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# The Impact of Single-Sex Education on Male and Female Gains in Mathematics and Reading at the Elementary Level in a Selected School in North Carolina

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The Impact of Single-Sex Education on Male and Female  
Gains in Mathematics and Reading at the Elementary Level  
in a Selected School in North Carolina

By  
Lisa O'Neill

A Dissertation Submitted to the  
Gardner-Webb University School of Education  
in Partial Fulfillment of the Requirements  
for the Degree of Doctor of Education

Gardner-Webb University  
2011

## Approval Page

This dissertation was submitted by Lisa O'Neill under the direction of the persons listed below. It was submitted to the Gardner-Webb University School of Education and approved in partial fulfillment of the requirements for the degree of Doctor of Education at Gardner-Webb University.

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could not have achieved this goal without him by my side. His belief in me and devotion to caring for our two young children enabled me to give 100% to my research and writing. I also dedicate this dissertation to my two children, Joseph and Kiley, who have given me an authentic desire to learn more about how to best educate young boys and girls. They gave me reasons to laugh on even my most stressful working days. Their smiles, laughs, hugs, and kisses helped get me through the last couple years with my sanity intact. I thank God for blessing me with my amazing family.

## **Abstract**

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The gender gap in achievement and the increasing awareness of differences between male and female cognitive development have ignited a growing interest in single-sex education. No Child Left Behind legislation and amendments to Title IX legislation have increased the number of schools in America offering single-sex education.

This 2-year quasi-experimental explanatory mixed methods study explores the impact of single-sex education on an economically disadvantaged school's fifth-grade students' academic gains in mathematics and reading achievement in comparison to their peers in demographically similar coeducational classrooms in the same school.

Quantitative data were collected from standardized state test scores in reading and mathematics for the participating students' fifth-grade year. One year's worth of growth was calculated using the students' prior year's standardized test scores as baseline data. Statistical tests, including univariate ANOVAs, repeated measures ANOVAs, *t*-tests, and chi-square tests, were used to determine whether there were any statistically significant differences between the various groups' growth in reading or mathematics that could be attributed to the gender composition (coeducational or single-sex) of the classes. In addition, qualitative data were collected through interviews with the participating fifth-grade teachers. The qualitative data explored the teachers' perceptions of how the gender composition of their classrooms impacted their students' growth in reading and mathematics.

Most of the statistical analyses reveal nonsignificant findings regarding the impact of single-sex education on academic gains. However, a deeper exploration of the descriptive statistics and qualitative data supports further research on single-sex education. While not always statistically significant, the single-sex classes tended to make larger gains in both mathematics and reading than the coeducational classes and subgroups. This is especially true for males in reading. Both years of the study revealed higher gains for single-sex males in this subject area. In addition, qualitative data from teacher interviews revealed teachers' support of single-sex education. These teachers believed that single-sex education had a positive impact on student gains in mathematics and reading. They noted that their students seemed more comfortable, asked more questions, and participated more often in single-sex classes.

This study adds to the limited body of research on single-sex education and provides reason to experiment with the strategy; analysis reveals no downside to single-sex education or support for coeducation. It suggests that with larger sample sizes there may be more findings revealing statistically significant differences favoring single-sex classes.

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## **Chapter 1: Introduction and Problem Statement**

### **Introduction**

A recent report by the Center on Education Policy (2010) revealed data that support the long-held view that there is a gap in the achievement levels between males and females. Studies reaching around the globe and spanning many years have upheld the belief that males typically excel in mathematics, science, and spatial reasoning and females in reading, writing, and verbal skills (Clark, 2004). The No Child Left Behind Act's requirement for schools to report test scores separated by sex supports the importance America places on monitoring and closing the achievement gap between the sexes (U.S. Department of Education, n.d.). Since the enactment of Title IX in 1972, which made discrimination in, or exclusion from, educational programs or activities that received federal funding based on sex illegal, many educational advancements, especially by females, have been made (The American Association of University Women [AAUW], 2009). However, many people believe the focused attention on the advancement of females over the last 38 years has actually ignited a crisis in the education of males, leaving them to be the forgotten sex and suffering in school (Sax, 2005).

Single-sex education is believed by many to have positive potential as a solution to the gender gap problem, regardless of which sex they see as the injured party. Most research on the effects of single-sex education thus far comes from outside of the United States, including the United Kingdom, New Zealand, Sweden, and Australia, where Title IX's almost complete banishment of public single-sex education is not in effect. During the educational reform focus of the 1980s and 1990s, American efforts to organize single-sex schools and classrooms to address the gender gap were stifled by the strict regulations of Title IX. However, this situation began to change in 2002 when the federal

government reauthorized the Elementary and Secondary Education Act (ESEA) through No Child Left Behind (NCLB). During the year prior to NCLB's official implementation, Republican Senator Kay Bailey Hutchinson and Democratic Senator Hillary Rodham Clinton teamed up to take a closer look at Subchapter V of the act, which allowed for funds to be used for innovative school programs. They added new legislation to the subchapter, which was passed with a unanimous vote, which legalized single-sex education under the provisions of Subchapter V (Cable & Spradlin, 2008; Sax, 2005). In addition, on October 25, 2006, specific amendments to Title IX were passed that made the organization of single-sex classrooms and schools even less complicated and problematic (Hughes, 2006-2007).

Over the past 5 years public school educators in the United States have begun to experiment more with the somewhat controversial organizational strategy of single-sex education. This is evidenced by the increase of single-sex opportunities across all grade levels in single-sex schools, single-sex classrooms within coeducational schools, and after school programs (Cable & Spradlin, 2008). According to the website of the National Association for Single Sex Public Education (NASSPE, n.d.), "as of April 2010, there are at least 540 public schools in the United States offering single-sex educational opportunities" (Schools, para. 1). This number includes entire single-sex schools, but is composed mostly of coeducational schools that offer the choice of single-sex classrooms. This more widespread implementation, coupled with the achievement gap based on sex, increased the awareness and interest in, as well as controversy over, single-sex education.

### **Purpose**

South Carolina has quickly become the forerunner in the United States in single-sex education. According to the NASSPE (n.d.) website, the state offers more single-sex

schools and classrooms, with 172 schools accounted for at the end of 2009, than any other state. South Carolina was the first state to create an official position, Coordinator of the Single-Gender Education Department, currently held by David Chadwell, which is completely responsible for managing single-sex education programs in South Carolina public schools. North Carolina is showing greater interest in single-sex education as well, as evidenced by the increase in number of public schools offering single-sex educational opportunities. Most of the single-sex initiatives in the United States at this point come from the middle and high school levels; the existing research on single-sex education at the elementary level is sparse. However, during 2009-2010, a local school district experimented with single-sex education at the elementary school level. The county has continued, and expanded, its single-sex programs during the 2010-2011 school year. The purpose of this 2-year explanatory mixed methods quasi-experimental study was to add to the limited body of research in this area by exploring single-sex education's impact on an economically disadvantaged school's fifth-grade students' academic gains in mathematics and reading achievement in comparison to their peers in demographically similar coeducational classrooms in the same school.

### **Problem Description**

The current data reveal that the gender gap continues to exist. A 2010 report by the Center on Education Policy (CEP) analyzed trends in scores for female and male achievement on high stakes tests that are used to report data for No Child Left Behind accountability. The findings reveal that females are performing almost as well as males in mathematics, but that they continue to significantly outperform males in reading at all grade levels and in all states (CEP, 2010). An additional study by Klecker (2005) found that the gap between males and females in reading increases from elementary school

through high school. There are many proposed explanations for the differences in achievement, from biological factors to societal factors; with no decisive answer as to what causes the achievement gap, educators have been left with the task of finding solutions to close it.

This study explores the possible impact one potential solution—single-sex education—may have on the academic achievement of males and females at the elementary level, which is where the gap in achievement becomes extremely apparent. The majority of research gathered thus far comes from countries outside of the United States and/or at the middle school, high school, and collegiate levels of education. Current studies all remind future researchers of the difficulties with trying to draw cause and effect relationships in educational research. It is virtually impossible to conduct true experiments and utilize random sampling, which would allow for stronger external validity. It is also difficult to control for all the extraneous variables present, such as teacher experience and style, classroom management methods, parental support, student attendance, student motivation, and student demographics. The United States Department of Education and the American Institute for Research conducted a meta-analysis of the existing research comparing single-sex education and coeducation on academic achievement (Mael, Alonso, Gibson, Rogers, & Smith, 2005). They found 2,221 citations, of which only 40 were deemed as usable studies by the team's specified criteria. The findings of the meta-analysis revealed that 41% favored single-sex, 45% found no difference, 6% were mixed, and 8% favored coed. Even with the varied results, almost all the studies agreed on the need for more controlled research in order to begin establishing a possible cause and effect relationship between gender composition of classrooms and academic achievement. The meta-analysis also revealed that very little

research has been conducted in the United States at the elementary school level on single-sex education. It is this researcher's goal to add a strong study to an area in educational research that is clearly lacking in both quantity and quality of research. Conducting a quasi-experimental study on the effects of single-sex education on academic gains is fertile ground for adding to educational research in a purposeful and meaningful way.

### **Demographics**

This study's sample was drawn from a K-5 public school located in an economically disadvantaged area in North Carolina. According to the most recently released data, from the 2009-2010 school year, the school district housing the chosen school had a 4-year graduation rate of 72% and a dropout rate of 3%. The individual school was comprised of 399 students and 43 teachers. The student population was 37.52% African American, 0.28% Asian, 41.84% Caucasian, 16.60% Hispanic, and 3.77% multicultural or mixed. Ninety-two percent of the population was considered economically disadvantaged. Forty-three percent of the population was identified as exceptional children, 0.56% as academically and intellectually gifted, and 5.16% as limited English proficient. There was a 95.99% attendance rate and student retention (nontransient students) was 76.72%. Ten percent of the student population was repeating a grade. One hundred percent of the teachers and paraprofessionals were highly qualified and 33% of the teachers had advanced degrees. There was a 0% teacher turnover rate between the 2 years of this study, the 2009-2010 and 2010-2011 school years. The school met 100% of its AYP goals the past 2 school years. During the last year of the study, the principal and assistant principal were in their third years at the school. This researcher was not affiliated in any way with the targeted school and was acting as an outside observer to assist in determining if there was a statistically significant difference,

through an analyses of variance, independent *t*-tests, and chi-square tests, in the academic gains in mathematics and reading achievement of males and females in the school's fifth-grade single-sex classes in comparison to their peers in demographically similar coeducational classrooms within the same school.

This 2-year study used data from the 2009-2010 and 2010-2011 fifth-grade classes at the school described. Chapter 3's description of the participants provides in-depth profiles of the three classes and teachers from 2009-2010 and the four classes and teachers from 2010-2011 that constituted the fifth-grade level during those respective years. The school principal and teachers shared that all classes were as similar as possible in regards to socioeconomic status, prior academic achievement levels, and behavior in order to create comparable groups of students. This helps control possible extraneous variables and isolates gender composition of the classes as the independent variable.

### **Research Questions**

The study explored the following research questions:

1. What impact does single-sex education have on fifth-grade males' gains in mathematics in comparison to their peers in similar coeducational classrooms as evidenced by standardized test scores and teachers' perceptions?
2. What impact does single-sex education have on fifth-grade males' gains in reading in comparison to their peers in similar coeducational classrooms as evidenced by standardized test scores and teachers' perceptions?
3. What impact does single-sex education have on fifth-grade females' gains in mathematics in comparison to their peers in similar coeducational classrooms as evidenced by standardized test scores and teachers' perceptions?

4. What impact does single-sex education have on fifth-grade females' gains in reading in comparison to their peers in similar coeducational classrooms as evidenced by standardized test scores and teachers' perceptions?

### **Limitations and Delimitations**

This mixed methods research study has several limitations and delimitations. Due to the difficulty of conducting true experiments in educational research, the study was a quasi-experimental design in which no attempt at random or stratified sampling was made. Due to the cluster intact sampling method that was utilized, it is difficult to generalize the findings to a larger population. In addition, this difficulty was confounded by the fact that the study only targeted one grade level, in one school, in one small geographic area. This made for a relatively small and homogeneous sample size. However, if most of the extraneous variables typically seen in educational research are controlled, the findings from the sample population may be generalizable to a larger population with similar demographics. There are several threats to the internal validity of the study, including the history and maturation of the participants. Many extraneous variables typically present in educational research may also affect the dependent variable, which is academic gains in mathematics and reading in this study. These include, but are not limited to, teaching style and experience, classroom management techniques, parental involvement, student motivation, attendance rates of teachers and students, classroom climate, and teacher-student rapport. Every attempt to control for threats to internal and external validity and present extraneous variables was made in the design of this study. Any limitations present in the study are discussed in greater detail in Chapter 5 of this dissertation.

## Definition of Terms

Most of the terms used in this study are common knowledge to most people; however, listed below are a few terms and acronyms that may need further explanation to better understand this study.

**Single-sex education.** Refers to a class or school which is composed of one sex. In this study SS is used to refer to single-sex education; this study's target is SS classrooms within coeducational schools as opposed to entire single-sex schools. This term is used synonymously with single-gender education, same-sex education, and same-gender education.

**Coeducation.** Refers to a class or school which is composed of both males and females; COED is used to refer to coeducational classrooms in this study.

**Economically disadvantaged.** Refers to students who qualify for free or reduced lunch due to their families' socioeconomic statuses; ED is used to refer to economically disadvantaged students in this study.

**Socioeconomic status.** A measure of one's social and economic position in relation to others; SES is used to refer to this term in this study.

**Title IX.** Federal law that prohibits discrimination based on sex in any education programs and activities that receive federal funding.

**Elementary and Secondary Education Act.** Federal legislation passed in 1965; emphasizes equal access to education and establishes high standards and accountability; currently reauthorized as No Child Left Behind Act.

**Nation at Risk.** Reagan administration's 1983 report that contributed to the sense that American schools are failing; began major educational reformation.

**SPSS.** Stands for Statistical Package for the Social Sciences; statistical software



program for data analysis.

**ANOVA.** Stands for analysis of variance; a statistical test to determine whether or not the means of several groups are equal.

**AIG.** Stands for academically and intellectually gifted.

**EC.** Stands for exceptional children.

**ESL.** Stands for English as a second language learner.

**End-of-grade tests.** Refers to high-stakes tests used in North Carolina to assess students' and schools' levels of achievement and growth; EOG is used to refer to this term.

**No Child Left Behind Act.** Refers to federal legislation passed in 2001 intended to ensure that all children have access to a high-quality education and reach at least proficient on state standards and assessments; NCLB is used to refer to this term.

**Sex and gender.** For the purposes of this study both terms refer to the dichotomous nature of being male or female; because the National Association for Single-Sex Public Education predominantly uses the term *sex*, this study does as well, but the two may be used interchangeably based on best fit and flow within context.

## **Summary**

The remainder of this dissertation is divided into four additional chapters. Chapter 2 presents a review of the most current literature on the gender gap and single-sex education in the public school arena. Chapter 3 details the methodology of this explanatory mixed methods quasi-experimental study, including the procedures for data collection and analysis. Chapter 4 presents an analysis of the data. In conclusion, Chapter 5 provides a summary of the study, including a discussion of the findings and suggestions for future research.

## **Chapter 2: Literature Review**

### **Introduction**

The academic achievement of both males and females has become a major focus during the age of accountability in education. Federal and state mandates require high stakes test scores to be disaggregated by gender. Educators are intent on identifying strategies to address the diverse needs of both males and females. This literature review is two-fold in that it focuses on the differences in academic achievement between males and females, commonly known as the gender gap, in addition to the hotly contested strategy of single-sex education, which has been given much attention as a possible answer to the problems arising from the gender gap.

The following literature review provides evidence of the gender gap's existence over time in both the United States and worldwide. It also reveals the importance educators and policymakers place on the need to address the discrepancies between male and female academic achievement. In addition, the review focuses on single-sex education as a possible solution to the gender gap. The literature reveals the progression of single-sex education from its historical beginnings to its renewed interest and current implementation. Arguments from both the proponents and opponents are included to provide a realistic view of the status of single-sex education in public schools in America today. The literature review ends with an overview of the existing research on the impacts of single-sex education on the academic success of males and females in today's schools.

Much time was spent searching educational journals, current newspapers and magazines, books, and online to gather information for the literature review. However, the bulk of the research comes from the Academic Search Premier Database and ERIC

Database, where many scholarly, peer-reviewed articles on the topics of interest are available. It should be noted that most of the literature and research is very current, from the first decade of the 21<sup>st</sup> century. However, due to the limited research on single-sex education, seminal studies that come from as far back as 1996 are cited. In order to most effectively organize the content of the literature review, the choice was made to structure the review by topic as opposed to date. Therefore, at times the literature review moves back and forth in time. The use of subheadings will be incorporated to help the reader follow the general timeline regarding the gender gap and single-sex education.

### **Gender Gap**

During the mid-to-late 1980s much attention was placed on the achievement gap between the sexes, commonly referred to as the gender gap; however, this was not a new issue. Much literature and research cite the well-publicized achievement gap between males and females in various countries, including the United States, Australia, England, Scotland, Wales, Austria, and New Zealand (Malacova, 2007; Mulholland, Hansen, & Kaminski, 2004).

Studies around the globe and over many years have supported the widely held belief that males typically excel in mathematics, science, and spatial reasoning, while females excel in reading, writing, and verbal skills (Clark, 2004). In 1985, the International Association for Evaluation of Educational Achievement (IEA) found gender to be the greatest predictor of success when analyzing writing achievement across 14 countries (as cited in Taylor, 2004). In 1988, IEA revealed that girls had higher literacy scores across the board in 32 countries (Taylor, 2004). According to Willingham and Cole (as cited in Riordan & Galipeau, 1998), the Educational Testing Service conducted a 4-year study analyzing the gender gap. The study revealed that differences between

males and females have gotten much smaller. Females have almost closed the gap in mathematics and science, but males have not done so in reading and writing (Riordan, 1998). In the 2006 Progress in International Reading Literacy Study, which assessed fourth-grade literacy skills in 40 countries throughout the world, females outscored males on all indicators for countries with adequate data (Sadowski, 2010). The Center on Education Policy (2010) analyzed state test score trends in the United States from the 2002 implementation of the No Child Left Behind Act through 2007-2008. Results revealed that females were scoring higher, by as many as 10 points, on state standardized reading achievement tests in all states that had sufficient data. A United Kingdom study analyzing a national data bank for a 6-year period found that though the gender gap is lessening due to female achievement increasing, it does continue to exist (Malacova, 2007). In addition, according to Sukhnandan (as cited in Wills, 2007, p. 130), “The general outperformance by girls of boys for pupils of all races is consistent for those pupils from working-class backgrounds.” The data continue to go back and forth between which gender is in need of assistance. Leonard Sax, a family physician and psychologist known for his research on gender differences and support for single-sex public education, claims, “Boys have problems, girls have problems. Both are disadvantaged, but they are disadvantaged in different ways” (as cited in Ellison, 2010, para. 12).

**Disadvantaged females.** Prior to 1972, the disadvantaged group, in regards to the gender gap, was commonly believed to be the female subgroup (Riordan, 1998). In 1949, only 30% of college students were female (Sax, 2007). In 1971, 43% of bachelor’s degrees and 40% of master’s degrees were held by females, while 41% of all college students were female (Riordan, 1998). In an analysis of gender gap trends from 1972-

1992 in Catholic high schools, Riordan (1998) claimed that girls continued to be the disadvantaged group, lacking academic opportunity, being held to lower standards and expectations by teachers, and being excluded from many extracurricular activities. Most females during this time period were found to do more homework and work less part-time hours, but were less likely to be on a college track program in high school (Riordan, 1998). These concerns for females prompted federal legislation, Title IX of 1972, that sought to level the educational playing field for females.

**Disadvantaged males.** With the attention given to providing females with equity in education during the 1970s, 80s, and 90s, many people began to perceive a *boys' crisis* occurring in American public schools (Cable & Spradlin, 2008). According to Sax (2005), also the founder of the National Association for Single-Sex Public Education, some believe males are far behind in academic achievement in general, whereas females are now believed to outperform males in all subject areas based on report card grades and standardized test scores. Females are beginning to even outperform males in historically male-favored subjects, such as mathematics and science (Mulholland et al., 2004). According to the National Assessment of Educational Progress (NAEP) data (as cited in Sadowski, 2010), the percentage of males scoring at or above the *proficient* level in reading is, and has been for decades, below the percentage of females doing so in 48 of the 50 states. According to Viadero's (2006) analysis of NAEP reading scores, females have outperformed males in fourth, eighth, and twelfth grades since 1971. In addition, the gap between the genders in reading increases from fourth to twelfth grade (Klecker, 2005). According to Hedges and Nowell (as cited in Riordan, 1998), there is also a significant and profound difference, favoring females, in writing by fourth grade. James (2007) added to this research through an analysis of writing scores at the fourth-, eighth-,

and twelfth-grade levels. Her longitudinal study revealed that females held a 16 to 20 point advantage over males in 1998, which increased to 17 to 24 points in 2002 (James, 2007). In addition, females are closing the gap in mathematics and science, leaving a slight gap favoring males in mathematics and no statistically significant difference in science (Taylor, 2004). Contrary to the earlier cited mid-20<sup>th</sup> century statistics on higher education favoring males, the National Center for Education Statistics reported that, as of 2001, females earned 59% of master's degrees and 57% of bachelor's degrees (as cited in James, 2007). In addition, only 45% of all those enrolled in college were male (Tyre, 2005). These numbers continue to rise in favor of females and as of 2010, 60% of all college students were female (Ellison, 2010).

Riordan (1998) has identified many gender-based trends in his work on the achievement gap. He found that males are currently less likely to take a college-prep curriculum in high school, read for pleasure, study, be named valedictorian, and attend or graduate college. In addition, males are more likely to be labeled as learning disabled; repeat a grade; have lower grades, standardized test scores, and class ranks; become involved with drugs or crime; cut class, drop out, and finish school earlier; and have lower educational and occupational expectations (Connell, 1996; Riordan, 1998; Tyre, Murr, Underwood, Springen, & Wingert, 2006). Another study revealed that eleventh-grade males' writing skills were equivalent to females' skills in eighth grade and that males were 1½ years behind females in reading, less committed to learning, and less likely to go to college (Riordan, 1998; Sax, 2005). The gender gap is not limited to academics. Multiple research studies reveal that males account for the majority of discipline referrals, suspensions, and behavior disorders, in addition to having higher percentages with learning disabilities, dropout status, lower grade point averages, college

admission rates, and standardized test scores (Ellison, 2010; King & Gurian, 2006; Viadero, 2006).

**Renewed concern for females.** Even with all the evidence to the contrary, some still view females as the disadvantaged gender in the classroom. They believe teachers spend more time teaching males and that females remain behind in mathematics and science, especially during middle school (Sax, 2005). A 2010 report by the Center on Education Policy supports this view, revealing data that show females are indeed catching up to males in mathematics, but remain still slightly behind them. According to Sadker & Zittleman (2005) and Weil (2008), females are less likely to show an interest or pursue a career in science, technology, or mathematics. Weil (2008) claimed that females suffer a drop in self-esteem and participation in upper grades. Sadker and Zittleman (2005) added that females are less positive about school and their abilities and perform less well in the upper grades. According to Kessels and Hanover (2008), females rarely major in physics and are underrepresented in computer science, physical science, and engineering. In fact, enrollment by females in information technology courses dropped from 24% in 1991 to 19% in 1998 (Norton, 2006) and the percentage of females taking the advanced placement exam in computer science dropped from 34% in 1987 to 18% in 2010 (Ellison, 2010). The negative self-concept in mathematics, science, computer technology, and engineering continues to exist in the female subgroup (Kessels & Hanover, 2008). In addition, Connell (1996) stressed that all the educational successes females have had over the last few decades do not alter the reality that females' post-school experiences, such as annual income and occupational status, remain inferior to that of males.

There are many proposed explanations for the gender gap seen over the years and

around the globe. Some believe in biological causes, while others support environmental factors. These causes range from differences in brain structure to exposure to sex hormones to societal expectations. Many proponents of single-sex education believe that separating the sexes in the classroom would increase achievement for all students; whereas others believe it would be a backlash on the post-Title IX advancement of women. Regardless of which side one stands on the issue of the gender gap, it is causing much interest on the topic of single-sex education as a means to effectively meet the unique needs of both of the sexes.

### **History of Single-Sex Education**

Single-sex education, also known as single-gender education, is not a new idea. Katherine Bradley (2006-2009) defined single-sex education as “education of students in an environment which consists of a single gender; that being all-male or all-female” (para. 2). This method of grouping students has been around since the beginning of education. While there were some instances of coeducational schools and classrooms in the late 17<sup>th</sup> century, most settings were still single-sex until the mid-1800s when public education began to expand rapidly (Cable & Spradlin, 2008).

Historically, single-sex education was practiced predominantly in private schools (Hughes, 2006-2007). The perception of many during, and prior to, the 1800s was that the school’s primary reason for existence was to prepare males and females for the very different roles they would take on in society (Cable & Spradlin, 2008). Boys were taught skills to succeed in work, politics, and war; while girls were taught how to take care of a home and children (Rury, 2008). In order to do this, people felt it was best to teach the sexes in different settings, thus the utilization of single-sex education.

During the 18<sup>th</sup> and 19<sup>th</sup> centuries, coeducational schools gradually began to



replace single-sex schools, primarily due to financial constraints, but also due to religious dissention of the times (Rury, 2008). The desire to educate both sexes on religious beliefs brought males and females into classrooms and schools to improve their reading and writing abilities and strengthen their knowledge base of their religious beliefs. With townships so spread out, it was difficult to fill separate schools for males and females, thus becoming financial burdens to operate. However, the move to coeducational schooling was met with much resistance from many opponents, including physicians and religious groups. Therefore, even though many areas began to operate coeducational schools and classrooms, single-sex classrooms existed in various areas up until the 1960s and early 1970s (Cable & Spradlin, 2008).

Over time the division in gender roles in the American society began to blur. Feminist groups actively lobbied for mandating coeducation and banning single-sex education in an effort to ensure equality in education for females (Rury, 2008). In 1972, their efforts were rewarded with the passage of Title IX (Cable & Spradlin, 2008). This law made discrimination in, or exclusion from, educational programs or activities that received federal funding based on sex illegal, which essentially banned most public single-sex educational organizations. The few single-sex programs that were still in operation were quickly dismantled and were replaced with coeducational schools and classrooms. Efforts to address gender-related issues in American education through the implementation of single-sex education came to a halt. However, Title IX was only in effect in the United States. During this time period other countries, including Australia, Germany, and Japan, continued single-sex education (Connell, 1996). Others, especially the United Kingdom, saw a decline in these opportunities (Jackson & Bisset, 2005).

During the 30 years or so following the passing of Title IX in the United States,

single-sex education continued to be practiced in private schools, but was taken out of the public school sector. It was during this time that the public school system began taking much criticism. Many people felt public schools in America were failing and *A Nation at Risk* was published in 1983. This intensified the involvement of the federal government in education. Several areas of education were investigated and educational reform was underway. Numerous schools attempted to implement single-sex education as a means to increase student achievement and close the gender gap. Specifically, in the 1980s, many inner-city schools attempted to implement single-sex schools in an effort to improve reading and mathematics scores, attendance records, suspension rates, and parental involvement (Riordan et al., 2008). These attempts, and many others, were met with much criticism. Some believed separating the sexes would create unequal educational opportunities and reverse all the advancements made by females since the enactment of Title IX. The research that existed on single-sex education was typically from other countries or the private sector. Very little research was strong enough to give educators the foundation needed to implement such a controversial strategy. Thus, the efforts of the 1980s to organize single-sex schools and classrooms to address the gender gap were stifled by the strict regulations of Title IX. However, the past half decade, beginning in 2005, has seen a renewed interest in single-sex education in American public schools due to the loosening of these regulations with the legislation of the No Child Left Behind Act and specific amendments to Title IX.

### **Renewed Interest in and Implementation of Single-Sex Education**

One of the more recent reform efforts in education is the No Child Left Behind Act, which was signed by former President George Bush in 2002. During the year prior to its official implementation, Republican Senator Kay Bailey Hutchinson and

Democratic Senator Hillary Rodham Clinton teamed up to take a closer look at Subchapter V of the act, which allowed for funds to be used for innovative school programs. The senators crafted new legislation, which passed with a unanimous vote, that legalized single-sex education under the provisions of the subchapter. Several years later, on October 25, 2006, regulations that made experimentation with single-sex education even less complicated were implemented (Cable & Spradlin, 2008; Garland, 2006; Gurian, Stevens, & Daniels, 2009; Hughes, 2006-2007; Riordan et al., 2008; Sax, 2005). The impact of this legislation can be seen in the growing number of single-sex schools and classrooms. According to Weil (2008), in 1995 there were only two public, single-sex schools in America; in 2008, there were 49; in 2011, there were 103 (NASSPE, n.d.). Data for single-sex classrooms are more difficult to retrieve because there are so many and some schools do not report that they are offering single-sex opportunities. However, according to the National Association for Single-Sex Public Education's website, in March of 2002 there were approximately 12 schools offering some type of single-sex grouping; that number has grown to 524 as of January of 2011 (NASSPPE, n.d.).

In the beginning stages of the current era in single-sex education, some single-sex organizations were experimented with on the middle and high school levels. Since the publication of the regulations for single-sex education on October 25, 2006, even elementary schools have experimented with the somewhat controversial organizational strategy (NASSPE, n.d.). This more widespread implementation, coupled with the attention placed on the gender gap and advancing research on the differences between males' and females' development and learning styles, increased the awareness and interest in single-sex education.

Single-sex education can now be seen across the grade levels in single-sex schools, single-sex classrooms within coeducational schools, and after school programs (Cable & Spradlin, 2008). To ensure that these single-sex groups are created for their intended purpose, which is imbedded in the fact that there are indeed discrepancies between the successes of males and females and the single-sex programs would diminish these differences, the Department of Education has issued a few rules and regulations to govern single-sex education in public schools. In 1997, Newquist believed that there should be definitive proof that one sex was not achieving as well as the other before single-sex programs should be created. According to Cable and Spradlin (2008), the Department of Education requires single-sex educational organizations to provide a rationale for why they are separating the sexes and what they hope to accomplish. They must also provide coeducational opportunities in the same course or grade level. Single-sex schools are exempt from this regulation, but must follow all others. All organizations implementing single-sex educational groups must conduct a review every 2 years to prove that they are meeting all the requirements (Cable & Spradlin, 2008). Participation in single-sex education must be voluntary and must provide equal services to both genders, in addition to refraining from promoting stereotypes (Salomone, 2003). If these requirements are satisfied, any educational group may offer single-sex opportunities for its students in an effort to meet students' needs and close any achievement gaps that may exist between the two sexes. Over the past decade many people have joined well-known single-sex advocate Leonard Sax, and other supporters, in the endeavor to implement single-sex education in public schools.

### **Proponents for Single-Sex Education**

There are many individuals and groups who support single-sex education. The

reasons they do so, and the benefits they perceive, vary greatly. Regardless of the specific reasons groups advocate for single-sex education, proponents typically fall into one of two groups: (a) they believe males and females have different social experiences and different social needs, or (b) they believe males and females are genetically different and need to be taught differently (Weil, 2008). The nature-nurture debate continues. Both of these groups believe single-sex education would help address the differences in a more effective way in the classroom, because it is near impossible to teach both sexes the same content, in the same way, at the same time (NASSPE, n.d.).

**Rationale.** Some proponents for single-sex education simply believe parents should be provided with options for their children's education, including the gender composition of their classrooms and schools. These same people believe this has been a privilege only given to those wealthy enough to pay for private schooling up until the recent movement for single-sex public schools (Salomone, 2003). Others are concerned about the apparent disengagement of males in school and see single-sex education as a way to tailor the classroom to males' interests and learning styles. These proponents view the school curriculum, as early as kindergarten, as too rigorous and developmentally inappropriate for young males (Sax, 2007). They feel the gender gap favors females across the board and single-sex education could help to close the gap (Gurian et al., 2009; Sax, 2005). On the other hand, some advocates for the advancement of women believe that females are still on the disadvantaged side in education and could be the more benefited group in a single-sex setting. These groups believe females receive less quality time from the teacher, are called on less, participate less, and have lower academic self-esteem than males when in coeducational settings (Clark, 2004).

Other proponents of single-sex education assert that coeducational settings

reinforce and encourage traditional gender stereotypes, while single-sex settings may help weaken them (NASSPE, n.d.). Wills (2007) pointed to the negative relationships and conflicts that often adversely impact student achievement in coeducational settings as impetus for single-sex education. Some people even claim the high rates of teen pregnancy and sexual harassment as reasons enough to separate the sexes in schools (Cable & Spradlin, 2008).

In addition, likely the most widespread and discussed reason for single-sex education is the belief that males and females are wired differently genetically and, thus, are most effectively taught separately (Sax, 2005). Tyre (2005) argued that males and females are different—biologically, developmentally, and psychologically. This view is strongly supported by Leonard Sax in his work with the National Association for Single-Sex Public Education and his books on gender differences.

**Gender differences.** Males and females are clearly different. This is not a new revelation. Years of research have repeatedly revealed these differences. At one time people believed children were born androgynous and that differences between the sexes were socially constructed (Sax, 2005). The most contemporary era of research on gender differences began in 1964 with Herbert Lansdell. His work focused on the anatomic sex differences in the design of female and male brains, which he found exist at birth (as cited in Sax, 2005). His research led to the discovery that male and female brains are compartmentalized differently and composed of different tissue. These genetic brain differences account for many observable differences between males and females. However, during the mid-1960s to the mid-1990s it became politically incorrect to suggest that there were innate differences between the sexes; that the sexes were somehow limited by their genetic makeup (Sax, 2005). In the decade following the No

Child Left Behind legislation, much research in brain development has gone against this belief. Sax (2005) contended that boys and girls are just different; they play, learn, and view the world differently, and not because their culture raises them differently, but because they are different genetically. This contention is reminiscent of the recurrent nature versus nurture debate in human development.

As mentioned earlier, the brains of males and females are different from birth. According to Sax (2005), both the tissue and the developmental sequence of individual brain areas are different. Sex hormones make some of these differences even larger and, thus, more important as children get older; however, by age 30 the brains of both sexes have usually fully matured (Sax, 2005). The development of four major areas of the brain involved in language, spatial memory, motor coordination, and getting along with others occurs at different times, in a different order, and at a different rate between the sexes (NASSPE, n.d.).

In studies based on stroke victims, male brains were found to be extremely compartmentalized (Sax, 2005). The findings revealed that males predominantly use their left brain, which is not completely developed in young males, for language. Females use both sides of their brains for language. The sexes' tapping of different areas of the brain for various functions holds true in other situations as well, including how individuals navigate and follow directions (Sax, 2005). Males process language and emotion in two different areas of their brains, which makes it more difficult for them to talk about their emotions. Females process language and emotion in the same area of the brain, which makes it easier to talk about emotions (Cable & Spradlin, 2008; Sax, 2005). The cross-talk between the brain hemispheres in females could be the reason they are better multi-taskers than males and that males are more lateral than females (King &

Gurian, 2006). The best known explanation for why males' thinking is so compartmentalized is taken from Dobson's (2001) book, *Bringing up Boys*. In it he stated that males receive a testosterone bath in the womb around 7 weeks of conception. This large influx of testosterone permanently changes the brain, including its color, and damages the corpus callosum, which connects the two hemispheres and makes cross-talk between the two more difficult (Dobson, 2001).

According to Sax's research on brain development, various areas of the brain develop at different times in males and females. The areas responsible for language and fine motor skills in females begin developing earlier and mature a full 6 years before those areas in male brains; on the other hand, the areas responsible for targeting, or tracking moving objects, and spatial skills in males begin developing earlier and mature a full 4 years before those areas in female brains (Sax, 2005). The prefrontal cortex, or frontal lobe, which is responsible for moderating emotions, regulating self-control, and aiding in decision making develops during the adolescent years and appears to begin and reach maturity earlier in females than males (James, 2007; King & Gurian, 2006). This could be the reason for adolescent females acting less impulsively than their male counterparts. In addition to different brain development and function, males and females show differences in hearing and vision.

Studies from birth have shown that females' hearing is seven times stronger than that of males (James, 2007; Sax, 2005). Males are often labeled as inattentive when they simply may not be able to hear as well as one, often a soft spoken female, expects. They also have a higher tolerance for noise in the learning environment and elsewhere (Sax, 2005). This difference in hearing is partly explained in the genetic design of the ear. Males have longer cochlea; thus, it takes a longer time for males to hear the sound being



transferred (James, 2007).

Studies have also revealed differences in the genetic design of the eye. According to Sax (2005), males' corneas are composed of mostly thicker m-cells; while females, on the other hand, have thinner corneas composed of p-cells. The m-cells are more connected to rods, which sense movement and direction; therefore, males tend to draw pictures of objects in motion, as well as show interest in toys that move. The p-cells are more connected to texture and color. This could be responsible for females' interest in textured toys, including dolls and stuffed animals, and human faces, as well as their use of many different colors in drawing. Their drawings tend to be of nouns that lack motion, including houses, people, and flowers (Sax, 2005).

Females and males are indeed wired differently. Their brains, hearing, and sight all develop and function very differently. These differences manifest themselves in many observable characteristics in the classroom. It is extremely important for educators to be aware of basic gender differences when teaching males and females, but to keep in mind that they are only generalities; not all males think and act like the average male and neither do all females think and act like the average female.

Males tend to be more right brained. They have strong targeting and spatial awareness skills (NASSPE, n.d.). They thrive on competition and tend to speak out in class more often using louder voices (Newquist, 1997). They are often impulsive in the classroom (Norton, 2006). They like to be physically active and engaged in hands-on learning. Males are less motivated to learn unless they are interested in the topic. Boys tend to extract, or view components in isolation, when learning (Norton, 2006). They prefer to study alone and usually consult the teacher for help as a last resort. Males are often aloof from the teacher because of their belief that it is socially unacceptable to be

close to a figure of authority (Sax, 2005). Unfortunately, males tend to dislike early school experiences. This can be attributed to the advancing, developmentally inappropriate curriculum being implemented in early elementary classrooms. The expectations to sit still for long periods of time, use quiet voices, and cut and color to create socially accepted pictures do not support the ways young males are built or develop (Sax, 2005).

Conversely, females tend to be more left brained. Their language and fine motor skills are well established, which makes them successful with reading and writing (Sax, 2005). They prefer to work in small, cooperative groups and seek teachers' help and approval (Cable & Spradlin, 2008). Females enjoy homework and working quietly (Norton, 2006). They complete assignments on time and are often hurt by negative assessments. They expect teachers to be allies and often look to them as role models to imitate (Sax, 2005). Females tend to be great listeners, but often do not speak out in class due to feeling intimidated by boys and the fear of being labeled as *brains* or *dummies* (Newquist, 1997). Females tend to succeed in early elementary school when the content of the curriculum and the style of instruction seem to be developmentally appropriate for their gender's needs. However, they seem to struggle in later years when the foundation of curriculum and instruction changes considerably (Sax, 2005).

Most educators now realize that males and females are genetically different and, thus, have diverse educational needs. They often strive to meet the varied needs of the two sexes by using materials somewhere in the middle of *Dear God, It's Me Margaret* and *Huckleberry Finn*. According to Sax (2005), attempting to educate children in a gender-blind setting is not working. He stated that there is not enough quality material in this gender-neutral area to teach children effectively. In addition, when available gender-

neutral material is utilized, both genders often lose interest and many educational opportunities are missed. Some gender-specific strategies are simply impossible to implement in a coeducational class. For example, males tend to perform better in a cooler classroom, whereas girls do so in a warmer classroom (Sax, 2005). Sax (2006) often refers to this difference between the sexes as “six degrees of separation,” which is impossible to tailor to both genders in one room (p. 193). It is vital that teachers recognize gender differences, break down the stereotypes that accompany them, and identify and utilize the most effective strategies to meet both females’ and males’ needs.

According to Sax (2005) there are many effective strategies to utilize when teaching males. Seating them near the teacher and using a louder voice during instruction helps males maximize their less sensitive hearing. Teachers should move around frequently (Bradley, 2006-2009). This will target the anatomic design of males’ eyes which is prone to sensing movement. Providing concise directions one at a time and asking questions throughout lessons increases the likelihood that males understand the lesson and remain focused (Bradley, 2006-2009; Cable & Spradlin, 2008). When teaching reading, teachers should choose nonfiction texts or fictional literature with strong characters and much action. Supporting activities should be objective and tap into males’ spatial skills, like creating a map to detail the content in *Lord of the Flies*, not just subjective, like role playing a central character and discussing his feelings (Sax, 2005). Males need shorter segments of instruction, with multiple breaks and more opportunities to move around and be physically active, including standing up by their desks, sitting on their knees, or even engaging in short, structured exercise breaks (Bradley, 2006-2009; Cable & Spradlin, 2008; Ellison, 2010; King & Gurian, 2006; Sax, 2005; Tyre, 2005; Wood, 2008). Lessons should be designed for this preferred kinesthetic learning style.

In addition, males respond well to the stress and pressure that group competitions and timed tests bring (Bradley, 2006-2009; Sax, 2005; Tyre, 2005). Timed activities with loud buzzers often motivate males to perform well. In addition, the use of small group competitions encourages cooperation and collaboration amongst males in the small groups. Direct confrontation is often successful in disciplining males and giving them the reality checks that their male egos often need; however, making direct eye contact can often destroy the progress that the confrontation makes; thus, it is advised to talk to males shoulder to shoulder instead of face to face (Bradley, 2006-2009; Cable & Spradlin, 2008; Sax, 2005). Males typically understand and respond to learning for learning's sake; therefore, teachers should be straightforward with instruction. Males tend to make light of teachers' genuine attempts to connect learning to real life and often get in trouble due to this *misbehavior* (Sax, 2005). Most of these strategies, discussed by Sax, are based more on years of research on males' brain development and the resulting gender differences than on the socially-constructed stereotypes society has created. The strategies may not work with all males, but they will with most.

Females' needs are different from males. Teachers must meet them with different strategies. Sax (2005) discussed many of these effective strategies in *Why Gender Matters*. Since females' hearing is very sensitive, it is important to use a softer voice and keep the room free of excess noise. Teachers can help reduce stress, which hinders females' performance, by eliminating timed tasks and actively teaching relaxation techniques. Using small cooperative groups capitalizes on females' desires to work together and talk with one another (Bradley, 2006-2009; Sax, 2005). This strategy also builds leadership skills in the females within the groups. When teaching reading, teachers should choose fictional literature with complex characters and themes. They can

help females explore deeper understandings through role playing and discussion activities (Bradley, 2006-2009). When teaching mathematics, teachers should make direct connections to real life applications to cement females' understandings of the topics. Females understand content better when they know the context from which it stems (Bradley, 2006-2009). Teachers should foster a supportive, non-confrontational environment for females, where they feel comfortable asking questions when they do not understand and loved when they are disciplined (Bradley, 2006-2009; Sax, 2005). Using bean bags, carpeted areas, and couches can help develop this classroom climate (Bradley, 2006-2009). In addition, teachers should gently encourage females to take risks and comfortably challenge them. Females often have insecurities and low self-esteem (Bradley, 2006-2009). Teachers must actively encourage and build up their females to help them understand that they can indeed learn and excel. Teachers of both sexes must remember that "There are no differences in what girls and boys can learn. But there are big differences in the best ways to teach them" (Sax, 2005, p. 106). Understanding the differences between the sexes and implementing appropriate best practices can bring many benefits to all those involved.

**Benefits.** Proponents see many benefits to single-sex schooling for both sexes. These benefits are as varied as the reasons they support the movement and include the reduced distraction of the opposite sex, increased concentration and participation, improved self-confidence, deterioration of traditional gender stereotypes, broadened educational opportunities, higher career aspirations, and even increased academic achievement (Bradley, 2006-2009; Hughes, 2006-2007; Sax, 2005). In addition, some reports show that single-sex schooling increases attendance rates and decreases discipline issues (Bradley, 2006-2009; Hughes, 2006-2007). This benefit gives teachers more time

to teach. When the sexes are separated, this time can be spent more effectively meeting the sexes' diverse needs and incorporating their learning styles and interests. Proponents claim that single-sex education makes females more competitive inside the classroom and out of it. They take on more leadership positions in the classroom and are more involved and competitive in sports (Cable & Spradlin, 2008). Females from single-sex settings are more likely to take classes in mathematics, science, and technology and to later major in a mathematics or science area (NASSPE, n.d). Males in single-sex settings, on the other hand, learn to collaborate better in single-sex settings. Males display a better attitude towards activities and subjects that are traditionally geared towards females. In addition, they show more gains in literacy than their COED counterparts (Brutsaert, 2006; Laster, 2004; Malacova, 2007; Stotsky, Denny, & Tschepikow, 2010).

Regardless of the sex of the students, many proponents see the greatest impacts and benefits in the most disadvantaged groups; the lower the prior attainment levels of the children, the stronger the observed impact of single-sex education (Riordan, 1998; Wood, 2008). Proponents who study disadvantaged populations in single-sex settings observe higher test scores and grades, increased leadership, improved homework, tougher course loads, higher educational expectations, better attitudes, less stereotyping, and more self-control (Wood, 2008). Well-known single-sex proponent Cornelius Riordan supports single-sex schools over single-sex classrooms. He feels the school-wide unified gender composition creates a more positive culture throughout the entire school and often enables the above benefits of single-sex education to make a more direct impact (as cited in Wood, 2008). However, the many proponents of single-sex education do not have the sole voice in the current debate over the educational movement.

## Opponents of Single-Sex Education

Not all people support single-sex education. Many groups, like the American Association of University Women (AAUW), the National Organization for Women (NOW), and the American Civil Liberties Union (ACLU), believe that any separation of the sexes is too closely linked to the 1896 ruling of *Plessy v. Ferguson* that separated African American and Caucasian students under the doctrine of *separate but equal*. These groups worry that one group, especially females, may receive an inferior education due to the separation (AAUW, 2009; Ellison, 2010). Groups also claim that single-sex education is going against the Equal Protection Clause of the Fourteenth Amendment and will destroy all the improvements that have been made since the enactment of Title IX of the Education Amendment (Salomone, 2003). Others believe that single-sex settings are detrimental to social development, claiming that single-sex education perpetuates traditional gender stereotypes, leads to sexism, strengthens aggression and competition in males, and further glamorizes the opposite sex (Brutsaert, 2006; Cable & Spradlin, 2008; Ellison, 2010; Gray & Wilson, 2006; Hughes, 2006-2007).

Many opponents believe the regulations controlling the establishment of single-sex schools and classrooms are not stringent enough. Others are adamant that research for single-sex schooling is weak, describing the existing data as inconclusive at best. They accuse the advocates of single-sex education of *cherry picking* their studies to support their beliefs (Weil, 2008). They add that the sample sizes are too small to draw definitive conclusions and the similarities between the sexes are greater than the differences. In addition, many opponents believe that any differences found in the studies are attributed more to student ability, SES levels, and pedagogy than to gender composition (Martino, Mills, & Lingard, 2005). These groups believe educational

funding would be spent more wisely on strategies proven to increase achievement for all students, including lowering class sizes, providing quality professional development, increasing parental involvement, and offering effective preschool, as opposed to single-sex education which has limited research (AAUW, 2009; Cable & Spradlin, 2008).

### **Existing Research on Single-Sex Education**

One consistent fact mentioned in almost every existing study and piece of literature on single-sex public school education in the United States is that there is a dearth in the research. This is especially true at the elementary level. Much of what has been learned about single-sex education comes from studies in other countries, in private schools in America, and at the middle and secondary school levels. The shortage in quality research can be partly explained by the difficulty in designing and implementing true experiments to determine the impact single-sex education has on student growth and achievement. True random assignment to control for many of the extraneous variables present in educational research is very difficult. Another reason for the lack of research in America is the restrictions placed on single-sex education by Title IX. While other countries experimented with the grouping strategy, attempts by the United States at single-sex education were often thwarted by the strict regulations of Title IX. Due to the limited research for this literature review, the researcher has chosen to organize the existing studies by geographic area, beginning with those in the United States.

With the number of single-sex opportunities available in public schools growing each year, mostly due to the legislation in NCLB that loosened the restrictions of Title IX, the U.S. Department of Education teamed with RMC Research Corporation to conduct a systematic review of the existing research on single-sex education to determine its possible effects (Mael et al., 2005). The review began with a comprehensive search



for existing literature on single-sex education and then used three review phases to identify the highest quality studies. Of the 2,221 studies found in the initial search, only 40 quantitative studies met all three phases' criteria for inclusion. Some of the criteria included that the study be based on the K-12 age group; written in English; set in schools similar to those in the United States, as well as in single-sex schools as opposed to single-sex classrooms; and used statistical controls for preexisting differences. These 40 studies were then evaluated by two reviewers using the designed coding guide and checklist in order to identify the findings of the study as in favor of single-sex education or coeducation, or having mixed or null findings. To insure validity of their findings, there was an attempt made to contact all original authors to contribute their input to the study. Thirty-five of the 40 authors did so. Of the 40 quantitative studies reviewed, 41% favored single-sex education, 45% were null, 8% favored COED, and 6% had mixed findings, which means that the study showed single-sex and COED settings to have different impacts on different groups in different categories. The study also revealed trends in the existing literature, which identified more research on females' schools than on males' schools, and more at the secondary level than the elementary level. In addition, the study found an overall deficiency in quality research on the topic (Mael et al., 2005).

In 2008, the U.S. Department of Education teamed with RMC Research Corporation again in the creation of a report titled *Early Implementation of Public Single-Sex Schools: Perceptions and Characteristics* (Riordan, 2008). The report utilized the systematic literature review on single-sex education by Mael et al. (2005), a survey of public single-sex schools, and observations of a subsample of those schools in an attempt to answer five research questions about the impact of single-sex education. In 2005, the

survey for public single-sex schools was given to 19 of the 20 single-sex schools in operation in the fall of 2003. Ninety-five percent of the principals responded, as did 88% of teachers for a sample size of 18 principals and 478 teachers. The evaluation team used the national Schools and Staffing Survey (SASS) from 1999-2000 and 2003-2004 to choose 150 COED comparison schools with 146 principals and 723 teachers representing similar demographics. The evaluation team used the data from the 150 COED comparison schools and 19 single-sex schools in an attempt to determine what characteristics of single-sex schools could be seen as potential hypotheses for future research. The data investigated demographic and background characteristics of schools, principals, teachers, parents, and students. A team then conducted onsite observations of a subsample of the schools to explore more internal differences, such as school climate, programs, beliefs, and activities. Eight single-sex schools, 40% of those in operation at the time, were visited. Securing cooperation from the COED schools was difficult, thus only one COED elementary school and one COED middle school were visited. The evaluators found many similarities between the schools, but also identified areas of difference that could be used for further study with single-sex education including 14 identified theoretical benefits to the grouping strategy (Riordan et al., 2008).

The above two studies were massive undertakings by the U.S. Department of Education that yielded valuable information regarding single-sex education. In addition, this literature review reveals several other smaller scale research studies worthy of mentioning. As with most of the research on single-sex education, the studies are not true experiments and thus their results cannot be generalized to the larger population nor can direct causal relationships be drawn between single-sex education and its impacts. However, the studies can be used as building blocks for theorizing about single-sex

education and designing future experimental or quasi-experimental studies. In addition, as with most of the research on single-sex education, the studies are typically from other countries, from private schools, and/or at the middle or secondary levels of education. The elementary level in public schools in the United States remains largely uncharted territory. The remainder of this review first discusses studies on and experimentation with single-sex education in the United States, followed by those from various countries.

*Newsweek* published an article entitled “The Segregation Debate: Can Educating Girls and Boys Separately Fix Our Public Schools, or Does It Reinforce Outmoded Gender Stereotypes?” (Ellison, 2010). Conflicting information is presented in the article. Pedro Noguera, a New York University professor, found no statistical differences when he experimented with a single-sex school for African American males. In the same article, Sax (as cited in Ellison, 2010) shared the findings from a 3-year study in Florida comparing the scores of children in single-sex and COED classes on Florida’s standardized tests. Males in COED classes scored 37%, while their single-sex counterparts scored 85%. Females in COED classes scored 59%, in comparison to their single-sex counterpart’s score of 75% (Ellison, 2010). Sax elaborates on this Florida study on the website for the National Association for Single Sex Public Education (NASSPE, n.d.). The study took place in Woodward Avenue Elementary School at the fourth-grade level. The students were assigned to single-sex or COED classes that were matched with respect to class size and demographics. The teachers had the same training on single-sex education. In addition to the above data, after the 4-year pilot study, 55% of the males in COED classes scored proficient on the FCAT, in comparison to 85% of the males in single-sex classes (NASSPE, n.d.).

The principal of Marzolf Primary School in the Shaler Area School District of

Pennsylvania implemented single-sex groups for part of the day during the second half of the 2009-2010 school year after hearing a speech by Leonard Sax (Michael, 2010). The teachers used the information from Sax's (2005) book, *Why Gender Matters*, to create gender-specific and appropriate strategies to use during the 40-minute single-sex learning time block. At the end of the year, every student was on grade level. The principal viewed the trial as a success, but also admitted that the results may have come out the same way if the groups had been COED. He shared his belief that, although it may be more difficult, it is possible to use gender-specific strategies in COED groups and reap the benefits of both single-sex education and coeducation (Michael, 2010).

In another case at Douglas Elementary School in Denver, Colorado, third-through fifth-grade boys were lagging 13 points behind girls in literacy standardized achievement tests. After 1 year of implementing single-sex grouping within COED classes and implementing boy-friendly teaching strategies, there was an overall gain of 21.9 points on the Colorado State Assessment Program, with the male subgroup gaining 24.4 percentage points (King & Gurian, 2006).

In Pueblo, California, a middle school guidance counselor, Mike Horton, randomly assigned sixth-grade students to single-sex classes in core subjects. After one year, the single-sex female class scored higher in all subjects, followed by the all male class, and then the COED classes (Tyre et al., 2006). The study is continuing and plans to look more closely at growth comparisons between the sex-based subgroups.

In a New Zealand study, conducted by Gibb, Fergusson, and Horwood (2008), data were used from an existing New Zealand longitudinal study of 1,265 children from birth to age 25 to examine the effects that single-sex schools and coeducational schools have on the achievement gap between males and females. These researchers were

interested in the effects single-sex and coeducational schools have on students' academic achievements throughout high school and post-high school education. The researchers gathered their data from an existing 1977 birth cohort in New Zealand. There were 1,265 participants in the original study, but their study only used 940 of them. Reasons for the reduced sample size included emigration from New Zealand, refusal to participate, death, missing information for covariates, and attendance records at both single-sex and coeducational schools during years 14, 15, and 16. During research, the authors found that some factors, including IQ, SES, maternal age, and educational level, among several others, were related to school choice. The researchers also found that participation in single-sex schools was related to advantages in each of these covariates and, therefore, used nested regression models to adjust the covariates. After these adjustments were made, Gibb et al. (2008) found that at "coeducational schools there were consistent and significant ( $p < .05$ ) tendencies for females to outperform males" and at "single-sex schools there were small and nonsignificant ( $p > .10$ ) tendencies for males to outperform females" (p. 312). These findings supported their hypothesis that single-sex education may help diminish the gap between genders in academic achievement (Gibb et al., 2008).

A 2-year descriptive study in classrooms within two economically disadvantaged, COED elementary level Tasmanian schools explored the behaviors of teachers and students in the two single-sex schools and two COED schools (Wills, 2007). The study used weekly observations, surveys, and interviews to provide data on how the participants behaved in the different settings. After 2 years of observations, the observer found that the participants in single-sex education had a greater sense of social cohesion. There was increased enjoyment by children and teachers, decreased behavior issues, better focus on gender needs, and stronger bonds and better relationships between the

students and teachers (Wills, 2007).

A study in an Australian coeducational primary school used established single-sex classes in sixth and seventh grade to explore the grouping strategy's impact on teaching practices and their effects. Martino et al. (2005) used interviews with principals, teachers, students, and parents involved with single-sex education to determine to what extent their teaching practices actually changed in response to the literature and existing research on single-sex education. The major finding in this study revealed teachers' tendencies to adapt their curriculum and instruction to meet gender-based stereotypical needs of males and females. The teachers were not as likely to differentiate for individual needs within the groups and taught the students as if they all fell into the assumed gender-based stereotypes they had learned about concerning males and females. The male students' responses revealed their belief that the single-sex curriculum, while fun, was less challenging and relevant than the curricula in both the single-sex females' and the coeducational classes. The teachers saw a vital need for more professional development on the practice of teaching in single-sex settings (Martino et al., 2005).

A study in Australia by Mulholland et al. (2004) investigated optional, single-sex, ninth-year mathematics and language arts classes in a coeducational secondary school to determine the possible impacts single-sex education had on mathematics and language arts achievement. Standardized test scores in both subjects were obtained both before and after the intervention. Teachers and parents both were interviewed in an effort to capture the experience of the participants and to identify impacts of the intervention. While females scored statistically higher in language arts and males scored statistically higher in mathematics on the pretest and posttest, the comparison of gender-based subgroups was not as clear cut. In analyzing the gains of students from pretest to posttest

in mathematics, there were no statistically significant differences; however, when doing the same in language arts, there was a statistically significant difference favoring the single-gender classes, especially the female group (Mulholland et al., 2004).

A popular Internet website entitled *Girls Learn Differently* shares findings from several studies that support the belief that males and females perform better when taught separately. Dr. Ken Rowe of Australia conducted a 20-year study of 270,000 children that revealed 15 to 22 point higher standardized test scores when taught in single-sex settings ("Advantages of single-sex schools," n.d.). In addition, a 2001 study of almost 4,000 elementary and secondary schools supported the fact that almost all female participants, regardless of SES or ability, scored better in single-sex settings than COED ones ("Advantages of single-sex schools," n.d.).

Brutsaert (2006) investigated the impact of single-sex education on perceived peer group acceptance and gender-role identity in secondary schools in Belgium through self-reported questionnaires. Females showed no significant differences on these two characteristics in relation to school type; however, males in single-sex settings were found to be more aggressive than their COED counterparts. In addition, less masculine males tended to relate better in COED schools, where the negative reference group for males was the female group as opposed to the less masculine male subgroup in single-sex schools (Brutsaert, 2006).

In Germany, Kessels and Hannover (2008) tested the impact single-sex education may have on females' self-concepts in physics at the middle school level. Students from four COED schools were randomly assigned to single-sex or COED physics classes. Surveys were used to measure self-concept concerning physics both before and after the intervention. As was hypothesized, male self-concept was higher in both groups;

however, the focus of this study was on the impact single-sex education may have on females' physics self-concepts. The females in the single-sex groups rated themselves much higher than the females from the COED classes (Kessels & Hannover, 2008).

A study in Ireland by Gray and Wilson (2006) used a questionnaire survey and interviews with teachers and students to identify perceptions of the single-sex initiative and its impact on student achievement and behavior. The strategy was implemented in an attempt to improve both of these areas, especially for males. However, the results revealed that most teachers attributed the further decline of academics and behavior, especially for males, to the newly implemented grouping strategy. The male classes seemed to have lower educational standards and increased competition and aggression. In addition, the teachers felt ill-prepared to teach single-sex classes (Gray & Wilson, 2006).

A study by Malacova (2007) in the United Kingdom sought to determine the effect of coeducational and single-sex education on students' growth from age 14 to 16 by analyzing their standardized test scores. After accounting for prior attainment, females in single-sex classrooms had higher growth than their COED counterparts. This pattern was true for males as well. The study also pointed out that the more selective the school was, typically private single-sex schools, the larger the gains were. Malacova (2007) was quick to point out that it may be the selectivity factor causing the difference, as opposed to the gender makeup of the school.

### **Summary**

The research is inconsistent. Some findings report that there is no difference between the achievement levels of students in single-sex or coeducational classrooms; others report that there is a difference—some claim it is significant, while others claim it



is not. Some studies maintain single-sex education benefits certain groups of students; the affected groups vary from study to study—males, females, economically disadvantaged, higher achieving, lower achieving. A paper found in the Education Working Paper Archive (Stotsky et al., 2010) discussed this in great detail. The study explored whether fifth- and sixth-grade single-sex classes in Alabama could improve male reading achievement. It cited the already mentioned *Single-Sex Versus Coeducational Schooling: Systematic Review* (Mael et al., 2005) and the obvious dearth in research at the elementary level. The authors' 2010 study sought to fill in this gap with their Alabama study (Stotsky et al., 2010). The findings were mixed, but suggested, as much of the existing research does, that trends in gain scores for both genders support single-sex grouping.

The literature reviewed in this chapter establishes a connection between the existing gender gap and the current interest in incorporating single-sex education in public schools as a possible solution to help close the gap and increase achievement for both sexes. Throughout the reading and research for this literature review, one fact is apparent: more controlled research in the United States at the elementary level is needed to better understand any impact single-sex education may have on elementary school students' academic achievement. The information gleaned on the gender gap, gender differences, perceived advantages and disadvantages of single-sex education, and the findings from recent single-sex studies, in addition to the clear dearth in quality research in the United States at the elementary school level, guided the direction of the following mixed methods, quasi-experimental study on the impact of single-sex education on male and female gains in mathematics and reading at the elementary level in a selected school in North Carolina.

## **Chapter 3: Methodology**

### **Introduction**

The purpose of this study was to add to the research by exploring the impact of single-sex education on an economically disadvantaged school's fifth-grade students' academic gains in mathematics and reading achievement in comparison to their peers in demographically similar coeducational classrooms within the same school. Two years of data were collected and analyzed by statistical tests (ANOVAs, independent *t*-tests, and chi-square tests) in order to draw any possible conclusions regarding cause and effect. This chapter describes the study's methodology, including a reiteration of the research questions, the research type and design, the researcher's role, a description of the participants, and the methods of data collection and analysis.

### **Research Questions**

The study explored the following research questions:

1. What impact does single-sex education have on fifth-grade males' gains in mathematics in comparison to their peers in similar coeducational classrooms as evidenced by standardized test scores and teachers' perceptions?
2. What impact does single-sex education have on fifth-grade males' gains in reading in comparison to their peers in similar coeducational classrooms as evidenced by standardized test scores and teachers' perceptions?
3. What impact does single-sex education have on fifth-grade females' gains in mathematics in comparison to their peers in similar coeducational classrooms as evidenced by standardized test scores and teachers' perceptions?
4. What impact does single-sex education have on fifth-grade females' gains in reading in comparison to their peers in similar coeducational classrooms as evidenced by

standardized test scores and teachers' perceptions?

### **Research Type**

This explanatory mixed methods applied research study was quasi-experimental in methodological design. The explanatory mixed methods type of research was utilized in order to develop a more complete understanding of the impact single-sex education has on academic gains in mathematics and reading. This particular study's design statistically analyzed, first and foremost, quantitative data taken from EOG test scores. In addition, qualitative data gathered from brief, informal open-ended, one-on-one and small group interviews were collected and analyzed to provide a more in-depth understanding of the study, especially regarding the teachers' perceptions of the impact single-sex education had on their students. This mixed methods approach strengthened the study by exploring responses that multiple teachers from multiple years shared regarding their perceptions of how single-sex education impacts students' achievement and whether or not the EOG test scores reflected their observations.

### **Research Design**

A true experimental design is the best method to use when attempting to establish cause and effect relationships; however, since it is extremely difficult to randomly assign groups in educational research, this study was quasi-experimental. There was one control group for each year of the study and two experimental groups for school year 2009-2010 and three experimental groups for school year 2010-2011, which were all intact fifth-grade classes, assigned by the principal with a great deal of thought given to creating similar groups. During each year, all classes had approximately the same student-teacher ratio. The two control groups were coeducational, or mixed-sex, and taught by female teachers. In 2009-2010, the two experimental groups were single-sex classes. The

female single-sex class was taught by a female teacher. The male single-sex class was taught by a male teacher, which may be seen as a limitation of the study in that the question arises as to whether the make-up of the class or the sex of the teacher was the more influential variable on gains in achievement. However, during 2010-2011, there were two all-male groups; one was taught by a male and the other a female. The female class was taught by a female. Due to the lack of random assignment of participants in a quasi-experiment, there is a greater threat to the internal and external validity of the study than if it were a true experimental design. In this study, the threats to internal validity may include history, maturation, selection, and interaction with selection; whereas the threats to external validity include the interactions of selection, setting, and history with treatment. In any educational research one must consider the many confounding variables, including, but not limited to, prior attainment levels, motivation of students, attendance of students and teachers, teaching experience and style, classroom management, student-teacher rapport, and parental involvement, that may affect the dependent variable, which in this case is academic gains in mathematics and reading. Every effort to control for these threats to both internal and external validity is made in the design of the quasi-experiment and discussed in further detail in Chapter 5 of this dissertation.

### **Researcher's Role**

This researcher was given the opportunity to conduct a 2-year quasi-experiment in a local public elementary school. The principal had already decided to implement single-sex education at the fifth-grade level. The existing composition of the grade level lent itself to experimental groups and a control group each year. Data that already existed, standardized test scores, could be used to analyze the impact of the single-sex program on

student achievement and growth. This researcher's dissertation interest in single-sex education and relationships within the county school system connected her with the school and principal. A relationship developed naturally between the two as they recognized the strength they could be for each other's educational goals. The researcher simply collected existing data and statistically analyzed it through ANOVAs, independent *t*-tests, and chi-square tests to help the school determine the impact the single-sex education program had on its students' academic gains. The researcher did not work with any students or administer any treatment during the course of the study. It should be noted here that a treatment was in fact administered, as it is in any quasi-experiment; however, the treatment, the implementation of single-sex classrooms, was administered by the principal and teachers of the school, not the researcher. The researcher received full permission and cooperation from participating teachers, the principal, testing coordinator, and the county's central office to conduct the study (see Appendix A for Informed Consent and Appendices B and C for Communication Letters).

### **Participants**

Data for this mixed methods quasi-experimental study were gathered over 2 school years, from two different groups of students and teachers at the same school. School year 2009-2010 is referred to as year 1, while school year 2010-2011 is referred to as year 2. Below is a description of both years' teachers and students (see Appendices D and E for a complete description of student and teacher demographics for year 1 and year 2). While there are some differences, which are discussed in greater detail in Chapter 5's discussion of this study's limitations, it should be noted here that every effort was made by the principal to balance the classes and ensure that the groups were as similar as possible. Data were gathered over 2 years in order to identify whether the findings varied

based on differences between the students and teachers from year 1 and year 2 and to pool a larger sample size. The repetition of data collection and analysis strengthens the internal validity of the study with regards to drawing a possible cause and effect relationship between gender composition and academic gains.

**Year 1 teachers.** The number of students in fifth grade ( $n = 70$ ) in year 1 called for the creation of three classes, one single-sex male class ( $n = 24$ ), one single-sex female class ( $n = 23$ ), and one coeducational class ( $n = 23$ ). The male class was taught by a male teacher; the female class was taught by a female teacher; and the COED class was taught by a female teacher. The teachers were all Caucasian and ranged in age from 32 to 42. The teachers had between 3 and 11 years of teaching experience; all except 1 of those years were taught at the current school. All three teachers had Master's Degrees in Education. None of the teachers had special training on single-sex education.

**Year 1 students.** Each class had 23 or 24 students, with the COED class being composed of 15 boys and eight girls. The classes lost between three and six students between the start and end of the year and gained between three and nine; the single-sex male's class was noticeably more transient than the others. All three classes were ethnically diverse, having five or six Caucasian students and a mix of other ethnicities, including Hispanic, African American, and multiracial. All classes were predominantly composed of economically disadvantaged students due to the fact that the school was 92% free and reduced lunch. None of the students in year 1 were labeled AIG (Academically and Intellectually Gifted), but each classroom had a cluster of three to five children, called composers, who were pulled for small group acceleration in mathematics and reading. In addition, each class had between three and five children who were repeating fifth grade (known as retainees).

**Year 2 teachers.** The numbers for fifth grade ( $n = 73$ ) in year 2 increased slightly, thus creating the need for four classes instead of three. The group as a whole had more boys; therefore, two single-sex male classes were formed ( $n = 18$ ;  $n = 17$ ), along with one single-sex female class ( $n = 18$ ) and one COED class ( $n = 20$ ). Again, the female class and COED class were taught by females; however, during year 2 one of the male single-sex classes was taught by a male and the other was taught by a female. The teachers were all Caucasian and ranged in age from 29 to 43. The teachers had between 5 and 12 years teaching experience; the majority of those years were taught at the current school. Two of the teachers had Master's Degrees in Education, while two did not. None of the teachers received special training on single-sex education and only one teacher in the group had taught a single-sex class in the past.

**Year 2 students.** Each class had between 17 and 20 students, with the COED class being composed of 10 boys and eight girls. The classes lost between one and three students from the start of the year to the end and gained between zero and four students. All four classes were racially diverse, and had a mix of ethnicities including Caucasian, Hispanic, African American, and multiracial. All classes were composed of predominantly economically disadvantaged students due to the fact that the school was 92% free and reduced lunch. Three students in year 2 were labeled AIG (Academically and Intellectually Gifted). These students were divided across the grade level. In addition, each classroom had one to five children, called composers, who were pulled for small group acceleration in mathematics and reading. No class had more than one retaineer.

**Comparison of participants.** It is this researcher's belief that the 2 years of this study provide valuable information for understanding how single-sex education impacts

academic achievement. The 2 years of data were collected in the same school, which was headed by the same administrator. No major changes were made to the curriculum or instruction used between the 2 years. The school-wide demographics did not change either, which left both years' participants very similar in regards to SES levels, ethnicity, prior attainment levels, and home life. While there were some differences amongst the teachers, as well as the students, it appears that the teachers were comparable and the composition of the classes was as similar as possible in an educational setting.

There were a few differences between the participants of the 2 years that are worthy of consideration during this study. First, in year 1 there were more transient students than in year 2. In addition, year 1 had more children repeating fifth grade than year 2 did. Year 2 is different in that it had two all-male classes, which were led by a male and female teacher. In addition, after reading the above descriptions and reviewing the complete demographics in Appendices D and E, it could be stated that year 1 participants, students, and teachers, were much more homogenous than year 2's participants. In year 1, teachers had the same qualifications, were closer in age, and had similar years of experience; classroom rosters were more similar in regards to ethnic background composition and special needs. There was much more diversity in the students and teachers in year 2. The differences between the 2 years could be a factor in the findings of this study.

### **Data Collection**

Data collection for this explanatory mixed methods quasi-experiment is two-fold. In addition, before any data were collected permission was obtained from the county's central office and teachers and principal at the elementary school.

**Quantitative.** Numeric data were collected from existing EOG scores in



mathematics and reading. Available data included developmental scale scores (DSSs), achievement levels, needed growth for the current year, actual growth, whether expected growth is met, and growth levels. Data from the fifth-grade EOGs were collected for each student for the current year of the study (2009-2010 or 2010-2011), as well as from the previous year, which were data from fourth-grade EOGs (or fifth grade if the student had been retained). The collection of the prior year's test scores served two purposes. First, it helped calculate students' DSS growth during the study's targeted year. Second, these baseline scores helped account for students' levels of prior attainment, which established the similarity of the classes in this study since there were no statistically significant differences in the classes' prior scores in mathematics or reading for either year. This is discussed in greater detail in Chapters 4 and 5 of this dissertation. The measurement instrument, the EOG test, is perceived to be both reliable and valid in that it is a standardized test given to all public elementary school students in Grades 3 through 8. The data analyzed existed independently from this study and were available for use. The data were input in SPSS and analyzed for statistical significance using two types of ANOVAs, independent *t*-tests, and chi-square tests. Permission for access to data was obtained and all participant names were replaced with student numbers, before released to this researcher, to ensure confidentiality. Release of all quantitative data was handled by the school's testing coordinator.

**Qualitative.** Qualitative data were collected through open-ended, one-on-one and small group interviews with the participating fifth-grade teachers. Conversations took place at the beginning of the study to explore their perceptions and expectations of how the implementation of single-sex classrooms within their coeducational school may impact both female and male gains in mathematics and reading in comparison to their

peers in the coeducational classrooms. There were additional follow-up interviews, again very informal and open-ended, at the end of both years to explore the educators' perceptions of the actual impact of single-sex education on their students' achievement, whether their observations of the impact are supported by the data from the EOG scores, and their overall experience with single-sex education. Interviews were audio recorded and notes were taken and organized into an MS Word table for analysis. The questions for the follow-up interviews were:

1. How do you believe the gender composition of your classroom has impacted males' and/or females' academic gains in mathematics?
2. How do you believe the gender composition of your classroom has impacted males' and/or females' academic gains in reading?
3. Do you believe the EOG test scores are true reflections of the impact single-sex education has had on your school's fifth-grade students' academic gains in mathematics?
4. Do you believe the EOG test scores are true reflections of the impact single-sex education has had on your school's fifth-grade students' academic gains in reading?
5. What extraneous variables do you feel need to be taken into consideration when determining the possible impact single-sex education has had on your school's fifth-grade students' gains in mathematics and reading?

### **Data Analysis**

Data analysis for this explanatory mixed methods study was also two-fold. Due to the explanatory mixed methods design chosen, quantitative data were analyzed first. Qualitative data were then analyzed in order to gain additional insight into the teachers' perceptions of the impact of single-sex education on their students' growth in

mathematics and reading and to provide a more complete picture of the impact of the study.

**Quantitative.** The quantitative data were analyzed to compare growth made on the EOG reading and mathematics tests to determine if there were statistically significant differences between the various groups. Comparisons were made between the growth of the females in the single-sex classes and the females in the coeducational classes, as well as between the males in the single-sex classes and the males in the coeducational classes. In addition, comparisons were made between the various classes to see the different impacts single-sex education had on males and females in comparison to each other and COED classes. Lastly, comparisons were made between the 2 years of the study. These comparisons were made for mathematics and reading. The Statistical Package for the Social Sciences (SPSS) was the chosen statistical program to assist in the quantitative data analysis due to its availability to the doctoral candidate researcher and its ease. The student numbers, prior scores in mathematics and reading, current scores in mathematics and reading, whether or not they met expected growth, growth levels, gender, class type, year of study, and gender of the teacher were input and cleaned to verify that all data were entered accurately. SPSS was then used to calculate the growth scores for each student in mathematics and reading. Descriptive statistics, including the mean, median, and the standard deviation, were used to summarize the data, especially growth, for each group in both subject areas. Inferential statistics were used to compare the groups and determine if their scores were good estimates of larger populations and valid enough to be used to make predictions about and generalizations to similar populations. The parametric ANOVA was used to determine if the group scores had statistically significant differences. Two types of ANOVAs, the univariate and repeated measures, were used to

strengthen the findings. The use of ANOVAs was implemented because the statistical test is more efficient and accurate than running multiple *t*-tests when comparing several different means (Kaufhold, 2007). However, independent *t*-tests were also used for specifically comparing SS and COED subgroups. Chi-square was also used to analyze categorical data.

**Qualitative.** The qualitative data, open-ended interviews, were analyzed by the researcher to identify global themes in the teachers' responses. The decision to analyze by hand, as opposed to by computer program, was made for several reasons. First, the number of interviews, seven, yielded a relatively small amount of data to analyze. Secondly, the researcher believes coding by hand is a more sensitive process, which may yield themes that a statistical program might miss. The researcher looked for common threads in the educators' responses to the prepared interview questions and the conversations they ignited. These themes were used to further explain the quantitative data and provide a more complete picture of the impact single-sex education actually had on the students' academic achievement as perceived by their educators. The responses to these qualitative interview questions also led to ideas for future research on single-sex education. Further analysis of this qualitative data is included in the results and discussion sections of this dissertation.

## **Summary**

In review, this researcher was acting as an outside observer throughout the duration of this 2-year explanatory mixed methods quasi-experimental study on the impact of single-sex education on student gains in mathematics and reading at a disadvantaged elementary school in North Carolina. The setting for the study was chosen for several reasons, including the school's implementation of single-sex grouping and the

willingness from the central office, administrators, and teachers to be a part of the study. The principal had already decided to implement single-sex education at the fifth-grade level. The researcher merely collected and analyzed existing data from standardized tests and open-ended interviews to determine if there were statistically significant differences between the academic gains in mathematics and reading for students in single-sex classes versus those in similar coeducational classes within the same school.

## **Chapter 4: Results**

### **Introduction**

The purpose of this 2-year, explanatory mixed methods quasi-experimental study was to add to the limited body of research on single-sex education by exploring its impact on an economically disadvantaged school's fifth-grade students' academic gains in mathematics and reading achievement in comparison to their peers in demographically similar coeducational classrooms within the same school. The study explored the following research questions:

1. What impact does single-sex education have on fifth-grade males' gains in mathematics in comparison to their peers in similar coeducational classrooms as evidenced by standardized test scores and teachers' perceptions?
2. What impact does single-sex education have on fifth-grade males' gains in reading in comparison to their peers in similar coeducational classrooms as evidenced by standardized test scores and teachers' perceptions?
3. What impact does single-sex education have on fifth-grade females' gains in mathematics in comparison to their peers in similar coeducational classrooms as evidenced by standardized test scores and teachers' perceptions?
4. What impact does single-sex education have on fifth-grade females' gains in reading in comparison to their peers in similar coeducational classrooms as evidenced by standardized test scores and teachers' perceptions?

In order to answer the research questions, descriptive statistics, including means, medians, and standard deviations, were utilized to describe the central tendencies of the various groups. A heavy emphasis was placed on the growth score between the prior and current year's developmental scale scores (DSSs) on the mathematics and reading tests.

To be included in this analysis, the student must have been enrolled in the school at least 140 days and have both the prior and current years' EOG scores in mathematics and reading. These two requirements reduced the actual number of participants from the original class sizes and decreased the total sample size, but also helped eliminate the threat and effects of participant mortality in the study. After describing the groups' central tendencies with descriptive statistics, three statistical tests were utilized to determine if there were statistically significant differences between any of the groups that could be attributed to the gender composition of the classes. The use of multiple statistical tests, univariate ANOVA, repeated measures ANOVA, independent *t*-tests, and chi-square tests, added strength to the study's findings.

The remainder of this chapter reports the findings of this study. The 2009-2010 school year is referred to as year 1 and is presented first, while the 2010-2011 school year follows and is referred to as year 2. Due to the nature of the explanatory mixed methods design, quantitative data results for each year are discussed first, followed by the qualitative data. Quantitative data, standardized EOG scores in mathematics and reading, were analyzed using both descriptive and inferential statistics. For each year of the study, descriptive statistics are presented first, followed by the inferential statistics. Qualitative data, open-ended teacher interviews, provided deeper insight into the teachers' perceptions of how the treatment, single-sex education, impacted student growth in the areas of mathematics and reading. The qualitative data were analyzed by hand to identify any central themes in teachers' responses. The chapter ends with a summary of the study's results.

### **Quantitative Analysis**

Descriptive statistics and inferential statistics were both used to analyze the

impact of single-sex education on male and female gains in mathematics and reading as indicated by their standardized end-of-grade test scores. Data were reported for year 1 and year 2 separately, in addition to the 2 years combined. The focus was placed on one year's worth of growth for each student in mathematics and reading as indicated by their growth on standardized EOG tests. For most students this growth was determined by calculating the difference between their fifth-grade and fourth-grade EOG developmental scale scores (DSS) in both mathematics and reading. For some students, those repeating fifth grade, the year's worth of growth was calculated from the difference between their previous fifth-grade scores and their current fifth-grade scores, which remains indicative of one full year's worth of growth. From this point forward, the two scores are referred to as prior score and current score regardless if the prior scores are from fourth or fifth grade. The mean, median, and standard deviation for each of the classes, in addition to the male (COEDM) and female (COEDF) subgroups in the COED classes, were calculated to summarize the growth of each class and subgroup in both mathematics and reading. While this is the strategy most teachers use to determine student growth, it should be noted that it is not a completely accurate portrayal of true growth. This is because the DSS scales on the reading and mathematics tests change at each grade level. So while it may appear to a teacher that a child gained seven points in mathematics, the child may have actually remained at the bottom of the same level he was in the year before; the changing scale from one grade to the next simply implies a certain number of growth points. However, since this method is still widely practiced and is indeed consistent for every student, it was used in this study.

In addition, North Carolina uses a complex formula to assess whether or not students have met their expected growth and to denote what level of growth they have



achieved. First, predicted change scores are established, which are based on students' prior years' EOG scores and a standard deviation from the norming year of the tests. Once students take the tests, actual change scores are calculated. The difference between these two scores determines whether or not expected growth has been met; a positive number indicates *yes*, a negative number indicates *no*. In addition, another formula determines what level of growth (high, expected, not expected, or low) the students achieved. However, due to the changing scale scores for each grade level, there is no way to determine true points gained from one year's test to another. This data, growth met and growth level, are also reported in this section.

**Year 1 descriptive statistics.** During 2009-2010, the fifth-grade students at the targeted school were divided into three classes: single-sex female (SSF), single-sex male (SSM), and coeducational (COED). After eliminating students who did not meet the required criteria discussed earlier, the SSF class had a sample size of  $n = 19$ , the SSM class had a sample size of  $n = 13$ , and the COED class had a sample size of  $n = 14$ . It should be noted that the coeducational class was originally more heavily composed of males, with a 15:8 boy-girl split. In the final data analysis for this group, only two of the 14 students were female. The impact this small sample has on the validity of the data analysis and findings is presented in more detail later in this chapter and further discussed in Chapter 5 of this dissertation. It should also be noted that there were no statistically significant differences between the groups in prior attainment in mathematics,  $F(3, 42) = .211, p > .05$ , or reading  $F(3, 42) = .308, p > .05$ . Based on the statistical analysis, which did not reveal statistically significant differences in the prior year's EOG scores for the groups, it can be stated that all classes were on similar academic levels at the start of the fifth-grade year and, thus, at the beginning of the single-sex education

treatment.

In regards to the DSS mean growth scores in mathematics, the SSF class had the largest average growth score, followed by the SSM class, the COEDF subgroup, the COED class, and finally, the COEDM subgroup. See Table 1 for a complete list of the various groups' mean, median, and standard deviations with respect to growth in DSSs in mathematics. Minimum and maximum growth scores for each group are also included, which would affect the mean growth scores recorded.

Table 1

*Descriptive Statistics for Growth Scores on Mathematics Test*

Group	M	MD	SD	Minimum	Maximum
SSM (13)	6.39	6.00	5.28	-4.00	16.00
SSF (19)	6.84	7.00	5.13	-3.00	18.00
COED (14)	5.00	5.50	4.26	-3.00	14.00
COEDM (12)	4.83	5.50	4.60	-3.00	14.00
COEDF (2)	6.00	6.00	1.41	5.00	7.00

In regards to the state formula for expected growth in mathematics, a higher percentage of students from the SSF class met expected growth. This class was followed by the SSM class, the COEDM subgroup, the COED class, and the COEDF subgroup. These percentages, along with the percentages of students scoring within each level of growth (high, expected, not expected, or low), are reported in Table 2 for easy comparison. It is evident from these descriptive statistics that a higher percentage of students in the SS classes met their expected growth than in the COED classes.

Table 2

*Descriptive Statistics for Meeting Expected Growth on Mathematics Test*

Group	% Met	% High	% Expected	% Not Met	% Low
SSM (13)	69.2%	30.8%	38.5%	15.4%	15.4%
SSF (19)	73.7%	36.8%	36.8%	26.3%	0.0%
COED (14)	64.3%	28.6%	35.7%	28.6%	7.1%
COEDM (12)	66.7%	33.3%	33.3%	25.0%	8.3%
COEDF (2)	50.0%	0.0%	50.0%	50.0%	0.0%

In regards to the DSS mean growth scores in reading, the SSM class had the largest average growth score, followed by the COEDM subgroup, the SSF class, the COED class, and finally, the COEDF subgroup. See Table 3 for a complete list of the various groups' mean, median, and standard deviations with respect to growth in DSSs in reading. Minimum and maximum growth scores for each group are also included, which would affect the mean growth scores recorded.

Table 3

*Descriptive Statistics for Growth Scores on Reading Test*

Group	M	MD	SD	Minimum	Maximum
SSM (13)	7.61	8.00	6.67	-8.00	20.00
SSF (19)	6.74	7.00	5.67	-4.00	18.00
COED (14)	5.50	3.00	6.67	-4.00	16.00
COEDM (12)	6.75	6.00	6.36	-4.00	16.00
COEDF (2)	-2.00	-2.00	1.41	-3.00	-1.00

In regards to the state formula for expected growth in reading, a higher percentage of students from the COEDM group met expected growth. This class was followed by the SSM class, the COED class, the SSF class, and the COEDF subgroup. These percentages, along with the percentages of students scoring within each level of growth (high, expected, not expected, or low), are reported in Table 4 for easy comparison. It is evident from these descriptive statistics that a higher percentage of male students, regardless of their class type, met their expected growth than female students. In addition, the COED class had a higher percentage of students earn high growth.

Table 4

*Descriptive Statistics for Meeting Expected Growth on Reading Test*

Group	% Met	% High	% Expected	% Not Met	% Low
SSM (13)	61.5%	23.1%	38.5%	23.1%	15.4%
SSF (19)	52.6%	21.1%	31.6%	47.4%	0.0%
COED (14)	57.1%	42.9%	14.3%	21.4%	21.4%
COEDM (12)	66.7%	50.0%	16.7%	25.0%	8.3%
COEDF (2)	0.0%	0.0%	0.0%	0.0%	100%

**Year 1 inferential statistics.** In order to determine whether or not the differences in academic gains between the three classes were statistically significant, SPSS was used to conduct several different statistical tests. Two types of analysis of variance were conducted on both the mathematics and reading data. In addition, to more specifically determine whether or not the differences in academic gains between SS males and COED males, as well as SS females and COED females, were statistically significant, independent *t*-tests were conducted in mathematics and reading. Chi-square

tests were also conducted on the met growth percentages.

The first test conducted to determine the differences between the groups was a univariate analysis of variance (ANOVA). It compared the average growth scores for each of the groups in mathematics to determine statistical significance. The test did not reveal any statistically significant differences between the groups' growth in mathematics,  $F(3, 42) = .41, p > .05$ . According to this statistical analysis of variance, the gender composition of the classroom did not have a statistically significant impact on the students' growth in mathematics based on EOG test scores.

The second statistical test, a repeated measures ANOVA, was conducted because it is more sensitive to the growth of individual students. Whereas the univariate ANOVA uses the mean scores of each group for comparisons, the repeated measures ANOVA analyzes each individual student's growth between the prior and current scores. The expectation is that the repeated measures ANOVA will detect differences the univariate analysis may miss. The repeated measures ANOVA revealed that all groups had statistically significant growth in mathematics,  $F(2, 90) = 67.98, p < .001$ . However, even though all classes showed statistically significant growth in mathematics, the repeated measures ANOVA showed the actual effect of the class type, or gender composition of the classes, to have a nonsignificant impact on students' growth,  $F(2, 90) = .58, p > .05$ . Thus, the repeated measures ANOVA produced similar findings to the univariate ANOVA in that it did not find statistically significant differences in students' growth in mathematics that were related to the gender composition of the classrooms.

In addition, independent *t*-tests were utilized to determine whether there were any statistically significant differences specifically between the SS males and their COED

counterparts, as well as between the SS females and their COED counterparts. The  $t$ -test did not reveal any statistically significant differences between the males' growth in mathematics,  $t(23) = .781, p > .05$ . Likewise, for the female groups, the  $t$ -test did not find statistically significant differences between the two,  $t(19) = .226, p > .05$ . An additional analysis, through a chi-square test, of the percentages of students meeting their expected growth in mathematics did not reveal any statistically significant differences between any of the class types. Therefore, the gender composition of the classrooms, according to this analysis, did not have a statistically significant impact, positively or negatively, on whether students met their expected growth on the mathematics EOG test. Thus, none of the statistical tests conducted reveal any statistically significant differences between any of the year 1 groups in mathematics that could be attributed to the gender composition of the classes.

The two ANOVAs revealed similar results when analyzing reading growth for statistical significance. The univariate ANOVA did not reveal any statistically significant differences between the groups' growth,  $F(3, 42) = 1.46, p > .05$ . The more sensitive repeated measures ANOVA showed statistically significant growth in reading, as it did in mathematics, for all groups with  $F(2, 90) = 49.94, p < .001$ ; it did not find any statistically significant growth related to the gender composition of the groups  $F(2, 90) = .391, p > .05$ . Thus, the gender composition of the classroom did not have a statistically significant impact on the students' growth in reading based on EOG test scores. In addition, the independent  $t$ -tests did not find any statistically significant differences between SS males and COED males in reading,  $t(23) = .332, p > .05$ . However, the female analysis yielded slightly different results that must be interpreted with a reminder of the COEDF subgroup's extremely small sample size. The SSF class

had an  $n = 19$ , whereas the COEDF subgroup only had an  $n = 2$ . The COEDF's extremely small number of participants drastically impacted its average scores and calls the validity of the statistical analysis into question. This is discussed in greater detail in Chapter 5. However, the  $t$ -test revealed a statistically significant difference favoring the SSF class in reading,  $t(19) = 2.13, p < .05$ . In an attempt to validate this statistically significant finding, data from a second year was analyzed and then the 2 years were combined to establish a larger sample size to analyze.

In addition, a chi-square test on the percentages of students meeting their expected growth in reading did not reveal any statistically significant differences between any of the class types. Therefore, the gender composition of the classrooms did not have a statistically significant impact, positively or negatively, on whether students met their expected growth on the reading EOG test.

**Year 2 descriptive statistics.** During 2010-2011, the fifth-grade students at the targeted school were divided into four classes: single-sex female (SSF), two single-sex male (SSM1 and SSM2), and coeducational (COED). After eliminating students who did not meet the required criteria discussed earlier, the SSF class had a sample size of  $n = 12$ , the SSM1 class had a sample size of  $n = 14$ , the SSM2 class had a sample size of  $n = 10$ , and the COED class had a sample size of  $n = 14$ . The COED class had eight males and six females. The two single-sex male classes were grouped together for analysis with a sample size of  $n = 24$ . There were no statistically significant differences between the groups in prior attainment in mathematics,  $F(3, 46) = .146, p > .05$ , or reading,  $F(3, 46) = .989, p > .05$ . Based on the statistical analysis, which revealed no significant differences in the prior year's EOG scores for the groups, it can be stated that all classes were on similar academic levels at the start of the fifth-grade year and, thus, at the

beginning of the single-sex education treatment.

In regards to the DSS mean growth scores in mathematics, the SSM class had the largest average growth score, followed by the COEDM group, the SSF class, the COED class, and finally, the COEDF subgroup. See Table 5 for a complete list of the various groups' mean, median, and standard deviations with respect to growth in DSSs in mathematics. Minimum and maximum growth scores for each group are also included, which would affect the mean growth scores recorded.

Table 5

*Descriptive Statistics for Growth Scores on Mathematics Test*

Group	M	MD	SD	Minimum	Maximum
SSM (24)	6.17	6.50	5.45	-3.00	16.00
SSF (12)	4.33	3.00	5.23	-3.00	13.00
COED (14)	3.43	3.50	5.42	-6.00	12.00
COEDM (8)	4.38	5.50	6.65	-6.00	12.00
COEDF (6)	2.17	2.50	3.31	-2.00	6.00

In regards to the state formula for expected growth in mathematics, a higher percentage of students from the SSM class met expected growth. This class was followed by the SSF class and the COEDM subgroup, the COED class, and the COEDF subgroup. These percentages, along with the percentages of students scoring within each level of growth (high, expected, not expected, or low), are reported in Table 6 for easy comparison. It is evident from these descriptive statistics that a higher percentage of students in the SS classes met their expected growth than in the COED classes. In addition, the SS classes have higher percentages of students earning high growth.



Table 6

*Descriptive Statistics for Meeting Expected Growth on Mathematics Test*

Group	% Met	% High	% Expected	% Not Met	% Low
SSM (24)	75.0%	37.5%	41.7%	25.0%	0.0%
SSF (12)	50.0%	16.7%	33.3%	50.0%	0.0%
COED (14)	35.7%	7.1%	28.6%	64.3%	0.0%
COEDM (8)	50.0%	12.5%	37.5%	50.0%	0.0%
COEDF (6)	16.7%	0.0%	16.7%	83.30%	0.0%

The descriptive statistics, with respect to the DSS mean growth scores in reading, were more mixed; they did not completely favor SS or COED. The COEDF subgroup had the largest average growth score, followed by the SSM class, the COED class, the SSF class, and finally, the COEDM subgroup. See Table 7 for a complete list of the various groups' mean, median, and standard deviations with respect to growth in DSSs in reading. Minimum and maximum growth scores for each group are also included, which would affect the mean growth scores recorded.

Table 7

*Descriptive Statistics for Growth Scores on Reading Test*

Group	M	MD	SD	Minimum	Maximum
SSM (24)	5.38	5.00	5.12	-4.00	15.00
SSF (12)	2.42	3.00	4.64	-5.00	11.00
COED (14)	3.29	3.50	5.99	-11.00	14.00
COEDM (8)	0.88	1.50	6.06	-11.00	10.00
COEDF (6)	6.50	5.50	4.51	2.00	14.00

In regards to the state formula for expected growth in reading, a higher percentage of students from the SSM class met expected growth. This class was followed by the COEDF subgroup, the SSF class, the COED class, and the COEDM subgroup. These percentages, along with the percentages of students scoring within each level of growth (high, expected, not expected, or low), are reported in Table 8 for easy comparison. It is evident from these descriptive statistics that a higher percentage of SS students met their expected growth than COED students.

Table 8

*Descriptive Statistics for Meeting Expected Growth on Reading Test*

Group	% Met	% High	% Expected	% Not Met	% Low
SSM (24)	62.5%	29.2%	33.3%	37.5%	0.0%
SSF (12)	41.7%	8.3%	33.3%	58.3%	0.0%
COED (14)	28.6%	7.1%	21.4%	71.4%	0.0%
COEDM (8)	12.5%	0.0%	12.5%	87.5%	0.0%
COEDF (6)	50.0%	16.7%	33.3%	50.0%	0.0%

**Year 2 inferential statistics.** In order to determine whether the differences in academic gains between the three class types (SSF, SSM, and COED) were statistically significant, SPSS was used to conduct several different statistical tests. Two types of analysis of variance were conducted on both the mathematics and reading data. In addition, to more specifically determine whether or not differences in academic gains exist between SS males and COED males, as well as between SS females and COED females, independent *t*-tests were conducted in mathematics and reading. Chi-square tests were also conducted on the met growth percentages.

The first test conducted to determine statistical significance was a univariate analysis of variance (ANOVA). It compared the average growth scores for each of the groups in mathematics to determine statistical significance. The test did not reveal any statistically significant differences between the groups' growth in mathematics,  $F(2, 46) = 1.25, p > .05$ . According to this statistical analysis of variance, the gender composition of the classroom had no statistically significant impact on the students' growth in mathematics based on EOG test scores.

The second statistical test, a repeated measures ANOVA, was conducted because it is more sensitive to the growth of individual students. Whereas the univariate ANOVA used the mean scores of each group for comparisons, the repeated measures ANOVA analyzed each individual student's growth between the prior and current scores. The expectation is that the repeated measures ANOVA will detect differences the univariate analysis may miss. The repeated measures ANOVA revealed that all groups had statistically significant growth in mathematics,  $F(2, 98) = 23.77, p < .001$ . However, even though all class types showed statistically significant growth in mathematics, the repeated measures ANOVA showed the actual effect of the class type, or gender composition of the classes, to have a nonsignificant impact on students' growth,  $F(2, 46) = 1.01, p > .05$ . Thus, the repeated measures ANOVA produced similar findings to the univariate ANOVA in that it did not find statistically significant differences in students' growth in mathematics EOGs that were related to the gender composition of the classrooms.

In addition, independent *t*-tests were utilized to determine whether there were any statistically significant differences specifically between the SS males and their COED counterparts, as well as between the SS females and their COED counterparts. The *t*-test did not reveal any statistically significant differences between the SSM and COEDM groups in mathematics,  $t(30) = .76, p > .05$ . Likewise, for the female groups, the *t*-test did not find statistically significant differences between SSFs and COEDFs,  $t(16) = .92, p > .05$ . Thus, none of the statistical tests conducted on DSS gains revealed any statistically significant differences in mathematics between any of the groups that could be attributed to gender composition. An additional analysis, with the chi-square test, of

the percentages of students meeting their expected growth in mathematics did reveal a statistically significant difference favoring the SSM group,  $\chi^2 (2, N=50) = 6.02, p < .05$ . Therefore, the gender composition of the classroom did have a statistically significant positive impact on whether or not students met their expected growth on the mathematics EOG test, especially for males.

The two ANOVAs found similar results when analyzing reading growth for statistical significance. The univariate ANOVA did not reveal any statistically significant differences between the groups' growth,  $F (2, 46) = 1.48, p > .05$ . The more sensitive repeated measures ANOVA also showed statistically significant growth in reading for all groups,  $F (2, 98) = 13.81, p < .001$ ; it did not find any statistically significant growth related to the gender composition of the classes,  $F (2, 98) = 1.46, p > .05$ . Thus, according to both ANOVAs, the gender composition of the classroom did not have a statistically significant impact on the students' growth in reading based on EOG test scores.

In addition, the *t*-test did not find statistically significant differences in reading between SSFs and COEDFs,  $t (16) = -1.78, p > .05$ . However, the *t*-test did reveal a statistically significant difference favoring the SSM group over the COEDM group in reading,  $t (30) = 2.06, p < .05$ . Thus, the findings from the *t*-test support that single-sex education does positively impact gains in reading for males. A chi-square test on the percentages of students meeting their expected growth in reading did not reveal any statistically significant differences between any of the class types. Therefore, the gender composition of the classrooms did not have a statistically significant impact, positively or negatively, on whether or not students met their expected growth on the reading EOG test.

**Combined years' analyses.** Year 1 and year 2 of this study had relatively small sample sizes,  $n = 50$  and  $n = 46$ , respectively, which created low power in the statistical analysis. This simply means that it may be possible to miss statistically significant differences that are actually present between the groups because the sample size was too small. To address this, the samples from the 2 years of the study were combined and then analyzed to determine if a larger sample size ( $n = 96$ ) revealed statistically significant differences between the class types (SSM,  $n = 37$ ; SSF,  $n = 31$ ; COED,  $n = 28$ ; COEDM,  $n = 20$ ; COEDF,  $n = 8$ ) in respect to gains in mathematics and reading on EOG tests.

**Combined years' inferential statistics.** The same statistical tests, the univariate ANOVA, repeated measures ANOVA,  $t$ -test, and chi-square test, were conducted to determine if the larger sample revealed statistically significant differences in mathematics or reading. None of the tests found statistically significant differences in either subject between any of the groups when the 2 years were combined. The univariate ANOVA reported  $F(2, 95) = 1.33, p > .05$  in mathematics, and  $F(2, 95) = .76, p > .05$  in reading; the repeated measures ANOVA reported  $F(2, 92) = 1.05, p > .05$  in mathematics, and  $F(92, 92) = .50, p > .05$  in reading. When comparing SSFs to COEDFs, the  $t$ -tests also revealed nonsignificant differences in mathematics,  $t(37) = 1.40, p > .05$ , and in reading,  $t(37) = .31, p > .05$ . For males, the  $t$ -tests reveal nonsignificant differences in mathematics,  $t(55) = 1.08, p > .05$  and in reading,  $t(55) = 1.04, p > .05$ . Thus, when statistically analyzing the impact single-sex education had on academic gains in mathematics and reading during these 2 years, it appears as if there was no impact, positive or negative. However, one must look deeper at the descriptive data for the larger sample, which appears to favor SS classes over COED classes.

**Combined years' descriptive statistics.** In reviewing the descriptive statistics

for larger sample size's gains in developmental scales scores, it is evident that, in mathematics, the SSM class had the largest average growth score, followed by the SSF class, the COEDM subgroup, the COED class, and finally, the COEDF subgroup. See Table 9 for a complete list of the various groups' mean, median, and standard deviations with respect to growth in DSSs in mathematics. Minimum and maximum growth scores for each group are also included, which would affect the mean growth scores recorded.

Table 9

*Descriptive Statistics for Growth Scores on Mathematics Test*

Group	M	MD	SD	Minimum	Maximum
SSM (37)	6.24	6.00	5.32	-4.00	16.00
SSF (31)	5.87	7.00	5.23	-3.00	18.00
COED (28)	4.21	5.00	4.85	-6.00	14.00
COEDM (20)	4.65	5.50	5.34	-6.00	14.00
COEDF (8)	3.13	4.50	3.36	-2.00	7.00

In regards to the state formula for expected growth in mathematics, a higher percentage of students in the SSM class met their expected growth, followed by the SSF class, COEDM group, the COED class, and then the COEDF group. These percentages, along with the percentages of students scoring within each level of growth (high, expected, not expected, or low), are reported in Table 10 for easy comparison. It is evident from these descriptive statistics that a higher percentage of students in the SS classes met their expected growth in mathematics than in the other groups. In addition, the SS classes have higher percentages of students earning high growth.

Table 10

*Descriptive Statistics for Meeting Expected Growth on Mathematics Test*

Group	% Met	% High	% Expected	% Not Met	% Low
SSM (37)	73.0%	35.1%	40.5%	21.6%	5.4%
SSF (31)	64.5%	29.0%	35.5%	35.5%	0.0%
COED (28)	50.0%	17.9%	32.1%	46.4%	3.6%
COEDM (20)	60.0%	25.0%	35.0%	35.0%	5.0%
COEDF (8)	25.0%	0.0%	25.0%	75.0%	0.0%

The descriptive statistics, with respect to the DSS mean growth scores in reading, revealed that the SSM class had higher average gains, followed by the SSF class; the COEDM subgroup, the COED class, and the COEDF subgroup were all an extremely close third. See Table 11 for a complete list of the various groups' mean, median, and standard deviations with respect to growth in DSSs in reading. Minimum and maximum growth scores for each group are also included, which would affect the mean growth scores recorded.



Table 11

*Descriptive Statistics for Growth Scores on Reading Test*

Group	M	MD	SD	Minimum	Maximum
SSM (37)	6.16	6.00	5.72	-8.00	20.00
SSF (31)	5.06	4.00	5.63	-5.00	18.00
COED (28)	4.39	3.00	6.32	-11.00	16.00
COEDM (20)	4.40	3.00	6.75	-11.00	16.00
COEDF (8)	4.38	3.50	5.50	-3.00	14.00

In regards to the state formula for expected growth in reading, a higher percentage of students in the SSM class met their expected growth, followed by the SSF class, the COEDM subgroup, the COED class, and the COEDF subgroup. These percentages, along with the percentages of students scoring within each level of growth (high, expected, not expected, or low), are reported in Table 12 for easy comparison. It is evident from these descriptive statistics that a higher percentage of students in the SS classes met their expected growth in reading than in the COED classes.

Table 12

*Descriptive Statistics for Meeting Expected Growth on Reading Test*

Group	% Met	% High	% Expected	% Not Met	% Low
SSM (37)	62.2%	27.0%	35.1%	32.4%	5.4%
SSF (31)	48.4%	16.1%	32.3%	51.6%	0.0%
COED (28)	42.9%	25.0%	17.9%	46.4%	10.7%
COEDM (20)	45.0%	30.0%	15.0%	50.0%	5.0%
COEDF (8)	37.5%	12.5%	25.0%	37.5%	25.0%

Thus, while there were no statistically significant differences reported for the larger sample during the 2 years of the study, the descriptive statistics seem to favor the SS classes over the COED classes. In this explanatory mixed methods study, the qualitative data must be considered to provide a better understanding of teachers' perceptions of how single-sex education impacted their students' gains in mathematics and reading.

### **Qualitative Analysis**

In this explanatory mixed methods study, the qualitative data is secondary to the quantitative data. Simple teacher interviews were used to explore the teachers' perceptions concerning how the gender composition of their classrooms impacts their students' growth in mathematics and reading. The responses were analyzed by the researcher to identify broad, global themes in the teachers' responses. The qualitative data for each year were gathered during end of the year open-ended interviews with the fifth-grade teachers (year 1, n = 3; year 2, n = 4). These interviews opened meaningful dialogue that yielded insightful information regarding the teachers' perceptions of how

single-sex education impacted their students' growth in mathematics and reading. The interviews were audio recorded in order to accurately capture all responses. The questions were then entered into an MS Word table with all teachers' responses recorded beside them (see Appendix F). During this process, several overriding themes emerged. These included themes regarding the impact of single-sex education on mathematics, the impact on reading, satisfaction with EOG scores, and extraneous variables. Due to the small number of teachers ( $n = 7$ ) and the similarities in the 2 years' interviews, responses and themes from both years are reported together.

**Impact on mathematics.** The SSM teachers found that they could move through mathematics material more quickly than the other teachers. This allowed more time to extend the curriculum by challenging male students with more complex, yet related, mathematics problems. On the other hand, one SSF teacher said, "I am amazed at how long it takes to teach each concept to basic mastery." She shared her revelation that in past years her male students have probably covered for her females' inadequate mathematics skills by carrying them through each concept and into the next. However, she noted how much more involved the females became in mathematics, stating, "My girls volunteer more and ask more questions when there are no males present." According to the teachers' perceptions, the females in the SSF classes did not seem as hesitant to try new mathematics concepts as did the females in COED classes. One SSF teacher shared how her females had to be "pumped up for math," which was easier to do with males not present. She said her girls "doubt themselves in math, probably due to the stereotypes they have always been faced with." She changed the time of day she taught math to first thing in the morning and used a lot of peer teaching. She saw her females' confidence in math improve and believed "they will be very successful in middle school

math.” She attributed much of this change to the single-sex dynamics of her class. A COED teacher confirmed much of the information shared by the SS teachers. She said, “My boys overpower my girls in mathematics.” The males answered questions more often; whereas the females were hesitant to participate in anyway, including asking questions when they did not understand. Another teacher shared her experience with COED as being “completely opposite of what I expected.” While her males liked math more, they were less confident than the females. However, the females’ confidence was often a smokescreen for their continued low performance and lack of understanding. They rarely asked for help and often scored poorly on assignments and tests.

**Impact on reading.** One SSM teacher was very pleased with his males’ successes in reading throughout the year, stating, “My boys’ fluency and comprehension has improved greatly. They are very motivated to read and participate in the school Accelerated Reader program. They talk about what they are reading and seem to genuinely enjoy reading.” Other SSM teachers seemed to feel the same way and shared how much more comfortable their males seemed when discussing what they were reading. On the contrary, the year 1 SSF teacher was actually disappointed with her females’ reading success. “They do not seem to enjoy reading or read as much as I expected from girls who typically excel in reading.” The year 2 SSF teacher shared how much more her class accomplished during reading. “We are able to follow plans more closely because the girls are more organized and structured. They are more interested in reading and discussing. We are able to be more engaged in learning.” One COED teacher was not surprised with her observations. She felt that the females carried the males through reading. “My girls take more Accelerated Reader tests and discuss their weekly basal stories more often than my boys.” According to her observations, the males

in the COED class did not seem interested in reading or as motivated to read. However, the year 2 COED teacher again made different observations with her group. Her males had stronger reading skills and were able to find more interesting books. They seemed to like reading more than her females did.

**Satisfaction with EOG scores.** The teachers believed separating the sexes may bring greater gains in DSSs, with a larger difference between the SS classes and the COED class scores. However, all the teachers supported the belief that standardized test scores cannot reveal the entire impact of the single-sex program. In addition, they believed there needs to be a more in-depth analysis of the scores than what they have seen thus far before they can make a more informed judgment concerning the impact of single-sex education on the students' academic gains as evidenced by EOG scores. They also shared their concern regarding extraneous variables, outside of the gender composition of their classes, which may have impacted their students' growth in reading and mathematics.

**Extraneous variables.** Several concerns surfaced as the teachers shared their ideas as to what variables may have impacted the students' scores in addition to the gender composition of their classes. Three common variables arose in every conversation. These included teaching styles, classroom management techniques, and student-teacher rapport. All the teachers perceived their students as being on roughly the "same playing field" in regards to prior attainment, home life, and socioeconomic status, which could all impact achievement. However, the teachers were keenly aware of the different impact they make merely by how they teach the curriculum, manage the classroom, and relate to the students. These are extraneous variables that are nearly impossible to control in educational research. In addition, the teachers, especially the

COED, discussed behavioral issues. The COED teachers both noted more concerns with behavioral problems interfering with teaching and learning time, which they attributed mostly to the dynamics of males and females being together. One teacher said, “The boys will do something silly, the girls will laugh, the boys will continue to show out for them. This doesn’t happen in a single-sex classroom.”

The teachers also voiced their concern about differences between the classes with respect to attendance rates and transient populations. A teacher in year 1 stated, “We can’t teach them if they aren’t here.” This comment prompted the researcher to explore the attendance records for each of the classes to see if there were any major differences that could have impacted student growth. In year 1, the SSF class missed an average of 5.47 days per student, the SSM class missed an average of 6.23 days per student, the COED class missed an average of 4.79 days per student, with the COEDF subgroup averaging 2.5 days and the COEDM subgroup averaging 5.17 days (this information was provided by the school’s office staff; means were calculated using only the students included in the quantitative data analysis portion of this chapter). In addition, the SSM class had a noticeably more transient population than the other classes. The attendance rates and transient populations were not concerns in year 2.

Lastly, one point that surfaced during discussion was the lack of training on single-sex education. None of the teachers received any training on effective pedagogy for teaching single-sex classes. Anything they learned they learned on their own. One teacher stated, “Some teachers are more open to new ideas than others. Some just want to teach the way they have always taught. We all need to be trained on gender-specific strategies to use and then we need to implement them if we want to see results.” This lack of training and the importance for designing and implementing quality training is

supported in current research; simply separating boys and girls, decorating in blue and pink, and then teaching the same old way is not going to get the desired results. Lack of quality training on single-sex education is a real issue in the single-sex movement.

### **Summary**

The various statistical tests on the quantitative data collected revealed mixed findings, most of which were not found to be statistically significant. The exceptions included a *t*-test conducted in year 2 that favored SSM over COED males in reading gains and another statistically significant finding from year 2 regarding the percentage of students meeting expected growth in mathematics, which also favored SSM students. A deeper look at the descriptive data for both years combined, as well as the individual years, revealed a favoring of SS classes over COED classes. The qualitative data added teachers' support for single-sex classes. They perceived them as having less behavioral issues, more time to teach, and less distracted and more comfortable students. The teachers also believed they could better identify and address male and female needs in single-sex classes, but also added a warning that not all students fall into gender stereotypes and teachers must not assume they do.

## **Chapter 5: Discussion and Conclusions**

### **Introduction**

The best practices for educating children are constantly changing, as are the theories supporting them. Current trends in educational reform show that schools are experimenting with single-sex education. The somewhat controversial strategy can be seen in schools throughout the world, at all levels of education, and in the private and public school sectors. Single-sex education is being implemented in order to meet the diverse needs of males and females in the classroom, with the intent of raising the achievement levels of both sexes. Is the strategy effective? Does utilizing single-sex classrooms impact student learning? This study attempted to answer these questions. The remainder of Chapter 5 provides a summary of this study, an in-depth discussion of the findings, its implications for education, strengths and limitations of the study, as well as recommendations for future research.

### **Summary of the Study**

The purpose of this 2-year, explanatory mixed methods quasi-experimental study was to add to the limited body of research on single-sex education by exploring its impact on an economically disadvantaged school's fifth-grade students' academic gains in mathematics and reading achievement in comparison to their peers in demographically similar coeducational classrooms within the same school. The study explored the following research questions:

1. What impact does single-sex education have on fifth-grade males' academic gains in mathematics in comparison to their peers in similar coeducational classrooms as evidenced by standardized test scores and teachers' perceptions?
2. What impact does single-sex education have on fifth-grade males' academic



gains in reading in comparison to their peers in similar coeducational classrooms as evidenced by standardized test scores and teachers' perceptions?

3. What impact does single-sex education have on fifth-grade females' academic gains in mathematics in comparison to their peers in similar coeducational classrooms as evidenced by standardized test scores and teachers' perceptions?

4. What impact does single-sex education have on fifth-grade females' academic gains in reading in comparison to their peers in similar coeducational classrooms as evidenced by standardized test scores and teachers' perceptions?

To answer these research questions, quantitative and qualitative data were collected over 2 years at one disadvantaged elementary school in North Carolina where single-sex education had just been implemented at the fifth-grade level. It should be noted here that the second year of the study was not a continuation of the first; it was actually a repetition of the study. Years 1 and 2 had completely separate and different teacher and student data for analysis. Year 1 consisted of three classrooms, one COED, one SSM, and one SSF, with three lead teachers; whereas, year 2 consisted of four classrooms, one COED, two SSM, and one SSF, with four lead teachers. Quantitative data collected for the study came from EOG scores in mathematics and reading. Qualitative data came from teacher interviews that explored teacher perceptions on single-sex education's impact on their students' gains in mathematics and reading. Descriptive statistics were used to describe central tendencies of the various groups, with a focus on identifying 1 year of growth in mathematics and reading as evidenced by the changes in students' DSSs on EOGs from the prior year to the current year in both subjects. The data were analyzed for statistical significance using different types of statistical tests, the univariate ANOVA, repeated measures ANOVA, *t*-test, and chi-

square test. While the tests only revealed three statistically significant differences in growth in mathematics and reading that may be attributed to the gender composition of the classrooms, the descriptive data and the qualitative data both added support to the theory that single-sex education may have potential to increase achievement for both sexes. Thus, while this particular study on single-sex education did not reveal statistically significant findings across the board, it did provide support that single-sex education may have a positive impact on students' gains in mathematics and reading as evidenced by their EOG test scores and teachers' perceptions.

## **Discussion**

Even though single-sex education is not a new concept, the literature review, the limited amount of research, and this study's conclusions indicated that more research must be conducted to establish a better understanding of any impact single-sex education may have on academic gains and student achievement. The absence of focus on the effects of single-sex education in America is due in part to the restrictions of Title IX, which banned most attempts at single-sex education in the United States during the last 30 years of the 20<sup>th</sup> century. It is obvious when searching the literature, that other countries continued implementing this strategy in an effort to close their achievement gaps and meet the individual sexes' needs. Most of the existing research on single-sex education comes from outside the United States. Those studies from within the United States are typically from private school settings and mostly at the middle and high school levels, as well as in higher education. However, NCLB in 2002 and amendments to Title IX in 2006 opened the door for single-sex education in the United States. The strategy can now be seen across the country in public and private schools, at the elementary, middle, and high school levels, in individual classrooms, whole schools, and special

programs. This growing interest and increasing availability of single-sex education can be attributed in part to Dr. Leonard Sax's establishment of the National Association for Single-Sex Public Education in 2002 (NASSPE, n.d.). Since then, numerous books, articles, and organizations have allowed educators to access information to help successfully implement single-sex education in their areas. However, as with every educational trend, the question must be asked if there is sufficient research and data to support its incorporation in schools. What impact does single-sex education have on students' academic gains and achievements? This study seeks to add to this limited area of research.

**Inferential statistics.** After conducting several different types of statistical tests on the various subgroups and within the two subject areas, only a few areas revealed statistically significant differences. The validity of the finding favoring SSF over COEDF in regards to reading growth via the *t*-test in year 1 can be questioned due to the small sample size of the COEDF subgroup. The SSF ( $n = 19$ ) did indeed grow significantly more in reading than their COEDF counterparts ( $n = 2$ ), but certainly the two COED females are not representative of larger groups of females in other COED classes. Thus the *t*-test's claim of statistical significance is not a valid finding. No other analysis of year 1's data revealed statistically significant differences between the various groups with respect to growth in mathematics or reading as evidenced by EOG test scores.

During year 2, statistically significant findings favoring SSM in two areas were revealed; one in DSS score gains in reading and one in the percentage of students meeting expected growth in mathematics. It is interesting to note that the same teacher taught SSF in year 1 and SSM in year 2. It would add to the research for this teacher to

teach a COED group if the program continues for a third year. Are the performances of her students more due to being in SS classes or more due to her teaching experience, which is several years more than the other teachers? Analyzing the results from a third year with her teaching a COED group would help answer this question and add more to the research on single-sex education. Even though most of the findings are not statistically significant, discussion on this experiment with single-sex education should not end here. When exploring the impact single-sex education may have on student academic gains, the descriptive statistics and qualitative data should also be considered.

**Descriptive statistics.** In looking at the descriptive statistics of the various groups, it is clear that certain groups grew more than others. For the purposes of this discussion, median statistics are used since they are not as affected by extreme scores as are mean scores (Kaufhold, 2007). It is interesting to see that in year 1 the SSM class had the highest median growth score (MD = 8) in reading, while the SSF class had the highest median growth score (MD = 7) in mathematics. Historically, there has been a gap in achievement favoring females in reading and males in mathematics. This gap is actually one of the primary reasons the principal decided to try single-sex education—to increase male achievement in reading and female achievement in mathematics. These results may add support to the theory that single-sex education can help close the gaps in achievement in these two subject areas. It would not be valid to make any comparisons between the SSF and COEDF groups because of the small sample size in the COEDF subgroup. However, the SSM class showed larger gains in reading (MD = 8) than the COEDM subgroup (MD = 6). The same is true in mathematics, but with a smaller difference between the two groups. The SSM class had a MD = 6, whereas the COEDM subgroup had a MD = 5.5. The larger difference between the SSM and COEDM groups in reading

over mathematics may add support to the existing belief that single-sex education has the greatest impact in areas where students are already behind or struggling.

In year 2, males had the highest median growth score in reading (MD = 5); they also had the highest median score in mathematics (MD=6.5). This, again, could be attributed more to teacher experience, as previously discussed, than gender composition of the class. In addition, the SSM class showed statistically significant larger gains in reading than the COEDM subgroup (MD = 1.5). The SSM also had a higher median growth score in mathematics, but with a smaller, nonsignificant difference between the two groups; the COEDM subgroup had a MD = 5.5. Again, this difference between reading and mathematics gains may strengthen the view that single-sex education has the greatest impact in areas where students are weaker; typically males struggle more in reading than in mathematics. The comparisons for females in year 2 were mixed. Whereas the SSF group had a higher median score in mathematics (MD = 3) than the COEDF group (MD = 2.5), it had a lower score in reading (SSF MD = 3 and COEDF MD = 5.5). This again could add support to the view that single-sex classes have a more positive impact in areas where students are typically struggling, which for females would include mathematics. Based on these descriptive statistics, it can be stated that separating the sexes helps females more in mathematics and males more in reading.

**Qualitative data.** Test scores cannot possibly reveal the complete impact single-sex education has on students' improvements in mathematics and reading. It is important to dig deeper into the qualitative data to provide a clearer picture of how teachers perceive single-sex education has impacted their students. Overall, single-sex and coeducational teachers from these 2 years believed that single-sex education had a positive impact on their students' improvement in mathematics and reading. They

believed the students' academics improved greatly. According to the teachers, the students enjoyed school more and were more willing to participate and ask questions. The teachers reported that the single-sex groups had stronger bonds and worked more cooperatively than the students in COED classes. The teachers were very satisfied with the single-sex program. They look forward to teaching other groups to identify how each is impacted and how their teaching changes with respect to their groups' gender composition and needs.

**Contributions.** This quasi-experimental study has made several contributions to the field of education and, more specifically, to the body of knowledge on single-sex education. The available research on single-sex education, especially at the elementary level in the United States, is clearly lacking in both quantity and quality. This study meaningfully adds to the body of research in both ways; it adds a small scale study of high quality to the research base. The design of the study controls many of the extraneous variables that remain present in most of the current research on single-sex education, which include the school type, SES, student and teacher demographics, the administrative team's leadership style, the implemented curriculum, and the available resources. In addition, the literature review provides a strong background for why educators may want to experiment with single-sex education at their schools. This may help increase the number of schools experimenting with single-sex education and thus provide the educational community with additional insight into the impact of single-sex education. The research design used for this study provides an effective, yet simple, method for evaluating the impact of single-sex education at any school that uses annual standardized tests as a measurement tool. The study can be easily replicated.

## **Limitations and Strengths**

Every study brings with it both strengths and limitations, and this particular study is no exception. In general, educational research is known for its limitations. This is because it is nearly impossible in educational research to conduct a true experiment that allows for random sampling, which would control for many of the threats to internal and external validity (Kaufhold, 2007). Therefore, most educational experiments, as this one is, are quasi-experimental in design. The lack of random sampling in this study leaves it vulnerable to several threats to internal validity, including history and maturation. It is impossible to control all that occurs in a student's life outside the classroom doors. In addition, it is difficult to control all that happens inside the classroom. Even though the teachers at this school all used the same curriculum and had the same resources, they had their own style of teaching. The exact instructional strategies and classroom management strategies they chose differed from one another. The rapport they built with their students and the climate of their classrooms differed as well. An educator's teaching style is often influenced by the amount of experience a teacher has. During the 2 years of this study, one teacher in particular, the lead teacher of the SSF class in year 1 and the SSM class in year 2, had several more years experience than the other teachers, especially at the fifth-grade level. In addition, during year 1 the SSM class was taught by a male teacher. This adds another dimension to the study in that some may wonder if the impact on that particular group stemmed more from the gender composition of the class or the matching gender of the teacher. This was true of the SSF class as well, but since female teachers are the norm in elementary school, this configuration does not raise as many concerns. All of these extraneous factors could impact students' academic gains and achievement as much or more than the gender composition of the class.

Other limitations were introduced to this study by the sampling method and population used. The sample was taken from one grade level, in one school, in one county in North Carolina. This limits the extent to which the findings can be generalized to larger populations. In addition, the relatively small sample size lowered the observed power in the statistical analyses, which made it more difficult to identify any statistically significant differences that may have existed between the groups. This is especially true with the sample size of the COEDF groups (year 1  $n = 2$ ; year 2  $n = 6$ ). The intact cluster sampling method left little control over who participated in the study. This created a specific problem in year 1 when the COED class was more heavily weighted with males (15:8) from the start of school. At the end of the year, only two of the original eight females were included in the data analysis. Reasons for losing so many of the female participants included students changing schools mid-year, not being enrolled sufficient days, changes in testing requirements for some students, and missing pretest or posttest scores for individual students. These events were out of the researcher's control. Due to the small sample size of females in the COED classes it was difficult to make valid comparisons between the SSF and the COEDF groups to determine the true impact single-sex education may have had on student growth, especially for the female groups. The results of this study must be reviewed with all of these limitations in mind. However, they do not necessarily devalue the study's merit.

The strengths of this study outweigh its weaknesses. When compared to other studies found during the literature review portion of this research, this explanatory mixed methods study has a stronger design and is better controlled. Most published research on single-sex education compares one school to another, which is understandable considering the limited number of single-sex opportunities in many areas. However, in



these situations the researchers are not able to control many of the extraneous variables that exist in educational research, such as school administration, student demographics, and chosen curriculum. This study's design eliminated many of these confounding variables. By using one school for both of the control groups and all of the experimental groups, many of the extraneous variables were held constant. For example, the student demographics were similar for all classrooms. The students came from similar neighborhoods, socioeconomic classes, and home situations. The administration, which has such an impact on teaching and learning, was the same for all groups. The maturity of the students was similar due to the sample being drawn from one grade level. The curriculum and resources the teachers utilized were the same for all classes. In addition, as previously discussed, an ANOVA was conducted that did not find statistically significant differences between the prior attainment levels of any of the classes. This showed that all classes were on similar academic levels at the start of the school year and, thus, the beginning of the quasi-experiment with single-sex education. The combination of all of the above supports the claim that all classes were as similar as possible in all areas, which helped isolate the gender composition of the classrooms as the independent variable of the study.

Another strength in this study came from the statistical tests conducted to determine if there were statistically significant differences in academic gains between the classes. Two different ANOVAs, the univariate ANOVA and the repeated measures ANOVA, and *t*-tests were conducted in reading and mathematics on all groups and subgroups to identify any statistically significant differences between the students' academic gains in reading and mathematics as evidenced by student EOG scores. In addition, chi-square tests were conducted on the met growth percentage of students from

each subgroup. Finally, taking the teachers' perceptions of single-sex education into account added to the quantitative data analysis. Utilizing different statistical tests, as well as teachers' perceptions, strengthened the study's findings and conclusions.

There are several other strengths to the study. EOGs, the measurement tool in this study, are perceived as valid and reliable in that they are state adopted standardized tests that are administered in the same way to most students in Grades 3 through 8. Thus, the scores used for statistical analysis and comparisons in the study are reliable and valid. In addition, the threat of experimental mortality was controlled by eliminating any student from the data collection and analysis who did not have a prior and current EOG score or was not enrolled in the school for 140 days.

Lastly, the design of the study itself is a strength of it. The use of control and experimental groups (COED and SS), pretest scores (the prior year's EOG scores), treatment (single-sex education) and posttest scores (the current year's EOG scores) is the best design to control for the various threats to internal and external validity (Kaufhold, 2007). This design allows the results of the study to be generalized to similar populations. While it would be ideal to switch the groups and repeat the study, in this study that was not a possibility. However, the principal did change teaching assignments during the second year, which allowed year 1's SSF teacher to teach the SSM class in year 2 and year 1's COED teacher to teach the SSF class in year 2. The repetition of the study a second year, even though the teachers and students were different, provided additional insight into the impact of single-sex education, allowed for numerous comparisons between various groups, and opened multiple avenues for future research with single-sex education.

## **Implications**

This study on single-sex education has several implications for education. Its findings favoring single-sex education, as well as its lack of findings supporting coeducation, clearly support the need for continued research on the impacts of single-sex education. Any school experimenting with single-sex education should purposefully and diligently collect data to analyze the impact of single-sex education on the school's students. Findings from even these small scale research studies can add to the growing body of knowledge on the impacts of single-sex education. In addition, larger studies will help increase the observed power in the statistical analyses and possibly find significant differences that this study may have missed due to its small sample size. The information gleaned from the literature review, as well as the interviews with teachers, support the need for quality training for single-sex educators. None of the teachers involved in year 1 or 2 of the study had any special training on effectively teaching in a single-sex classroom. This is also true for many of the published research articles used in this study's literature review. Teachers must be made aware of gender differences and best practices to use with each gender to most effectively teach their group of students. Simply separating the sexes and teaching them the same way COED students have always been taught will not have the impact that single-sex proponents believe is possible. It is vital that quality professional development to prepare teachers for teaching in single-sex education be developed and implemented.

In addition, there are several recommendations for the specific school targeted during this study. The first is to make sure that all faculty members participate in quality training on single-sex education; without this training, the time, effort, and money spent on implementing single-sex education could be for naught. Another suggestion is to

implement single-sex education at other grade levels; currently, the strategy is only being implemented in fifth grade. The principal could expand this to include an additional grade level each year. This would open the door for a multitude of research projects, including those exploring the impact of single-sex education on various grade levels, as well as the effect single-sex education may have on students over several years. Another suggestion for the targeted school is to rotate the various classes (SSF, SSM, and COED) through the different teachers, so each class is instructed by all the teachers. This will help control many of the extraneous variables that teaching style and experience bring to the study. More specifically, it is suggested that the teacher with the most experience, who taught the SSF class in year 1 and the SSM class in year 2, teach the COED class if single-sex education is continued next year. It would be interesting to see how the gains her students make in a COED class compare to the gains her students made in SS classes in years 1 and 2.

### **Recommendations for Future Research**

This explanatory mixed methods study on the impact of single-sex education on academic gains in reading and mathematics is relatively small scale and limited. However, the fact that every statistical test conducted did not reveal statistically significant differences between groups in regards to student growth in mathematics and reading does not detract from its worth. Based on the findings of the study, including the interviews with teachers, and the knowledge gained from the existing literature on single-sex education, several recommendations for future research have been made. The recommendations for future research are as follows:

1. Repetition of the study with increased sample sizes at various grade levels and with various demographics.

2. Further studies where it may be possible to switch the control and experimental groups between the different teachers, in order to hold constant the variables that are associated with teaching style and classroom management (especially holding teacher experience constant).

3. Further studies analyzing specifically whether SS education is more beneficial for males or females.

4. Further studies analyzing specifically whether SS education is more beneficial in one subject area or another.

5. Further studies exploring the impact SS education has on student behavior, student motivation to learn, student attitudes toward school, social skills, and levels of self-esteem.

6. Further studies exploring the impact SS education has on students of varying achievement levels, including levels I, II, III, and IV on EOG tests, with a focus on whether or not SS education may be more beneficial for lower or higher achieving students.

7. Further studies exploring the impact SS education has on students of various SES levels, with a focus on whether or not SS may be more beneficial for students from lower or higher SES levels.

8. Further studies exploring the impact SS education has on students who have been retained, with a focus on whether or not SS may be more beneficial for retainees or nonrepeaters.

9. Further studies on the impact of the classroom teacher's gender on students' achievements in SS classrooms, specifically exploring the relationship between the gender of the teacher and that of the students in the classroom. The dynamics that exist

when the teacher is the same sex as the students, as well as when the teacher is the opposite sex of the students, need to be explored to see if there is a more positive impact when they are the same sex or different.

10. Further studies on whether or not SS education helps students meet expected growth on state standardized achievement tests.

11. Further studies on parents' reasons for choosing SS education for their children.

12. Further studies on principals' reasons for implementing SS education within COED schools.

13. Further studies on teachers' levels of buy-in concerning the SS trend.

14. Further studies on the level of satisfaction with SS education amongst various stakeholders, including students, parents, teachers, principals, and district and state levels of administration.

15. Further studies investigating the amount and type of training SS teachers are receiving before being placed in a SS classroom.

16. Further studies investigating the extent to which teachers' instructional practices, classroom management strategies, and behavior management techniques actually differ dependent upon the gender composition of the classroom; a strong focus placed on determining whether teachers modify their practices to meet the needs of the gender in their classrooms.

These suggestions for further study regarding single-sex education simply touch on the possibilities that the current literature and research reveal. Further research and studies will continue to open avenues for additional exploration with single-sex education, which will in turn develop stakeholders' understandings of the possible

impacts single-sex education has on teaching and learning.

### **Concluding Statements**

Teaching is a dynamic profession. The strategies teachers use should constantly change to meet the diverse and shifting needs of their students. However, every new trend or fad raises the questions, “Is this it? Will this be the strategy that actually works?” Recently, single-sex education has been one *trend* given much attention as a potential strategy to successfully meet the unique needs of males and females in the classroom. Historically, males have excelled in mathematics and science and females in reading and writing, thus creating a gender gap in achievement. Many proponents for single-sex education believe separating the sexes will increase achievement for both males and females and enable teachers to meet the students’ differing needs. However, in today’s data-driven society, stakeholders, as well as policymakers, want to see evidence that what teachers are doing will in fact make a positive difference for students. With limited research on the impact of single-sex education, this is extremely difficult. This study adds to the existing body of research on single-sex education, which helps provide people with the data they need to make informed decisions regarding single-sex education.

While the study was not large scale or void of limitations, it may be of significance to those considering single-sex education as a strategy to implement. The trends observed, especially in the descriptive data, concerning growth in mathematics and reading over this 2-year study support continued and expanded research on the impact of single-sex education. While not all the findings from this study favoring single-sex education are statistically significant, there are no findings in it that suggest the strategy is harmful to students or that coeducation is better for either males or females. In other

words, there is no reason to halt experimentation with single-sex education. The findings from this study support the expansion of research on single-sex education. It urges future researchers to increase sample sizes studied and to control for as many extraneous variables as possible, especially teacher experience. This will add strength to future studies and depth to the theoretical and practical understanding of the impact of single-sex education.



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Appendix A  
Informed Consent

To Potential Participants:

The following information is provided to help you decide whether you wish to participate in the present study, entitled *The Impact of Single-Sex Education on Male and Female Mathematics and Reading Achievement*. You should be aware that you are free to decide not to participate or to withdraw at any time without affecting your relationship with this researcher or the affiliated university.

The purpose of this study is to determine the possible impact single-sex education has on fifth-grade male and female students' academic achievement in mathematics and reading in comparison to their fifth-grade peers in a coeducational classroom within the same elementary school.

Quantitative data will be collected from the North Carolina End-of-Grade standardized tests regularly administered in mathematics and reading. Qualitative data on the participating educators' perceptions of the impact of single-sex education on academic achievement will be collected through open-ended interviews.

Do not hesitate to ask questions about the study at anytime. At the conclusion of the study the findings will be reviewed with you. Your name will not be incorporated in the report at anytime. Only the researcher will know your identity.

There are no known risks to you, your colleagues, your students, or your school. The expected benefits include the statistically analyzed impact of the single-sex program you are implementing by choice within your school. The researcher is not interacting with students in any way or administering a treatment. She is simply collecting and analyzing existing data on a program being implemented currently. In addition the researcher has already received permission and full cooperation from both the principal of the school, as well as the county's central office.

Thank you for your time and assistance. Your support and cooperation is greatly appreciated. Please sign this consent form to acknowledge that you have full knowledge of the nature and purpose of this study. A copy of the form will be given to you to keep. Thank you again.

Sincerely,

Lisa M. O'Neill  
*Full-Time Lecturer, Belmont Abbey College*  
*Doctoral Candidate, Gardner-Webb University*

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

## Appendix B

### Superintendent Communication Letters

School District Address

September 29, 2009

Dear Deputy Superintendent of Instruction of Schools:

Thank you so much for talking with me today and approving my plan for conducting educational research within your district. I know you are extremely busy. As discussed in our phone conversation, I am writing this letter to record the intentions for my research study.

I am very interested in research on single-sex education at the elementary level as part of my curriculum and instruction doctoral work through Gardner-Webb University. I have met and spoken with the suggested school's principal and his fifth-grade team. They seem very excited about their program and receptive to my research. The study is entitled *The Impact of Single-Sex Education on Academic Gains in Reading and Mathematics at the Elementary School Level*. I will not administer any treatment or interact with the students in anyway. I will simply collect existing End-of-Grade test scores in reading and mathematics and statistically analyze them to determine if there is a significant difference between the gains in single-sex classes versus their coeducational counterparts. All data will be completely confidential and anonymous.

As I shared with you earlier, I commend the principals who are experimenting with single-sex classrooms. They appear to be on the cutting edge of educational reform. It is a fertile field for research in developing best practices. Thank you so much for allowing me to collect and analyze the data in one of your schools to provide a strong, data-driven foundation for single-sex education.

Sincerely,

Lisa O'Neill



School District Address

October 4, 2010

Dear Deputy Superintendent of Instruction of Schools:

Welcome to the district! Thank you so much for speaking with me this week regarding the continuation of the study I have been conducting for my doctoral work in curriculum and instruction through Gardner-Webb University.

As you are aware, your predecessor granted me permission, through central office protocol, to collect data in one of your elementary schools on the impact single-sex education has on student gains in reading and mathematics. As discussed, I am not implementing any treatment. The principal has already implemented single-sex grouping at the fifth-grade level. I am simply acting as an outside researcher, collecting and analyzing existing End-of-Grade test scores in reading and mathematics to determine if there is a statistically significant difference between single-sex classes and their coeducational counterparts. All data will be kept confidential and anonymous.

Thank you again for speaking with me and approving the second, and final, year of my study entitled *The Impact of Single-Sex Education on Academic Gains in Reading and Mathematics at the Elementary School Level*. I intend on analyzing the data in the summer of 2011 and will share the findings with you once that is complete. Again, thank you for your cooperation and support. I could not embark on this research without it.

Sincerely,

Lisa O'Neill

## Appendix C

### Principal Communication Letter

School Address

October 1, 2009

Dear Principal:

Thank you so much for meeting with me regarding my desire to conduct educational research in your school. I admire your interest in experimenting with innovative strategies to increase student learning and achievement.

As discussed in our meeting, I am currently pursuing my doctoral degree in curriculum and instruction through Gardner-Webb University. One of my research interests is the impact single-sex education has on student gains in mathematics and reading at the elementary school level. Thank you for your willingness to be a part of that research.

Since you have already implemented single-sex education in your fifth-grade classes, it will not be necessary for me to implement any treatment or interact with any students. I will simply collect existing End-of-Grade test scores in reading and mathematics and statistically analyze them to determine if there is a significant difference between the gains in single-sex classes versus their coeducational counterparts. All data will be completely confidential and anonymous.

Thank you again for allowing me access to your fifth-grade test data for my study entitled *The Impact of Single-Sex Education on Academic Gains in Reading and Mathematics at the Elementary School Level*. I intend on analyzing the data in the summer of 2011 and will share the findings with you once that is complete. I hope you will find the report useful in helping you determine whether to continue the single-sex program at your school, eliminate it, or even expand it. Again, thank you for your cooperation and support. I could not complete this research without it.

Sincerely,

Lisa O'Neill

## Appendix D

### Teacher Demographics for Years 1 and 2

Table D1

*2009-2010 Teacher Demographics*

Demographics	SSF	SSM	COED
Age	32	32	42
Sex/Gender	F	M	F
Years Teaching Experience	11	3	6
Years at School	10	3	6
Years in 5th Grade	8	1	1
Undergraduate Degree(s)	Elementary Education	Psychology/ Cognitive Neuroscience	Educational Studies
Advanced Degree(s)	Master's in Elementary Education	Master's in Education/Minor Language	Master's in Administration (in progress)
Related Training	None	None	None

Table D2

*2010-2011 Teacher Demographics*

Demographics	SSF	SSM1	SSM2	COED
Age	F	F	M	F
Sex/Gender	43	33	33	29
Years Teaching Experience	7	12	6	5
Years at School	7	11	1	5
Years in 5th Grade	2	9	1	1
Undergraduate Degree(s)	Educational Studies (lateral entry)	Elementary Education	Elementary Education	Elementary Education with Pre K specialization
Advanced Degree(s)	Master's in Administration	Master's in Elementary Education	None	None
Related Training	None	None	None	None

## Appendix E

### Student Demographics for Years 1 and 2

Table E1

*2009-2010 Student Demographics*

Demographics	SSF	SSM	COED
# of Students	23	24	23
# of Boys	0	24	15
# of Girls	23	0	8
# of Retainees	2	3	6
# of Students Lost	3	7	5
# of Students Added	3	9	6
# of Caucasian	5	6	5
# of African American	16	10	8
# of Multiracial	1	2	3
# of Hispanic	1	6	7
# of Other	0	0	0
# of EC	3	4	5
# of AIG	0	0	0



Table E2

*2010-2011 Student Demographics*

Demographics	SSF	SSM1	SSM2	COED
# of Students	20	18	17	18
# of Boys	0	18	17	10
# of Girls	20	0	0	8
# of Retainees	1	1	0	0
# of Students Lost	1	1	3	2
# of Students Added	2	0	4	2
# of Caucasian	5	1	6	7
# of African American	13	10	7	5
# of Multiracial	0	2	0	2
# of Hispanic	0	3	3	3
# of Other	2	2	1	1
# of ESL	0	2	3	2
# of EC	2	6	5	3
# of AIG	1	1	1	0
# with Behavior Contracts	0	2	5	2
# with PEPs	3	8	7	2

## Appendix F

### Teacher Interview Responses for Years 1 and 2

## Teacher Interview Questions 2009-2010

Teacher A=SSF	Teacher B=SSM	Teacher C=Coed
How do you believe the gender composition of your classroom has impacted males' and/or females' academic gains in mathematics?	Teacher A: "I am amazed at how long it takes to teach each concept to basic mastery;" easier to target females' needs in math without boys present; seem to ask more questions, volunteer more, not scared to try new problems; seemed to improve math skills	
	Teacher B: Seem to move through topics more quickly, don't like to show their work—could push them to, could use more male-based teaching strategies	
	Teacher C: "My boys overpower my girls in mathematics;" the girls are less likely to attempt problems; boys carry girls into next topic even though girls didn't really master the last	
How do you believe the gender composition of your classroom has impacted males' and/or females' academic gains in reading?	Teacher A: "They do not seem to enjoy reading or read as much as I expected from girls who typically excel in reading;" not as interested as expected; not on the achievement level expected	
	Teacher B: "My boys' fluency and comprehension has improved greatly;" boys talk more about what they are reading, are motivated to read, participate with AR more, and enjoy reading; "It's been a great experience."	
	Teacher C: Girls seem to carry the boys in reading; "My girls take more Accelerated Reader tests and discuss their weekly basal stories more often than my boys;" boys aren't as interested or motivated to read.	
Do you believe the EOG test scores are true reflections of the impact single-sex education has had on your school's fifth-grade students' academic gains in mathematics?	Teacher A: Not sure yet, still analyzing; see improvement in girls' math that a test can't measure; possibly expected greater gains in DSSs for SS classes; more in depth analysis of the scores needed than what they have seen thus far before they can make a more informed judgment	
	Teacher B: Not sure yet, still analyzing; more in depth analysis of the scores needed than what they have seen thus far before they can make a more informed judgment	
	Teacher C: Not sure yet, still analyzing, a test can't reveal the whole impact of the program; more in depth analysis of the scores needed than what they have seen thus far before they can make a more informed judgment concerning the impact of single-sex education on the students' academic gains as evidenced by EOG scores.	

Do you believe the EOG test scores are true reflections of the impact single-sex education has had on your school's fifth-grade students' academic gains in reading?	Teacher A: Not sure yet, still analyzing; more in depth analysis of the scores needed than what they have seen thus far before they can make a more informed judgment
	Teacher B: Not sure yet, still analyzing; more in depth analysis of the scores needed than what they have seen thus far before they can make a more informed judgment
	Teacher C: Not sure yet, still analyzing; more in depth analysis of the scores needed than what they have seen thus far before they can make a more informed judgment
What extraneous variables do you feel need to be taken into consideration when determining the possible impact single-sex education has had on your school's fifth-grade students' gains in mathematics and reading?	Teacher A: Attendance, home life, teaching style, teacher-student rapport and classroom climate
	Teacher B: Transient students, home life, teacher-student rapport and classroom climate
	Teacher C: Home life, teacher-student rapport and classroom climate
Other common themes that surfaced during interviews and conversations.	Interest/Enjoyment: All teachers enjoyed experimenting with single-sex and would do it again; coed teacher would try single-sex class, but hesitant—loves both sexes and how they mix; single-sex teachers would teach either sex. Parents and students all seemed to enjoy the experiment and didn't resent being part of a particular class, as revealed by teachers
	Needs: Strong training on effective, gender-specific teaching techniques.
	Social Impact: Girls tended to exclude new girls or girls from coed class and only interested in boys from single-sex class; boys in all boy class really bonded and took up for each other—boys from coed class weren't included in their group

## Teacher Interview Questions 2010-2011

Teacher A=SSF	Teacher B=SSM1	Teacher C=Coed	Teacher D=SSM2
How do you believe the gender composition of your classroom has impacted males' and/or females' academic gains in mathematics?	Teacher A: more willing to ask questions; all participated; didn't seem as vocal as teacher expected; still struggled to master basic isolated skills (place value, division), but improved more complex skills (geometry, problem solving); "girls doubted themselves in math;" "needed to be pumped up;" lived down to "stereotypes they were faced with;" confidence has improved; stronger teamwork and friendship—helped, trusted, and depended on each other especially in math		
	Teacher B: good memorizers; some hated math, which was not expected; did not want lecture; needed to do it for themselves; learned from each other; used small groups with one skilled leader		
	Teacher C: "completely opposite of what I expected;" males liked math more, but were less confident than the females; girls rarely asked for help and often scored poorly on assignments and tests; boys were quick to ask for help		
	Teacher D: boys made a lot of connections from home; utilize lots of hands on learning; move often		
How do you believe the gender composition of your classroom has impacted males' and/or females' academic gains in reading?	Teacher A: Enjoy reading; gets into the genres and skills (affective skills) in the curriculum; struggled with composition; systematic; creative; visual; teacher could follow plans more closely; girls could keep up; pleasers; mimickers; get more done; not as much movement, as many breaks/transitions; how much more her class accomplished during reading. "We are able to follow plans more closely because the girls are more organized and structured. They are more interested in reading and discussing. We are able to be more engaged in learning."		
	Teacher B: "Able to target specific skills boys lacked;" more willing to talk, but still "like pulling teeth to get them to explain;" more breaks and movement; lost a lot of time due to transitions, breaks, and movement, but they were needed (takes boys "so long to refocus").		
	Teacher C: Males had stronger reading skills and were able to find more interesting books; they seemed to like reading more than her females did		
	Teacher D: "All boys do not like boy things. I learned very quickly I had to bring other reading material into the classroom;" diverse interest; variety; more comfortable and		

	less frustrated with girls not present; competed with other groups—wanted to win; “shared more because they weren’t being judged;” discussion over lecture; very comfortable discussing what they were reading
Do you believe the EOG test scores are true reflections of the impact single-sex education has had on your school’s fifth-grade students’ academic gains in mathematics?	Teacher A: Not sure yet, still analyzing; a test can’t reveal the whole impact of the program; more in depth analysis of the scores than what they have seen thus far before they can make a more informed judgment concerning the impact of single-sex education on the students’ academic gains as evidenced by EOG scores.
	Teacher B: Not sure yet; bring greater gains in DSSs, with a larger difference between the SS classes and the COED class scores; still analyzing; more in depth analysis of the scores than what they have seen thus far before they can make a more informed judgment concerning the impact of single-sex education on the students’ academic gains as evidenced by EOG scores.
	Teacher C: Not sure yet, still analyzing; more in depth analysis of the scores than what they have seen thus far before they can make a more informed judgment concerning the impact of single-sex education on the students’ academic gains as evidenced by EOG scores.
	Teacher D: Not sure yet, still analyzing; more in depth analysis of the scores than what they have seen thus far before they can make a more informed judgment concerning the impact of single-sex education on the students’ academic gains as evidenced by EOG scores.
Do you believe the EOG test scores are true reflections of the impact single-sex education has had on your school’s fifth-grade students’ academic gains in reading?	Teacher A: Not sure yet, still analyzing; a test can’t reveal the whole impact of the program; more in depth analysis of the scores than what they have seen thus far before they can make a more informed judgment concerning the impact of single-sex education on the students’ academic gains as evidenced by EOG scores.
	Teacher B: Not sure yet; bring greater gains in DSSs, with a larger difference between the SS classes and the COED class scores; still analyzing; more in depth analysis of the scores than what they have seen thus far before they can make a more informed judgment concerning the impact of single-sex education on the students’ academic gains as evidenced by EOG scores.
	Teacher C: Not sure yet, still analyzing; more in depth analysis of the scores than what they have seen thus far before they can make a more informed judgment concerning the impact of single-sex education on the students’ academic gains as evidenced by EOG scores.

	Teacher D: Not sure yet, still analyzing; more in depth analysis of the scores than what they have seen thus far before they can make a more informed judgment concerning the impact of single-sex education on the students' academic gains as evidenced by EOG scores.
What extraneous variables do you feel need to be taken into consideration when determining the possible impact single-sex education has had on your school's fifth-grade students' gains in mathematics and reading?	Teacher A: teaching style; teacher-student rapport and classroom climate: expectations; classroom management; being a parent
	Teacher B: classroom management; willingness to try new ideas; teaching experience; getting wrapped up in gender stereotypes
	Teacher C: Classroom management; behavior, "The boys will do something silly, the girls will laugh, the boys will continue to show out for them. This doesn't happen in a single-sex classroom;" experience; student relationships and dynamics; parental involvement
	Teacher D: student-teacher rapport; classroom environment and culture; experience; student attitudes; gender of the teacher, "My boys fought the whole guy (teacher) thing because they come from single-parent families where the dads have left them."
Other common themes that surfaced during interviews and conversations.	Interest/Enjoyment: All teachers enjoyed their assignments; would do it again next year; would change classes; want what is best for children
	Needs: Strong training on effective, gender-specific teaching techniques; more support
	Social Impact: SS classes bonded more easily; built stronger relationships; boys were "slow to trust, but once they do, they'll do anything;" comfortable with each other