

THE EFFECTS OF SINGLE-SEX CLASSROOMS ON STUDENT OUTCOMES ON
MATHEMATICS AND READING IN AN ELEMENTARY SCHOOL

by

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ABSTRACT

The curriculum for elementary students has undergone a significant change in the past decade. This led to an increased expectation for higher academic performance for fifth grade students in the areas of reading and mathematics. Teachers seek innovative ways to provide instructional practices within their classrooms that will aid success for all students. A Title I elementary school in a large metropolitan school system was enduring a high failure rate on the Criterion Reference Competency Test (CRCT). In an effort to decrease the failure rate on the fifth grade CRCT reading and mathematics subtests, the school's teachers and administrators implemented a single-sex class for 2 years. A quantitative data collection method compared the reading and mathematics achievement of fifth grade students in single-sex and coeducational classrooms. The results of the finding were mixed with single-sex students in single-sex student classrooms scoring significantly higher the first year of implementation, but decreasing the second year. These findings point to the fact, that more research is needed in the areas of single-sex classrooms.

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CONTENTS

ABSTRACT	ii
ACKNOWLEDGMENTS	iii
LIST OF TABLES	vii
1 BACKGROUND OF THE PROBLEM.....	1
Positionality	5
Statement of the Problem.....	7
Purpose of the Study	8
Research Questions and Hypotheses	8
Variables	9
Limitations	10
Definition of Terms.....	10
Organization of Study.....	11
2 REVIEW OF LITERATURE	13
History of Single-sex Education	13
Law and Gender Equity	15
Cognitive Gender Differences	17
International Studies of Single-sex Education	20
U.S. Studies of Single-sex Education	23
Factors Hindering the Educational Success of Single-sex Classrooms	29
Behaviorism and Constructivism Learning Theories	32

3	RESEARCH METHODOLOGY	39
	Research Questions	40
	Research Design.....	41
	Quantitative Data	42
	Sampling	42
	Instrumentation	44
	Data Collection and Analysis.....	45
	Statistical Method	45
	Validity and Reliability.....	46
	Summary	47
4	FINDINGS	48
	Comparison of Students Prior to Entering Single-sex Classrooms: Results of the 2007 Data	48
	Comparison of Single-sex and Coeducational Classes for 2008 Data.....	52
	Research Question 2: 2008	52
	Research Question 3: 2008	53
	Research Question 5: 2008	55
	Comparison of Students Prior to Entering Single-sex Classrooms: Results of the 2008 CRCT	57
	Comparison of Single-sex and Coeducational Classes for 2009 Data.....	59
	Research Question 2	59
	Research Question 3	59
	Research Question 4	60
	Research Question 5	61

5 INTRODUCTION	66
Conclusion	66
Research Question 1	69
Research Question 2	70
Research Question 3	71
Research Question 4	72
Research Question 5	73
Policy	74
Future Research	75
Summary	77
REFERENCES	78

LIST OF TABLES

1	Percentage of Boys and Girls Scoring Proficient on the 2008 Florida Comprehensive Assessment Test Scores in Coeducational and Single-sex Classes	3
2	Description of the School.....	43
3	Number of Students Enrolled in Fifth-Grade Single-sex and Coeducational Classes from 2008-2010	44
4	Research Questions--Statistical Method.....	46
5	2007 Descriptive Statistics Before Grouped: Total Reading.....	49
6	2007 Descriptive Statistics Before Grouped: Reading Subtests.....	50
7	2007 Descriptive Statistics Before Grouped: Total Mathematics.....	51
8	2007 Descriptive Statistics Before Grouped: Mathematics Subtests.....	51
9	2008 Descriptive Statistics: Total Reading.....	53
10	2008 Descriptive Statistics: Total Mathematics	53
11	2008 Descriptive Statistics: Reading Subtest	55
12	2008 Descriptive Statistics: Mathematics Subtests.....	56
13	2009 Descriptive Statistics: Total Reading.....	59
14	2009 Descriptive Statistics: Total Mathematics	60
15	2009 Descriptive Statistics: Reading Subtests.....	61
16	2009 Descriptive Statistics: Mathematics Subtests.....	62
17	2008 Statistical Findings of the Data.....	63
18	2009 Statistical Findings of the Data.....	64

CHAPTER 1

BACKGROUND OF THE PROBLEM

Public schools are under attack more than ever before for failing to deliver academic rigor (Datnow, Hubbard, & Woody, 2001). A plethora of solutions, including magnet, pathfinder, science, engineering, and technology schools have been proposed (McNeil, 2000; Murnane, 2000; Nash, 2000). One promising approach adopted in some districts is the single-sex classroom, or single-sex school. Trickett, Trickett, Castro, and Schaffner (1982) and Fraser and Fisher (1986) found that single-sex classrooms appeared to be more organized and structured, as well as more academically challenging and satisfying. Bracey (2006) and Younger and Warrington (2006) favored the single-sex configuration because of the effect it has on improving academic achievement for both boys and girls. The status of single-sex education began to change when the No Child Left Behind Act (NCLB) supported the use of differentials of instruction (National Coalition for Women and Girls in Education, 2002), specifically sections 5131 (a)(23) and 5131(c), which authorized single-sex education in public schools (Federal Register, 2002).

No Child Left Behind legislation provides an incentive for educational districts across the country to develop single-sex schools through increased federal funding. These concerns have prompted policymakers to seek the expansion of school choice within the public school system (Datnow, Hubbard, & Conchas, 2001). As a result, many public school districts are piloting single-sex classrooms and schools as possible solutions to the problems of public education. The National Association for Single-sex Public Education (2012) during the 2011-2012 school year,

reported 506 public schools in the United States offering single-sex opportunities. Almost 400 ($n = 390$) of those schools are coeducational schools that offer single-sex classrooms with at least some coeducational activities. Only 116 of the 506 schools qualify as single-sex *schools* having most or all of their school activities in a setting that is all boys or all girls (National Association for Single-sex Public Education, 2012).

One of the most significant sections of legislation passed by Congress to support the educational equity of single-sex classrooms was the Title IX Education Amendments Act of 1972. This legislation states, “ No person in the United States shall, on the basis of sex, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any education program or activity receiving federal financial assistance” (Duke, 2004). Title IX persuaded school systems to revisit their approach to all male courses and programs, as well as, how female students were advised regarding career options. The federal government provided funds for the local education agencies to establish single-sex classes, extracurricular activities, and gender differentiated instruction. Both sexes were offered equal educational opportunities, allowing for an even distribution of resources, textbooks, sport activities, and innovative programs--including single-sex classes and schools (Cable & Spradlin, 2008). Title IX suggests single-sex education as an optimal model for primary and secondary public schools because research conducted on student achievement clearly indicates this strategy leads to significantly improved performance without infringing on individual rights (Streitmatter, 1999). Therefore, after the passing of the Title IX Act, school systems reassessed the traditionally all-male programs; guidance counselors reviewed their advisement approach with female students regarding career options. In 2002, NCLB made sure that all school programs were supported by current and relevant, scientifically-based research.

Researchers at Stetson University in Florida completed a 4-year pilot study on students in the fourth grade that compared Florida Comprehensive Assessment Test achievement of students in single-sex classrooms and coeducational classrooms at Woodward Avenue Elementary School (National Association for Single-sex Public Education, 2012). The teachers received professional development on both effective and ineffective teaching strategies. The students' class size and demographics were the same in the study. These data included single-sex classrooms of male students with learning disabilities, particularly attention deficit disorder. Table 1 provides the findings from the study (National Association for Single-sex Public Education, 2012).

Table 1

Percentage of Boys and Girls Scoring Proficient on the 2008 Florida Comprehensive Assessment Test Scores in Coeducational and Single-sex Classes

Gender	Type of class	
	Coeducational	Single-sex
Boys	55	85
Girls	59	75

In order to provide males and females with equitable educational opportunities, it is paramount to accept and understand different learning styles and become more aware that one size does not fit all. The National Association for Single-sex Public Education (2012) provides research comparing single-sex education and coeducation. Teachers who have appropriate training with single-sex education and professional development usually do quite well with students in the single-sex setting (Sax, 2005).

Although males and females are clearly different in some ways, teachers do not have extensive knowledge about the way the brain of each gender differs, including the social, physiological, and emotional differences that many claim exist between boys and girls (Sax, 2005). Dunn's research (1992, 1999, 2001) provides different snapshots of how boys and girls function, and brings forth serious implications for how we teach and reach them in educational settings. Dunn found that boys develop gross motor skills early in life compared to girls, who develop small motor skills before gross motor skills. Girls tend to be more verbal than boys and can remember best; males tend to remember least by listening. Females remember well by talking and reading. Males remember best by being actively involved with a hands-on approach.

Much research has examined the differences of how girls and boys learn in regard to gender equity issues (Abu El-Haj, 2003; Bracey, 2006; Spencer, Porche, & Tolman, 2003). The world's largest study of brain development in children was an ongoing longitudinal study in Bethesda, Maryland (Waber et al., 2007). This study clearly demonstrates the differences in brain development in girls and boys, with more than two standard deviations of difference separating girls from boys at age 11. This research indicates a profound difference regarding sequence of development of the various brain regions between girls and boys. This affects education because an educator's lack of understanding of gender differences has the unintended consequence of reinforcing gender stereotypes (National Association for Single-sex Public Education, 2004b).

The Supreme Court decision *Brown v. Board of Education of Topeka* changed the education landscape. It is clearly understood that schools cannot separate children by race, even when the intent is to improve instruction. Unlike gender, race is not a conducive and ethically relevant category for discrimination between students. However, in the case for many other

urban schools, populations are de facto segregated. Hence, economics and social conditions permit experimentation on the effects of differentiated gender instruction among minority groups (Bracey, 2006).

Positionality

The study was conducted in a Title 1 elementary school in a large metropolitan school system located near a major city in the southeastern region in the United States. The school enrollment was comprised of 97% African American students. This study was conducted at a time when teachers in U.S. public schools were pressed to improve student achievement and maintain an orderly learning environment. Accountability for student achievement in fifth grade was measured by standards set by state guidelines. The expectation for fifth-grade students was to pass the reading and mathematics portions of the Criterion-Referenced Competency Test (CRCT). A large percentage of the students attending the school district were not on grade level, in comparison to similar-aged children who attended schools in other areas of the metropolitan area.

In my position as a building-level administrator, my responsibilities include working with parents, children, and staff, fostering instructional strategies and behavioral techniques that produce lifelong learners for this global society. I monitor testing and the curriculum, purchase equipment and provide resources for teachers and students, conduct professional development training, and handle behavioral referrals.

The administrative team observes students' ability to process information as well as cultural and social factors evolving from their immediate economic environment. As a whole, the school boasts strong attendance records from first through fourth grade. Indeed, the majority

of students matriculate from first through fourth grades in the same school district. However, fifth grade students often experience social and cultural problems that put intense pressure on their performance.

A special concern of fifth grade teachers in the school is that the students enter the year unprepared academically to handle the curriculum. Some of the students are deficient in reading and mathematics. After reviewing both heterogeneous groups' end-of-the-year data, there were many disparities in the male scores compared to the female scores. The administration studied the data and discussed implementations of various programs and initiatives over the previous two years, and saw that boys' scores were steadily decreasing compared to the girls.

The administrative team decided to implement a single-sex class for boys and the next year to have single-sex classes for both girls and boys. This implementation would be the first fifth grade elementary single-sex, self-contained, all-day class in the district's history. The principal approached a fifth grade male teacher who agreed to be teacher of record for this new initiative. The model was presented to the school council and the PTA board members. Everyone was supportive of the initiative.

Invitations were sent home with every fourth grade male student. Parents had the opportunity to enroll their child in the program. The class had 25 seats to fill and it was on a first-come basis. The male and female students in fourth grade were strongly encouraged to participate in the new initiative. Two parent meetings were held to discuss the program. The first single-sex classes included enrollment of 21 male and 22 female students.

Statement of the Problem

The curriculum for elementary students has undergone a significant change in the past decade. This led to an increased expectation for higher academic performance for fifth grade students in the areas of reading and mathematics. Since the 2004-2005 school year, all fifth grade students must achieve proficient scores on the Georgia Criterion Reference Competency Test (CRCT) in the areas of reading and mathematics, in order to be promoted to the sixth grade. School administrators are attempting to meet the mandates of NCLB, but schools are failing to meet adequate yearly progress (AYP). The NCLB mandates expect students to achieve at grade level or better on state assessments in Grades 3-8 (Georgia Department of Education, 2006-2007).

Teachers seek innovative ways to provide instructional practices within their classrooms that will aid success for all students. Sax (2006) and Salomone (2006) suggested that many of the problems associated with coeducational classes change the classroom environment and alter how teachers provide instruction. Teachers also spend a large amount of time disciplining students, which reduces instructional time (Rose & Rudolph, 2006). Sax (2006) contended that single-sex classes provide a more conducive academic atmosphere for both males and females by changing the dynamics of the classroom.

A Title 1 elementary school in a large metropolitan school system located in the southeastern region of the United States was enduring a high failure rate on the CRCT. In an effort to increase the pass rate on the fifth grade CRCT reading and mathematics subtests, the school's teachers and administrators implemented a single-sex class for students during the 2008-2009 school year.

Purpose of the Study

The purpose of this study was to examine the effectiveness of single-sex classrooms to determine whether teaching girls and boys separately affects their academic achievement in reading and mathematics. The study compares the effects of single-sex fifth grade classrooms to coeducation fifth grade classrooms in the academic areas of reading and mathematics subtests on the CRCT Test in one southeastern public school system over a period of three years. The focus of the study compared the previous fourth grade coeducation students and the same students in the fifth grade who were enrolled in single-sex and coeducational classes between 2008 and 2009 at the school. The study was designed to determine whether differences in academic achievement existed between students who were instructed in single-sex and coeducational classes.

Research Questions and Hypotheses

In order to assess the benefits for students who attended the single-sex and coeducational programs in a public school system, the following research questions were used to guide this study.

Research Question 1. Are there differences in CRCT scores for boys and girls on mathematics and reading subtests in the years before and after single sex classrooms were instituted?

Ho1: There are differences between students from the previous years' scores in the areas of mathematics and reading subtests.

Research Question 2. Do single-sex classrooms help promote the academic performance of fifth grade students on the reading portion of the CRCT?

Ho2: Fifth grade students in single-sex classrooms will score higher on the reading portion of the CRCT than students in coeducation classrooms.

Research Question 3. Do single-sex classrooms help promote the academic performance of fifth grade students on the mathematics portion of the CRCT?

Ho3: Fifth grade students in single-sex classrooms will score higher on the mathematics portion of the CRCT than students in coeducation classrooms.

Research Question 4. Are there differences between coeducational and single-sex classrooms on reading subtests, (a) reading literary comprehension, (b) reading information, and (c) reading skills and vocabulary acquisition?

Ho4: There are differences between coeducational and single-sex classrooms reading subtests, (a) reading literary comprehension, (b) reading information, and (c) reading skills and vocabulary acquisition.

Research Question 5. Are there differences between coeducational and single-sex classrooms on mathematics subtests, (a) number sense and numeration, (b) geometry, and (c) measurement?

Ho5: There are differences between coeducational and single-sex classrooms on mathematics computation subtests, (a) number sense and numeration, (b) geometry, and (c) measurement.

Variables

The independent variable for this study was the instructional setting (single-sex and coeducation). The dependent variables were fifth-grade students' reading and mathematics subtest scores as measured by the CRCT assessment. Data were collected to determine whether

the independent variable, classroom setting, had an impact on the dependent variables of reading and mathematics subtest scores on the CRCT assessment.

Limitations

1. Participants were limited to fifth grade students in the public school being studied; therefore, generalization of the results to other areas is not possible.

2. Students who attended the single-sex classes were assigned voluntarily, and coeducational classes were randomly chosen only during the 2010 school year. The 2008 and 2009 coeducational classes were not randomly selected.

Definition of Terms

Coeducational classroom. Coeducational classroom are where both male and females are educated at the same institution or in the same classes.

Criterion-Referenced Competency Test (CRCT). Georgia law requires the development and administration of the CRCT in the content areas of reading, English/language arts, mathematics, science, and social studies. Each spring students in Grades 1 through 8 take the reading, English/language arts, and mathematics CRCT. Students in Grades 3 through 8 also take the science and social studies CRCT. These tests are designed to measure student achievement of the Georgia Performance Standards.

Georgia Performance Standards. The performance standards provide clear expectations for instruction, assessment, and student work. They define the level of work that demonstrates achievement of the standards thus enabling a teacher to know “how good is good enough.” The performance standards isolate and identify the skills needed to use the knowledge and skills to

problem solve, reason, communicate, and make connections with other information. They also tell the teacher how to assess the extent to which the student knows the material or can manipulate and apply the information.

Literary comprehension. According to the Georgia Department of Education (2006-2007), literary comprehension refers to the skills required to comprehend and explore literary works by identifying and analyzing elements of various texts. Texts may include short stories, dramas, folktales, poetry, fables, and descriptive narratives.

Number and operations. According to the Georgia Department of Education (2006-2007), numbers and operations refer to students' skill in developing an understanding of numbers, the meanings of multiplication and division of decimals, and the use of decimals and common fractions in computation and problem solving.

Single-sex classroom. Single-sex classroom is a class grouping of students of the same sex within a coeducational setting.

No Child Left Behind Act (NCLB). According to the United States Act of Congress, this act requires individual states to develop assessments to test basic skills in selected grade levels to receive federal funding for schools.

Adequate Yearly Progress (AYP). According the United States Department of Education, AYP is one of the sources used to determine how public school and school district are performing academically based on the states selected standardized tests.

Organization of Study

The remainder of the study is organized and presented in the following manner. Chapter 2 presents the literature review of the history of single-sex education related to the effects of

single-sex education in a public school environment. Chapter 3 will outline details of the methodology of the study of the program over a period of 3 years, and contains a description of the methods and procedures used in the study. Chapter 4 presents the findings without the attempt of evaluating the data, tables and figures accompanying the data. Chapter 5 presents the summary, conclusions, and recommendations.

CHAPTER 2

REVIEW OF LITERATURE

This chapter provides an overview of the literature addressing single-sex education and its educational impact on children. Of primary interest is the growth of single-sex classrooms and schools in the United States and the impact that a quality single-sex program has on students' educational future. The review of literature examines (a) a history of single-sex education, (b) a discussion of the law and gender equity, (c) cognitive gender difference, (d) the benefits of single-sex versus coeducational education, (e) factors hindering single-sex educational success, (f) factors affecting male and female educational success, and (g) behaviorism and constructivism learning theories.

History of Single-sex Education

During the 19th century, single-sex schooling was common. There were more single-sex Catholic schools than schools in the public school setting. In addition, all military academies and agriculture and engineering schools admitted only middle-class male students. The surge of mass education promoted coeducation as an alternative to single-sex schools. Females began to push for more coeducational programs after becoming conscious of the significantly different educational experiences males experienced than they did. Finally, coeducation classes became the standard with the ruling of the Education Amendment Act of 1972, which provided females with equal educational opportunity (Spielhagen, 2006).

Title IX of the Education Amendment Act of 1972 banned single-sex discrimination in schools in the areas of academics and athletics. Prior to the signing of the Education Amendment Act of 1972, a large number of schools refused to admit females to their schools or specific academic programs. The Educational Amendment Act also changed the way in which single-sex universities selected students (Spielhagen, 2006).

In 1996, the United States Supreme Court ruled on the constitutionality of single-sex public education in the case of *United States v. Virginia* (The Oyez Project, 1996). From that ruling, females were able to attend all military academics. According to Salomone (2006), Title IX has afforded females the opportunity to receive 38% of medical degrees, compared to 9% in 1972. In 1994, 44% of all doctoral degrees received in the United States were awarded to females, an increase from 25% in 1977. Also in 1994, 43% of the law degrees conferred were earned by woman, as compared to 7% in 1972.

The Education Amendment Act Title IX, allows public schools to separate students based on gender, under special circumstances. The school must justify single-sex classes with research and identify the anticipated academic and social outcomes with supporting evidence that specific goals were achieved. The school district must ensure that the single-sex program is equally funded (Bracey, 2006).

Georgia public schools are currently implementing the single-sex curriculum in at least 17 programs (Sax, 2007). Other public single-sex schooling includes Afrocentric academies for boys and girls, and the Young Women's Leadership schools (Datnow et al., 2001). In California, the Single-sex Academies legislation is the largest example of a state's role in the creation of single-sex public schools (Datnow et al., 2001). Although single-sex schools still exist primarily in the private and parochial sectors in the United States (Tyack & Hansot, 1990), single-sex

education is occurring in other countries. For example, while Britain's single-sex schools make up a small, selective group, countries such as Australia, New Zealand, and Ireland have a sizeable number of single-sex schools (Smyth, 2010). Although, coeducation has been the norm for most public schools in the United States throughout the 19th and 20th centuries, after Title IX became a law, there is a small strong consistent push toward incorporating more single-sex classes (Hughes, 2007; Sax, 2006).

Law and Gender Equity

Several Supreme Court decisions and legislation at the federal and state levels led to changes in education. In 1954, *Brown v. Board of Education of Topeka* was the first case attempted by the federal government to desegregate schools in the 1950s and 1960s. The Civil Rights Act prohibited schools that practiced race discrimination from receiving federal funds. In 1975, Public Law 94-142, Education of All Handicapped Children Act, increased the public's responsibility for educating students with handicapping conditions. In 1973, the Title IX law prohibited sex discrimination in schools and ensured equity for females.

The Title IX legislation in 1973 was the first comprehensive federal law that promoted gender equity and prohibited sex discrimination against students and employees of educational institutions. Title IX was instrumental in the closing of single-sex schools, but allowed females to attend all-male schools, academies, and military programs (Brown & Russo, 1999). Bracey (2006) referred to Title IX as the "*Brown v. Topeka Board of Education*" that ruled that race segregated schools were inherently unequal. This push from single-sex schools continued during the 1960s and 1970s in secondary and postsecondary schools for social and economic reasons (Lee & Bryk, 1986). Secondary and postsecondary institutions were viewed as being more

appropriate, liberating, and enlightening (Meyer, 2008). According to Salomone (2006), school systems prohibited separating boys and girls during the school day or for any part of the school day.

Now, in the 21st century, No Child Left Behind (NCLB) paved the way for an aggressive approach to educational reform. NCLB included incentive grants for single-sex schools. These grants gave schools the opportunity to revisit the idea of single-sex classrooms or single-sex schools. In 2002, the U.S. Department of Education began revising Title IX provisions to make it easier for schools to adopt single-sex policies (Hughes, 2007). It has now been established that there are no legal constraints keeping public schools from creating single-sex education.

Gender equity became a concern after the passing of Title IX. The assumption is that single-sex schooling can reinforce sex stereotypes, implicitly suggesting that girls are inherently deficient in certain academic areas (Salomone, 2006). Mathematics is often the arena where equity issues abound (Abu El-Haj, 2003; Ping & Weiling, 2002). Based on research conducted by Ping and Weiling (2002), it was discovered that in mathematics girls were in an inferior position compared to boys in terms of how teachers interacted with each sex during mathematics lessons. Moreover, they found that teachers interacted more with boys than girls and preferred teaching boys.

In the past three decades, gender equity literature has focused on girls (Bracey, 2006; Wiens, 2006). However, in recent years, underachieving boys have become the focus of research. Gender equity will continue to evolve, and future studies are needed to determine whether single-sex education is beneficial for students. Issues continue to revolve around the benefits of single-sex education based on cognitive gender differences.

Cognitive Gender Differences

Sax (2005) and Wiens (2006) recognize cognitive differences between boys and girls. Girls read and write better than boys do. Girls are better at tasks that require listening, speaking, and writing whereas boys rely on pictorial representations and moving objects to form word connections (Gurian, 2006). The area of the brain that involves language and fine motor skills matures about 6 years earlier in girls than in boys; the areas of the brain involved in targeting and spatial memory mature about 4 years earlier in boys than in girls (Hanlon, Thatcher, & Cline (1999). Gurian and Bellew (2003) also noted that at younger ages, males tend to use a lot of space. For example, if a boy and girl are working together at a table the boy might spread his papers over the entire table, leaving little room for the girl. They asserted that this tendency can affect psychosocial dynamics; in other words, some teachers might misunderstand this behavior as rude or aggressive when in fact boys are often just learning in the way their spatial brains require.

Other single-sex education advocates point to brain differences as evidence for the benefits of separating girls from boys in the classroom. According to a 2007 longitudinal pediatric neuroimaging study led by a team of neuroscientists from the National Institute of Mental Health, various brain regions develop in a different sequence and tempo in girls compared with boys (Lenroot et al., 2007). The researchers found several differences in the 829 brain scans gathered over 2 years from 387 participants from 3 to 27 years old. One major finding showed rapid development in girls 6 to 10 years old, while boys showed the largest growth after 14 years old. Disparities were also shown in language processing between the sexes, concluding that the language areas of the brain in many 5-year-old boys look similar to

that of many 3-year-old girls. These findings have significant implications on the academic and behavior needs of students.

Another notable gender difference learning style is movement. Boys are able to complete tasks that require movement holistically better than girls. Gurian and Bellow (2003) found that boys tend to benefit more from the use of movement because research shows they are always moving and they have a tendency to be squirmy or restless, which can be perceived as distracting by female students and the teacher. Gurian and Ballew (2003) attributed this natural movement to closed space because of their lower serotonin and higher metabolism, which can create fidgety behavior. They further contended that movement seems to stimulate male brains and helps to manage impulsive behavior, and that they need movement to increase their learning (Gurian & Bellow, 2003). Other researchers have noted additional challenges faced by male students in the educational setting (Gurian, 2006).

Emotional activity is processed in different areas of the brain in boys and girls. The locus of emotional activity lies deep in the amygdale in young children. The locus of emotional activity moves to the cerebral cortex as girls get older whereas with boys it remains in the amygdale, the primitive subcortical area of the brain. As a result, girls are likely to be more talkative and expressive than boys are (Killgore, Oki, & Yurgelun-Todd, 2001). Boys tend to be more disruptive in the classroom and experience negative interaction with teachers because of their misbehavior (Francis, 2000). From this perspective, the presence of boys in the classroom is seen as having a negative effect on girls' academic engagement and achievement. Boys and girls also contend with stress differently. Girls *tend and befriend* stress whereas boys *fight or take flight* in their reactions. Girls' heart rate and blood flow to the brain decrease, while the

heart rate and blood flow to the brain of boys increase. However, researchers say that stress actually enhances learning in males and hinders learning in females (Taylor et al., 2000).

Wiens (2006) stated that schools have become *feminized*, making it challenging for boys to be successful. Davis (2003), whose research focused on the academic achievement of African American males, views the educational setting as a feminine institution that induces oppositional behaviors. Male students become disengaged and alienated from the learning process, leading to poor academic performance (Davis, 2003). Gurian (2006) believed that boys' brains go into a rest state, in which they appear that they are zoned out or have drifted off, making it seem as if they are not interested in the lesson being taught. Boys are more competitive and aggressive than girls.

Girls and boys experience academic difficulties very differently. Here are the findings of Pomerantz, Alterman, and Saxon (2002):

Girls generalize the meaning of their failures because they interpret them as indicating that they have disappointed adults, and thus they are of little worth. Boys, in contrast, appear to see their failures as relevant only to the specific subject area in which they have failed; this may be due to their relative lack of concern with pleasing adults. In addition, because girls view evaluative feedback as diagnostic of their abilities, failure may lead them to incorporate this information into their more general view of themselves. Boys, in contrast, may be relatively protected from such generalization because they see such feedback as limited in its diagnosticity. (p. 402)

The personalities of boys and girls are also very different. Weiman (2004) tends to believe that boys receive more attention than girls and that boys participate more in whole-group activities, dominating the class discussions. Girls have higher standards in a class setting and rate their performance more critically than do boys. Educational psychologists have consistently found that girls tend to have higher standards in the classroom, and evaluate their own performance more critically.

Girls also outperform boys in school (as measured by student grades), in all subjects and in all age groups (Feingold, 1994). While girls do better in school (as measured by report card grades), one might imagine that girls would be more self-confident about their academic abilities, and have higher academic self-esteem. However, that is not the case (National Association for Single-sex Public Education, 2004a). Paradoxically, girls are more likely to be excessively critical in evaluating their own academic performance. Conversely, boys tend to have unrealistically high estimates of their own academic abilities and accomplishments (Pomerantz et al., 2002).

Cassidy and Ditty (2001) conducted a study on normal newborns' hearing. They found that the amplitude threshold for girls was three times softer than the threshold for boys who have a shorter, stiffer cochlea. Therefore, girls hear more keenly than boys hear and function better in a quieter setting. On the other hand, boys benefit from a louder volume (National Association for Single-sex Public Education, 2004b).

There are strong arguments that suggest cognitive gender differences between boys and girls in school and classroom environments directly affect academic achievement. Educators should be aware of the various learning styles and implement appropriate strategies to ensure success in the school and classroom. They must provide the most conducive and supportive educational environment for all students.

International Studies of Single-sex Education

There has been much discussion, research, and debate internationally regarding whether single-sex schooling yields academic advantages for girls and boys. The English-speaking countries such as Australia, New Zealand, and Ireland continue to have a sizeable number of

single-sex schools, compared to the United States and Great Britain (Smyth, 2010). Dale (1969, 1971, 1974) conducted the first large-scale studies on single-sex education in Great Britain, which suggested that coeducation provided the best preparation for adult life for both sexes (Smyth, 2010). Other studies conducted in Britain during the 1970s and 1980s suggested that girls tend to have higher academic achievement in single-sex settings. However, Dean (1998) reported the results of a study conducted by the British Office for Standards in Education that measured whether socioeconomic variables might account for the superior performance of students in single-sex schools. In examining test results from 800 schools, superior performance appeared to be the direct result of single-sex education. In 2000, almost all of the 50 top-ranked British high schools were single-sex (O'Leary, 2000).

Other international studies (Spielhofer, Benton, & Schagen, 2004) found that, in England, there were some performance gains among girls and boys in single-sex schools. The National Foundation for Educational Research studied 2,954 high schools throughout England and concluded that even after controlling for students' academic ability and other background factors, both girls and boys performed significantly better in single-sex schools than in coeducation schools. The benefits were larger and more consistent for girls than boys at the high school level. Girls at all levels of academic ability did better in single-sex schools, with the greatest advantages found in the area of science; only boys at the lower end of the ability scale benefited (Spielhofer et al., 2004).

Researchers at Manchester University in England tested single-sex classroom advantages by assigning students in five public schools to either coeducational or single-sex classrooms. The experiment resulted in 68% of the boys in single-sex classes passing a standardized test of

language skills compared to 33% in coeducational classes. Among the girls, 89% in single-sex classes passed the test, compared to 48% in coeducational classes (Henry, 2001).

Britain's most recent studies conducted by Malacova (2007) found that female and male students in a more selected single-sex setting performed better on their academics. Sullivan et al. (2010), using Steedman's cohort data, found that girls in single-sex schools had higher chances of obtaining five or more passing grades on the State Ordinary level exam than girls in a coeducational setting in mathematics and science. The boys performed better in the languages in the single-sex setting

A year-long study from Germany (Hoffman, 2002) involved physics students in six coeducational high schools. The students were assigned to either coeducational physics classes or part single-sex and part coeducational. The study revealed that girls who had half their physics instruction in the all-girl classes did significantly better than girls who were in coeducational classes. They also remained just as interested in physics at the end of the year. Wong, Lam, and Ho (2002) found similar results in a study of 45,000 students in 400 schools in Hong Kong where about 10% of the schools are single gender. They discovered that girls in single-sex schools performed significantly better on the mathematics examination than did girls in coeducational schools.

The Republic of Ireland is a country with a historical tradition of single-sex schooling, with single-sex schools still making up over a third of all secondary schools. A large-scale study found no significant differences in overall academic achievement between single-sex and coeducational schools for both girls and boys at lower and upper secondary levels (Hannan et al. 1996). However, there was evidence that girls achieved somewhat lower mathematics grades in coeducational schools than in single-sex schools (Smyth, 2010). Rowe (2000) found that the

achievement of boys and girls in single-sex environments was, on average, 15-22 percentile points higher than was their counterparts in coeducational settings. Rowe credited attitudinal differences in the students' behaviors and perceptions to the limitations of coeducational schools to accommodate differences in the cognitive, social, and developmental growth rates of adolescent boys and girls.

New Zealand, on the other hand, found no differences in females or males academic achievement in a controlled background single-sex setting (Woodard et al., 1999). Harker (2000) found no major differences in English, mathematics, and science achievement for both males and females once controls were introduced. Canada implemented single-sex classes in the 1980s and 1990s to address the low achievement in mathematics and science among the female population. According to Demers and Bennett (2007), the single-sex schooling did not result in significant gains in mathematics and science, but provided a safe and secure learning environment for the teachers and female students.

U.S. Studies of Single-sex Education

Riordan (2002) found a positive effect of single-sex schooling of both boys and girls, but suggested that the effect is much greater for, if not limited to, low socioeconomic status and ethnic minority students. Streitmatter (2002) examined perceptions of students in single-sex mathematics classes (taught by the same teacher) in one U.S. public high school. Girls reported less distraction and more self-confidence in their mathematics ability, which they contrasted with male dominance and misbehavior in other classes. Boys had views that were more neutral but felt being in a single-sex class made no difference in their mathematics achievement.

Various comparative studies of Catholic and coeducational schools show support for single-sex education (Datnow et al., 2001). Riordan's (1985) study of Catholic schools found academic benefits resulting in higher achievement test scores for females and males attending single-sex schools than for students attending coeducational schools. Females in single-sex schools demonstrated the greatest benefits, outperforming males and females in coeducational settings (Riordan, 1985). A study conducted by Lee and Bryk (1986) revealed similar results, with boys and girls in single-sex schools outscoring their peers in coeducational schools.

Other researchers suggest that single-sex schools benefit both males and females by providing an opportunity to interact with peers of the same gender who are pursuing academic and leadership roles in a climate free of distractions (Finn, 1980; Jimenez & Lockheed, 1989; Lee & Byrk, 1986). Other researchers point out those single-sex schools benefit males by promoting bonding and optimizing character development (Hawley, 1993; McGough, 1991; Reisman, 1991; Watts, 1994). Moore, Piper, and Schaefer (1993) concluded that single-sex schools offer positive benefits for females more so than for males.

Improved behavior has also been noted by other researchers. Vail (2002) concluded that by providing single-sex classes or single-sex schools, student attendance improves, distractions decline, and student participation increases, all of which serve to maximize student achievement. In coeducational classrooms, boys and girls are easily distracted by one another. Vail (2002) reported that, "The advantage most often associated with schooling boys and girls separately is that it eliminates distraction. Single-sex class settings free male and female students from the worries of impressing the opposite sex, boys and girls can focus on their books" (p. 35).

Another characteristic of improved behavior is increased participation. Boys and girls, each in their own way, blossom in an environment free from the inhibiting factor contributed by

the presence of the opposite sex. In single-sex classes or single-sex schools girls feel more comfortable participating in all facets of the lessons or activities (Hughes, 2007). Other studies have indicated similar findings. Streitmatter (1998) studied and compared the results of girls taking physics in a coeducational and single-sex setting. It was discovered that the girls repeatedly asked the teacher questions and used the answers as opportunities for group learning. The opportunities for increased participation improved achievement. Streitmatter found that in the single-sex physics class, 88% of the girls made an A and 12% of the girls made a B whereas in the coeducational class only 14% of the girls made an A, 14% made a B, and 71% made a C. These findings suggest that girls benefit the most in the area of participation when boys are not present in the class.

Girls tend to learn better in quiet, structured environments and boys learn best in an atmosphere high in energy and movement (Froschl & Sprung, 2005). As a result, girls in coeducational settings are more likely to conform to behaviors that society deems appropriate. Sadker and Sadker (1994) noted that girls display their frustrations differently to boys. Males in single-sex learning environments perform better in the areas of reading, writing, art, and music than do their peers in coeducational settings. Male students in single-sex schools are more engaged in their work, achieve higher academic success, have fewer discipline problems, and have higher levels of self-esteem (Sadker & Sadker, 1994). Same-sex classes not only eliminate distractions caused by the opposite sex, but they allow teachers to use teaching techniques specifically geared to how boys or girls learn best. In addition to providing the breakdown of gender stereotypes, the single-sex format offers opportunities to teachers and students that do not exist in coeducational classrooms (Chen, 2012).

Salomone (2001) argued that in coeducation lies a hidden curriculum, a subtle harmful institutionalized program of male dominance, differential teacher expectations, and an attitude that prepares students for gender-specific roles in society. Single-sex public education provides poorer families the chance to see their children excel in single-sex classrooms (Salomone, 2001). Additional studies suggest that females who have been in a coeducational setting respond better in a single-sex environment. In several schools, curriculum and instruction were tailored to different needs of the sexes whereas in other schools efforts are made to keep curriculum and instruction consistent for both sexes (U.S. Department of Education, 2005). Females in a single-sex setting are more prone to adopt leadership roles and become engaged in traditionally male-dominated subjects such as mathematics and science (Lee & Bryk, 1986). Bauch (1989) also argued that all-female environments promote inclusiveness, caring, and values. Furthermore, girls in single-sex educational institutions are more likely to pursue politics, advanced degrees at selective colleges, and eschew gender stereotypes (Kolb & Kolb, 2001). Additional studies on single-sex environments are characterized by increased interest among girls in mathematics and fewer behavioral problems (Hutchinson, 2001).

Colley, Comber, and Hargreaves (1994) surveyed British students between the ages of 11-12 and 15-16 years from single-sex girl and boy schools and coeducational schools. The students were asked to rank their school subject preferences. In the younger age group, girls from single-sex schools showed stronger preferences than did their female coeducational peers for stereotypical masculine subjects such as mathematics and science, and boys from single-sex schools showed stronger preferences than their male coeducational peers for stereotypical feminine subjects such as music and art.

Single-sex schools break down gender stereotypes and coeducational schools reinforce gender stereotypes (National Association for Single-sex Public Education, 2012). Norfleet, Richards, and Richards (2003) found that boys who attended single-sex schools were more than twice as likely to pursue interests in subjects such as art, music, drama, and foreign languages, compared to boys of comparable ability who attended coeducational schools.

Proponents also pointed to the success of many single-sex schools across the country as evidence that single-sex education is effective. Novotney (2011) reported on a public all-male, predominantly Black high school located in one of Chicago's most beleaguered neighborhoods where only 4% of the inaugural freshman class at the school could read at grade level the first year the school opened in 2006. However, by the time the class graduated 4 years later, 100% had been accepted to 4-year colleges or universities, and many had been offered academic scholarships. According to Novotney, many education experts attribute the school's success to the single-sex format and use of teaching methods that are engaging to young men.

Research supports the finding that minority students and students who live in poverty-stricken areas are not performing as well as other students in the public school system. Studying minorities attending Catholic schools, Riordan (2002) found that Black and Latino students in single-sex schools academically outperformed their peers in coeducational Catholic schools. Riordan argued that single-sex schools provide greater equality and achievement for low-income and working-class students classified as African American and Hispanic American boys and girls.

Single-sex schools for disadvantaged students score and achieve higher on standardized tests in mathematics, reading, science, and civics. They also display higher levels of leadership behavior in schools and complete most of their homework. The course load is more challenging

and teachers have higher levels of educational expectation. Students in this environment have a higher level of control, a more positive attitude toward school, and gender dominance (Riordan, 2002).

Single-sex schools or classrooms can also offer effective positive role models for racial and ethnic minorities and for females (Ascher, 1992; Narine, 1992; Riordan, 1994). Role models have been identified as especially important for low socioeconomic urban African American males, who often have a scarcity of positive role models in their homes or communities. As Riordan noted,

Teachers, counselors and classmates model gender-appropriate behavior for all students. . . . In terms of academic outcomes, single-sex schools may be particularly advantageous for girls and minority males since the top students in all subjects and all extracurricular activities will be of their own gender, and hence, capable of serving as successful role models. (p. 183)

In the present emphasis on high-stakes testing, standardized tests continue to suggest achievement gaps due to race, gender, and socioeconomic status. Single-sex classes are emerging as a viable alternative for a significant number of school districts. Willis, Kilpatrick, and Hutton (2006) indicated that,

If the single-sex class concept is to achieve its full potential it must begin early in primary school and may not have achieved its full potential until children reach adolescence [and] there may be an extended lag between establishing changed social relationships and measurable academic outcomes. (p. 277)

Shmurak (1998) reported the results from a 5-year longitudinal case study comparing two single-sex schools and two coeducation schools. The study indicated there were no differences between the groups in the scores on a gender attitude measure and SAT scores. On the advanced placement test, the girls' scores in the single-sex setting were significantly higher whereas the girls in the coeducational setting took more science classes and got into higher rated colleges. The girls in the coeducational schools were more interested in sports, and girls in single-sex

schools were more interested in art. The career aspirations for single-sex and coeducational schools were not different (U.S. Department of Education, 2005).

Halpern et al. (2011) reported on a U.S. Department of Education systematic review of single-sex schools and coeducational schools on all-subject achievement tests and found that single-sex schools are more effective than coeducation schools on all-subject achievement tests. The study examined mathematics, science, English, and civics achievement outcomes for single-sex schools. In each case, roughly a third of all studies reported findings favoring single-sex schools, with the remainder of the studies split between null and mixed results. Males continue to be underrepresented in this realm of research (U.S. Department of Education, 2005).

The debate over single-sex programs and gender equity issues goes as far back as the 1980s (Datnow, Hubbard, & Conchas, 2001). Trickett et al. (1982) conducted a study that compared students in private single-sex schools with students in the private coeducational schools in the United States. They found that students in the single-sex schools had a far more positive attitude toward academics than did students in the coeducational schools. The students at the single-sex school developed better organizational skills and were more involved in the classroom activities (Trickett et al., 1982).

Factors Hindering the Educational Success of Single-sex Classrooms

Many studies indicate that girls and boys benefit from single-sex schools, while others disagree with the configuration and feel it is not beneficial for everyone. According to Signorella, Frieze, and Hershey (1996), girls in single-sex schools do not have a consistent advantage compared to girls in coeducational schools (Barton & Cohen, 2004). Boys in coeducational classes make more progress in language than boys in single-sex settings (Belfi,

Goos, De Fraine, & Van Damme, 2012; Van de gaer, Pustjens, Van Damme, & DeMunter, 2004).

Comparing single-sex classes to coeducational schools in the area of verbal and English achievement, Marsh, Smith, Marsh, and Owens (1988); Lee and Marks, (1990); and Belfi et al., (2012) found no significant differences between males and females. Harker (2000) also compared single-sex schools to coeducational schools and found no significant differences in English achievement among male and female students. More research is necessary to determine if single-sex environments have a positive effect on achievement for all students.

Research supports two major issues that face single-sex settings--race and class (Carpenter & Hayden, 1987; Finn, 1980; Young & Fraser, 1992). Researchers argue that single-sex schooling must consider pre-existing differences in academic achievement and student background factors when considering success (Harker & Nash, 1997; Marsh, 1989). Riordan (1990) conducted a study using longitudinal data to clarify the effects of single-sex education by sex and race on academic and attitudinal outcomes. Riordan found that both male and female African American and Hispanic American students attending Catholic secondary, single-sex schools scored higher on standardized cognitive tests than their peers in coeducational schools. In African American single-sex female settings, teachers stressed service and nurturing rather than academics, as well as stereotypical roles of African American women (Grant, 1994). As it relates to disadvantaged African American males, low teacher expectations have been exhibited toward them in public school classrooms (Fordham, 1996).

Noguera's (2003) is concerned that single-sex classes do not become dumping grounds for African American boys where negative behaviors are reinforced. Cohen (2009) cautioned that popular media portrays boys in a negative way and that boys in single-sex settings might

reinforce these negative images. Latino males and females face different social and academic pressures depending on where they live in an urban or rural environment (Gandara, Gutierrez, & O'Hara, 2001).

Gender equity issues are a large concern of single-sex schooling. Some believe in a single-sex setting where sex stereotypes are reinforced suggesting that girls are inherently deficient in certain academic areas and that it provides an opportunity for some students to explore homosexual relationships (Salomone, 2006). Feminists are not only concerned with gender equity between females and males but question whether separate can be equal (Datnow et al., 2001).

The factors motivating female students are their desire to please their parents and teachers (Pomerantz et al., 2002). On the other hand, male students are less motivated to study unless the material interests them (Pomerantz et al., 2002). Sax (2007) attested that while a single-sex format can change a male student's attitude toward school from sullen resentment and apathy to enthusiasm and energy, this does not automatically happen by placing all males in one classroom. Teachers must be trained to know how to address boys' academic learning styles (Sax, 2007). Equipping teachers with the resources and training needed to address the educational needs of boys and girls can be a challenge (Datnow & Castellano, 2001). To make single-sex classes successful, teachers need to adjust their curriculum and teaching style to the particular behavioral and learning patterns of males and females. Furthermore, whether students are taught in coeducational or single-sex classrooms, educators must agree with the school of thought that learning differences do exist between the sexes.

Behaviorism and Constructivism Learning Theories

Many learning theories related to behavior also address how people learn. Behaviorism is considered a worldview that operates on a principle of stimulus-response, meaning that all behavior is caused by external stimuli (operant conditioning) and can be explained without the need to consider internal mental states or consciousness (Learning Theories Knowledgebase, 2012). Behaviorism is a worldview that assumes a learner is essentially passive, responding to environmental stimuli. Behavior is shaped through positive reinforcement or negative reinforcement. Both positive reinforcement and negative reinforcement increase the probability that the antecedent behavior will happen again. In contrast, punishment (both positive and negative) decreases the likelihood that the antecedent behavior will happen again. Positive indicates the application of a stimulus whereas negative indicates the withholding of a stimulus. Learning, therefore, is defined as a change in behavior in the learner. Much behaviorist work was conducted with animals then generalized to humans (Learning Theories Knowledgebase, 2012).

Behavioral theories demonstrate how conditioning can be used to learn new information and behaviors; therefore, they have important implications to teaching and learning. Pavlov was one such theorist who posited classical conditioning. Classical conditioning is a type of learning on the association of a stimulus that does not ordinarily elicit a particular response with another stimulus that does elicit a response (Santrock, 1988). Association is key; learning occurs through associations between an environmental stimulus and a naturally occurring stimulus. Pavlov discovered that an unconditioned stimulus (such as food) generates an instinctual reflexive, unlearned behavior (such as salivation) when eating. The salivation was called an unconditional response because it was not learned (Santrock, 1988).

Watson built on the classical conditioning theory and proposed that human learning and behavior were controlled by experience (McLeod, 2009). Watson was the first to study how the process of learning affects behavior, and he formed the school of thought known as behaviorism. Watson further believed that human learning and behavior was not genetically predetermined and that everything from speech to emotional responses are simply patterns of stimulus and response. Watson denied completely the existence of the mind or consciousness (McLeod, 2009). While classical conditioning depends on developing associations between events, operant conditioning involves learning from the consequences of one's behavior.

Skinner, who is regarded as the father of operant conditioning, believed in studying observable behavior in the form of actions and consequences (McLeod, 2009). Skinner believed behavior that is reinforced tends to be repeated or strengthened and behavior not reinforced tends to be extinguished or weakened. Skinner identified three types of responses or operants that can follow behavior. Neutral operants are responses from the environment that neither increase nor decrease the probability of a behavior being repeated. Reinforcers are responses from the environment that increase the probability of a behavior being repeated and can be either positive or negative. Punishers are responses from the environment that decrease the likelihood of a behavior being repeated, thus weakening behavior (McLeod, 2009).

Skinner's theory of operant conditioning was built on the ideas of Edward Thorndike. Thorndike believed that learners form associations or connections between a stimulus and a response and that through trial and error, rewarded responses would be strengthened. Thorndike put forward a law of effect that formulates that any behavior that is followed by pleasant consequences is likely to be repeated, and that any behavior followed by unpleasant consequences is likely to be stopped (McLeod, 2009).

Social learning theory extends behaviorism (Eggen & Kauckak, 2007). Both behaviorism and social learning theorists agree that experience is an important cause of learning. They also include the concepts of reinforcement and punishment in their explanation of behavior. Furthermore, they agree that feedback is important in promoting learning. Learning Theories Knowledgebase (2012) refers to social learning theory as a bridge between behaviorist and cognitive learning theories because it encompasses attention, memory, and motivation. Bandura's social learning theory posits that people learn from one another, via observation, imitation, and modeling (Learning Theories Knowledgebase, 2012). People learn through observation of others' behavior and attitudes and the outcomes of those behaviors. Social learning theory explains human behavior in terms of continuous reciprocal interaction between cognitive, behavioral, and environmental influences.

Bandura believed that most human behavior is learned observationally through modeling that involves four components (Learning Theories Knowledgebase, 2012). Each of these components has a role to play either in the acquisition of information about events and/or rules or in the decision to put this information to use in guiding behavior. First, the observer must pay attention to events that are modeled. Attention refers to the various factors that increase or decrease the amount of attention paid, and is determined by a variety of variables, including the power and attractiveness of the model as well as the conditions under which behavior is viewed. Second, when material has been attended to, it must then be retained. In the third step, reproduction occurs and refers to reproducing the image into appropriate actions similar to the originally modeled behavior. The final process governing observational learning involves motivational variables. For example, there must be sufficient incentive to motivate the actual performance of modeled actions (Learning Theories Knowledgebase, 2012).

Although Sears and Bandura are both social learning theorists, their approaches are different. Bandura's theory was influenced by Skinner's behaviorism, while Sears was influenced by stimulus-response theory (Grusec, 1992). Sears' focus on socialization processes had a particularly strong impact on research and theory in social developmental psychology (Grusec, 1992). Much of his theoretical effort was extended to developing and understanding the way children come to internalize the values, attitudes, and behavior of the culture in which they are raised. Sears' interest centered on issues having to do with the control of aggression, the growth of resistance to temptation, and the acquisition of culturally approved sex-role behaviors. Sears stressed the place of parents in fostering internalization, concentrating on features of parental behavior that either facilitated or hampered the process, features that included both general relationship variables such as parental warmth and permissiveness, and specific behaviors such as punishment in the form of love withdrawal and power assertion, as well as reasoning (Grusec, 1992).

In the traditional behaviorist model, learners undergo some form of conditioning (Boghossian, 2006). Ultimately, the goal of conditioning is to produce a behavioral result. In an academic venue, changing behavior is more difficult to measure than in other contexts, like a karate class, where there are observable physical behaviors that result from physical stimuli. Boghossian used a hypothetical karate class as an example. If students do not form straight lines they are punched in the shoulder (stimuli); after a few people get out of line and get punched, the line becomes noticeably straighter (behavioral response). However, in an academic context, behaviorists substitute verbal behavior (e.g., responding appropriately to a question) for physical behavior. The behaviorist would interpret, for example, a student's correct answer to a question as a sign of successful conditioning, and then continue to reinforce correct responses

behaviorally by assigning good grades. Behaviorism thus views the student as an unreflective responder. There is no subjective element to learning, either in determining what to study or in how information is interpreted, used, or understood (Boghossian, 2006).

While behaviorism dominated the educational landscape 20 years ago, the foremost learning theory today is constructivism. Unlike behaviorists, constructivists argue that there are multiple realities constructed by individuals. There are many different types of constructivism. Among the most popular are cognitive, critical, radical, and social (Boghossian, 2006). However, they all share the same core--the idea that learners are active participants in a learning process by seeking to find meaning in their experiences. For constructivists, helping students arrive at the truth is impossible; therefore, it cannot be the purpose of education. Constructivist learning theory is about the process of learning and helping people discover their truths.

Vygotsky's social development theory is one of the foundations for constructivism (Liu & Chen, 2010). Constructivism is a theory about the thinking process and how we learn rather than about how a student can memorize and recite a quantity of information. From Vygotsky's perspective, learners construct meaning from reality but do not passively receive what is taught in their learning environment (Liu & Chen, 2010). Therefore, constructivism means that learning involves constructing, creating, inventing, and developing one's own knowledge and meaning.

The major theme of Vygotsky's theoretical framework is that social interaction plays a fundamental role in the development of cognition (Culatta, 2012). A second aspect of Vygotsky's theory is the idea that the potential for cognitive development depends upon the *zone of proximal development* (ZPD), a level of development attained when children engage in social behavior. Full development of the ZPD depends upon full social interaction. The range of skill

that can be developed with adult guidance or peer collaboration exceeds what can be attained alone. Vygotsky's theory is complementary to Bandura's work on social learning and a key component of situated learning theory as well (Culatta, 2012).

The general idea of situated learning theory is that if a learner is placed in a real world situation (authentic context) and interacts with other people, learning occurs (Culatta, 2012). Behavior results from the interaction of the individual with the environment based on social development theory (Smith, 1999). However, rather than looking to learning as the acquisition of certain forms of knowledge, Lave and Wenger's situated learning theory looks at the types of social engagements that provide the proper context for learning to take place. Therefore, learning is not seen as the acquisition of knowledge by individuals so much as a process of social participation.

Lave and Wenger treat learning as changing participation in changing practice, and they conceive practice as pervasively social and relational (Arnseth, 2008). Practice is given a primary role in shaping and constituting knowledge and knowing. Knowing is conceived as a way of acting within a community of practice where social development is given a primary role in shaping and constituting reality, and social practice is the primary locus of inquiry for any study of learning and knowing (Arnseth, 2008). To learn therefore is to become able to master these procedures gradually through participation.

Discovery learning, promoted by Bruner, is another example of constructivism. Bruner was one of the founders of constructivist theory (Cooper, 2009). Bruner's theoretical framework is based on the theme that learners construct new ideas or concepts based upon existing knowledge. Learning is an active process. Facets of the process include selection and transformation of information, decision making, generating hypotheses, and making meaning

from information and experiences. Eventually Bruner was strongly influenced by Vygotsky's writings and began to turn away from the intrapersonal focus he had for learning, and began to adopt a social and political view of learning (Cooper, 2009). Bruner argued that aspects of cognitive performance are facilitated by language. He stressed the importance of the social setting in the acquisition of language. His views are similar to those of Piaget, but he places more emphasis on the social influences on development (Cooper, 2009). Piaget, on the other hand, focused on the theory that development is a progressive reorganization of mental processes because of maturation and experience.

Piaget's theory focuses on development rather than addressing learning of information or specific behaviors. McLeod (2009) noted the three basic components of Piaget's theory: (a) schema, which are building blocks of knowledge; (b) process, which enables the transition from one stage to another; and (c) stages of development. While Piaget focuses on stages, Vygotsky and Bruner view development as continuous. In addition, Vygotsky and Bruner consider the effect of social setting and culture on cognitive development while Piaget concentrated on the universal stages of cognitive development and biological maturation.

Behaviorist and constructivist learning theories provide educators with techniques to facilitate learning as well as to manage behavior. Learning and behavior are linked: learning can change or modify behavior, while behaviors are often antecedents for additional learning. Differing views of learning and the learning process allows both behaviorism and constructivism to complement each other in order to address the complex process of learning and behavior more adequately. In addition, instructional decisions should be made based on the child's learning characteristics, the task, and the content rather than teaching from a predetermined philosophy. The best teaching will integrate ideas from constructivist and behaviorist principles.

CHAPTER 3

RESEARCH METHODOLOGY

This chapter will describe the procedures used in this study to determine whether coeducational or single-sex classrooms have an effect on academic achievement in reading and mathematics subtests as measured by the fifth grade Criterion Reference Competence Test (CRCT). The research design, sampling, instrument, data collections and analysis, and statistical methods, will be outlined.

A special concern of fifth-grade teachers in this study school was the lack of preparedness of fifth graders. Many students were very deficient in the areas of reading and mathematics. It was also found that fifth-grade students in my school often experienced social and cultural problems that put intense pressure on their performance. The preparation of fifth graders to pass Georgia's CRCT mandated high-stakes test is a concern at the school. No Child Left Behind (NCLB) requires each state to develop and implement measures for determining whether schools are making Adequate Yearly Progress (AYP). For schools that do not meet state AYP goals, NCLB requires the implementation of specific interventions, and these interventions must continue until the school has met AYP for 2 consecutive years (Government Accountability Office, 2012).

One promising suggestion to these challenges is the establishment of single-sex classrooms. Trickett et al. (1982) found that single-sex classrooms appeared to be more organized and structured, as well as more academically challenging and satisfying. Younger and Warrington (2006) favored the single-sex configuration because of the effect it has on improving

academic achievement for both boys and girls. Therefore, this study compared the achievement of fifth-grade students in single-sex classrooms and coeducation classrooms in reading and mathematics in one Georgia public elementary school. This chapter contains the research methodology, a description of the participants, a description of the data collected, and the analyses proposed to answer the research questions.

Research Questions

In order to assess the benefits for students who attended the single-sex and coeducational programs in a public school system, the following research questions will be used to guide this study.

Research Question 1. Are there differences in CRCT scores for boys and girls on mathematics and reading subtests in the years before and after single sex classrooms were instituted?

Ho1: There are differences between students from the previous years' scores in the areas of mathematics and reading subtests.

Research Question 2. Do single-sex classrooms help promote the academic performance of fifth grade students on the reading portion of the CRCT?

Ho2: Fifth grade students in single-sex classrooms will score higher on the reading portion of the CRCT than students in coeducation classrooms.

Research Question 3. Do single-sex classrooms help promote the academic performance of fifth grade students on the mathematics portion of the CRCT?

Ho3: Fifth grade students in single-sex classrooms will score higher on the mathematics portion of the CRCT than students in coeducation classrooms.

Research Question 4. Are there differences between coeducational and single-sex classrooms on reading subtests, (a) reading literary comprehension, (b) reading information, and (c) reading skills and vocabulary acquisition?

Ho4: There are differences between coeducational and single-sex classrooms reading subtests, (a) reading literary comprehension, (b) reading information, and (c) reading skills and vocabulary acquisition.

Research Question 5. Are there differences between coeducational and single-sex classrooms on mathematics subtests, (a) number sense and numeration, (b) geometry, and (c) measurement?

Ho5: There are differences between coeducational and single-sex classrooms on mathematics computation subtests, (a) number sense and numeration, (b) geometry, and (c) measurement.

Research Design

The purpose of this study was to determine whether or not females and males perform significantly better in single-sex settings than their counterparts in coeducational classrooms. The results of this study may provide the local school with findings that will determine whether single-sex classrooms help with the improvement of test scores on the CRCT.

The research design was a quantitative data collection method to answer each research question and hypothesis. The quantitative component of the study compared the reading and mathematic achievement of fifth-grade students in single-sex and coeducational classrooms. In addition, the quantitative methodology identified the cause and effect comparison between

classroom setting and student performance (Creswell, 2007). The quantitative methods provided greater understanding of the population under study, providing for a systematic and effective research (Creswell, 2007).

Quantitative Data

The study used pre-historical groups of fifth-grade students using archived test scores from their fourth grade test results from the Criterion-Referenced Competency Test (CRCT) in the following reading subtests: literary comprehension, information and media, literary and reading skills, and vocabulary acquisition; and the mathematics subtests: number and operations, measurement, and geometry of the 2008-2009 school years. The data were located in the local school where the study was conducted and utilized school data from the district and State website.

Sampling

The data were collected from one elementary school with two single-sex classrooms and two coeducational classrooms. The participants for this study attended a Title I elementary school in an urban school system in the Southeastern United States. The school was nestled in a community surrounded by beautifully landscaped homes and apartments. Over the years, the majority of the homeowners left the area and the homes became rental properties, with only a few of the original homeowners living in this area. The community where the school is located had experienced a shift from a White middle-class school population to an African American population within the past 15 years. While a few ethnic groups were represented, the major influx was African American households with earnings ranging from \$25,000 to \$100,000 and a

level of education ranging from ninth grade to post-graduate degrees. The working members of the African American communities were low-income trade workers and professional workers.

The school was built more than 50 years ago and was renovated on three separate occasions. The Title 1 School experienced a decline in student enrollment from kindergarten through Grade 5. Sixty-one percent of the students were eligible for the free and reduced lunch program, and the English as a Second Language population was about 7%. The demographics of this school are presented in Table 2.

Table 2

Description of the School

Characteristic	Students		Teachers	
	<i>n</i>	%	<i>n</i>	%
Gender				
Male	191	52.8	5	14.3
Female	171	47.2	30	85.7
Ethnicity				
Black	333	92.0	26	74.3
White	2	0.6	8	22.9
Hispanic	18	5.0	0	0.0
Asian	7	1.9	1	2.9
Multi-racial	2	0.6	0	0.0
Eligible for free/reduced lunch	221	61.0	NA	NA

CRCT reading and mathematics scores of approximately 146 fifth-grade students enrolled between 2008 and 2009 were collected. The number of males and females in coeducational and single-sex classrooms for each year are listed in Table 3.

Table 3

Number of Students Enrolled in Fifth-Grade Single-sex and Coeducational Classes from 2008–2010

Year	Type of class							
	Single-sex				Coeducational			
	Females		Males		Females		Males	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
2008	13	43.3	17	56.7	20	56.8	16	43.2
2009	16	50.0	16	50.0	13	52.0	12	48.0
Total	29	46.8	33	53.2	33	54.1	28	45.9

Instrumentation

The Criterion Reference Competency Test (CRCT) was created with input and revision from teachers across the state of Georgia. The guidelines were established based on the Georgia Performance Standards, which outline what students learn in a particular grade. Stakeholders created a shared understanding of the purpose for this standardized test (Georgia Department of Education, 2012). In addition, Georgia employed reputable testing agencies in the design of the CRCT. The various groups of educators assessed the alignment of the curriculum across the state. These different measures speak to the reliability of the CRCT as a standardized assessment (Georgia Department of Education, 2012).

The Governor’s Office of Student Achievement (GOSA) serves as the reporting and accountability agency for education in Georgia. In 2008, GOSA launched its academic auditing program, an additional component to its service of reporting student progress and completion within Georgia’s public schools. Through an academic audit, GOSA reviews student assessment data and other school records reported to the Georgia Department of Education to confirm accuracy and to explore the effectiveness of local school initiatives in improving achievement (Governor’s Office of Student Achievement, 2007).

Data Collection and Analysis

The researcher conducted a comparative study that involved the collection of the CRCT reading and mathematics scores. The data were collected after the university and school institutional review boards (IRB) granted permission. The quantitative data (CRCT reading and mathematics subtest scores from 2008-2010) were collected from archival records at the school.

Statistical Method

A univariate analysis of variance (ANOVA) was used to address Research Questions 1 and 2. An analysis of variance (ANOVA) and ANCOVA (for question 3 only) were used to address Research Questions 3 and 4, and an ANOVA and MANVOA was used for Research Question 5 (see Table 4). The independent variable was type of class (single-sex or coeducational). The dependent variables were the CRCT reading and mathematics scores from 2008 to 2009. This allowed the researcher to compare the mathematics number and operation and measurement. The reading subtests for reading comprehension and reading skills and vocabulary data were taken from the CRCT. Year is not an independent variable. All data were aggregated across the years of the study.

Table 4

Research Questions--Statistical Method

Research questions	Statistic
Are there differences between scores from the previous year's scores in the areas of mathematics and reading subtests?	ANOVA/MANOVA computed by year for mathematics and reading subtests
Do single-sex classrooms help promote the academic performance of fifth-grade students on the reading portion of the CRCT?	ANOVA computed for each year
Do single-sex classrooms help promote the academic performance of fifth-grade students on the mathematics portion of the CRCT?	ANOVA computed for each year
Are there differences between coeducational and single-sex classrooms on reading subtest, a) reading literary comprehension, b) reading information and c) reading skills and vocabulary acquisition?	ANOVA/ANCOVA computed by year for reading subtests
Are there differences between coeducational and single-sex classrooms on mathematics subtests, a) number sense and numeration, b) geometry and measurement, and c) problem solving?	MANOVA computed by year for math subtests

Validity and Reliability

The CRCT was designed to assess students' knowledge of the Georgia Performance Standards (GPS) curriculum. Students from third through eighth grades were tested on 50 to 70 content related questions in a multiple choice format in English/language arts, mathematics, science, and social studies. The assessed data were used to measure academic achievement at student, class, school, system, and state levels. It also identified individuals' strengths and weaknesses. Three measures of performance were used: Does Not Meet Expectation (below 800), Meet Expectation (800 - 849), and Exceeds Expectations (850 or above) (GaDOE, 2013).

The content validity of the CRCT is built into the development of the instrument. The primary test creation cycle started with the Georgia Performance Standard (GPS) curriculum. Georgia educators reviewed the GPS and recommended test specifications. The field results were reviewed to check for errors, bias, and sensitivity issues. The CRCT has been used since 2001. Finally, GADOE conducted external and internal studies against the GPS and similar CRCT measures as evidence for validity.

The reliability of the CRCT is indicated by two measures: Cronbach's alpha and the standard error of measurement (SEM). The various tests have alpha values within the range 0.86 to 0.94. The conditional standard error of measurement (CSEM) is used to define the range of "cut scores" within which the students meet or exceed performance. The CSEMs range from 7 to 11 for "Meets Cut Scores" and from 9 to 13 for "Exceeds." The CSEMs were calculated using Hambleton and Swaminathan's formula (Wallace, 2013).

Summary

This study used a comparative research design with a data collection plan to determine whether single-sex classrooms help promote the academic achievement of fifth grade students. The CRCT of the subtests in reading and mathematics scores from 2008-2010 were collected from students enrolled in single-sex and coeducational classes in one Title 1 urban elementary school to determine whether the achievement was different in the two types of classrooms.

CHAPTER 4

FINDINGS

The purpose of this study was to examine the effectiveness of single-sex classes and determine whether teaching girls and boys separately improves their academic achievement in reading and mathematics. To this end, comparisons were made between single-sex fifth grade classrooms and coeducation fifth grade classrooms in the areas of reading literacy comprehension, information media literacy, reading skills, vocabulary/acquisition, number sense and numeration, measurement, and geometry subtests on the CRCT test in a southeastern public school system over a period of 2 years. During this previous year, students were grouped in coeducational classes. Accordingly, a comparison of fifth grade students' 2007 and 2008 CRCT scores was used to determine if there were differences between reading and mathematics scores for single-sex or coeducation classrooms. Table 5 contains the total reading results of the means and standard deviations of the year 2007.

Comparison of Students Prior to Entering Single-sex Classrooms: Results of the 2007 Data

In an effort to determine whether students were distributed into single-sex or coeducational classrooms with no differences in abilities, I compared student scores on

mathematics and reading in the year prior to beginning placement into the single-sex classrooms. Question 1 addresses this comparison. The first research question is “Are there differences in CRCT scores for boys and girls on mathematics and reading subtests in the years before and after single-sex classrooms were instituted?” The hypothesis predicted, “There are no differences between scores in students groups by single-sex classroom or coeducational classroom for the previous year (2007) based on the mathematics and reading scores.”

Table 5

2007 Descriptive Statistics Before Grouped: Total Reading

Group	<i>M</i>	<i>SD</i>	<i>N</i>
Males	27.12	6.900	17
Females	25.08	9.836	13
Coeducation	28.42	8.513	36
Total	27.42	8.383	66

To address this hypothesis, an ANOVA was calculated and no significant differences were found between the groups, $F(2, 63) = .768, p = .468$.

Table 6

2007 Descriptive Statistics Before Grouped: Reading Subtests

Groups	<i>M</i>	<i>SD</i>	<i>N</i>
Comprehension			
Males	13.29	2.972	14
Females	11.00	4.655	13
Coeducation	11.72	3.723	36
Total	11.92	3.807	63
Literacy			
Males	10.29	2.301	14
Females	9.77	3.244	13
Coeducation	11.72	3,723	36
Total	11.00	3.422	63
Vocabulary			
Males	5.50	1.653	14
Females	4.31	2.594	13
Coeducation	4.97	1.594	36
Total	4.95	1.862	63

Further, to determine if CRCT reading subtest scores differed between students in male only, female only, and coeducational classrooms, a MANOVA was calculated. No significant differences were found for comprehension $F(2,60) = 1.344, p = .269$, literacy $F(2,60) = 2.11, p = .142$, or vocabulary $F(2,60) = 1.406, p = .253$. Table 6 contains the reading subtest results for the year 2007.

Another purpose for Question one was to determine whether there are differences between students grouped from the previous year by comparing the total math scores for all students for 2007 prior to placement in the single-sex or coeducation classrooms.

Table 7

2007 Descriptive Statistics Before Grouped: Total Mathematics

Group	<i>M</i>	<i>SD</i>	<i>N</i>
Males	31.18	5.151	17
Females	29.92	6.788	13
Coeducation	30.08	8.520	36
Total	30.33	7.374	66

To address the hypothesis, an ANOVA was calculated on the total mathematics comparing male only classrooms, female only classrooms and coeducational classrooms and no significant differences were found $F(2.63) = .148, p = .863$.

Table 8

2007 Descriptive Statistics Before Grouped: Mathematics Subtests

Group	<i>M</i>	<i>SD</i>
Numeration		
Males	9.18	2.128
Females	10.17	1.992
Coeducation	9.19	2.424
Total	9.37	2.275
Measurement		
Males	11.00	1.871
Females	9.92	2.778
Coeducation	10.44	3.573
Total	10.49	3.052
Geometry		
Males	11.00	1.871
Females	10.42	2.539
Coeducation	10.44	3.573
Total	10.58	3.005

To address the hypothesis, a MANVOA was calculated on the mathematics subtests and no significant differences were found for male only classroom, female only, and coeducational classrooms on numeration subtest: $F(2,62) = .902, p = .411$, measurement $F(2,62) = .445, p = .643$, and geometry $F(2,62) = .215, p = .807$. The null hypothesis was accepted.

Comparison of Single-sex and Coeducational Classes for 2008 Data

Research Question 2: 2008

The purpose of question 2 was to determine whether single-sex classrooms promote academic performance. A comparison of the students' 2008 total reading scores was used to determine the effect of class setting affected on CRCT test. Table 9 contains the total reading results of the means and standard deviations for the year 2008.

The second hypothesis predicted that, "Fifth grade students in single-sex classrooms will score higher on the reading portion of the CRCT than students in coeducation classrooms." To address the hypothesis, an ANOVA was calculated on total reading and there were significant differences found: $F(2,63) = 4.093, p = .021$ between the groups, male only, female only, and coeducational classrooms. A post-hoc analysis was calculated and the single-sex male ($p=.006$) classroom students scored significantly higher than the coeducation and single-sex female classroom students did. Single-sex female ($p = .273$) classrooms did not score any differently on total reading than coeducational classrooms. The null hypothesis was rejected.

Table 9

2008 Descriptive Statistics: Total Reading

Groups	<i>M</i>	<i>SD</i>	n
Males	29.53	5.821	17
Females	26.92	5.937	13
Coeducation	26.12	6.800	36
Total	26.12	6.701	66

Research Question 3: 2008

The purpose of question 3 was to determine whether single-sex classrooms promote academic performance on the fifth grade mathematics portion of the CRCT test. The related hypothesis stated, “Fifth-grade students in single-sex classrooms will score higher on the mathematics portion of the CRCT than students in coeducation classrooms.”

To address this hypothesis, an ANOVA was calculated and differences were found between groups: $F(2,63) = 4.474, p = .015$. A post-hoc analysis was calculated and both the single-sex male ($p = .011$) and single-sex female ($p = .034$) classes scored higher than the coeducation classroom students. Male and female single-sex classrooms did not score any differently on total mathematics scores ($p = .854$). As such, the null hypothesis was rejected.

Table 10

2008 Descriptive Statistics: Total Mathematics

Groups	<i>M</i>	<i>SD</i>	n
Males	36.41	5.646	17
Females	35.92	6.062	13
Coeducation	30.89	8.127	36
Total	33.30	7.571	66

Research Question 4: 2008

The purpose of question 4 was to determine whether there are differences between coeducational and single-sex classrooms on the reading subtests; reading literary comprehension, b) reading information, and c) reading skills and vocabulary acquisition. The related hypothesis predicted that there are differences between coeducational and single-sex classrooms reading subtests.

To address the hypothesis, a multivariate test (MANOVA) was calculated and significant differences were found between male only classrooms, female only classrooms, and coeducational classrooms in comprehension: ($F(2,63) = 4.503, p = .015$) and vocabulary ($F(2,63) = 4.847, p = .011$) on the 2008 reading subtests. No significant differences were found in literacy: ($F(2,63) = 1.65, p = .206$) between the comparison groups (male only, female only and coeducational classrooms). A post-hoc analysis was calculated and the single-sex male ($p=.004$) classroom students scored significantly higher than the coeducation classroom students on comprehension. The single-sex male ($p = .004$) classroom students also scored significantly higher than the coeducation classroom students on vocabulary. The null hypothesis was rejected for differences between male only, female only, and coeducational classrooms on vocabulary and comprehension because there were differences between groups. However, the null hypothesis was accepted with no differences between groups on literacy.

Table 11

2008 Descriptive Statistics: Reading Subtest

Groups	<i>M</i>	<i>SD</i>	<i>N</i>
Comprehension			
Males	11.94	2.536	17
Females	10.69	2.323	13
Coeducation	9.69	2.649	36
Total	10.47	2.696	66
Literacy			
Males	11.06	2.883	17
Females	10.23	2.651	13
Coeducation	9.47	3.167	36
Total	10.03	3.033	66
Vocabulary			
Males	6.53	1.328	17
Females	6.00	1.683	13
Coeducation	5.06	1.820	36
Total	5.62	1.778	66

Research Question 5: 2008

The purpose for Question 5 was to determine whether there are differences between coeducational and single-sex classrooms on the mathematics subtests (number sense numeration, geometry, measurement) on the fifth grade portion of the CRCT test. It was predicted that there are differences between coeducational and single-sex classrooms on these measures.

To address the hypothesis, a multivariate test (MANOVA) was calculated on the mathematics subtests and no significant differences were found between the groups (male only, female only, and coeducational classrooms) in numeration: $F(2,54) = .321, p = .727$, measurement $F(2,54) = .001, p = .999$, and geometry $F(2,54) = 1.735, p = .126$. A post-hoc analysis was not calculated. The null hypothesis was accepted.

Table 12

2008 Descriptive Statistics: Mathematics Subtests

Group	<i>M</i>	<i>SD</i>
Numeration		
Males	18.76	2.818
Females	18.62	2.844
Coeducation	15.54	4.642
Total	17.00	4.180
Measurement		
Males	13.29	2.756
Females	4.77	1.641
Coeducation	11.00	3.573
Total	10.35	4.248
Geometry		
Males	4.35	.996
Females	12.54	3.733
Coeducation	4.11	1.051
Total	5.86	3.844

In summary, the 2007 CRCT scores did not show any differences in total reading, reading subtests, total mathematics, or mathematics subtests by sex before students were divided into single-sex groups during 2008. In 2008, differences were found between the groups on the total reading scores. The single-sex male classroom students scored higher than the coeducational classrooms, but the single-sex female classroom did not score any differently on total reading than the coeducational classrooms. Similarly, on the total mathematics scores, both single-sex male and female classrooms scored higher on the total mathematics test than the coeducational classroom students. The single-sex male and female classrooms did not score any differently on total math.

The 2008 reading subtest scores indicated there were significant differences found in comprehension and vocabulary between the comparison groups. The single-sex male classroom students scored higher than the coeducation classroom on comprehension, and on vocabulary, the

single-sex male class scored higher than the coeducation classroom students did. On the mathematics subtests, the single-sex male classrooms scored higher on numeration and measurement than the coeducation classrooms. The single-sex female classroom scored higher on geometry than the single-sex male and coeducation classrooms.

In an effort to determine if students were distributed into the single-sex or coeducational classrooms with no differences in abilities, I compared students scores on mathematics and reading in the year prior to beginning placement into the single-sex classrooms. The first research question was “Are there differences in CRCT scores for boys and girls on mathematics and reading subtests in the years before and after single-sex classrooms were instituted?” The hypothesis predicted, “There are no differences between scores in the students groups by single-sex classrooms or coeducational classroom for the previous year (2008) based on the mathematics and reading scores.”

To address the hypothesis, an ANOVA was calculated and no significant differences were found between groups: $F(2,54) = 1.887, p = .161$ on total reading for students during 2008 who entered into male only, female only and coeducation classes during 2009.

To determine if differences existed between groups in total mathematics scores, an ANOVA was calculated comparing all students during the 2008 year who entered into male only, female only, and coeducation classes for 2009. There were no significant differences found $F(2,54) = .825, p = .444$.

Another purpose for question one was to determine if there were differences between students grouped from the previous (2008) year by comparing the reading subtests (comprehension, literacy and vocabulary). A MANOVA was calculated on the reading subtests and there were significant differences found in comprehension $F(2,54) = 3.344, p = .043$. A post

hoc analysis was calculated using the least significant difference (LSD), and there were differences between female's single-sex and the coeducation classroom $p=.013$. The mean for the single-sex females for 2008 comprehension score was 14.58 and for the coeducation class the mean was 11.80. No other pairwise significant differences were found for the 2008 reading subtests.

In an effort to determine if differences existed between students, mathematics subtests were compared. A MANOVA was calculated on and no significant differences were found for the mathematics subtests on numeration $F(2,53) = .985, p = .387$, measurement $F(2,53) = 1.69, p = .193$ and geometry $F(2,53) = .274, p = .762$ for the students, during 2008, for those entering male only, female only and coeducation classrooms for 2009.

An ANCOVA was used in analyzing the 2009 data for comprehension since this was the only subtests found to be different at the start of placement into the single-sex or education classroom from the 2008 data. The covariate was the 2008 comprehension scores and the dependent variable was the 2009 comprehension scores. There were no significant differences between single-sex male, single-sex females and coeducation classroom for comprehension for 2009 $F(2,53) = 1.185, p = .314$. The estimated marginal means for the single-sex male ($M = 11.361$), single-sex female ($M = 11.438$) and the coeducation ($M = 10.449$) classrooms. The null hypothesis was accepted because no differences were found.

Comparison of Single-sex and Coeducational Classes for 2009 Data

A comparison of the students' 2008 total reading scores was used to determine if the type of class settings influenced their performance on the CRCT test.

Research Question 2

The related hypothesis predicted that, "Fifth grade students in single-sex classrooms will score higher on the reading portion of the CRCT than students in coeducation classrooms."

To address the hypothesis, an ANOVA was calculated and no significant differences were found: $F(2,54) = 2.561, p = .087$. The null hypothesis was accepted because there were no significant differences between groups.

Table 13

2009 Descriptive Statistics: Total Reading

Groups	<i>M</i>	<i>SD</i>	n
Males	27.44	6.663	16
Females	28.38	6.174	16
Coeducation	23.88	7.172	25
Total	26.14	6.952	57

Research Question 3

The purpose of Question 3 was to determine whether single-sex classrooms promote academic performance on the fifth grade mathematics portion of the CRCT test. A comparison of the students' 2009 total mathematics scores was used to determine whether the type of class settings impacted their performance on the CRCT test. An ANOVA results was: $F(2,54) = 4.474, p = .015$. A post hoc was calculated and both the single-sex male ($p = .011$) and single-

sex female ($p = .034$) classes scored higher than the coeducation. The null hypothesis was rejected because significant differences were found between groups.

The related hypothesis stated, “Fifth grade students in single-sex classrooms will score higher on the mathematics portion of the CRCT than students in coeducation classrooms.”

To address this hypothesis, an ANOVA was calculated on total mathematics scores and no significant differences were found: $F(2,54) = .192, p = .826$. The null hypothesis was accepted because no differences were found.

Table 14

2009 Descriptive Statistics: Total Mathematics

Groups	<i>M</i>	<i>SD</i>	n
Males	35.25	9.936	16
Females	35.63	10.145	16
Coeducation	33.88	8.936	25
Total	34.75	9.427	57

Research Question 4

The purpose of Question 4 was to determine whether there are differences between coeducational and single-sex classrooms on the reading subtests on the fifth grade section of the CRCT test.

The hypothesis stated, there are differences between coeducational and single-sex classrooms reading subtests, (a) reading literary comprehension, (b) reading information, and (c) reading skills and vocabulary acquisition.

Because there were differences on comprehension for 2008 data prior to single-sex comparisons, individual ANOVAs were calculated on literacy and vocabulary. An ANCOVA

was calculated for comprehension since the comprehension score was different prior to the formation of single-sex classrooms. The ANCOVA found no significant differences in the all male, all female, and coeducation classroom on comprehension $F(2,53) = 1.185, p = .314$. An ANOVA found no significant differences in the all male, all female, and coeducation classrooms on literacy $F(2,54) = 1.467, p = .240$. An individual ANOVA found no significant differences in the all male, all female, and coeducation classrooms on vocabulary $F(2, 53) = 1.162, p = .321$. The null hypothesis was rejected.

Table 15

2009 Descriptive Statistics: Reading Subtests

Groups	<i>M</i>	<i>N</i>
Comprehension		
Males	11.32	16
Females	11.32	16
Coeducation	10.40	25
Literacy		
Males	10.00	16
Females	10.00	16
Coeducation	8.64	25
Vocabulary		
Males	5.94	16
Females	6.27	16
Coeducation	5.52	25

Research Question 5

The purpose of Question 5 was to determine whether there are differences for coeducational and single-sex classrooms on the mathematics subtests. It was predicted that there are differences between coeducational and single-sex classrooms on Mathematics computation subtests, a) number sense and numeration, b) geometry or c) measurement.

To address the hypothesis, a multivariate test (MANOVA) was calculated including each math subtest and no significant differences were found between the groups (male only, female only, and coeducational classrooms) in numeration: $F(2,54) = .321, p = .727$, measurement $F(2, 54) = .001, p = .999$, and geometry $F(2,54) = 1.735, p = .186$. The null hypothesis was accepted because no significant differences were found.

Table 16

2009 Descriptive Statistics: Mathematics Subtests

Group	<i>M</i>	<i>SD</i>
Numeration		
Males	17.13	5.136
Females	17.81	4.996
Coeducation	16.60	4.272
Total	17.09	4.672
Measurement		
Males	13.38	4.241
Females	13.38	4.365
Coeducation	13.32	3.987
Total	13.35	4.090
Geometry		
Males	4.75	1.183
Females	4.44	1.459
Coeducation	3.96	1.399
Total	4.32	1.378

Table 17

2008 Statistical Findings of the Data

Research Questions and Hypothesis	Results
<p>RQ1 – Are there differences in CRCT scores for boys and girls on mathematics and reading subtests in the years before and after single-sex classrooms were instituted? Ha1: There are differences between students from the previous year’s scores in the areas of mathematics and reading subtests.</p>	<p>No differences were found in the all male, all female and the coeducation classes in the 2007 CRCT test score on the mathematics and reading tests. The null hypothesis was accepted.</p>
<p>RQ2 – Do single-sex classrooms help promote the academic performance of fifth grade students on the reading portion of the CRCT? Ha2: Fifth grade students in single-sex classrooms will score higher on the reading portion of the CRCT than students in coeducation classrooms.</p>	<p>Differences were found. According to the post-hoc analyses, the males scored higher than the females and coeducation on total reading 2008 CRCT test scores. The hypothesis was accepted.</p>
<p>RQ3 - Do single-sex classrooms help promote the academic performance of fifth grade students on the mathematics portion of the CRCT? Ha3: Fifth grade students in single-sex classrooms will score higher on the mathematics portion of the CRCT than students in coeducation classrooms.</p>	<p>Differences were found. According to the post-hoc analyses, the males scored higher than the coeducation on total mathematics 2008 CRCT test scores. The hypothesis was accepted.</p>
<p>RQ4 – Are differences between coeducational and single-sex classrooms on reading subtests, (a) reading literary comprehension, (b) reading information, and (c) reading skills and vocabulary. Ha4: There are differences between coeducational and single-sex classrooms reading subtests, (a) reading literary comprehension, (b) reading information, and (c) reading skills and vocabulary acquisition.</p>	<p>Differences were found. According to the post-hoc analyses, the males scored higher on comprehension and vocabulary than the female and coeducation classrooms. The hypothesis was accepted.</p>
<p>RQ5 – Are there differences between coeducational and single-sex classrooms on mathematics subtests, (a) number sense and numeration, (b) geometry, and (c) measurement? Ha5: There are differences between coeducational and single-sex classrooms on mathematics computation subtests, (a) number sense and numeration, (b) geometry, and (c) measurement.</p>	<p>No differences were found in number sense and numeration, geometry and measurement between the male only, female only and coeducational classrooms. The null hypothesis was accepted.</p>

Table 18

2009 Statistical Findings of the Data

Hypothesis	Results
<p>RQ1 – Are there differences in CRCT scores for boys and girls on mathematics and reading subtests in the years before and after single-sex classrooms were instituted?</p> <p>Ha1: There are differences between students from the previous year’s scores in the areas of mathematics and reading subtests.</p>	<p>No differences were found in the total reading, total mathematics, vocabulary, comprehension, literacy, numeration, geometry and measurements in the all male, all female and the coeducation classes in the 2008 CRCT test scores. The null hypothesis was accepted.</p>
<p>RQ2 – Do single-sex classrooms help promote the academic performance of fifth grade students on the reading portion of the CRCT?</p> <p>Ha2: Fifth grade students in single-sex classrooms will score higher on the reading portion of the CRCT than students in coeducation classrooms.</p>	<p>No differences were found among the male only, female only and coeducational classroom in total reading 2009 CRCT test scores. The null hypothesis was accepted.</p>
<p>RQ3 - Do single-sex classrooms help promote the academic performance of fifth grade students on the mathematics portion of the CRCT?</p> <p>Ha3: Fifth grade students in single-sex classrooms will score higher on the mathematics portion of the CRCT than students in coeducation classrooms.</p>	<p>No differences were found among the male only, female only and coeducational in total mathematics on the 2009 CRCT test scores. The null hypothesis was accepted.</p>
<p>RQ4 – Are differences between coeducational and single-sex classrooms on reading subtests, (a) reading literary comprehension, (b) reading information, and (c) reading skills and vocabulary.</p> <p>Ha4: There are differences between coeducational and single-sex classrooms reading subtests, (a) reading literacy comprehension, (b) reading information, and (c) reading skills and vocabulary acquisition.</p>	<p>No differences were found among the male only, female only and coeducational classrooms in comprehension, literacy and vocabulary on the 2009 CRCT test scores. The null hypothesis was accepted.</p>
<p>RQ5 – Are there differences between coeducational and single-sex classrooms on mathematics subtests, (a) number sense and numeration, (b) geometry, and (c) measurement?</p> <p>Ha5: There are differences between coeducational and single-sex classrooms on mathematics computation subtests, (a) number sense and numeration, (b) geometry, and (c) measurement.</p>	<p>No differences were found among the male only, female only and coeducational classrooms in number sense and numeration, geometry and measurement on the 2009 CRCT test scores. The null hypothesis was accepted.</p>

In summary, the 2008 scores did show differences between the groups on the total reading and total mathematics scores. Overall, the 2009 findings in reading and mathematics did not indicate any significant differences between any of the groups. The only year findings indicated differences was 2008. The single-sex male and female classrooms scored higher than the coeducation classroom. These findings reveal the mixed results of the data.

CHAPTER 5

INTRODUCTION

Single-sex education has emerged as a possible solution to address student performance. In 2002, the United States government passed the No Child Left Behind Act (NCLB), which permitted the implementation of single-sex classrooms in public schools. In years that followed the NCLB Act, educators have adopted single-sex classrooms approach in hope of improving student achievement. Do single-sex classes work? Some researchers argue in support of the single-sex classroom and others in support of coeducation classrooms. As the findings in my study demonstrate, the answer is complex. I will argue that while single-sex classes are not an immediate solution to a difficult problem, there are reasons for educators to embrace single-sex classrooms as an effective means to increase student performance in certain situations.

This chapter consists of three sections. The first section explores the conclusions that can be drawn from the research findings. The second section discusses what policies emerge from those considerations. Finally, the third section presents suggestions for future research.

Conclusion

In 2008, a school located in the southeastern United States implemented the single-sex classroom initiative in hopes to improve student performance in mathematics and reading. The school had experienced a decrease in students' CRCT scores on the fifth grade level. The teachers were open to the adoption of innovative instructional practices that would increase test scores.

The implementation of the single-sex program started in 2008 and continued through 2009. The fifth grade level was chosen for the experiment. Given the enrollment, one male, one female, and two coeducation classes were formed for the two school years starting in 2008 and ending in 2009. The teacher of record was the same gender as the class; that is a male teacher taught the male class and a female teacher taught the female class. During those years, the same male and female teachers were the teacher of record.

The students were not randomly selected, therefore only students interested in the program had the opportunity to participate for the year. The single-sex classes had a very controlled environment. This consisted of parents with similar socioeconomic status and educational backgrounds. Local controls included scheduled restroom breaks and lunch times, where teachers ate with the students. All male students followed the “tuck and pull rule”, which required them to tuck their shirt inside their pants. In addition, once a month, the students had to make oral presentations before the class. Finally, all parents had to attend mandatory teacher conferences and participate in a number of service projects.

Single-sex classes were common during the 19th century. They were particularly popular with Catholic and other private schools. In 1972, the ruling of the Title 1 Educational Amendment Act of 1972, made coeducation classes the standard, which provided females with equal educational opportunities and banning single-sex discrimination in schools. The Supreme Court ruled on behalf of single-sex public education in 1996 (the Oyez Project), allowing females to attend all military academies. In 2002, No Child Left Behind (NCLB) opened the doors for single-sex education and even provided grants for its implementation (Hughes, 2007).

After the passing of the Education Amendment Act Title IX 1972, gender equity became a great concern for female students. The assumption was that single-sex schooling could

reinforce sex stereotypes, suggesting that girls are inherently deficient in academic areas such as mathematics. More recently, male students have become the target of discussion, because they are scoring below their potential on required tests, for example the CRCT test. Issues of gender equity are sure to continue and evolve, making research on the effectiveness of the single-sex classroom increasingly important.

In my review of the literature, Gurian (2006) stated that male students rely on pictorial representation and moving objects as well as the need for more physical space, which can be misunderstood by teachers as being rude and aggressive. My research also points out that boys are able to complete moving tasks better than female students when completing various mathematics assignments, in particularly geometry. With all the movement, male students have the tendency to be squirmy or restless, which can be perceived as distracting by teachers. Female students tend to talk more than male. However, males handle stress better than females as well as learn better under stress than females (Taylor et al., 2000). Further, Cassidy and Ditty (2001) argue that females have keener hearing than males and function better in quiet a place. Males need loud noises. Given these sex-specific characteristics, educators must be familiar with the different learning styles if they are to utilize appropriate strategies in the classroom.

Many English speaking countries have a large number of single-sex schools. As a result scholars New Zealand, Australia and England have done more extensive research on single-sex education than their American counterparts. Some of their studies support coeducation as being the best setting for students (Smyth, 2010). The weight of evidence in Great Britain, for example, suggests that females do better in single-sex settings (Smyth, 2010).

Studies conducted in the US tend to support the social and emotional improvement of students as one of the benefits of being in a single-sex classroom. Vail concludes that students'

attendance and distractions decline, while students' participation increases. Norfleet, Richards and Richards (2003) found that more male students pursue subjects such as art, music, drama, and foreign languages when grouped in single-sex classrooms. For disadvantaged students, single sex classes introduce stronger leadership behavior, a more positive attitude toward academics, and stronger incentives to become more involved in classroom activities (Trickett et al., 1982).

According to my review of literature, when comparing single-sex classrooms to coeducational schools in the areas of reading and English achievement, research reveals no significant differences between males and females (Belfi, et al., 2012). In African American single-sex classes, teachers stressed service and nurturing rather than academics as well as exhibiting low expectations toward public school classrooms (Fordham, 1996). Noruera (2003) does not support single-sex classes for African American males because he believes they become "dumping grounds" in which negative behaviors are reinforced. Appropriate professional development might help teachers understand how to address students' learning styles and differences. Behaviorist and constructivist learning theories provide educators with techniques to facilitate learning as well as to manage behavior. Instructional decisions must be made based on the child's learning characteristics, and thus seems, is strongly influenced by their sex.

Research Question 1

Question 1 addressed the differences in the CRCT scores for boys and girls on the mathematics and reading subtests before and after single-sex or coeducation classes in 2007. The 2007 results indicated no significant differences between the 2008 school year within the groups.

More research is necessary to determine if single-sex environments have a positive effect on achievement for all students. Dale (1969, 1971, 1974) conducted the first large-scale studies on single-sex education in Great Britain that suggested that coeducation provided the best preparation for adult life for both sexes (Smyth, 2010), but my study is based on the younger age groups. My findings support Dale's findings on the 2007 and 2009 results on the CRCT test in reading and mathematics totals and subtests. Based upon Dale's and my finding, coeducation classes do prepare students in broad ages groupings to be successful in their academics.

Research Question 2

The second research question investigated whether a single-sex classroom promoted academic performance on the fifth grade reading portion of the CRCT test. I compared the 2007 student scores on total reading, which was the year prior to the beginning placement into the single-sex classrooms, to the 2008 grouped students' data in total reading. Based on the findings, the results indicated that all the students were at the same academic level before they were grouped into single-sex male and female as well as coeducational classrooms.

In 2008, the students were grouped into three classes, which consisted of all male, all female, and coeducational. The total reading scores indicated the single-sex male students scored significantly higher than the coeducational classroom of students, as indicated in chapter 4; but the single-sex female students did not score any differently on the total reading scores than the coeducational classrooms. In 2009, there was no significant difference on the total reading section of the CRCT test. The single-sex female and male classrooms did not score any differently on the total reading than the coeducational classrooms.

Similar to Demers and Bennett's (2007) findings, Novotney (2011) conducted a study on a public all-male predominately African American school in one of Chicago's most troubled neighborhoods, where students' reading and mathematics scores have improved using the single-sex model. Students were non-readers or were reading on a first grade level; but by the end of the program, these students were reading on grade level. Although my study was for only two years, the findings confirmed that male students performed better on the reading section of the CRCT in a single-sex setting.

Single-sex male classes can have positive effects on student performance in the areas of comprehension and vocabulary, according to the findings of my study. This partially supports the research of Wiens (2006) for the single-sex female and male students with the total reading scores. Although my research partially supports Weins and other studies, the failure to find the effect for females needs to be investigated. This may be due to the teacher of record, the background of the male and female students, or one of a number of other factors.

Research Question 3

Question 3 explored whether single-sex classrooms promoted academic performance on the fifth grade mathematics portion of the CRCT test. On the 2007 CRCT test, there were no significant difference in the scores on mathematics between the single-sex and coeducation student before they were placed into groups. In 2008, after grouping the students, the CRCT scores indicated significant differences between the 2007 students' scores before they were grouped in mathematics. Both the single-sex male and female classrooms scored practical significantly higher than the coeducation classrooms; lending support to the claim that single-sex classrooms have an effect on student performance in mathematics. However in 2009, there was

no significant difference on total mathematics; in single-sex or coeducational classes, the students performed at the same level on the CRCT mathematics section of the test. During the 2009 school year, there were two new teachers added to the fifth grade staff, but the teachers for the single-sex classes did not change. In addition to the administration, the assistant principal was promoted, and a new assistant principal was hired. This might have had an effect on student performance.

Lee and Bryk (1986) and Carpenter and Hayden (1987), believes that there are academic benefits of students attending single-sex classrooms. My findings support their research, because the single-sex male students performed better than coeducation students in mathematics on the 2008 CRCT test. Sadker and Sadker (1994) believed males and females perform better in single-sex classroom if the schools provide the students with a rigorous academic program. Abu El-Haj (2003) stated that in the area of mathematics, females faced many equity issues. My findings for 2008 indicated that female students did score slightly higher in mathematics given single-sex grouping, especially in numeration and geometry. Ping and Weiling's (2002), findings in mathematics, indicated that female students tend to be in an inferior position compared to the male students because of teachers' positive interaction with the male students. In my study, the teacher of the single-sex female class was a female teacher that worked with the students for two consecutive years, which may have ensured success in the classroom.

Research Question 4

The purpose of the fourth question was to determine whether there are gender differences between coeducation and single-sex classrooms on the reading subtests on the fifth grade section of the CRCT test. In 2007, there were no significant differences found between students in

students groups by single-sex classroom or coeducational classroom for the previous year. However, the 2008 CRCT data revealed significant differences in the areas of comprehension and vocabulary. No significant differences were found in the area of literacy between the comparison groups. In 2009, there were no significant differences found on the reading subtests.

According to the 2009 vocabulary subtest, the single-sex female class performed better than the single-sex male and coeducation classes, but the 2008 vocabulary subtest indicated single-sex males performed significantly higher than the single-sex females and coeducation students on the CRCT test. Therefore, while my study provided mixed results, findings do support the premise that single-sex classrooms can affect students' performance.

Research Question 5

The purpose of Question 5 was to determine whether there are differences between coeducational and single-sex classrooms on the mathematics subtests on the fifth grade CRCT test. On the 2007 test, baseline data before the students were grouped indicated that there were no significant differences on the mathematics subtests. In 2008, there were significant differences found between the groups (male only, female only, and coeducational classroom) in numeration, measurement, and geometry.

In 2009, the single-sex female students scored higher than the coeducation classes in numeration, measurement, and geometry. Ping and Weiling (2006) stated that females are inferior to males in mathematics, but according to the 2009 mathematics results, the single-sex female students scored better than single-sex male or coeducation students. This raises questions about the validity of their research.

Students might experience greater success with teachers trained in using differentiated teaching strategies specifically for students in single-sex settings. Such skills are necessary when working with male and female students in any learning setting, single-sex or coeducational. Gurian and Bellew (2003) stated that male students need more space to complete simple tasks and require more movement. The findings in 2008 on the mathematics subtests do support this research. The single-sex classes, male or female, performed significantly better on the entire 2008 mathematics subtests than the coeducation students.

Policy

According to Bracey (2006), school districts must ensure that the single-sex programs are equally funded. The school used in my study implemented the single-sex classes to increase student performance in a Title 1 school in reading and mathematics. The administration decided to evaluate the effectiveness of single-sex classrooms in the fifth grade level in the school. The findings of my study suggested that single-sex male female fifth grade classes could benefit in reading and mathematics. The 2008 data supported the single-sex classes in total reading and mathematics, and all reading, numeration and measurement subtests, for which all male classes performed better than coeducation classes. Conversely, the coeducation classes did not score significantly better than the single-sex classes.

The statistical data favor the single-sex classroom program for this school for the fifth grade level, according to the mean and standard deviation in chapter 4, 2008 CRCT scores. On the 2009 CRCT tests, there were no differences found in the data supporting the single-sex classrooms settings.

The findings of this study lend support to the research on single-sex education and suggest that schools continue to experiment with single-sex classroom instruction. This would provide instructional time for the students that would need additional help with their studies. The instructional time provided for single-sex and coeducational classrooms have to ensure that resources are equally distributed among the groups to guarantee equality among the students. Also, researchers should have the freedom to experiment with various methodologies, which would provide different prospects to the research.

Future Research

While the findings from this study clearly indicate that students enrolled in single-sex classrooms perform better than students in a coeducation classroom in the subject areas of reading and mathematics, further investigations still must be done. The findings were significant, but a broader study would add to the data to support the relevancy of the study.

A longitudinal study should be conducted that will follow a sample of students over an extended period of time using pre- and post-tests to measure learning trends. This study would provide the students' background information and academic history as well as the parents. A longitudinal study would provide an opportunity to try a randomized trial to comparing groups of students through their school careers. This may not give a clear answer concerning the effects of a single-sex classroom on reading and mathematics, but it will encourage researchers to continue the pursuit for more research-based information.

As the single-sex classroom continues to be discussed, researchers need a much larger database to study the reading and mathematics scores. Many states, as well as the federal government, maintain extensive databases of student personal and academic information that

should be readily available to educators. Accessibility to more accurate data will help to ensure comprehensive decisions that eliminate bias from evaluations. Although Lee and Bryk (1986) disagreed with the analysis, in general the existing data would afford additional discussion on the effects of single-sex classrooms in public schools.

A collection of mixed method studies involving quantitative and qualitative data should be used to determine whether single-sex classrooms affect student performance. This study however, used quantitative data, which did not develop a clear sense of the total makeup of the classes because of the missing social and affective aspects of the research. In addition, teachers' observations and interviews would provide more information on students learning styles. This information would be beneficial in order to provide a clearer understanding of the variables that affect experimental groups.

Harker (2000) found no major differences in the mathematics scores between single-sex classes and coeducation classes once the students' socioeconomic backgrounds and learning levels were introduced. Demers and Bennett (2007) concurred with Harker's findings. In my study, both the coeducation and single-sex classes came from similar background and economic status. In both single-sex classes, the male and female students scored higher on the mathematics section of the CRCT. I recommend also, a multiple regression analysis for the existing variables.

To be successful, teachers of single-sex classrooms need gender-related pedagogical training. As such, a study should look at allowing the teacher to evaluate the teaching strategies and review the students' learning styles for improvement for the next school year. In addition, a study should be done on the relationship between the teacher's sex and that of the class. Does it make a difference if the male or female class is taught by a male or female teacher? Research

should also assess students' attendance and discipline records. Finally, the students' socioeconomic and culture background could be considered. A particular interest is the effect of single-sex education for children from single-parent household.

Although this was a quantitative study, which assessed the students' test scores only, a mixed study using a quantitative and qualitative data should be completed. This would afford additional information that would provide a total assessment of the socio-economic status of the students, ethnicity, educational levels, and whether students come from single parent environments.

Summary

When considering single-sex classrooms, we must be certain that we understand every aspect of the student's educational background. Although there are pros and cons in every situation, the findings of this study indicate that the single-sex classroom is an essential element of educational success. Students who are enrolled in those classes tend to be more prepared in reading and mathematics. I can agree that additional research on the effectiveness of single-sex classrooms is necessary. Moreover, we all can agree that we need to construct an educational environment that meets the social and intellectual needs of males and females. As educators, our future population is in our hands, and we must ensure that all students are academically prepared by providing the best sound educational programs possible.

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