, they positioned themselves as a “One-on-One” mathematics student.

“Nervous” about participating in mathematics. A participant positioned themselves as “Nervous” about participating in mathematics if they covered their face, shook their head, or put their head on their desk when Ms. Taylor used popsicle sticks to randomly select students. If a participant spoke (Gee, 1999) about feeling like their work was wrong in comparison to other students, spoke (Gee, 1999) about being anxious and nervous when demonstrating or sharing their work, or would not share their work with others then they positioned themselves as being “Nervous” about participating in mathematics.

Jordan often engaged in multiple storylines, positioning herself as a student who was a “One-on-One” mathematics student but also “Nervous” about participating in mathematics. Although Jordan engaged in these storylines, this positioning was not directly related to this particular classroom environment. For instance, during our interview Jordan discusses how she feels about being in her mathematics class:

Jordan: Um, it is really helpful because I was really struggling a lot. Like at my old school. Um I wasn’t really good at like decimals and stuff. So now, cause when I went to this school it kind of really helped me and I’m like woah that’s
easy. See at my other school they weren’t, they was like you got to get this right.
You got to get this right.

Further in our interview, Jordan continues to talk about how she feels about being in this particular mathematics classroom:

Researcher: Is there anything else you can think of in terms of being in the class?
Jordan: Um, it’s kind of like your own place. Like, say what you want, like it’s okay, cause when I first saw Ms. Taylor I thought she was going to be like mean like all my other teachers at my old school. But you know, when you get to know her like she is really like a calm person and very funny.

_During member-checking Jordan said Ms. Taylor was also really helpful._

Researcher: Okay. So you, would you say you enjoy being in this class?
Jordan: Mmm hmm.

Researcher: How do you feel about being in other classes?
Jordan: Um, it’s like the same. Just easier.

_During member-checking Jordan said she really struggled in 1st grade and got held back and is supposed to be in 7th grade, but her 1st grade teacher thought she wasn’t ready yet. She felt sad and upset when she saw her friends in the hall when she first got held back. Her friends made her feel sad. But now she realizes it was helpful to be held back._

Jordan enjoyed being in the coeducation mathematics classroom and the classroom environment did not impact her role in this storyline.

**Summary of Coeducation Emergent Storylines**
Nautica and Jordan occupied different roles and engaged in different mathematical Discourses (Moschkovich, 1999) while in the same coeducation mathematics classroom. For instance, Nautica occupied the role of a “Can I Teach You?” mathematics student, while also positioning herself as a “Get Up There and Talk” participant throughout each lesson. Nautica often positioned herself as a “I Just Freely Talk” student, while also a “I Love Doing that Stuff” student towards participating in mathematics, and an on task mathematics student. Jordan frequently occupied the role of a “One-on-One” mathematics student who was “Nervous” about participating in mathematics. Nautica and Jordan were both participants in the coeducation mathematics classroom but the storylines they engaged in were often different. Nautica engaged in constructing a mathematical Discourse (Moschkovich, 2003) through written, spoken, acted, listening, and interacted (Gee, 1999) mathematical Discourse (Moschkovich, 2003). Jordan rarely engaged in spoken (Gee, 1999) or interacted (Gee, 1999) mathematical Discourse (Moschkovich, 2003); however, Jordan engaged in listening (Gee, 1999) and written (Gee, 1999) mathematical Discourse (Moschkovich, 2003).

Nautica and Jordan were both participants in the coeducation classroom, and through their mathematical Discourse (Moschkovich, 2003), positions, and storylines, each participant occupied different roles within the coeducation classroom. The mathematical Discourses (Moschkovich, 2003) in the coeducation classroom were varied and constructed in different ways by participants who represented opposite ends of a continuum.
Cross-Case Analysis: Single-Gender and Coeducation Middle Grades Mathematics Classroom

Introduction

Ms. Taylor taught the single-gender and coeducation mathematics classes which were described in the context of Chapter Three. Ms. Taylor’s instruction was largely invariant. The single-gender and coeducation class started the exact same way with the exact same problems. Ms. Taylor engaged students in the exact same lecture. In planning, Ms. Taylor attempted to be consistent in her teaching between the single-gender and coeducation mathematics classes.

Ms. Taylor did make adjustments in the coeducation class during lesson 2 because students were struggling to understand the content. Ms. Taylor sent Nautica to get base 10 blocks from a neighboring teacher and used the blocks to demonstrate fractions. After the base 10 block demonstration Ms. Taylor restarted the lesson. Although Ms. Taylor intended to teach the exact same content each day, she did adjust content to best suit the needs of the students each day. In both classes, Ms. Taylor encouraged classroom discussion. Students often responded chorally, posed questions, displayed their work on the board, and sometimes talked (Gee, 1999) with peers to try a problem similar to what Ms. Taylor had taught. Ms. Taylor frequently facilitated opportunities for classroom discourse.

In considering research question c, I examine the similarities and differences among storylines and positionings in the single-gender and coeducation classroom. There were similarities in storylines across the single-gender and coeducation data, as well as a
few differences. The goal for recruitment of the four participants was to show a broad range of perspectives among types of mathematical Discourses (Moschkovich, 2003) constructed in these classroom settings. Therefore, I compare the storylines and positionings between similar participants within each classroom setting.

In the following sections I compare Maria and Nautica, and I compare Leah and Jordan. A detailed comparison across cases is provided in the following sections.

Cross-Case Analysis of Maria and Nautica

Similarities across Maria and Nautica. Similarities in storylines across Maria and Nautica include a “Can I Teach You?” mathematics student, a “Get Up There and Talk” participant in the mathematics classroom, on task mathematics student, and “I Love Doing that Stuff” student towards participating in mathematics. In comparing the two participants, I found Maria and Nautica occupied similar roles in each of their corresponding mathematics classrooms. Maria and Nautica represented one end of a participation continuum, in which they were both very engaged in all forms of mathematical Discourse (Moschkovich, 2003).

“Can I Teach You?” mathematics student. Throughout all three lessons, I observed Maria and Nautica occupying the role of a “Can I Teach You?” mathematics students. Maria and Nautica both responded to questions posed by Ms. Taylor and both students shared their mathematical thinking. For instance, Maria shared her method of solving a problem on the board and taught the class how to solve that particular problem. Nautica often answered questions posed by Ms. Taylor and was eager to share her work
at the board. I frequently observed both students responding to questions posed by Ms. Taylor, sharing their mathematical thinking, and answering mathematical questions.

**“Get Up There and Talk” participant in the mathematics classroom.** Maria and Nautica positioned themselves as “Get Up There and Talk” participants in the mathematics classroom by their gestures, actions, and interactions (Gee, 1999) with peers and Ms. Taylor. Maria and Nautica responded chorally to mathematical questions posed by Ms. Taylor, watched Ms. Taylor as she taught, and listened (Gee, 1999) to Ms. Taylor during each lesson. Additionally, Maria and Nautica shared their understanding of the mathematics they were learning and watched and listened (Gee, 1999) to their peers when their peers discussed or demonstrated mathematics. Maria and Nautica frequently contributed to classroom mathematical discussion (Moschkovich, 1999).

**On task mathematics student.** Maria and Nautica engaged in positioning themselves as students who were on task. Maria and Nautica wrote (Gee, 1999) mathematics, counted on their fingers, sought answers, asked questions when unsure, and engaged in conversations with Ms. Taylor about mathematics. I observed Maria and Nautica asking questions throughout each lesson when they were unsure of a concept or needed clarification.

**“I Love Doing that Stuff” student towards participating in mathematics.** Maria and Nautica occupied the role of “I Love Doing that Stuff” students towards participating in mathematics. Both students positioned themselves as “I Love Doing that Stuff” students towards participating in mathematics by their gestures, actions, and talk (Gee, 1999). I observed Maria clapping her hands and verbally stating her excitement when her
name was called to demonstrate her mathematics. During our interview, Maria talked about enjoying and loving mathematics class, as well as her excitement towards mathematics. Nautica shouted her excitement during class and talked about how much she enjoyed doing problems at the board during our interview.

**Differences across Maria and Nautica.** Differences in storylines across Maria and Nautica included a “I Just Freely Talk” student. There were few differences in constructed mathematical Discourses (Moschkovich, 2003), positionings, and storylines across Maria and Nautica.

**“I Just Freely Talk”**. In comparing the two participants, I found Nautica frequently occupied the role of a “I Just Freely Talk” student by her talk, actions, interactions (Gee, 1999), and gestures. Nautica frequently shouted out responses, answered questions posed by Ms. Taylor for other students to answer, and shouted out responses while other students were thinking. Nautica read problems aloud meant for Ms. Taylor to read. Additionally, Nautica got on her knees and waved her hands in the air to get Ms. Taylor’s attention so she could talk (Gee, 1999) about mathematics. Although Maria occupied similar roles as Nautica in the single-gender classroom, Maria never engaged in the role of a “I Just Freely Talk” student.

**Cross-Case Analysis of Leah and Jordan**

**Similarities across Leah and Jordan.** Similarities in storylines across Leah and Jordan included a “One-on-One” mathematics student and “Nervous” about participating in mathematics. In comparing the two participants, I found Leah and Jordan occupied similar roles in each of their corresponding mathematics classes. Leah and Jordan both
represented one end of a participation continuum, in which they both engaged in limited forms of mathematical Discourse (Moschkovich, 2003).

“One-on-One” mathematics student. Leah and Jordan frequently positioned themselves as “One-on-One” participants in the mathematics classroom by their gestures, actions (Gee, 1999), and limited interactions (Gee, 1999) with peers and Ms. Taylor. Leah and Jordan rarely shared their mathematical thinking publicly, and they were unwilling to demonstrate their mathematical work for the class to observe unless selected by Ms. Taylor. Leah and Jordan watched and listened (Gee, 1999) to Ms. Taylor when she taught; however, they typically did not respond to her questions publicly. Leah typically engaged in “One-on-One” conversation with Ms. Taylor, while Jordan rarely communicated with Ms. Taylor. Although Leah and Jordan rarely contributed publicly to mathematical discussion (Moschkovich, 1999), they both engaged in written (Gee, 1999) mathematical Discourse (Moschkovich, 2003).

“Nervous” about participating in mathematics. Leah and Jordan positioned themselves as “Nervous” about participating in mathematics by their gestures, talk, and actions (Gee, 1999). Leah and Jordan both talked (Gee, 1999) about feeling nervous during their interviews. Leah and Jordan both covered their faces, put their heads on the desk, or shook their heads when they listened for Ms. Taylor to select a student to demonstrate their mathematics work publicly. During their interviews, both Leah and Jordan mentioned their nervousness towards demonstrating their work publicly for peers and Ms. Taylor to observe.
**Differences across Leah and Jordan.** Differences in storylines across Leah and Jordan included on task. There were limited differences in constructed mathematical Discourses (Moschkovich, 2003), positionings, and storylines across Leah and Jordan.

**On task mathematics student.** This storyline was common among the majority of the participants. Maria, Leah, and Nautica were frequently on task. In comparing Leah and Jordan, I found Leah occupied the role of a student who was on task through her written (Gee, 1999) mathematics, counting on fingers, seeking answers, asking questions when unsure, and engaging in conversations with Ms. Taylor about mathematics. Although Leah did not engage in public conversations, she would clarify her understanding in “One-on-One” conversations with Ms. Taylor.

**Summary of Findings**

There were many similarities in constructed mathematical Discourses (Moschkovich, 2003) between the all-girls and coeducation classroom settings. All participants occupied multiple storylines. Maria and Leah occupied multiple storylines in the all-girls mathematics classroom, and Nautica and Jordan occupied multiple storylines in the coeducation mathematics classroom. Maria and Nautica frequently occupied the role of “Can I Teach You?” mathematics students, while also positioning themselves as “Get Up There and Talk” participants, who were “I Love Doing that Stuff” students towards participating in mathematics, and who were on task. Leah and Jordan frequently occupied the role of “One-on-One” mathematics students, who were “Nervous” about participating in mathematics.
There were some differences in the constructed mathematical Discourses (Moschkovich, 2003) between the all-girls and coeducation classroom settings. For instance, Leah sometimes positioned herself as a student who was on task; however, Jordan did not engage in this storyline. Further, Nautica occupied a role of “I Just Talk Freely”; however, Maria did not engage in this storyline. The mathematical Discourses (Moschkovich, 2003) in the single-gender and coeducation classroom settings were varied and constructed in different ways.
CHAPTER FIVE

DISCUSSION AND IMPLICATIONS

Overview of Study

This study examined ways girls in single-gender and coeducation classrooms engage in constructing mathematical Discourses (Moschkovich, 2003) with their teacher and peers. There were two bounded settings within this study: an all-girls sixth grade mathematics classroom and a coeducation sixth grade mathematics classroom. The four individual cases for this study are Maria and Leah (Single-Gender) and Nautica and Jordan (Coeducation). As detailed in Chapter Four, Maria and Nautica were more actively engaging in constructing mathematical Discourse (Moschkovich, 2003), and Jordan and Leah were more reserved in constructing mathematical Discourse (Moschkovich, 2003).

Discussion of Findings

In both classroom settings, mathematical Discourses (Moschkovich, 2003) varied and were constructed in different ways. There were multiple storylines which frequently emerged in both classroom settings. The biggest differences in constructed mathematical Discourses (Moschkovich, 2003), positionings, and storylines occurred within each classroom setting, rather than across cases in different classroom settings. There were a few differences in constructed mathematical Discourses (Moschkovich, 2003), positionings, and storylines across cases in different classroom settings.

This study examined the following research question: How do girls in middle grades mathematics classes engage in constructing mathematical Discourses in both
coeducational and single-sex environments? As outlined in Chapter Four, I found girls in each classroom setting engaged in constructing a mathematical Discourse through their gestures, actions, interactions, listening, writing, and talk (Gee, 1999). Maria and Nautica frequently engaged in all forms of constructing a mathematical Discourse (Moschkovich, 2003) in each of their respective classroom settings. Leah and Nautica engaged in listening, written, and actions (Gee, 1999); however, they engaged in limited talk and interactive (Gee, 1999) mathematical Discourse (Moschkovich, 2003) in each of their respective classroom settings. Girls from each classroom setting, single-gender and coeducation, engaged in many forms of mathematical Discourse (Moschkovich, 2003).

The study examined the following secondary research questions: a: How do girls construct mathematical Discourse with other students in their classroom? and i: What forms of positioning do girls utilize as they construct mathematical Discourses with other students in their classroom? I found girls constructed mathematical Discourse with other students through talk, actions, interactions, and listening (Gee, 1999). Though there were limited opportunities for girls to talk about mathematics with other students during class time, when given the opportunity, the participants listened to their peers, watched as their peers spoke, and sometimes engaged in mathematical conversation. Maria and Nautica more frequently spoke to and interacted with peers about mathematics, positioning themselves as “Can I Teach You?” mathematics students, who were “Get Up There and Talk” students, and frequently on task mathematics students. Both girls occupied these storylines while they engaged in constructing mathematical Discourse (Moschkovich, 2003) in their respective classrooms. Leah and Jordan listened (Gee, 1999) to and
watched their peers as they spoke about mathematics, but rarely engaged in mathematical conversation. Leah and Jordan often positioned themselves as “One-on-One” students who were “Nervous” about participating in mathematics with their peers and publicly. Girls from each classroom setting, single-gender and coeducation, utilized different forms of positioning as they engaged in many forms of mathematical Discourse (Moschkovich, 2003) with their peers.

Additionally, this study examined the following secondary research questions: b: How do girls construct mathematical Discourse with their teacher in their classroom? and i: What forms of positioning do girls utilize as they construct mathematical Discourses with their teacher in their classroom? I found girls constructed mathematical Discourse with Ms. Taylor through talk, actions, interactions, and listening (Gee, 1999). There were many opportunities for the participants to interact with Ms. Taylor, and the participants often listened to Ms. Taylor, watched as she taught the class, and sometimes engaged in mathematical conversation with Ms. Taylor. Maria and Nautica frequently talked to Ms. Taylor and interacted with Ms. Taylor during each lesson, positioning themselves as “Can I Teach You?” mathematics students, who were “Get Up There and Talk” participants in the mathematics classroom, and frequently on task mathematics students. Maria and Nautica occupied these storylines while they engaged in constructing mathematical Discourse (Moschkovich, 2003) in their respective classrooms. Additionally, Nautica often engaged in the storyline of “I Just Freely Talk” by consistently engaging in conversation with Ms. Taylor even if it was out of turn. Leah and Jordan listened (Gee, 1999) to and watched Ms. Taylor as she spoke about
mathematics. Leah and Jordan often positioned themselves as “One-on-One” students who were “Nervous” about participating in mathematics with Ms. Taylor. Leah, however, would clarify her understanding when unsure and often positioned herself as an on task mathematics student. Girls from each classroom setting, single-gender and coeducation, utilized different forms of positioning as they engaged in many forms of mathematical Discourse (Moschkovich, 2003) with Ms. Taylor.

These findings give rise, in my opinion, to the following implications.

Implications

In seeking to contribute to our understandings of the affordances and drawbacks of single-sex classroom spaces, findings from this study suggest three implications: Variety of Storylines in Each Classroom Setting, Students’ Enactment of a Storyline Based on Level of Comfort and Safety in the Classroom Environment, and Ms. Taylor’s Interactions and Support Contributes to the Students’ Enacted Storylines. I discuss each implication below.

Variety of Storylines in Each Classroom Setting

The first implication from this study is there is a variety of storylines in each classroom settings. All participants occupied multiple storylines. Maria and Leah occupied multiple storylines in the all-girls mathematics classroom, and Nautica and Jordan occupied multiple storylines in the coeducation mathematics classroom. In the following sections I discuss the variety of storylines from each classroom setting by discussing storylines occupied by Maria and Nautica, and storylines occupied by Leah and Jordan.
Maria and Nautica. There were a variety of storylines occupied in the single-gender and coeducation classrooms between Maria and Nautica, which include a “Can I Teach You?” mathematics student, a “Get Up There and Talk” participant in the mathematics classroom, an on task mathematics student, and a “I Love Doing that Stuff” student towards participating in mathematics. Maria and Nautica occupied similar roles in each of their corresponding mathematics classes. Maria and Nautica both represented one end of a participation continuum, and they were both very engaged in all forms of mathematical Discourse (Moschkovich, 2003). Similar to findings from Kombe, Che, and Bridges (2019), both Maria and Nautica demonstrated positive perceptions of themselves as mathematics learners through positioning themselves as students who were eager to learn and understand mathematics, and both participants were excited to participate in mathematics. Throughout all three lessons, I observed Maria and Nautica occupying the role of “Can I Teach You?” mathematics students who were both “Get Up There and Talk” participants in their mathematics classrooms. Similar to findings from Simpson and Che (2016) and Wiegert and Che (2010), Maria and Nautica both expressed a sense of mathematical freedom through asking questions as they arose and answering questions posed by their teacher. Consistent with findings from Kombe, Carter, Che, and Bridges (2016), though the classroom environment was different for Maria and Nautica, both girls occupied the role of a “Can I Teach You?” mathematics student regardless of class type. Maria and Nautica, students from each classroom setting, were very comfortable contributing to mathematical discussion (Moschkovich, 1999) in their respective
classroom spaces and frequently positioned themselves as “Can I Teach You?”
mathematics students.

Gillibrand et al. (1999) claimed “research findings are far from conclusive as to
whether arranging classes in mixed schools by gender has any beneficial effects on girls’
interest, confidence level, and academic performance” (p. 350). The findings from this
study suggest girls’ interest in participating in mathematics, activeness in the
mathematics classroom, and confidence in being a mathematics student was not impacted
by the type of classroom, single-gender or coeducation. Both Maria in the all-girls
classroom and Nautica in the coeducation classroom were “Get Up There and Talk”
participants in mathematics and frequently positioned themselves as “Can I Teach You?”
mathematics students.

The “I Just Freely Talk” storyline was the only difference in storylines across the
single-gender and coeducation classrooms between Maria and Nautica. Nautica
frequently occupied the role of a “I Just FREELY Talk” student in her coeducation
mathematics class. Although Maria occupied similar roles as Nautica in the single-gender
classroom, Maria never engaged in the role of a “I Just FREELY Talk” student. This was the
only storyline that was different between Maria and Nautica.

**Leah and Jordan.** There were a variety of storylines occupied in the single-
gender and coeducation classrooms between Leah and Jordan, which include a “One-on-
One” mathematics student and “Nervous” about participating in mathematics. I found
Leah and Jordan occupied similar roles in each of their corresponding mathematics
classes. Leah and Jordan both represented one end of a participation continuum, in which
they both engaged in forms of mathematical Discourse (Moschkovich, 2003) for which they felt most comfortable. I observed Leah and Jordan occupying the role of “One-on-One” mathematics students who were both “Nervous” about participating in mathematics. Frenzel and Goetz (2007) examined emotions of enjoyment, pride, anxiety, hopelessness, and shame and their findings suggested girls and boys had similar grades in mathematics; however, “...girls reported significantly less enjoyment and pride than boys, but more anxiety, hopelessness and shame” (Frenzel & Goetz, 2007, p. 497). Similar to the findings of Frenzel and Goetz (2007), I found both Leah in the single-gender class and Jordan in the coeducation class experienced anxiety and less enjoyment in their mathematics class. Although Leah and Jordan expressed feelings of nervousness, Maria and Nautica did not have indications of these feelings and therefore, it is not safe to conclude that all girls experience anxiety and less enjoyment in the mathematics classroom.

Leah and Jordan are Black females who were both reserved in their respective classroom spaces. Leah and Jordan both mentioned feelings of nervousness and did not like to publicly share their mathematical work. According to Joseph, Hailu, and Matthews (2019):

Given that confidence in one’s own math ability is an important aspect of mathematics identity development, this finding about Black girls being more confident in others’ math competencies than their own is jarring. In many ways, Black girls are socialized to believe that they are intellectually incapable of learning and mastering mathematics content. (p. 136)
Leah and Jordan both shared feelings of nervousness when sharing work with the class, or how they did not enjoy speaking up about mathematics, or how Leah felt her work was wrong in comparison to a classmates, or how Jordan depended on a classmate to help her solve a mathematics problem publicly. Additionally, Joseph, Hailu, and Matthews (2019) stated, “…how adolescent Black girls experience mathematics classrooms, what they perceive about themselves as learners and doers of mathematics, and what type of mathematics teaching practices influence and shape their participation are all understudied lines of inquiry” (p. 148). The gendered class context, in this case, did not allow for more broad ways for either of these participants to participate. Both class types failed Leah and Jordan by not ultimately getting them to participate robustly.

The on task mathematics student storyline was the only difference in storylines across the single-gender and coeducation classrooms between Leah and Jordan. I found Leah occupied the role of an on task mathematics student. This was the only storyline that was different between Leah and Jordan.

**Summary of variety of storylines in each classroom setting.** In each class type, I would expect if I were to do a similar study, I would find a similar variability of storylines. As displayed in the findings and discussion of implication number one, many storylines were occupied in each classroom type. In the single-gender classroom participants occupied the role of a “Can I Teach You?” mathematics student, a “Get Up There and Talk” mathematics student, an on task mathematics student, “I Love Doing that Stuff” student towards participating in mathematics, “One-on-One” mathematics student, and a “Nervous” about participating in mathematics. In the coeducation
classroom participants occupied the role of a “Can I Teach You?” mathematics student, a “Get Up There and Talk” mathematics student, an on task mathematics student, “I Just Talk Freely”, “I Love Doing that Stuff” student towards participating in mathematics, “One-on-One” mathematics student, and a “Nervous” about participating in mathematics. These findings suggest that students in both classroom types occupy the role of “One-on-One” mathematics students, and students in both classroom types occupy the role of “Can I Teach You?” mathematics students. The take-away is that there is a wide variability of storylines occupied by the participants no matter the classroom type.

In considering the third research question, results from this study imply the methods and approaches of constructing mathematical Discourse (Moschkovich, 2003) for girls are consistent across the single-gender and coeducation classroom environment based on the participants level of engagement in mathematical Discourse (Moschkovich, 2003). Maria and Nautica constructed mathematical Discourse (Moschkovich, 2003) in similar ways and occupied similar positions and storylines in their respective mathematics classes. Additionally, Leah and Jordan constructed mathematical Discourse (Moschkovich, 2003) in similar ways and occupied similar positions and storylines in their respective mathematics classes. The different perspectives from each participant within each classroom setting demonstrate that girls construct mathematical Discourse (Moschkovich, 2003) in many ways and engage in a variety of storylines within each classroom setting.

Students’ Enactment of a Storyline Based on Level of Comfort and Safety in the Classroom Environment
The second implication from this study is that students’ enactment of a storyline seems to be based on how comfortable and safe they feel in their classroom environment. Although each participant occupied multiple storylines and positionings, each participant discussed their perspective of their comfort and safety level in their classroom based on Ms. Taylor and the classroom environment. In the following sections I discuss how the students’ level of comfort and safety supported their engagement in the enacted storylines.

**Ms. Taylor’s Support.** All four participants discussed Ms. Taylor and how her support played part in their engagement in various storylines. In the single-gender classroom, for instance, Maria mentioned “…in here I would easily be able to do that because I know Ms. Taylor is actually listening” when discussing how comfortable she felt teaching Ms. Taylor a new method of solving as compared to other teachers. Ahmad and colleagues stated, “Good interactions between teachers and students will create positive relationships in the classroom and contribute to effective learning” (2017, p. 58). Maria made it clear that she felt comfortable demonstrating a method in front of the class because of Ms. Taylor. Maria discussed how her willingness to stand up and teach a new method “..depended on the class. And the teacher and the people..”. Ms. Taylor and the students in Maria’s classroom had an impact on her role in occupying the “Can I Teach You?” storyline. Additionally, Maria discussed how Ms. Taylor and the students in her mathematics classroom had an impact on her engagement in being a “Get Up There and Talk” participant. I asked Maria how she felt about speaking up in class and she responded:
Maria: Oh I love it. But, if I were to go try to do that in ART class, with other people, wouldn’t be able to do it. Or adults, can’t do it. I have so much stage fright and then I get to this class, I don’t know if it is because it’s all-girls or I am very used to the people in this class, but I could, if everybody was in here I could stand up and write a whole speech.

I asked Maria to discuss this further:

Maria: I know everybody in here won’t judge me…let’s say if I was in a class with boys I wouldn’t be able to do that because I would think they were judging me the whole time…Or just other people in general. Maybe if it was other girls or if like I went to a new school and they didn’t know me. As well, as the people here do.

Maria feels very comfortable occupying the role of a “Get Up There and Talk” participant in her all-girls classroom. In this particular classroom, Maria is willing to speak (Gee, 1999) publicly and to share her mathematical thinking and work because she knows the people in this particular classroom will not judge her. Reyes et al. (2012) found “Classrooms high in positive climate and low in negative climate are characterized by a sense of connectedness and belongingness, enjoyment and enthusiasm, and respect” (p. 8). Similar to the findings of Reyes et al. (2012), Maria frequently occupied multiple storylines and Maria’s engagement in multiple storylines in this particular classroom occur because she feels safe and comfortable around Ms. Taylor and the students in her mathematics classroom.
I asked Leah if there is anything she would like to say about how she interacted or communicated with her teacher in the class and Leah said, “I talk to Ms. Taylor a lot about like learning and stuff like that”. Leah did not like talking publicly in any of her classes; however, Leah felt very comfortable talking to Ms. Taylor and she was willing to talk to the girls that sat at her table. Leah frequently positioned herself as “One-on-One” mathematics student and she felt comfortable having one-on-one conversations with Ms. Taylor. Additionally, Leah often did not share her mathematical thinking and was limited in her classroom engagement. During our interview, however, I asked Leah to talk to me about her favorite class and why it is her favorite class, and she said, “Ms. Taylor’s class. Um the girls that are in here are like funny. And talk a lot”. Although Leah was more reserved in public conversations, Leah viewed Ms. Taylor’s class as her favorite and liked the girls in her classroom. Similar to the findings of Ahmad et al. (2017) that “…when interaction between teachers-students are good, the learning comfort will exist” (p. 68), both Maria and Leah felt supported by Ms. Taylor. Maria felt comfortable to teach Ms. Taylor and Leah felt comfortable having one-on-one conversations with Ms. Taylor.

In the coeducation class, for instance, when I asked Nautica how she felt about being in mathematics class she said, “I like being in it because Ms. Taylor is very supportive and stuff”. Nautica mentioned multiple times that she frequently talked to Ms. Taylor and she often shouted out responses and talked freely. Additionally, Jordan often did not share her mathematical thinking and was limited in her classroom engagement. During our interview, Jordan said, “…say what you want, like it’s okay, cause when I
first saw Ms. Taylor I thought she was going to be like mean like all my other teachers at my old school. But you know, when you get to know her like she is really like a calm person and very funny”. Additionally, during member-checking Jordan said that Ms. Taylor was really helpful. Frenzel et al. (2009) found that “…a teacher’s enjoyment during teaching has positive effects on student enjoyment via observable enthusiastic teaching behavior….teachers do make a difference in terms of students’ emotional experiences in the classroom…” (p. 712). Nautica was very comfortable in her mathematics classroom, allowing her to engage in multiple storylines, and that was largely in part because of Ms. Taylor’s support. Although Jordan did not engage often in her mathematics classroom, she felt Ms. Taylor was really funny and helpful. 

Summary of Students’ Enactment of a Storyline Based on Level of Comfort and Safety in the Classroom Environment. The take-away from this implication is that students level of comfort and safety in the classroom environment is important for them to enact certain storylines. Specifically, it seems to me that a consistent influence in the students level of comfort and safety is the classroom teacher. Similar to the findings of Frenzel et al. (2009), I found all four participants enjoyed their mathematics classroom and mention Ms. Taylor has an impact in their classroom experience. All four students mentioned Ms. Taylor and how they talked to Ms. Taylor, felt supported by Ms. Taylor, felt Ms. Taylor was helpful, or that Ms. Taylor actually listened to them. In both the single-gender and coeducation classroom, the participants displayed that if they are going to enact a storyline their level of comfort and safety is important. A participant could feel equally uneasy in an all-girls classroom or a coeducation classroom, and their uneasiness
is not based on the fact they are in an all-girls or coeducation classroom. Occupying a storyline relates to how the participant feels in that classroom environment, which is a large indication of the classroom teacher. From the findings of this study, the larger influence on how students feel in the mathematics class is the teacher more so than whether the class is coeducation or single-gender.

**Ms. Taylor’s Interactions and Support Contributes to the Students’ Enacted Storylines**

In implication two I discussed how students’ enactment of a storyline was based on their level of comfort and safety in the classroom. I discussed how each participant mentioned Ms. Taylor’s support or helpfulness which impacted their engagement in the enacted storylines. In addition to the participants perspectives of their teacher, Ms. Taylor also spoke of her interactions and support in each of her classrooms which contributed to the enacted storylines. According to Davis (2003), “…research indicates teachers can influence the quality of their interactions with students and their students’ motivation and learning via the instructional contexts they embrace (Perry, 1998; Turner & Meyer, 2000)” (as cited in Davis, 2003, p. 212). Similar to these findings, Ms. Taylor frequently nurtured the enacted storylines by the participants. Although Ms. Taylor discussed differences between her all-girls and coeducation class during our interview, Ms. Taylor’s involvement in the enacted storylines, however, were the same across both classroom settings. Ms. Taylor’s responses to the participants played a large role on the enactment of the storylines and I provide examples below.
"Get Up There and Talk" participant in the mathematics classroom. Ms. Taylor provided many opportunities for students to be "Get Up There and Talk" participants in the mathematics classroom. I asked Ms. Taylor how she provided opportunities for students to contribute to ideas in class and if she thought that was important:

Ms. Taylor: …it’s definitely important…I let them come to my board, they can work in their partner groups…I know that I’m not always going to present the instruction to them on their level so it is always nice to have a student either come up to the board or explain their train of thought…the more they want to interact with me in my lesson, the better it is for me.

I asked Ms. Taylor if discussion and collaboration around mathematical tasks and activities were a norm in her classroom:

Ms. Taylor: I think they have to be a norm…there are so many ways to do math…we try, absolutely, to do it as many ways as we possibly can…but they know that my way is just my way, you do whatever way is comfortable for you, we will go over them…I feel like talking and expressing is so important…

Ms. Taylor encouraged and provided many opportunities for students to be “Get Up There and Talk” participants in the mathematics classroom.

"One-on-One" participant in the mathematics classroom. I asked Ms. Taylor how often students had opportunities to share their ideas and she responded, “…I feel like I give them an opportunity every class period. I am always stopping and asking okay do
you have questions…” I then asked Ms. Taylor how she decided when to select students to demonstrate their work for the class to observe:

Ms. Taylor: …most of the time I don’t even have to select them they want to do it themselves…sometimes I will and I have my cup system where I pull my names out of the cup and if they feel comfortable, now at the beginning of the year if they didn’t feel comfortable because they were getting used to me, but it helps me for them to come up to the board because not only can I help them but the students can as well…they know by this point that if I do call them up to the board it’s not to embarrass them or anything like that it’s simply let’s see what you know, what do you need help with.

Although Ms. Taylor provided opportunities for students to be “Get Up There and Talk” participants in the mathematics classroom, there were students who were “One-on-One” mathematics students. Unless students were selected by the cup system to demonstrate their work at the board or they personally choose to be a “Get Up There and Talk” participant, students were able to be “One-on-One” mathematics students. As Ms. Taylor said, she did not have to select students often because students normally wanted to share. Thus, students who were “One-on-One” mathematics students were easily able to engage in that particular storyline and were not pushed by Ms. Taylor to be “Get Up There and Talk” students. Although Ms. Taylor did not actively push the “One-on-One” students during my observations, I asked Ms. Taylor how she knew students were grasping the ideas she was teaching if they did not seem as engaged in their work or with their peers:
Ms. Taylor: I think I can see it when they turn individual assignments in with me. I do exit slips sometimes…it just lets me see their process…I can see it through that, then sometimes I can see it on their formative assessments…

Ms. Taylor was able to see if students were understanding the ideas she was teaching through their written (Gee, 1999) mathematics if they were not publicly active in the classroom. Ms. Taylor had an impact on both the “One-on-One” and “Get Up There and Talk” storyline in her classroom by supporting students who engaged in both storylines.

“Can I Teach You?” mathematics student. Ms. Taylor created a classroom environment that allowed students to position themselves as “Can I Teach You?” mathematics students, and often, Ms. Taylor positioned students as “Can I Teach You?” mathematics students. During our interview, I asked Ms. Taylor how she decided when to select students to describe or share their work verbally without coming up to work it out:

Ms. Taylor: Maria is a really good example. She will raise her hand and say “Ms. Taylor but can it be done this way?” and then if she does that, or any one really, they do that, they just raise their hand and I let them share out loud how they got it and most of the time they are pretty good at it.

Ms. Taylor specifically mentioned Maria in this particular conversation; however, she also says “most of the time they are pretty good at it”. I observed Ms. Taylor frequently positioning her students as “Can I Teach You?” mathematics students. For example, Ms. Taylor allowed Maria to teach her an entire new method to solving division, Ms. Taylor pushed Jordan to demonstrate her Morning Work problem at the SmartBoard for the class to observe, Ms. Taylor used Nautica’s mathematical response to push both Nautica and
other students to think further about their mathematical reasoning, and Ms. Taylor high-fived Leah and commented on her way of solving a problem. Ms. Taylor often positioned her students in both classrooms as “Can I Teach You?” mathematics students.

“Nervous” about participating in mathematics. Although Ms. Taylor positioned her students as “Can I Teach You?” mathematics students, she also provided additional support or encouragement for students who positioned themselves as “Nervous” about participating in mathematics. Although Jordan and Leah often positioned themselves as “Nervous” about participating in mathematics, Ms. Taylor provided extra encouragement and support when needed. For example, when Jordan was selected to demonstrate her mathematics work, Ms. Taylor guided Jordan and said things like “You got this” and “I know you can do it”. Ms. Taylor said the following in our interview:

Ms. Taylor: I have my cup system where I pull my names out of the cup and if they feel comfortable…they know by this point that if I do call them up to the board it’s not to embarrass them or anything like that it’s simply let’s see what you know, what do you need help with.

Although students were visibly nervous about participating, Ms. Taylor pushed all students to engage in mathematics and her goal was to see what they knew and how she could support them.

On task. I observed Ms. Taylor supporting students role in the on task storyline. Ms. Taylor provided opportunities for students to ask questions, seek understanding when they were unsure, or compare their answers to that of their peers. I observed Maria,
Nautica, and Leah asking for clarification or posing mathematical questions for Ms. Taylor to respond. Ms. Taylor supported this storyline because she always listened to her students' questions and responded when they needed extra help or support.

“I Just Talk Freely”. Ms. Taylor viewed student engagement as crucial to her classroom. I asked Ms. Taylor if there was anything she would like to say about student engagement around mathematics in her classroom:

Ms. Taylor: I feel like student engagement is very important to mathematics. I don’t feel like there is a lot…that you can do without showing some type of engagement. Whether it be engagement in writing the problem out, or talking about it with a peer buddy…it’s only building upon what they already know…

The students knew Ms. Taylor’s classroom was a space where they could speak freely and contribute to mathematical discussion (Moschkovich, 1999). Ms. Taylor, however, did address Nautica when she engaged in the “I Just Talk Freely” storyline. I observed Ms. Taylor asking Nautica to hold on or shushing Nautica if she spoke out of turn. Ms. Taylor never punished Nautica, rather she frequently let Nautica share and participate in the conversation. If Nautica did get completely out of line, Ms. Taylor would quickly address the situation.

**Summary of Ms. Taylor’s interactions and support contributes to the students’ enacted storylines.** Ms. Taylor was greatly involved in the storylines occupied by the participants. Similar to the findings of Frenzel et al. (2009), Ms. Taylor created a classroom environment that encouraged conversation, and she often gave students opportunities to share their mathematical thinking and learning. Ms. Taylor frequently
positioned her students as “Can I Teach You?” mathematics students and supported her students whether they were a “Get Up There and Talk” or “One-on-One” mathematics students. Ms. Taylor supported all types of storylines and her support mattered more to students than whether they were in an all-girls or coeducation mathematics classroom.

**Overview of Implications**

The findings and implications from this study suggest girls in middle grades mathematics single-gender and coeducation classrooms construct mathematical Discourse (Moschkovich, 2003) through engaging in written, spoken, acted, listening, and interacted (Gee, 1999) mathematical Discourses (Moschkovich, 2003). Some students positioned themselves as “Can I Teach You?” mathematics students and were also “Get Up There and Talk” participants in the mathematics classroom, while others positioned themselves as “One-on-One” mathematics students who were “Nervous” about participating in the mathematics classroom. I found very similar types of mathematical Discourse (Moschkovich, 2003) and positionings in the single-gender and coeducational mathematics classroom.

In seeking to contribute to our understandings of the affordances and drawbacks of single-sex classroom spaces, findings and implications from this study suggest there are a variety of storylines in each classroom setting, students’ enactment of a storyline is based on their level of comfort and safety in the classroom environment, and Ms. Taylor’s interactions and support contributes to the enacted storylines. Findings from this study are similar to other studies which suggest further exploration of these classroom spaces, and in some cases no differences in evidence to support single-sex education
versus coeducation (Che et al., 2012; Carter et al., 2014; Kombe et al., 2016). Findings from this study suggest these classroom settings do not seem to influence the ways students construct mathematical Discourse (Moschkovich, 2003). The students’ level of comfort and support from their teacher is important for constructing mathematical Discourse (Moschkovich, 2003) and for engaging in storylines.

**Further Research**

As previously mentioned, I believe it is important that we facilitate success for all students in mathematics. Following the influential work of Fennema (1974) all students have the ability to be successful in mathematics. Therefore, it is imperative we understand the affordances and drawbacks of these classroom spaces for girls and for boys. This study seeks to understand the impacts of single-sex classroom spaces for girls; however, another potential study which stems from this study is the need to examine how boys construct mathematical Discourse (Moschkovich, 2003) in single-sex and coeducation mathematics classes.

When considering the positioning of students in these classroom spaces and the storylines in which the participants engage, another possible research study which stems from this study would be to examine how the teacher positions girls or boys in single-sex classroom spaces. More specifically, examining how the teacher supports different positions or storylines occupied by students in an all-girls classroom versus positions or storylines occupied by students in an all-boys classroom.

In considering that the two less vocal students in this study were Black females, it is imperative that we need much more research about the experiences of underrepresented
students in mathematics classrooms. Not only did both students speak of not-so-nurturing previous classroom experiences, but also the ways we construct characteristics of Discourse and how we look for Discourse are almost certainly influenced by white-centered and white-privileged perspective. According to Jones (2003), “Little research has been conducted with or for young working-class black girls and their lived experiences as they construct mathematical identities” (p. 221). In addition to understanding how underrepresented students experience mathematics classrooms, we also need to further understand how those experiences may inhibit students from fully engaging in publicly shared discourses. Joseph, Hailu, and Matthews stated:

Malloy (1997) warned decades ago that “mathematics educators have little knowledge of how African American students perceive themselves as mathematics students, how they approach mathematics, or the role of culture in their perception and mathematics performance” (p. 23). Yet current research still has not sufficiently addressed this, particularly in examining how Black girls perceive themselves as mathematics learners and how those perceptions contribute to their success or failure” (2019, p. 137).

Pointing to the work of Joseph, Hailu, and Matthews (2019) and to the findings from this study, it is imperative that we continue to research the experiences of underrepresented students in the mathematics classroom and how those experiences impact mathematics perception and engagement in mathematical Discourse (Moschkovich, 2003).

**Strengths and Limitations**
A strength of this study was the extensive amount of collected and analyzed data. Three different lessons over three different units per class type were audio-visually recorded and transcribed for each case. Transcriptions included not only talk (Gee, 1999), but actions (Gee, 1999), gestures, and interactions (Gee, 1999) which took place for each participant with their peers and teacher. Data also included recordings of interviews with the teacher and students, which were transcribed and included in analysis. Analysis of all collected data took into account constructed mathematical Discourse (Moschkovich, 2003), positions, and storylines for each participant. Further, the teacher who taught these courses was a veteran teacher of fourteen years and eight years teaching single-gender mathematics classes.

A limitation of this study was that there were only four cases which included the same teacher in all four cases. One teacher allowed for a better comparison between the four cases; however, having additional cases would provide a richer picture for how students construct mathematical Discourse (Moschkovich, 2003) in these classroom spaces. An additional limitation was that I was the only researcher who designed, implemented, and analyzed all data. However, to address this limitation, I followed protocols for transparency, addressed my personal biases in my personal rationale, and used the collected data to describe what I observed in the single-gender and coeducation classrooms.
Appendix A

Case Study Protocol

Section A: Overview of the Case Study
- Objectives
- Case Study Issues
- Relevant readings about the topic being investigated

Section B: Data Collection Procedures
- IRB
- Sources of data
- Presentation of credentials to field contacts
- Logistical reminders

Section C: Data Collection Questions

<table>
<thead>
<tr>
<th>Research Questions</th>
<th>Sources of Evidence</th>
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<tbody>
<tr>
<td>In what ways do girls in middle grades mathematics classes engage in constructing mathematical Discourses in both coeducational and single-sex environments?</td>
<td>Classroom Observations, Audio-Visual Recordings, Student Interviews, Documentation</td>
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<tr>
<td>How do girls construct mathematical Discourses with other students in their classroom? What forms of positioning do girls utilize as they construct mathematical Discourses with other students in their classroom?</td>
<td>Classroom Observations, Audio-Visual Recordings, Student Interviews, Documentation</td>
</tr>
<tr>
<td>How do girls construct mathematical Discourses with their teacher in their classroom? What forms of positioning do girls utilize as they construct mathematical Discourses with their teacher in their classroom?</td>
<td>Classroom Observations, Audio-Visual Recordings, Student Interviews, Documentation, Teacher Interviews</td>
</tr>
</tbody>
</table>
How do these methods or approaches of constructing these mathematical Discourses compare across coeducational or single-sex environments?

| Classroom Observations, Audio-Visual Recordings, Student Interviews, Teacher Interviews, Documentation |

Section D: Guide for Case Study Report
- Outline
- Format for the data
- Use and presentation of other documentation
- Bibliographical information
Appendix B

Observation Protocol

Expanded Version of the Observation Protocol is Stored in Google Sheets

<table>
<thead>
<tr>
<th>Observation #</th>
<th>Time</th>
<th>Event</th>
<th>Scale</th>
<th>Storyline</th>
<th>Student Positioning</th>
<th>Teacher Positioning</th>
<th>Communication App</th>
<th>Distance of Interest</th>
<th>Description Notes</th>
<th>Reflective/Expanded Notes</th>
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Appendix C

Student Interview Protocol

Part 1

General Participant Information:

<table>
<thead>
<tr>
<th>Student Name (Pseudonym)</th>
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<tr>
<td>Grade</td>
<td></td>
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<tr>
<td>Mathematics Class</td>
<td></td>
</tr>
<tr>
<td>Teacher Name (Pseudonym)</td>
<td>Ms. Taylor</td>
</tr>
<tr>
<td>Interviewer</td>
<td>McKenzie Brittain</td>
</tr>
<tr>
<td>Date</td>
<td>11/11/2019</td>
</tr>
</tbody>
</table>

Part 2

1. Explain purpose of interview.
2. Obtain written consent with signature of Institutional Review Board (IRB) consent form.

Part 3

Interview Questions

1. Tell me how you feel about being in this class?
2. How do you feel about being in other classes?
3. How do you contribute to the ideas in this class?
4. How do you contribute to the understandings that y'all are developing?
5. Talk to me about your favorite class. Why is that class your favorite?
6. Is there anything else you would like to say about how you interact and communicate with your peers in this class?
7. Is there anything else you would like to say about how you interact and communicate with your teacher in this class?

Part 4

Interview Questions that Arose from Observations

1. How do you feel about speaking up in class?
2. How do you decide when to speak up in class and why?
3. How do you feel about volunteering to demonstrate your work at the board and why?
4. Is there anything else you would like to say about how you engage in your classwork?

Part 5

1. Thank the participant for their information and participation in the study.
2. Remind interviewee of the confidentiality agreement.
Appendix D

Teacher Interview Protocol

Part 1

General Participant Information:

<table>
<thead>
<tr>
<th>Teacher Name (Pseudonym)</th>
<th>Ms. Taylor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade</td>
<td>Teaches 6th Grade SS and CE</td>
</tr>
<tr>
<td>Mathematics Class</td>
<td>6th Grade Mathematics</td>
</tr>
<tr>
<td>Interviewer</td>
<td>McKenzie Brittain</td>
</tr>
<tr>
<td>Date</td>
<td>11/11/2019</td>
</tr>
</tbody>
</table>

Part 2

1. Explain purpose of interview.
2. Obtain written consent with signature of Institutional Review Board (IRB) consent form.

Part 3

Interview Questions

1. Talk to me about teaching your classes? What is that like for you? How do you feel about that?
2. How do you provide opportunities for students to contribute to ideas in class? Do you think that is important?
3. Think about your favorite class you have taught. Why was that class your favorite to teach?

Part 4

Interview Questions that Arose from Observations

1. Are discussion and collaboration around mathematical tasks and activities a norm in your classroom? Explain.
2. How often do students have the opportunity to share their ideas?
3. How do you decide when to select students to demonstrate their work for the class to observe?
4. How do you decide when to select students to describe or share their work verbally?
5. How do you decide when to allow students to share their responses in chorus?
6. If students do not seem as engaged in their work or with peers, how do you know they are grasping the ideas you are teaching?
7. Is there anything else you would like to say about student engagement around mathematics in your classroom?
8. Is there anything else you would like to say about how you interact and communicate with your students?
Part 5

___ Thank the participant for their information and participation in the study.
___ Remind interviewee of the confidentiality agreement.
## Appendix E

### Timeline

<table>
<thead>
<tr>
<th>Summer</th>
<th>Obtain IRB approval, Contact recruited school to discuss recruitment of teachers and start date.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Week 1 and Week 2</strong></td>
<td>Observe Classroom Twice, Determine Participants, Initial Meeting (all participants): handout consent forms, discussion of study, meet teacher, meet students in classrooms, overview of timeline. Collect consent forms. Initial Meeting (Teacher only): determine best dates/times for data collection over each unit.</td>
</tr>
<tr>
<td><strong>Week 3</strong></td>
<td>Collect all remaining consent forms.</td>
</tr>
<tr>
<td><strong>Unit 1</strong></td>
<td>Data Collection: Observe Lesson 1 in each classroom space, audio-visually record, collect documents</td>
</tr>
<tr>
<td><strong>Data Analysis</strong></td>
<td>Analyze data for Lesson 1 in single-gender and data for Lesson 1 in coeducational</td>
</tr>
<tr>
<td><strong>Unit 2</strong></td>
<td>Data Collection: Observe Lesson 2 in each classroom space, audio-visually record, collect documents</td>
</tr>
<tr>
<td></td>
<td>Additionally: Constant comparative method (Compare all data from Lesson 1 and Lesson 2)</td>
</tr>
<tr>
<td><strong>Data Analysis</strong></td>
<td>Analyze data for Lesson 2 in single-gender and data for Lesson 2 in coeducational</td>
</tr>
<tr>
<td><strong>Interview Participant Recruitment</strong></td>
<td>Contact teacher and arrange interview times and dates. Also determine time and date for teacher interview.</td>
</tr>
<tr>
<td><strong>Interviews</strong></td>
<td>Conduct Interviews with selected students and teacher.</td>
</tr>
<tr>
<td><strong>Unit 3</strong></td>
<td>Data Collection: Observe Lesson 3 in each classroom space, audio-visually record, collect documents</td>
</tr>
<tr>
<td>Data Analysis</td>
<td>Analyze data for Lesson 3 in single-gender and data for Lesson 3 in coeducational</td>
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<td>------------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------------</td>
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<tr>
<td></td>
<td>Additionally: Constant comparative method (Compare all data from Lesson 1, Lesson 2, and Lesson 3 + Interviews+Documents)</td>
</tr>
<tr>
<td>Interviews if Needed</td>
<td>After analyzing all data, determine if additional interviews are needed.</td>
</tr>
<tr>
<td>Last Week of Study</td>
<td>Collect any remaining documents or forms necessary to complete the study and address IRB. Thank all participants for their time and willingness to participate in the study.</td>
</tr>
</tbody>
</table>
Appendix F

Parent Letter for Class

Parent Permission Form
Clemson University

Girls’ Construction of Mathematical Discourse in Single-Sex and Coeducational Classroom Environments

KEY INFORMATION ABOUT THE RESEARCH STUDY

Voluntary Consent: Dr. Megan Che and McKenzie Brittain will be conducting a research study in your child’s class this year and will be video recording the class to observe how the students engage in their daily activities with their mathematics teacher and classmates. Dr. Che is a faculty member and McKenzie Brittain is a graduate student at Clemson University.
You may tell us at any time that you do not want your child to be in the study. Your child will not be punished in any way if he/she does not take part in the study or stop taking part in the study. Your child’s grades will not be affected by any decision you make about this study.

We will also ask your child if he/she wants to take part in this study. Your child may refuse to take part or quit being in the study at any time.

Alternative to Participation: Participation is voluntary and the only alternative is to not participate. If you do not want us to include your child in our observations, then let us know by August 23, 2019 and we will not include your child during data analysis.

Study Purpose: The purpose of this research is to gain an in-depth understanding of how girls engage in constructing mathematical discourses with both peers and teachers in single-gender and coeducational classrooms.

Activities and Procedures: Your child’s part in the study will be to engage in their daily activities with their mathematics teacher.

Participation Time: Ms. Brittain will collect data for one lesson per unit, over the course of three units.

Risks and Discomforts: There are no expected risks or discomforts that your child should experience if he/she takes part in this research.
**Possible Benefits:** Your child may not benefit directly for taking part in this study; however, this study will contribute to the field of education.

**AUDIO/VIDEO RECORDING AND PHOTOGRAPHS**
Each lesson will be audio-visually recorded. All recordings will be securely stored and will not be shared publicly. Recordings will be retained for 5 years.

**EQUIPMENT AND DEVICES THAT WILL BE USED IN THE RESEARCH STUDY**
Audio-visual recording devices will be used for each lesson.

**PROTECTION OF PRIVACY AND CONFIDENTIALITY**
The results of this study may be published in scientific journals, professional publications, or educational presentations.

Confidentiality: The researcher will appropriately protect the information disclosed to them. Data will be safely secured on a locking hard drive.

The video recordings of the class will not be used for future research studies or distributed to another investigator for future research studies.

**CONTACT INFORMATION**
If you have any questions or concerns about your child’s rights in this research study, please contact the Clemson University Office of Research Compliance (ORC) at 864-656-0636 or irb@clemson.edu. If you are outside of the Upstate South Carolina area, please use the ORC’s toll-free number, 866-297-3071. The Clemson IRB will not be able to answer some study-specific questions. However, you may contact the Clemson IRB if the research staff cannot be reached or if you wish to speak with someone other than the research staff.

If you have any study related questions or if any problems arise, please contact McKenzie Brittain at Clemson University at (864) 918-7041 or mhoxit@g.clemson.edu.

**CONSENT**
By allowing your child to participate in the study, you indicate that you have read the information written above, been allowed to ask any questions, and you are voluntarily choosing for your child to take part in this research. Your family does not give up any legal rights by taking part in this research study.

You may keep this notice for your records.
Appendix G

Parent Permission Form for Each Participant

Parent Permission Form
Clemson University

Girls’ Construction of Mathematical Discourse in Single-Sex and Coeducational Classroom Environments

KEY INFORMATION ABOUT THE RESEARCH STUDY

Voluntary Consent: Dr. Megan Che and McKenzie Brittain are inviting your child to volunteer for a research study. Dr. Che is a faculty member and McKenzie Brittain is a graduate student at Clemson University.

You may tell us at any time that you do not want your child to be in the study. Your child will not be punished in any way if he/she does not take part in the study or stop taking part in the study. Your child’s grades will not be affected by any decision you make about this study. We will also ask your child if he/she wants to take part in this study. Your child may refuse to take part or quit being in the study at any time.

Alternative to Participation: Participation is voluntary and the only alternative is to not participate.

Study Purpose: The purpose of this research is to gain an in-depth understanding of how girls engage in constructing mathematical discourses with both peers and teachers in single-gender and coeducational classrooms.

Activities and Procedures: Your child’s part in the study will be to engage in their daily activities with their mathematics teacher. As part of the study, I will collect instructional materials that coincide with the lessons observed, including lesson plans, homework assignments, etc.

A few students will be asked to participate in an individual interview; however, they are not required and may choose to not participate. In the individual interview, I will ask your child not to share any information that may be personal or embarrassing. Your child may refuse to answer any questions or leave the discussion at any time if he/she becomes uncomfortable.

Participation Time: McKenzie Brittain will collect data for one lesson per unit, over the course of three units. If your child is asked to participate in an individual interview, it will take your child about 30 minutes to be in this study.
Risks and Discomforts: There are no expected risks or discomforts that your child should experience if he/she takes part in this research.

Possible Benefits: Your child may not benefit directly for taking part in this study; however, this study will contribute to the field of education.

AUDIO/VIDEO RECORDING AND PHOTOGRAPHS

Each lesson and individual interview will be audio-visually recorded. All recordings will be securely stored.

EQUIPMENT AND DEVICES THAT WILL BE USED IN THE RESEARCH STUDY

Audio-visual recording devices will be used for each lesson and interview.

PROTECTION OF PRIVACY AND CONFIDENTIALITY

The results of this study may be published in scientific journals, professional publications, or educational presentations.

With your permission, video recordings of your child may be used for future research studies or distributed to another investigator for future research studies. We will ask you to sign a separate media release form.

CONTACT INFORMATION

If you have any questions or concerns about your child’s rights in this research study, please contact the Clemson University Office of Research Compliance (ORC) at 864-656-0636 or irb@clemson.edu. If you are outside of the Upstate South Carolina area, please use the ORC’s toll-free number, 866-297-3071. The Clemson IRB will not be able to answer some study-specific questions. However, you may contact the Clemson IRB if the research staff cannot be reached or if you wish to speak with someone other than the research staff.

If you have any study related questions or if any problems arise, please contact McKenzie Brittain at Clemson University at (864) 918-7041 or mhoxit@g.clemson.edu.

CONSENT
By allowing your child to participate in the study, you indicate that you have read the information written above, been allowed to ask any questions, and you are voluntarily choosing for your child to take part in this research.

___ I give permission for my child to be video recorded AND for video recordings to be shared publicly, used for future research studies or distributed to another investigator for future research studies. You have to sign a separate media release form.

___ I give permission for my child to be video recorded for this study only. Video recordings WILL NOT be shared publicly, used for future research studies or distributed to another investigator for future research studies. Recordings will be retained for 5 years.

Print child’s name: _____________________________________________

Print parent’s name: ___________________________________________

Parent’s signature: _______________________________ Date: __________

A copy of this form will be given to you.
Appendix H

Teacher Consent to Be in a Research Study Form

Information about Being in a Research Study
Clemson University

Girls’ Construction of Mathematical Discourse in Single-Sex and Coeducational Classroom Environments

KEY INFORMATION ABOUT THE RESEARCH STUDY

**Voluntary Consent:** Dr. Megan Che and McKenzie Brittain are inviting your child to volunteer for a research study. Dr. Che is a faculty member and McKenzie Brittain is a graduate student at Clemson University.

You may choose not to take part and you may choose to stop taking part at any time. You will not be punished in any way if you decide not to be in the study or to stop taking part in the study. Your decision to participate in the study will not affect your employment.

**Alternative to Participation:** Participation is voluntary and the only alternative is to not participate.

**Study Purpose:** The purpose of this research is to gain an in-depth understanding of how girls engage in constructing mathematical discourses with both peers and teachers in single-gender and coeducational classrooms.

**Activities and Procedures:** Your part in the study will be to engage in your daily activities in your mathematics classroom and to participate in an individual interview.

**Participation Time:** McKenzie Brittain will collect data for one lesson per unit, over the course of three units. The individual teacher interview will take about 60 minutes.

**Risks and Discomforts:** There are no expected risks or discomforts that you should experience if you take part in this research.

**Possible Benefits:** You may not benefit directly from taking part in this study; however, this study will contribute to the field of education.

**AUDIO/VIDEO RECORDING AND PHOTOGRAPHS**

Each lesson and individual interview will be audio-visually recorded. All recordings will be securely stored.
EQUIPMENT AND DEVICES THAT WILL BE USED IN RESEARCH STUDY

Audio-visual recording devices will be used for each lesson and interview.

PROTECTION OF PRIVACY AND CONFIDENTIALITY

The results of this study may be published in scientific journals, professional publications, or educational presentations.

With your permission, video recordings may be used for future research studies or distributed to another investigator for future research studies. We will ask you to sign a separate media release form.

If you DO NOT sign a media release form, the recordings will be retained for 5 years and will not be shared publicly, used for future research studies or distributed to another investigator for future research studies.

CONTACT INFORMATION

If you have any questions or concerns about your rights in this research study, please contact the Clemson University Office of Research Compliance (ORC) at 864-656-0636 or irb@clemson.edu. If you are outside of the Upstate South Carolina area, please use the ORC’s toll-free number, 866-297-3071. The Clemson IRB will not be able to answer some study-specific questions. However, you may contact the Clemson IRB if the research staff cannot be reached or if you wish to speak with someone other than the research staff.

If you have any study related questions or if any problems arise, please contact McKenzie Brittain at Clemson University at (864) 918-7041 or mhoxit@g.clemson.edu.

CONSENT

By participating in the study, you indicate that you have read the information written above, been allowed to ask any questions, and you are voluntarily choosing to take part in this research.

A copy of this form will be given to you.
Appendix I

Child Participant Release Form

Clemson University Authorization for Use of Photographic/Image/Video/Voice Recording

Clemson University Research Project: Girls’ Construction of Mathematical Discourse in Single-Sex and Coeducational Classroom Environments
Department: Teaching and Learning
Clemson University Contact: The faculty contact is Dr. Megan Che and the graduate student contact is McKenzie Brown.

Child Participant’s Name: ___________________________
Parent’s Name: ___________________________

By signing below, you are giving Clemson University permission to make audiovisual recordings and photographs of your child while he/she is participating in the research project described above and to use those recordings and photographs for research and/or educational purposes.

PLEASE READ THIS DOCUMENT CAREFULLY. It affects the rights you may have concerning the use by Clemson University of any photographs, video, images or voice recording taken of your child during the research project identified above.

I, ___________________________ hereby grant permission to Clemson University and its representatives, volunteers, students and employees to take photographs and/or videos of my child identified above, to make recordings of my child’s voice, and to obtain a transcript of my child’s spoken or written words during his/her participation in the Clemson University research project described above. I give Clemson University permission to use these images, recordings, and spoken or written comments, as follows:

1. To copy, reproduce, distribute, modify, display and perform.
2. To use in composite or modified forms in any media, now known or later developed, including but not limited to publications, books, journals, newspapers, television, radio, sound track recording, motion picture, filmstrip, still photograph, the Internet, the world wide web, or any transcript.
3. For education, and research purposes including but not limited to research and/or academic papers, books and publications; research presentations at academic conferences/meetings; and classroom presentations throughout the world and in perpetuity.
4. My child’s name and contact information will not be disclosed in connection with these uses.

I agree that I will receive no further consideration for these uses and that Clemson University owns all rights to the images and recordings. I waive the right to inspect or approve uses of the images, recordings or written copies.

I hereby release Clemson University, its representatives, agents, employees and assignees from any claims that may arise from these uses, including claims of defamation, invasion of privacy, or rights of publicity or copyright. This release is binding on me, my heirs, assignees and estate and represents the entire agreement between my child and Clemson University regarding the matters herein.

I agree that Clemson University is not obligated to use any of the rights granted under this Agreement.

______________________________  ___________________________
Signature of Parent or Guardian      Date
Appendix J

Adult Release Form

Clemson University Authorization for Use of Photographic/Image/Video/Voice Recording

Program Name: Clemson University
Dates of Program: ________
Clemson University Contact: ________

Participant’s Name: ______________________

PLEASE READ THIS DOCUMENT CAREFULLY. It affects the rights you may have concerning the use by Clemson University of any photographs, video, images or voice recording taken of you during the program identified above.

I, ______________________, hereby grant permission to Clemson University and its representatives and employees to take photographs or videos of me, to make recordings of my voice, and to obtain a transcript of my spoken or written words during my participation in the Clemson University ________. I give Clemson University permission to use these images, recordings, and spoken or written comments, as well as my name, likeness, voice and biographical information as follows:

1. To copy, reproduce, distribute, modify, display and perform.
2. To use in composite or modified forms in any media, now known or later developed, including but not limited to publications, newspapers, television, radio, sound track recording, motion picture, filmstrip, still photograph, the Internet, the world wide web, or any transcript.
3. For purposes including but not limited to education, research, trade, advertising, and promotion of the project throughout the world and in perpetuity.

I agree that I will receive no further consideration, other than that already received, for these uses and that Clemson University owns all rights to the images and recordings. I waive the right to inspect or approve uses of the images, recordings or written copies.

I hereby release Clemson University, its representatives, agents, employees and assigns from any claims that may arise from these uses, including claims of defamation, invasion of privacy, or rights of publicity or copyright. This release is binding on me, my heirs, assigns and estate and represents the entire agreement between me and Clemson University regarding the matters herein.

I agree that Clemson University is not obligated to use any of the rights granted under this Agreement.

Participant’s Signature ___________________________ Date ________________
References


Office for Civil Rights. (2002). *Guidelines on Title IX Requirements*.


Patton, M. Q. (2002). *Qualitative research & evaluation methods*. SAGE.


