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A comparative analysis of single-sex schools in terms of achievement in reading and math and student attendance

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A COMPARATIVE ANALYSIS OF SINGLE-SEX SCHOOLS
IN TERMS OF
ACHIEVEMENT IN READING AND MATH AND STUDENT ATTENDANCE

DISSERTATION

SUBMITTED TO

The School of Education and Allied Professions

THE UNIVERSITY OF DAYTON

In Partial Fulfillment of the Requirements for

The Degree

Doctor of Philosophy in Educational Leadership

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THE UNIVERSITY OF DAYTON

DAYTON, OHIO

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2010

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By

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The University of Dayton, 2010

Thomas Lasley, Ph.D., Committee Chair

Single-sex education is a reform initiative that is taking root in the United States and in many countries around the world as a possible solution to closing the racial, achievement, and gender gaps that have emerged where minority students lag behind their White counterparts and boys are falling behind girls academically. Although there have been research studies performed at the middle and high school levels to investigate the efficacy of educating boys and girls separately, very little research has been conducted on the elementary school level.

Dayton Public Schools began the implementation of single-sex programs in August 2005. The impetus for creating single-sex programs stemmed from the declining achievement of minority students. The purpose of this study was to determine whether or not girls and boys in Dayton Public Schools achieved significantly better academically, had fewer discipline issues, and attended school more regularly in single-sex settings compared to students in coeducational settings.

Nine elementary schools provided the population for this study: 3 schools with single-sex programs and 6 schools with coeducational programming. The results of

state developed assessments in math and reading were used to evaluate improvements in academic achievement. Attendance percentages were compared by school type and the number of discipline infractions per school was reviewed. The paired-samples t test and the independent-samples t test were the statistical analyses used to measure improvement in math and reading and to compare improvement across groups.

The findings of this study were mixed as evidenced by the fact that in the area of academic achievement there were some statistically significant results that favored the single-sex setting in some areas, some that favored the coed setting and some that showed no difference. In the areas of behavior and attendance the single-sex setting appeared to have a positive influence and since these areas are related to enhanced achievement it would be advantageous to continue to explore the single-sex option for students.

Single-sex education is an innovative reform model that still needs refinement and research. It is an initiative that requires thoughtful long-term planning, collaboration and stakeholder support.

To my family, friends, and colleagues who have supported and encouraged me
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CHAPTER I

INTRODUCTION

Rationale

According to Duke (2004), "No public idea has influenced more educational change over the past 50 years than equality of educational opportunity and the related notion of educational equity" (p. 40). This idea has been supported during the past century with various court decisions, provisions, and legislation including *Brown v. Board of Education of Topeka* (Kansas) in 1954; the Civil Rights Act of 1964, which included provisions to compel school districts to desegregate; the passage in 1965 of the Elementary and Secondary Education Act (ESEA), which provided funds to educate disadvantaged students; the reauthorization of ESEA in 1994 (called the Improving America's Schools Acts), which continued to serve disadvantaged students; another reauthorization of ESEA in 1999 (called the Educational Excellence for All Children Act), which shifted focus from remediation to meeting the challenge of implementing standards across every state in the United States; and the No Child Left Behind Act (NCLB) of 2001, which provided for comprehensive reauthorization of the ESEA of 1965 incorporating proposals in such areas as early reading, accountability, testing, and parental choice. The changes in law moved education in the United States towards a more equitable system.

Although initial attempts to improve equality of educational opportunity were focused on African American and poor students, court decisions in the 1970s began to target female students, non-English-speaking students, and students with disabilities who did not enjoy all the benefits of a public education. Perhaps one of the most

significant pieces of legislation passed by Congress was the Title IX Education Amendments Act of 1972. This legislation states that:

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, p. 42; Sadker & Sadker, 1994, p. 463)

Title IX led to school systems re-examining access to what were considered to be traditionally all-male courses and programs. Guidance counselors had to review how they advised female students regarding career options. Sex-role stereotyping came under increased scrutiny.

Educational equity is scaffolded by research. With the advent of NCLB in 2002, all programs implemented by school districts must be grounded in current and scientifically based, relevant research. Examining gender equity through a research lens yields information that can change schooling practices. In order to provide boys and girls with equitable educational opportunities, it is necessary to accept and understand the differences in how they learn and to become more aware that one size does not fit all. Acquainting oneself with gender research that is currently available is a first step in determining the direction additional research should take. Gender equity does not mean providing both sexes with exactly the same things. Gender equity prescribes providing both sexes with what they need in order to achieve success (Salomone, 2006). Looking through a research lens will clarify for educators the unique needs of both sexes.

Much of the educational discussion during the latter part of the 20th century dealt with equity issues centered on a racial achievement gap that exists between White students and minority students, as well as, a gap between economically disadvantaged students and their more affluent counterparts (typically those students in suburban contexts). The racial gap is not the only one evidenced in schools. Also evident is a gender gap (Gurian, 2006; King & Gurian, 2006). As we moved into the 21st century the concern shifted to the widening gulf in schools that indicates that girls are either outperforming boys or catching up with them in every academic area (Kafer, 2007; Sommers, 2000a; Warrington & Younger, 2000).

Girls surpass boys in the areas of reading, writing, civics, and the arts. They also receive better grades, are more engaged in the learning process and are more likely to graduate from high school and college. On the other hand, boys are more frequently in trouble. They are suspended and expelled more often than girls, and are enrolled in special education programs more frequently. Boys are incarcerated more often than girls and they have problems with smoking, drinking, and drugs. Although the gap between girls and boys spans every ethnic, racial, and socioeconomic group, African American males lag further behind academically than any other group (Davis, 2003).

According to the National Center for Education Statistics (NCES), which is part of the United States Department of Education, girls at the fourth grade level outperform boys in reading; 12th grade girls are catching up to boys in mathematics; girls dominate in extracurricular activities such as student government, music/performing arts, and academic clubs. Additionally, the Centers for Disease

Control and Prevention have found that boys are diagnosed with learning disabilities more often than girls; boys are also more likely to commit suicide.

Given that the achievement gap is widening between boys and girls in many curriculum areas, educators want to know why there is a gender reversal and boys are being characterized as the "second sex," "the failing sex," "lost," and experiencing "interminable decline" (Gunzelmann & Connell, 2006; Warrington & Younger, 2000) in the educational setting. The answer may lie in the literature on brain-based research. The literature advances the theory that there are brain-based differences between boys and girls and consequently they learn differently (Gunzelmann & Connell, 2006; Gurian, 2006; Sax, 2005). Gurian and Henley (2001) assert:

A primary area of concern for nearly every teacher is the differences we each intuit in the males and females we teach. We all know that there is immense overlap between the genders, and that each child is an inherently sacrosanct individual not to be limited by a gender stereotype, but we also know that *boys and girls learn differently right before our eyes.* (p. 9)

Based on Gurian's (2006) statement one might conclude that if boys and girls learn differently, then perhaps they should be taught differently. This idea references not what the content of teaching should be, but how the content needs to be delivered differently to boys and girls and in what settings.

Although boys and girls are clearly different in some ways, educators, and teachers in particular, simply do not have extensive knowledge about the hard-wired brain gender differences that are present, as well as, the social, physiological, and emotional differences that many claim exist between boys and girls (Sax, 2005).

Teachers do not know or seem to understand the differences in the way boys and girls need to be taught. 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. For example, Dunn (1992, 1999, 2001) found that boys develop gross motor skills early in life. They are non-conformists who need opportunities for mobility and informal classroom design. She posits that boys are peer oriented, anti-authoritarian, and are more tactual/visual/kinesthetic than females. Dunn also found that boys are global learners who prefer soft light, enjoy snacking while learning, and like to multi-task. Girls, on the other hand, develop small motor skills before gross motor skills. They are more verbal than boys and they can remember what they hear during a 40-50 minute lesson. Females are more academically motivated, persistent, self or authority oriented and auditory. Females tend to remember best and males tend to remember least by listening. More females than males remember well by talking or reading. Males remember best by being actively involved with a hands-on approach.

Statement of the Problem

Much of the research that examines the differences in how girls and boys learn deals with gender equity issues (Abu El-Haj, 2003; Bracey, 2006; Spencer, Porche, & Tolman, 2003). The unequal status of females in society, sex roles, socialization of males and females, cultural mores, and parent attitudes toward daughters and sons is also explained in the research (Froschl & Sprung, 2005; Kruse, 1996; Tiedemann, 2002). In fact, the literature depicts boys as being favored in the coeducational setting (Kruse, 1996; Sadker & Sadker, 1994). Girls are portrayed as feeling worthless and

neglected in the coeducational setting because much of the teaching time and resources are made available to and directed toward boys. Teacher perceptions and beliefs about the academic strengths and weaknesses of their female and male students have also been the focus of many studies (Evans, 1998; Tiedemann, 2002).

Although there have been multiple theories about the efficacy of boys going to school with only boys and girls going to school with only girls, in actuality there is a dearth of research grounding such practice (Lee & Bryk, 1986; Sadker & Zittleman, 2004; Salomone, 2006) vis-a-vis the effectiveness of single-sex education in public schools. According to Bracey (2006), single-sex schools primarily existed in the private sector sponsored by churches and independent organizations. Because there are few public sector single-sex schools and because in the United States they are relatively new, their effectiveness has not been studied to any great extent; in essence, there has been very little time to conduct research (Bracey, 2006).

On November 24, 2006, the United States Department of Education revised the Title IX regulations to make it easier for school systems to implement single-sex education programs under certain conditions. Previously Title IX prohibited the development of single-sex schools and programs due to concerns that boys and girls would not be treated equitably. In fact, the American Civil Liberties Union (ACLU) prevented single-sex classrooms from being offered and won a number of lawsuits under the premise that students in this setting received separate and unequal treatment.

With the revision of Title IX the number of single-sex schools and academies has increased in the public sector during the early part of the 21st century. This change

creates a need to find out if single-sex settings are really beneficial to students, in what ways, and to what extent they foster desired outcomes.

If educators are to improve the academic achievement of boys and girls and begin to close the gap between them, they need to know the brain-based similarities and differences between boys and girls; understand how they learn; learn how to create environments that support both boys and girls; and identify the factors impacting the achievement of both sexes.

Purpose of Study

Studies exist that examine teacher biases and student-teacher interactions that affect teacher perceptions about the competence of male and female students (e.g., Evans, 1998; Tiedemann, 2002). Gender differences in the area of mathematics have also been explored by some researchers (e.g., Abu El-Haj, 2003; Lummis & Stevenson, 1990). Hard-wired brain differences are used by some researchers (Gurian, 2006; Sax, 2005) to explain why boys and girls need to be taught in single-sex environments. Many of the studies that look at gender equity, gender differences, and single-sex education concentrate on students at the high school level and their teachers. Very little research has been conducted that examines how single-sex settings in the public sector affect the academic achievement of elementary school girls and boys (Mael, Alonso, Gibson, Rogers, & Smith, 2005). Even less research has been conducted that examines the educational experiences and outcomes of African American boys in the early grades (Davis, 2003). In essence, there is a need to increase the body of research in this area. The results of inquiry into this area of single-sex education can be used to develop teacher education courses, create

school/classroom environments that meet the unique strengths and needs of boys and girls, close the achievement gap that exists between boys and girls, and improve the academic achievement across curriculum areas for both sexes.

In addition to the wider regional and national interest in sex-based education, there is also a personal dimension. Specifically, the researcher was responsible for creating two single-sex public schools and supporting the conversion of a coeducational elementary school into single-sex classrooms in Dayton, Ohio. In August 2005, the doors of Charity Adams Earley Academy for Girls (CAEAG) opened with Grades kindergarten through 2. In 2006 Grade 3 was added and in 2007 Grade 4 was added. In August 2006 the Dayton Boys Prep Academy (DBPA) was opened with Grades pre-kindergarten to Grade 3. Grade 4 was added in 2007. Grade 5 was added to both the girls and boys schools in 2008 and currently (2009) both schools have added Grade 6. The plan for both schools is to continue adding grades until they extend to Grade 8 by 2011.

In 2005, the principal at Edison Elementary made the decision to move towards a single-sex classroom configuration because of the poor academic performance of the students in the school. After attending a training session on single-sex education that included the founder of the National Association for Single Sex Public Education (NASSPE; and author of *Why Gender Matters*), Leonard Sax, and the author of *Girls Will Be Girls*, Joanne Deaks, the principal met with the researcher to discuss moving her school towards a single-sex concept as a reform model to improve the performance of the students at Edison.

Although the researcher visited a girls school and a boys school in Toledo, Ohio, worked with consultants who had visited different public single-sex schools across the country; met with external consultants, read many articles and some books about single-sex education, the researcher discovered no definitive findings as evidenced in the literature relative to whether single-sex education makes a difference in the academic achievement of the students. The newness of the "single gender" concept in the public sector is part of the reason that research is not readily available. Although some conclusions may be drawn from private sector single-sex schools, especially in an urban setting, various factors can influence the conclusions that can be drawn about student academic performance.

The informal observations the researcher made in single-sex based settings, the focus groups that the researcher conducted, and the teacher surveys that the researcher disseminated during the inception of the single-sex concept in Dayton led the researcher to believe that students in single-sex settings would improve their performance in math and reading, increase their attendance and reduce their discipline infractions, especially those students attending schools in urban communities.

The purpose of this study was to determine whether or not girls and boys achieve better academically, have fewer discipline issues and attend school more regularly in single-sex settings than students in coeducational settings. This study will focus on the following objectives:

1. To compare the academic achievement, discipline and attendance of boys and girls in single-sex classrooms with girls and boys in coeducational classrooms to determine if there is a significant difference.

2. To determine if a particular sex achieves significantly better, has fewer discipline issues and attends school more regularly in a single-sex setting.

Research Questions

Three research questions are addressed in this study:

1. Is the academic achievement (reading and mathematics) of students, by gender, significantly different in schools with single-sex settings compared to coeducational schools?
2. Is the attendance of students, by gender, significantly different in schools with single-sex settings compared to coeducational schools?
3. Is the discipline of students, by gender, significantly different in schools with single-sex settings compared to coeducational schools?

Definition of Terms

Coeducational settings are settings where both girls and boys attend school together.

Gender-atypical children are those whose gender-specific behaviors are

different from the norm. For example, boys who are shy and prefer classrooms that are quiet with less activity or girls who are outgoing and rambunctious and do not like quiet classroom settings.

Gender-specific teaching are those strategies that teachers employ to take advantage of the differences in the ways boys and girls learn. For example, boys prefer activities that involve teamwork and competition, while girls prefer cooperative learning activities.

Hardwired brain differences are the innate brain differences that are present at birth

because various areas of the brain develop in a different order, time, and rate in girls compared to boys. For example, the areas of the brain involved in language development and fine-motor skills mature 4 years earlier in girls than in boys.

High performing schools are those schools that are rated by the Ohio Department of Education as being "Effective" or "Excellent."

Low performing schools are those schools that are rated by the Ohio Department of Education as being in "Academic Emergency" or "Academic Watch."

Single-sex education refers to educating males and females at the elementary, secondary, and postsecondary levels in separate settings. Single-sex schools admit boys or girls exclusively.

Student motivation has to do with a student's desire to participate in the learning process. It is a drive to do something in order to achieve something.

Limitations

The first limitation of this study is the sample size. The sample size is relatively small because only students in Grades 3 and 4 in schools and classrooms that are single-sex will be compared to 6 coeducational schools. The small *N* mitigates generalizing the findings to other populations if comparisons are made beyond schools in Dayton. Additionally, single-sex schools and classrooms tend to be smaller in size than coeducational schools and classrooms. This size differential could affect the findings.

A second limitation of this study is that students cannot be assigned to groups randomly (Salomone, 2006). Legally students could not be assigned to single-sex

schools other than voluntarily. "Scientifically based" research requires the use of randomized trials and experimental design. Such methods were not feasible when gathering data in existing schools that represent student and family "choice" educational environments. This condition also makes it difficult to identify comparison schools with identical demographics.

The fact that single-sex schools in Dayton are a choice option for parents, one might assume that the parents of students in "choice" schools are more involved with the education of their children than parents who did not exercise the choice. This "choice" condition could have a positive effect on student achievement. That is, it may be the "choice" and not the school structure that really makes or creates performance differences, should they surface.

Third, comparing assessment scores from the pre-tests, Ohio's Assessment System Grade 3 and 4 Reading Practice Tests; Ohio Assessment System Grade 3 and 4 Mathematics Practice Tests, and post-tests, Ohio's Achievement Tests Grade 3 and 4, March 2005 Previously Released Reading Tests; Ohio's Achievement Tests Grade 3, March 2005, Previously Released Mathematics Test; and Ohio Achievement Tests Grade 4, March 2006, Previously Released Mathematics Test (see Appendix), to measure student academic achievement may be a limitation since there are many factors that can impact student performance on standardized assessments. These factors include: student test anxiety, quality of teaching, comprehensiveness of test preparation strategies, testing conditions, the seriousness with which students approach the test and physical limitations that students may have.

Fourth, the researcher's personal investment associated with creating single-sex schools may be a limitation. That is, the researcher was instrumental in creating single-sex schools in Dayton and this factor may have tacitly influenced the data collection and data analysis process.

Fifth, discipline data were not collected at the student level so data are reported at the school level; as a result, given the small number of schools, statistical analyses could not be performed.

The sixth possible limitation was twofold because dual factors prevented the researcher from accurately measuring the impact of single-sex grouping on the population being studied. The first factor was that the data were not available to show the levels of achievement, discipline referrals or attendance of the participants prior to participating in the single-sex program. The unknown factors were whether students were high achieving or low achieving, whether or not they had discipline issues or whether they attended school regularly before the treatment of single-sex grouping was applied. The second factor was that there may have been an uneven implementation of the single-sex model. Teachers may not have changed their teaching practices to adjust to the gender differences that existed in their classrooms.

Finally, the conclusions of the statistical analyses must be made with caution because of increased risk of Type I error which is when you reject the null hypothesis when it is true. When testing many hypotheses with the same data set, there is a risk of elevating the Type I error (i.e., the risk of rejecting a null hypothesis when it isn't appropriate). The hypotheses testing results were interpreted without correcting the significance level due to the use of multiple tests.

Assumptions

There are several assumptions that must be considered. First, the researcher assumes that students in separate educational facilities within the same school district are receiving equitable educational opportunities because the school district has common curricula, instructional frameworks, pacing guides, and assessments. There are also professional development opportunities that are mandated district-wide, as well as, a requirement to offer 120 minutes of literacy instruction and 60 minutes of mathematics instruction every day.

Secondly, the researcher assumes that the assessment instruments used to determine the level of achievement of the students in both the single-sex and coeducational settings are reliable and valid. Reliability relates to the reproducibility of results and validity refers to the extent to which the assessments measure what they are intended to measure.

Finally, the researcher assumes that a single-sex configuration is a school reform model worthy of experimentation and that reading and mathematics scores, as well as, attendance and discipline referrals are legitimate measures of the reform's effectiveness. Findings from research (Fjortoft, 2005; van der Westhuizen, Oosthuizen, & Wolhuter, 2008; Winbinger, Katsiyannis, & Archwamety, 2000) indicate a strong correlation between attendance and discipline as factors affecting school effectiveness.

The Study

There has been limited research conducted regarding the efficacy of educating boys and girls separately at the middle and high school levels. Very few research

studies have examined single-sex schooling at the elementary school level. The increase in the number of single-sex schools and single-sex classrooms is grounded in the national effort to close both the racial and gender achievement gap that has been documented in the literature.

Historically, boys have been regarded as receiving preferential treatment in the classroom setting (Kruse, 1996) and as a result of this focus on boys, girls were believed to be neglected. To ensure equity for girls, all-girl schools seemed a viable remedy. With the advent of NCLB, educators, politicians and others began to examine achievement data for various sub-groups of students. This scrutiny made evident the emergence of an achievement gap with males being identified as performing poorly in the core academic areas as compared to their female counterparts. Girls outperformed boys in almost all areas. African American boys, in particular, lagged behind both their female and White male counterparts in every academic area.

Fueled by NCLB's call for accountability to educate all students, school systems sought a remedy for the poor performance of males in general, African American males in particular, and students living in poverty who also performed poorly. Single-sex programs were identified as a possible solution to close the achievement gap and to improve academic performance for all students.

As students matriculated into middle and high school the gap in academic performance widened; therefore, many single-sex programs took root at these levels. Few single-sex programs were initiated at the elementary school level. Although this study is an evaluation of a single-sex program in a medium size, urban school district,

it may fill the research gap that exists in determining if a single-sex structure that begins at the early stages of students' education can make a positive difference in their academic performance, thus, closing or eliminating an achievement gap.

CHAPTER II

Review of Related Research and Literature

Due to the increase in the number of single-sex programs, classes, and schools that are being implemented in the United States and in countries around the world (Kruse, 1996) and in response to the widening gender gap that exists between students of color and their White counterparts and between girls and boys, educators, policymakers and researchers question if single-sex education is a viable, alternative, academic reform that can address the issues of poor academic achievement. This research study responded to this query and determined whether there are significant educational benefits for boys and girls who attend single-sex programs compared to boys and girls who attend coeducational programs.

Single-sex education is an educational reform initiative fueled by the racial achievement gap and the gender achievement gap that exists where boys are becoming the "second sex" (Gunzelmann & Connell, 2006). In a move to improve the educational outcomes for both girls and boys, single-sex education has emerged as a possible solution to close the gap.

There has not been extensive research studies conducted on the efficacy of single-sex education (Lee & Bryk, 1986; Sadker & Zittleman, 2004; Salomone, 2006). The research conducted thus far does not indicate conclusively that single-sex schooling fosters better achievement results than coeducational schooling (Mael, Alonso, Gibson, Rogers, & Smith, 2005; Bracey, 2006). The lack of research on single-sex education is especially evident at the elementary school level. This review of literature examined single-sex education from a historical, legal, and gender equity

perspective. The other areas that are included in the discussion are: the gender gap and student achievement; single-sex versus coeducational programs; brain-based and cognitive gender differences; effects of single-sex education on attendance in school; and effects of single-sex education on behavior. These areas are organized in the conceptual map in Figure 1.

History, the Law, and Gender Equity

There has been a long history of educational initiatives that ensure that education is made available to all segments of society. In the United States, during the 19th century, single-sex schools were the primary source of formal education (Bracey, 2006). Initially girls did not attend school; they were educated, for the most part, at home. When girls began to attend schools in the 1800s they typically attended all girls' institutions. Due to the need to experience economy of scale, communities began to merge schools so that both sexes attended school together. These coeducational institutions were called "common" schools (Bracey, 2006).

Willis, Schubert, Bullough, Kridel, and Holton (1994) state that the common school movement, headed by Henry Barnard and Horace Mann during the 19th century was, "an effort to democratize American education by making the same kind of schooling available to all. No longer would differences in wealth or social status be abetted by differences in the amount, kind, or quality of schooling available" (p. 39). In addition to the economic benefits of coeducational schools, there was a belief that boys' behavior would improve in the presence of girls.

The notion of the common school for the common man was a hard fought battle in the 19th century (Sadker & Sadker, 1994). Horace Mann saw the common school

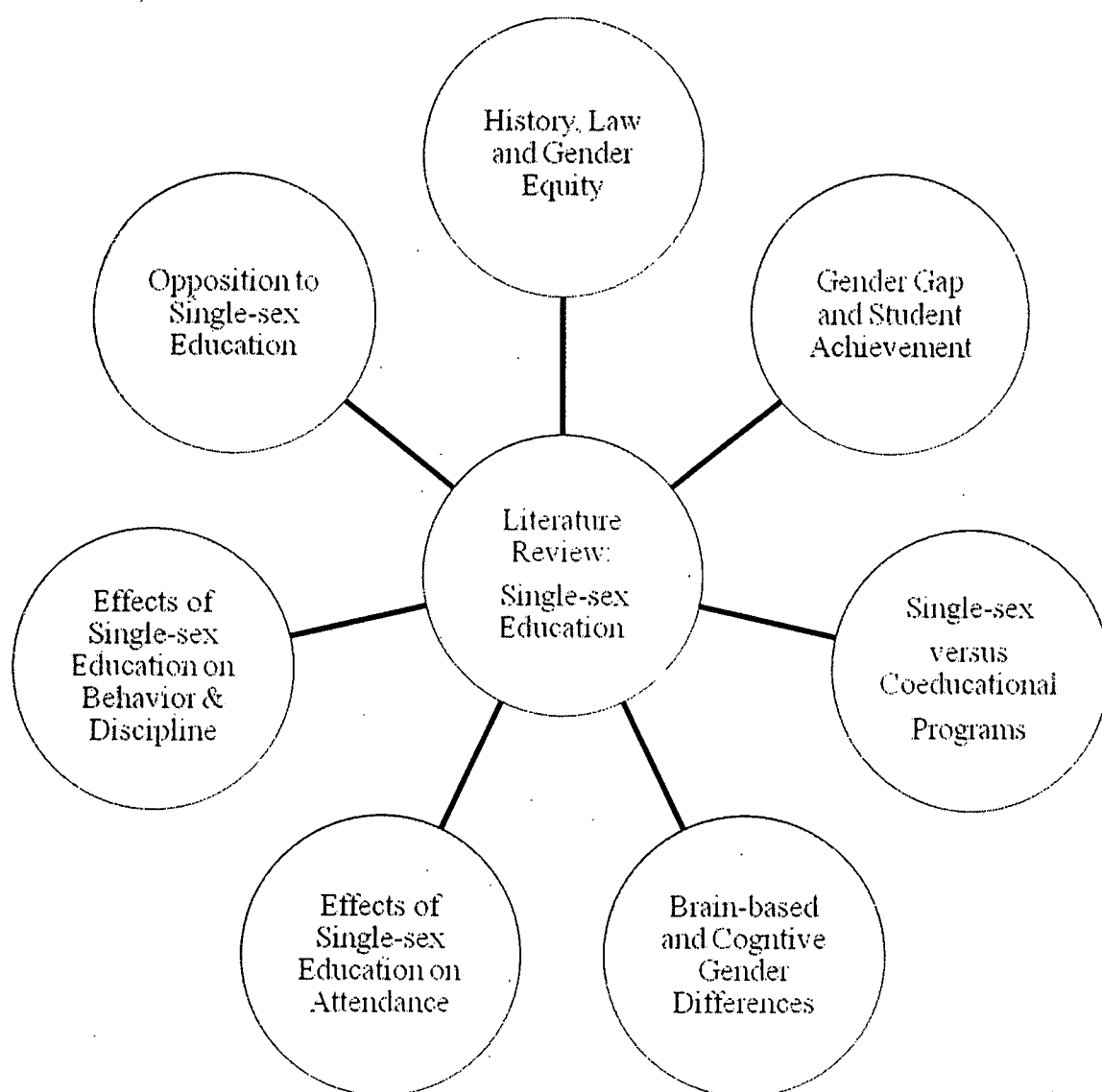


Figure 1. Conceptual Map of the Review of Literature

as a necessity in order to have an educated citizenry which equated to a productive economy.

According to Meyer (2008) single-sex schools were initially established for boys; girls were an afterthought. The girls' schools that did exist were "finishing" schools which were private schools that emphasized training in social and cultural activities. Finishing schools were intended to complete the educational experience for girls once their basic education was completed. Girls were not being prepared for higher education but rather for a wide variety of social situations with a focus on being a good wife and mother.

With the advent of common schools, single-sex schools were all but eliminated in the public sector and existed only in the private sector (Bracey, 2006; Sadker & Sadker, 1994). However, the exception to the move to coeducational schools was in the large urban centers of New York, Boston, Buffalo, Baltimore, Philadelphia, and a few cities in the South (Brown & Russo, 1999).

Several educational reforms were introduced after the advent of common schools; namely, the secondary school movement which led to the development of the high school. Following the inception of high schools came the development of junior high schools in 1910 and middle schools in the 1950s.

Supreme Court decisions and legislation at the federal and state levels led to many changes in the education landscape. In *Brown v. Board of Education of Topeka* 1954, the Supreme Court led the first attempt to desegregate schools in the 1950s and 1960s. In 1964 the Civil Rights Act was passed which prohibited schools that practiced race discrimination from receiving federal funds. Another groundbreaking

legislation was the 1975 passage of Public Law 94-142, Education for All Handicapped Children Act, which increased the public's responsibility for educating students with handicapping conditions.

The 20th century increased federal support for the educational rights of the disenfranchised, the poor, minorities, handicapped, and females. Title IX legislation in 1973 prohibited sex discrimination in schools and ensured enhanced equity for females.

Title IX made it illegal to create single-sex schools and classrooms in the public sector. This legislation was the first comprehensive federal law that promoted gender equity and prohibited sex discrimination against students and employees of educational institutions. Title IX provides for the fair and equal treatment of males and females in all areas of public schooling including: recruitment, admissions, educational programs and activities, course offerings, counseling, financial aid, scholarships, sexual harassment, and athletics. This law is sometimes referred to as the "Brown v. Board" for gender (Bracey, 2006), comparing this legislation to the 1954 Supreme Court Brown decision that held that race-segregated schools were inherently unequal.

Title IX not only contributed to the closing of single-sex schools, it also allowed females to attend all-male selective schools, academies, and military programs (Brown & Russo, 1999). Private schools were not governed by Title IX, nevertheless many of these schools reorganized as coeducational institutions.

The movement away from single-sex schools continued during the 1960s and 1970s, especially at the secondary and post-secondary levels for both social and

economic reasons (Lee & Bryk, 1986). During the 1960s and 1970s the civil rights and feminist movements created a platform for equality and access that led to the further demise of single sex institutions. Economics also played a part in the end to single-sex schools. Opening the doors of schools that struggled financially to both sexes helped those schools become economically sound.

Socially, single-sex programs were seen as barriers to male and female socialization. Also, coeducational institutions were viewed as being more appropriate, liberating and enlightened (Meyer, 2008). This movement lasted for 30 years prohibiting school systems from separating boys and girls during the school day or for any part of the school day (Salomone, 2006).

In 2001 Congress passed a law legalizing single-sex schools. Specific regulations governing how school systems should proceed under the new law were not identified at that time. As part of NCLB, funding was made available for innovative programs that included same sex schools and classrooms. This move was seen as an effort to advance district reform initiatives in order to close the achievement gap. In March 2004, the federal Department of Education issued regulations that made it possible for public school districts and charter schools to establish single-sex classrooms and schools (Salomone, 2006).

Given the loosening of the legal restraints that prohibited the creation of single-sex programs, there has been a renewed interest in this not-so-new phenomenon. School districts around the country began planning and implementing single-sex initiatives. As of May 2009, at least 542 public schools in the United States evidence some type of single-sex program. The majority of these schools are coeducational but

offering single-sex classrooms. Of the 542 schools at least 95 of them have all-boy or all-girl settings and all school activities, including lunch and electives, are single-sex. For example, in New York City there are currently 13 single-sex schools including the Young Women's Leadership School established in 1996 as the first single-sex school in the New York City Public School system. Additionally, two other New York City single-sex schools are notable in that they were established at the elementary school level which is unusual since most single-sex schools are established at the middle or high school levels. The Excellence Charter School of Bedford Stuyvesant, an all-boys school, established in 2006, currently enrolls boys in Grades kindergarten through Grade 3 with plans to expand to Grade 8. Girls Prep located on the lower east side of Manhattan, is a single-sex charter elementary school which opened in 2005 with Grades kindergarten through Grade 3 which will expand to Grade 5.

The creation of single-sex classes and schools has those concerned about gender equity issues worried about the relaxed regulations of Title IX. The belief is that single-sex schooling can reinforce sex stereotypes, implicitly suggesting that girls are inherently deficient in certain academic areas (Salomone, 2006). Gender equity fuels the debate about whether or not there are fundamental differences between females and males (Abu El-Haj, 2003).

The mathematics classroom is often the arena where equity issues abound (Abu El-Haj, 2003; Ping & Weiling, 2002). Ping and Weiling (2002) found in their analysis of elementary school mathematics materials that girls were in an inferior position compared to boys in terms of how teachers interacted with each sex during

mathematics instruction. These researchers found that teachers interacted more with boys than girls and preferred teaching boys. Teachers felt that interaction with boys was emotionally more stimulating than girls. Girls were more bashful and reticent to participate and therefore teachers reciprocated by not engaging in effective interactions that could improve the acquisition of knowledge for girls.

Female high school students do not fare much better than their elementary school counterparts because they experience classrooms that are not responsive to their learning styles or values. For example, females at the City Academy, a coeducational independent school located in St. Louis, Missouri, identified cooperative learning, peer mentoring and connected knowledge as preferable modes of mathematics knowledge acquisition (Abu El-Haj, 2003). This is in direct opposition to what male students identified as preferable modes of learning which included: competition, individualism, and decontextualized approaches to knowledge. In essence, female students did not benefit from instruction that was "boy focused"; the case could also be made that boys were impacted with programming that did not accommodate their unique learning needs.

Even though girls are outperforming boys (Kleinfeld, 1998; Warrington & Younger, 2000) across many curriculum areas, girls are still marginalized in the classroom by teachers who are more responsive to boys and by a curriculum that reinforces male notions of science and mathematics content (Bracey, 2006; Warrington & Younger, 2000). Findings in a report commissioned in 1998 by the American Association of University Women (AAUW) supported the notion that girls were at a disadvantage in the public school setting simply because they are girls. The

landmark AAUW report entitled, *How Schools Shortchange Girls*, was quite controversial and in some circles still is because it asserted that girls in Grades K-12 receive an inferior education compared to boys. The report also revealed that boys receive more attention in the classroom than girls. Another finding was that African American girls were more likely than White girls to be rebuffed by their teachers. Overall, girls were found to be subjected to gender bias, which, in turn, undermined their self-esteem and deterred them from considering non-traditional courses of study (e.g., math, science, and engineering).

More specifically, the AAUW report indicated several ways in which girls were disadvantaged: girls do not receive as much attention in class as boys; African American girls have fewer interactions with their teachers than do their White counterparts, and the instances of girls being sexually harassed by boys was increasing. The report also suggested that activities in the classroom are often centered on the interests of boys, and that boys emerge from the school setting with more confidence and self-esteem than girls.

Kleinfeld (1998) refuted the findings of the AAUW report. She strongly suggested that girls were not shortchanged and, in fact, were doing much better than their male counterparts in the areas of standardized test scores, class rank, attainment of advanced degrees, and reading achievement and writing skills. She asserted that boys fall behind girls in many areas of their schooling; however, she confirmed that a gender gap in achievement in the areas of mathematics and science existed, with girls not keeping pace with their male counterparts.

Sommers (2000b) also cited findings that disputed the AAUW report. She suggested that feminists invented a crisis in girls' education. She examined patterns of male underachievement in reading, writing and extracurricular activities and found that girls were thriving and boys were failing.

In the 1970s, 1980s and even in the 1990s gender equity literature focused on issues confronting girls. These issues often dealt with how girls are disadvantaged by the way in which schools structure career opportunities and subject area choices along masculine lines. In recent years the discussion of gender equity has transcended from equality for girls and women to one in which there has been a "boy turn" where underachieving boys are the focus of the research (Warrington & Younger, 2000; Wiens, 2006; Younger & Warrington, 2006) and where they are the disenfranchised group.

Gender equity discourse is fraught with dissenting and conflicting opinions. The examination of gender equity issues requires further research to determine whether a gender gap in academic achievement truly exists between boys and girls. If a gap exists, what defines it and how can the gap between girls and boys be closed? And, especially for the purposes of this study: Can single-sex schooling close the gap?

The Gender Gap and Achievement

During the latter part of the 20th century educators have been consumed with how to close the racial achievement gap that exists between White students and minority students, as well as, a gap between economically disadvantaged students (often in urban areas) and their more affluent counterparts (typically in suburban contexts). Depending on the researcher or study that is examined, this gap is

characterized as, either boys outperforming girls because schools are boy centered (Ping & Weiling, 2002; Tindall & Hamil, 2004) or girls outperforming boys because the gender equity debate has focused on them for some time (Burgess, McConnell, Propper, & Wilson, 2004; Warrington, Younger, & Williams, 2000; Wiens, 2006). This gap between girls and boys spans every ethnic, racial, and socioeconomic group.

The gender gap is not confined to the United States. Research conducted in England (Machin & McNally, 2005) found that the gender gap was apparent at earlier stages of schooling, as well as at later stages of a student's education. Machin and McNally examined how gender gaps evolved over time and the contexts in which they developed. Findings from their study where test results from a national assessment administered at the end of compulsory education were analyzed indicated that girls fared better than boys. Findings also showed that the average performance of girls, especially in English, exceeded that of boys at all levels of education, with the gaps widening over time.

Currently, the media, as well as researchers, focus on the gap that has girls outperforming boys. They report that boys are slipping behind girls in almost every area (Connell & Gunzelmann, 2004; Wiens, 2006). This discrepancy between the achievement of boys and girls has been explained by societal expectations, stereotypes, nature versus nurture, racism, and brain-based differences.

Wiens (2006) cites several research studies that quantify this gap between the achievement of girls and boys. She indicates that girls spend more time doing homework than boys and the gap increases as they move up in grade levels. Homework is an indicator that boys are not engaged in the learning process. Sax

(2005) concurs with this finding stating that girls are more likely to complete homework assignments even when they are not interested because they want to please the teacher. Boys are less likely to do homework unless the assignment is of interest to them. They only ask for assistance from teachers as a last option.

Some researchers assert that boys are 2 years behind girls in reading and writing when they enter kindergarten (Wiens, 2006). In the United States, boys are four times more likely to be diagnosed with attention deficit/hyperactivity disorder. Also, three out of four students receiving special education services are boys.

Froschl and Sprung (2005) had similar findings to those of Wiens (2006) but their focus was on African American boys because they suffer from the problems Wiens identified at a higher rate than their peers. In a report they compiled for the Educational Equity Center (EEC) at the Academy for Educational Development (AED) they found that African American boys lagged behind their female counterparts in both reading and writing. African American boys are more often labeled as having attention deficit disorder, learning disabilities, and social and emotional disturbances. They are more likely than girls to be suspended or expelled from school early in their education careers. The report provides more staggering statistics about African American boys that further characterize the "boy crisis." The authors note that although African American boys make up only 8.6% of national public school enrollments, 20% of them are classified as mentally retarded, 21% are labeled as emotionally disturbed, 22% are expelled from school, and 23% are suspended from school.

Although it is thought that teachers in classroom situations interact with boys more than girls and that they prefer teaching boys, the reality appears to change when the boys are African American and they move out of the early grades of schooling where they are on similar footing with girls (Borders, 2006; Davis, 2003). In the early childhood grades African American boys like their teachers, are engaged in the learning process and are achievement oriented. When these same boys enter the late elementary years there is a downturn, termed by Noguera (2003) as the "fourth grade syndrome." This is a period of time when young males assert their masculinity, as well as their readiness for conflict. This change in attitude evokes in teachers a sense of fear and tension which then leads to a mismatch between African American males and their White female teachers.

Even though African American boys exhibit attitudinal changes as they proceed through school they are still desirous of relational attachments with their teachers. The development of these relationships is often thwarted because these boys anticipate how people will react to them based on previous experiences that say that they do not fit in. Boys begin to feel isolated from their environments, their teachers, and their classmates. They disconnect emotionally and disengage from the learning process.

Girls experience more success in school than boys for a number of reasons. Girls experience greater facility in the area of language, excelling in both reading and writing, especially at the primary level (Ready, LoGerfo, Burkam, & Lee, 2005; Kafer, 2007; Sommers, 2000b). Reading and writing are foundational to all learning and instructional activities. Another aspect of girls' achievement in literacy and

boys' underachievement are the subtle messages that their mothers send, which include reading is for girls and play is for boys (Froschl & Sprung, 2005). Mothers tend to have higher expectations for their daughters than their sons in reading tasks. Boys take these subtle messages and internalize the idea that reading is for girls.

Machin and McNally (2005) also cite research that supports the notion that girls outperform boys academically. They characterize boys as getting bored easily, their levels of concentration are lower and their organizational skills are poorer than girls. They also provide evidence that boys have difficulty paying attention in class, working with others, keeping track of homework and class materials or asking for assistance. It is also suggested that socio-economic status has a notable effect on the performance of boys. Poverty further disadvantages boys in the academic setting more than their female counterparts.

Understanding the underachievement of boys requires an examination of the cultural settings of schools and the society in which they operate (Warrington, Younger, & McLellan, 2003). Boys bring to school a notion of masculinity that might be in direct opposition to the expectations that are valued in the school setting. Being smart or excelling in school is not perceived as being "cool" especially in the urban setting among economically disadvantaged youth. Conforming to macho expectations that place little value on authority, achievement, or academic work is the rule rather than the exception. Being a good student is in conflict with boys developing their masculine identities. Masculinity for some boys means impressing others, challenging authority and maintaining their superior status. Further, they may

pretend to be disinterested in school or not involved in their school work in order to maintain their masculine superiority.

Feminization of the school culture is in direct opposition to how boys learn and interact socially. Boys tend to be competitive and operate based more on an ethos of individuality. Typical experiences in the primary school setting are collaborative and codependent. This "context contradiction" may explain the underachievement of boys. Further, boys are enculturated to believe that learning is autonomous and the only guidance they should have is from the teacher while girls are more likely to seek assistance and offer help to one another (Daniels, Creese, Hey, Leonard, & Smith, 2001). The emergent masculinity of boys prompts them to bid for attention from the teacher in very different ways than girls. This bid for attention if left unsatisfied can result in disruptive behavior. In sharp contrast, girls will depend on their peers for academic support.

Brain-Based and Cognitive Gender Differences

As early as the late 1800s, French neurologist Charles Edouard Brown-Séquard and British neurologist Henry Charlton Bastian independently discovered that there were differences between the left side and right side of a man's brain (Sax, 2005). Each found that the left side affected language functions and that the right side affected spatial functions. The 1960s brought in the modern era of research in gender differences. During this time period it was found that male and female brains are organized differently. The functions of male brains are more compartmentalized, while the functions of female brains are more globally distributed. The left side of a man's brain is important for language functions; the right side is not. Women use

both sides of the brain for language functions. During the mid-1980s the compartmentalization in men's brains was obvious but this finding was not applicable to women's brains.

Brain-based research came into prominence in the 1990s. This area of research combines three fields (Gurian, 2006): neurological and hormonal effects, developmental psychology, and gender-difference research. Some researchers argue that the brains of girls and boys are structurally and developmentally different. The technologies of MRIs and PET scans show how the male and female brains differ and that blood flow and neurotransmission varies with gender (Gurian, 2006). For example, there is greater blood flow in the verbal centers in the brains of girls. Girls also have more neural connections between the verbal center and the emotive centers in the limbic systems than do boys (Gurian, 2006).

Some researchers (Sax, 2005; Wiens, 2006) recognize the cognitive, developmental, and emotional differences between boys and girls. These differences are characterized in both the rate and sequence that boys and girls develop skills in the areas of language, spatial memory, motor coordination, and relationships. Researchers at Virginia Tech (Sax, 2005) conducted a study that examined the brain activity of 224 girls and 284 boys and found that various regions of the brain develop in a different sequence in boys compared to girls. Indeed, although girls' brains are further along in development and mature at a faster pace than boys, boys are not academically or intellectually slower than girls. Girls develop language and fine motor skills 6 years ahead of boys, but boys develop spatial memory 4 years earlier than girls.

There are at least 100 differences between the male and female brain (Gurian & Henley, 2001). These differences have not been conclusively tied to specific behaviors; however, what is positively known is that differences exist in the way boys and girls hear and see. Girls evidence more sensitive hearing than boys and consequently boys must exert more effort to hear what is going on in class. The difference in hearing increases as children get older (Sax, 2005). These differences directly impact achievement: Girls will be distracted by loud, noisy classrooms because their hearing is so sensitive and boys may have difficulty hearing female teachers because their voices are below the range that they can hear easily.

Girls and boys also differ in their ability to see because of the sex differences in the anatomy of the eye (Sax, 2005). The composition of the retina is different for males and females. The male retina is thicker than the female retina which results in girls being hardwired to be interested in faces and boys hardwired to be interested in moving objects. Due to the structural differences of the eye girls are better able to see than boys. The female visual system relies more on type P ganglion cells than do males. These cells connect color variety and other sensory activity to upper brain functioning. The visual system of males relies more on type M ganglion cells. M ganglion cells enhance spatial activity and the accessibility of graphic clues. M cells also allow boys to detect movement better than girls (Sax, 2005; Gurian, 2006).

Almost immediately after birth physiological differences emerge in boys and girls (Gurian & Stevens, 2006). At 4 days of age, girls maintain eye contact with adults twice as long as boys. At 4 months of age boys are less likely than girls to distinguish between a known person and a stranger. Male babies spend more time

looking at objects moving in space while female babies are more likely to focus their attention on caregivers. These differences apparently are hardwired into the brains of males and females which means they are unlikely to change regardless of social or economic context.

As early as kindergarten the specific developmental strengths of boys and girls become evident. Biologically, the left hemisphere of the brain in girls develops before boys (Gurian, 2006). This means that girls read and write better than boys at an early age. The left hemisphere processes information sequentially and analytically. The left hemisphere is responsible for auditory processing, and verbal expression. Girls are better at tasks that require listening, speaking and writing. If one were to examine the writing of girls they would find that girls write longer more complex texts than boys; they include more complex sensory details using more verbs and adjectives; and they add more feeling details. Boys experience a gender-different writing process than girls because they rely more on pictorial representations and moving objects to form word connections (Gurian, 2006; Warrington, Younger, & McLellan, 2003). Their writing is more egocentric and event focused. Boys seldom tell stories from an observer's point of view. They are usually the center of the action.

Boys develop the right hemisphere of the brain earlier than girls and also use this hemisphere more often than girls (Gurian, 2006). Boys are able to complete tasks that require movement and visual-spatial skills more readily. In elementary schools boys are often the outsiders because the curricula emphasize left-brain, cognitive skills (Connell & Gunzelmann, 2004). Boys must meet a standard that is often set by

what girls are easily able to do. Wiens (2006) argues that schools have become "feminized," which makes it difficult for boys to be successful. That is, schools tacitly reward skills easily accomplished by girls; the same skills are developmentally more complicated for boys to perform.

Feminization of the school environment is evident in the area of reading (Warrington, Younger, & McLellan, 2003). Schools have been found to be more relevant to girls than boys because in the curriculum there is a focus in reading on narrative and fictional text. This type of text emphasizes emotions and relationships, areas that are naturally comfortable for girls due to the way their brains are organized. Boys tend to prefer reading non-fiction text and different kinds of literature such as comic books. The emphasis on fiction and narrative text in the classroom creates an aversive experience which leads boys to avoid the act of reading. Boys become bored and develop negative attitudes toward reading. This attitude is compounded because boys see reading as a feminized activity not only in the school setting but also at home. Female family members and female teachers provide the primary support for reading and are role models as readers.

Davis (2003), whose research focuses on the academic achievement of the African American male, also supports the view that schools are feminine institutions that do not meet the needs of boys. Davis argues that schools, or more specifically teachers, promote a feminine culture that induces males to exert oppositional behaviors (e.g., disobedience, aggression, disrespect). African American males, in particular, see learning as a feminine pursuit and therefore become disengaged and alienated from the learning process leading to poor academic performance.

Boys may also be at a disadvantage in the school setting because the male brain naturally goes into a rest state many times during the day (Gurian, 2006). During this period of time boys are not engaged in learning and seem to be inattentive. They "zone out," or "drift off," making it seem as if they are not interested in the lesson being taught. This "rest state" may cause some boys to fidget or engage in inappropriate behaviors in an effort to wake up and avoid the rest state. Girls' cerebral cortices are always on and therefore they do not go into a rest state.

The levels and processing of certain chemicals in the brain, including, oxytocin, dopamine, testosterone, and estrogen, affect how boys and girls learn and behave (Gurian, 2006). These chemicals affect the need boys have to engage in competitive activities. Boys are more naturally competitive and aggressive than girls. Although girls are competitive they spend less time in competitive learning and aggressive behaviors than boys. Boys have less oxytocin in their neural and physiological system which increases their impulsivity and reduces their desire to comply in order to please others (King & Gurian, 2006). Girls, who have different biochemical dynamics, often aim to please others.

Although the evidence of brain-based differences between boys and girls is compelling, there are researchers who offer alternative views that suggest that the research regarding brain-based differences is not universally accepted and that there is a body of knowledge that refutes the importance of brain-based sex differences.

Hyde (2005) advances a gender similarities hypothesis which argues that males and females are more psychologically alike than they are different. This researcher suggests that claims of difference are not consistent with available scientific data.

Hyde (2007) cautions that there should be a balanced reporting of both gender differences and similarities.

The weight of the evidence supporting gender difference may not be fully established; however, in the school setting differences in the ways students learn are apparent and need to be considered. In understanding these differences educators and policymakers must be sure not to reinforce sex stereotypes and sex discrimination especially in the ways boys are viewed. Cohen (2009), voices concerns regarding separating the sexes in order to educate them. The nexus of his concerns are twofold. First, with the flexibility provided in Title IX more single-sex schools will be created. Secondly, a caution for how boys will be viewed and treated in same-sex schools since the popular media describe boys as being aggressive, active and competitive and not in a good way. Cohen's discourse centers on notions of masculinity and how boys can be boys in a single-sex setting. It is important that boys understand that there is more than one way to be masculine and to ensure that their individuality is not stifled.

Given brain-based and cognitive gender differences that some suggest exist between boys and girls, the way they are instructed may require adjustments that align to these possible differences. The school and classroom environments can either make a positive or negative impact on the academic achievement of girls and boys if brain-based differences are not accounted for. Teachers should be knowledgeable about the discourse that surrounds brain-based research to determine what instructional approaches can be used to maximize the learning and achievement of both girls and boys.

Single-sex versus Coeducational Setting

In 2006, the United States Department of Education promulgated new guidelines to the Title IX regulations, a 36-year-old law that prohibits sex discrimination in classes and activities that receive federal funding. The new regulations expand authorization for schools to offer single-sex programs. Prior to the changed regulations that ease restrictions on single-sex education in public schools, schools were permitted to separate boys and girls only in limited circumstances—such as physical education, sex education, or for remediation.

Although single-sex schools have operated primarily in the private and parochial sector (Datnow, Hubbard, & Conchas, 2001; Mael, Alonso, Gibson, Rogers, & Smith, 2005), interest in creating single-sex programs in the public domain has increased due to the relaxation of the restrictions of Title IX. This interest is fueled by the apparent underachievement of boys (Younger & Warrington, 2006). Boys are viewed as being disadvantaged and subjected to a feminist schooling structure that is advantageous to girls.

There has been debate and controversy over the efficacy of single-sex programs. Feminists are part of the debate because they are concerned about gender equity issues, questioning whether or not separate can be equal (Datnow, Hubbard, & Conchas, 2001).

The National Organization for Women (NOW) opposes single-sex education in public schools because it views separate but equal as never really being equal for girls. It also believes that sex stereotypes about girls are fostered and that all boys schools increase sexism and exacerbate feelings of superiority towards women.

Further, NOW does not recognize that there is a "boy crisis" and now claims that segregating girls from boys does not improve academic performance. According to NOW, boys and girls need to interact and engage collaboratively because that is what they will have to do in the workplace and in life.

Generally, feminists subscribe to the notion that equity should and can occur for both sexes in coeducational settings. This debate goes as far back as the 1970s when studies were conducted to determine if single-sex independent schools were academically superior to coeducational independent schools (Trickett, Trickett, Castro, & Schaffner, 1982). These studies examined schools in England, Australia, and New Zealand. In England neither school configuration (i.e., single-sex nor coeducational) was superior to the other. The only difference was that students in coeducational schools experienced greater satisfaction than their single-sex counterparts. Students in Australia in coeducational settings experienced more satisfaction with school than their counterparts in single-sex settings. However, students who attended single-sex schools in New Zealand felt that their schools were more academically challenging and satisfying compared to coeducational schools.

Trickett, Trickett, Castro, and Schaffner (1982) conducted a study to compare and contrast the environments of independent and public high school, single-sex and coeducational schools. They found that single-sex classrooms appeared to be more organized and structured. Students in single-sex environments spent more time doing homework and less time on extracurricular activities. Females in single-sex schools believed that the women's movement had more support in their setting than was readily available at coeducational schools.

Even though the resurgence of single-sex learning environments has been initiated by the "boy problem" there is some evidence that girls benefit as much as boys from this structural configuration (Mael, Smith, Alonso, Rogers, & Gibson, 2004; Younger & Warrington, 2006). For example, single-sex settings provide a more comfortable environment free from sexually predatory behavior. Girls also have more opportunities to assume leadership roles in single sex settings.

The resurrection of single-sex schools and classrooms poses the question: Are single-sex schools more effective than coeducational schools in terms of improving student achievement (Mael, Alonso, Gibson, Rogers, & Smith, 2005)? Examining the benefits and the disadvantages may assist in determining whether or not single-sex education improves educational outcomes for students.

The single-sex configuration is favored in some contexts because of the impact it has on improving academic achievement for both boys and girls (Bracey, 2006; Datnow, Hubbard, & Conchas, 2001; Younger & Warrington, 2006). There are research studies to suggest that single-sex environments do produce positive outcomes for students as compared to coeducational settings. This is evidenced by students' increased interest in taking more difficult coursework, higher career aspirations especially for girls, and boys scoring significantly higher than their coeducational peers on reading, mathematics, and writing assessments (Mael, Alonso, Gibson, Rogers, & Smith, 2005; Marks, 2002).

Kruse (1996), who had conducted a number of studies with single-sex groups of students, had findings that suggested both benefits and drawbacks for girls and boys in single-sex settings. This researcher found that girls who were considered to be shy

in coeducational settings experienced feelings of safety in single-sex settings which allowed them to speak out without being harassed, ridiculed or violated by boys.

Kruse found that in single-sex settings girls pursued their own interests and emotional needs.

According to Kruse, boys' experiences in single-sex settings differed from the experiences of girls in several ways. For example, boys missed the presence of girls in the classroom more than girls missed the presence of boys. Boys had a dichotomy of feelings about the absence of girls because they were jealous of girls but they also felt disenfranchised by their absence. Without the presence of girls boys were either at the bottom or outside the hierarchies that exist in the classroom, positions that were traditionally held by girls. Boys in single-sex settings were both proud and angry. Some boys experienced solidarity and friendship with other boys but there were others who did not have this experience. Another observation that Kruse made was that all boy classrooms were often noisier than coeducational settings and boys used language that was "raw" when not in the presence of girls.

In a report prepared by the American Institutes for Research for RMC Research Corporation (Mael, Smith, Alonso, Rogers, & Gibson, 2004) the authors, like Kruse, suggest that there are benefits and drawbacks to single-sex schooling. They attempted to answer the question as to whether single-sex schooling is preferable to coeducation for some or all students. They discuss factors favoring and opposing single sex schooling. The authors state that single-sex schools are particularly effective for students who are from lower socio-economic settings, are minority, and are members of disadvantaged communities. In single-sex settings minority youth are

able to focus more on academics. Girls feel good about receiving good grades. The single-sex setting also promotes student bonding and positive same-sex role models.

These authors identify several drawbacks to single-sex schools that include: there is more peer harassment in single-sex male schools; single-sex schools do not prepare students to be successful in the mixed-sex workplace; traditional stereotypes are reinforced in single-sex settings, and female schools have fewer resources than all male and coed schools.

Some researchers suggest that students from at-risk environments, who live in poverty, and are minority, regardless of sex, are more likely to do well in single-sex settings (Bracey, 2006; Mael, Smith, Alonso, Rogers, & Gibson, 2004).

Single-sex schools provide an opportunity for "boy friendly" strategies (King & Gurian, 2006; Younger & Warrington, 2006) to be employed, while at the same time providing girls with an environment that allows them to express themselves without fear.

Although many studies suggest benefits for girls and boys in single-sex environments, there are also studies that suggest that the single-sex configuration may not be beneficial to everyone. Girls in single-sex schools do not have a consistent advantage as compared to girls in coeducational schools according to Signorella, Frieze, and Hershey (1996). Marks' (2002) review of research on school composition and peer effects indicates that single-sex schools do not outweigh coeducational schools in terms of higher achievement for both sexes.

Van de gaer, Pustjens, Van Damme, & De Munter (2004) hypothesized that single-sex classes and schools provide students with the opportunity to make more

academic progress. What they found was that boys in coeducational classes made more progress in language than boys in single-sex settings. Teachers also shared with these researchers that single-sex classes often created groups of boys with lots of behavior problems. The researchers also found no difference in achievement for girls in single-sex schools as compared to girls in coeducational schools in the areas of language and mathematics.

Sullivan, Joshi, and Leonard (2010) conducted a longitudinal study on a sample of British people born in 1958 to examine the impact of single-sex schooling on various academic outcomes. They found that boys in single-sex settings were not significantly advantaged or disadvantaged in this setting while girls at the age of 16 performed significantly better on exams than did their coeducational counterparts. This outcome for girls was only evident for some girls and not all girls. These researchers' findings were similar to those of Marks (2002) because there did not seem to be a clear advantage for single-sex schools compared to coeducational schools.

More research is necessary to determine if single-sex environments have a positive effect on achievement for all students.

Effects of Single-sex Education on Attendance

Research in education indicates a positive correlation between school attendance and student academic achievement (Fjortoft, 2005). Poor attendance is a major indicator of gradual alienation and disengagement and could eventually result in the student dropping out of school (Lan & Lanthier, 2003). Poor attendance patterns often begin when children are young. By the eighth grade these attendance patterns

are set and continue with each successive year of schooling. Students who miss 30 hours of instruction often experience poor grades. When students are absent and return to class they are often discipline problems. They also take additional teacher time and school resources. Therefore it is important to intervene at the elementary grades so that children can establish a positive relationship with school and avoid non-attendance.

The importance of school attendance is underscored by the role it plays in No Child Left Behind (NCLB). Attendance is so vital to achievement that it is included as a component of a school's and district's report cards for NCLB; therefore school and district leaders must focus on those factors that influence attendance and cause students to either attend or avoid coming to school.

Students with attendance problems or who are truant cite several reasons why they do not go to school aside from illness that include: boredom; a lack of positive relationships with teachers and peers; fear for their safety; too many suspensions; and poor academic performance. Lack of motivation and school culture and structure can also contribute to absenteeism. Single-sex education could provide a remedy for truancy and non-attendance. According to Datnow, Conchas, and Hubbard (2001), in a study of California's experiment with single-sex schools, one key outcome was that this structure created more opportunities for more meaningful interactions between teachers and at-risk students.

Davies and Lee (2006) interviewed 13 secondary school students who had severe attendance problems and as a result identified important themes regarding school attendance. They found that the quality of personal relationships with staff was of

more significance than what subjects individual teachers taught. The students defined the quality of relationships with staff in terms of mutual respect. Additionally, male students reported that relationship problems occurred mainly with staff and not with peers. Peer relationships were more significant for female students. Bullying and intimidation were seen as deterrents to attending school. The researchers also found that staff did not find poor student/teacher relationships as a causal factor for non-attendance.

Single-sex school officials report a rise in attendance and an improvement in attitude for students attending single-sex schools (Vail, 2002). They have observed that discipline problems decreased, attendance levels increased, academic performance improved and attitudes were more positive. Additionally, distractions declined and participation increased in the single-sex setting which served to maximize student achievement.

Schools where teachers have high expectations for students, where teachers know their students well and where teachers use a broad range of strategies tend to have high attendance rates. When students feel safe, cared for and engaged they tend to want to go to school. This is the very reason parents choose to send their children to single-sex schools because they perceive these schools to be safer, have fewer discipline problems, and have faculties that build positive, supportive relationships with their children.

Hubbard and Datnow's (2005) research indicated that teachers in single-sex schools were more disposed to providing their students with not only academic support but personal and social support as well. Teachers in the single-sex academies

that they studied developed close, trusting relationships with their students. These teachers believed it was their responsibility to provide emotional and moral guidance to their students, as well as, academic support. Students could have personal discussions with their teachers. Those who had previously attended coed schools did not feel that they could trust or talk to teachers in those schools. The researchers pointed out that not all teachers in the single-sex environment are caring and that teachers in the coed environment are not necessarily uncaring, they simply found that when the environment is supportive and caring teachers are present, they can alleviate the anxiety and stress that some students have, particularly those from at-risk environments.

Attendance plays a critical role in students' academic success. Positive relationships between faculty and students are a major factor that encourages students to come to school daily. If single-sex schools provide environments that nurture teacher and student positive relationships, then there should also be a positive outcome in the attendance rates for single-sex schools.

Effects of Single-sex Education on Behavior and Discipline

Discipline can be defined as the voluntary obedience of a child to the influence and leadership of a mature, adult educator. In the educational setting discipline and order are deemed to be the prerequisites to teaching, learning and student academic achievement. A lack of discipline and order has a negative effect on the organizational culture of a school (van der Westhuizen, Oosthuizen, & Wolhuter, 2008).

Schools in urban, low-income areas are often plagued with those stressors associated with inner-city living (e.g., crime, violence, substance abuse, and poverty). These stressors often manifest themselves in the educational setting in various negative physical, psychological, cognitive and/or behavioral outcomes. These outcomes may be influenced by a child's gender. Boys are more likely to externalize their responses leading to aggressive behavior. Girls internalize their responses and display more depression-related responses to the same type of trauma. There are consequences to children's exposure to violence, namely, difficulty interacting with peers, physical aggression and/or anti-social or violent behavior. Prevalence rates for students' disruptive behavior in urban, low-income communities are three times the national estimates (Atkins et al., 2002). Disciplinary and behavior problems that are left unresolved often follow students throughout their schooling careers.

With the increase in interest in single-sex education that occurred in the 1980s sprung a belief that the single-sex setting could potentially reduce the problems that occur in inner-city schools regarding behavior and discipline. The belief that behavior and discipline problems could be lessened in a single-sex setting was predicated on the theoretical constructs that include: better peer interactions (e.g., less teasing, less bullying, less dominance); less sexual harassment, violence, delinquency, drugs and predatory behavior; greater degree of order and control; and greater socio-emotional benefits leading to more self-efficacy and self-confidence (RMC Research Corporation, 2008).

Gurian (2006) suggests that "misbehavior" can be explained by examining brain differences in girls and boys. Boys are more physically aggressive than girls and girls

are more socially manipulative. Male brain chemistry compels them to use less eye-to-eye contact and more shoulder-to-shoulder contact. Girls tend to have more empathic interactions and reactions. Boys relate by bumping, prodding, and pushing each other, behaviors that are not necessarily school friendly.

Girls tend to have fewer discipline problems and drop out of school less often than boys. They are also less likely to experience learning, psychiatric or behavioral disorders. Boys make up two-thirds of learning disabled students and 90% of the behaviorally disabled. Girls are only 20% of students identified with attention deficit and hyperactivity disorder (ADHD) and attention deficit disorder (ADD). For every girl that commits suicide, four boys do. Violence in school is also primarily a boy problem. Boys are more often the victims of violence on school property by a three-to-one margin than are girls. Girls, however, are most often the victims of sexual harassment.

Although girls are more often victimized by sexual violence from males, the instances of boy on boy violence in terms of physical fights far exceeds boy on girl violence.

Teachers often cite discipline issues as the primary problem they experience in the classroom centering their concerns on the aggressive behaviors of boys. Teachers who have not had training in brain research and are not knowledgeable about boy-girl differences in behavior may view boy behaviors as hostile and aggressive even though these types of behaviors are relatively normal for boys.

The male brain is more impulsive and less mature than the female brain. This is due to the fact that the male brain secretes less serotonin than the female brain which

explains their impulsivity and causes them to fidget and get into more trouble in the classroom. Discipline strategies that work for girls when applied to boys are not as effective since these strategies are often inconsistently applied and lack profound authority. Boys need consistency and authority. They must sense that the teacher is the authority figure with ultimate power.

Although some teachers report that when they separate boys and girls discipline issues are reduced, this might not be the case in all situations. The United States Department of Education conducted a descriptive study in 2008 of existing single-sex schools to evaluate the effects of single-sex schooling on student achievement, the benefits and disadvantages of single-sex settings and finally, to find out what are the contextual, instructional and behavioral practices unique to single-sex schools. They found that in both the elementary and middle schools in their sample there were more positive academic and behavioral interactions between teacher and students (both girls and boys) observed in single-sex schools than in the coeducational comparison schools. Additionally, teachers at single-sex high schools rated student behavior problems as less serious than their counterparts in coeducational high schools. The opposite was the case in middle schools and in elementary schools. There were no differences between the ratings of teachers in single-sex schools and those in coeducational settings.

The impact of a single-sex setting on student behavior and discipline remains to be seen; however researchers Oosthuizen, van der Westhuizen, and Wolhuter, conducted a study in 2008 which examined the organizational culture and student discipline in a boarding school. They determined that there is evidence that a

relationship exists between organizational culture (i.e., traditions, ceremonies, symbols and the external and internal appearance of the organization) and student discipline; effective student discipline is a determinant of the effectiveness of the organizational culture, and effective organizational culture determines the effectiveness of student discipline. If this is the case, then the single-sex setting should have a positive effect on student behavior and discipline.

Opposition to Single-sex Education

The single-sex education movement has provided inconclusive evidence that single-sex approaches are either beneficial or detrimental to the education of children. For this reason there are many who advocate for single-sex schooling because they believe that it addresses the needs of students; there are also those who oppose this structure because they do not believe that it makes a positive difference in the performance of children in school.

Those who oppose single-sex schooling are concerned with gender equity issues. They believe that in a single-sex setting sex stereotypes are reinforced, suggesting that girls are inherently deficient in certain academic areas (Salomone, 2006) and that it provides an opportunity for some students to explore homosexual relationships.

Feminists are part of the debate because they are not only concerned with gender equity issues but also question whether separate can be equal (Datnow, Hubbard, & Conchas, 2001). Further, NOW also opposes single-sex education in public schools because it views separate but equal as never being equal for girls and that all boys schools exacerbate feelings of superiority towards women. The members of NOW

believe that girls must interact and engage with boys because that is what they will have to do in the workplace and in life.

Noguero (2003) voices a different concern regarding single-sex schools, which focuses on African American boys in single-sex settings. He advances the idea that single-sex classrooms can become dumping grounds for boys that other schools do not want. As a result, single-sex classrooms could become environments that are hyper masculine where negative behaviors are reinforced.

Cohen's (2009) concerns are similar to those held by Noguero regarding how boys are viewed in single-sex settings. He cautions that since the popular media sometimes portrays boys in a negative way that boys in single-sex settings might reinforce these negative images.

Perceived brain-based and cognitive gender differences have emerged as a science that could explain differences in how boys and girls learn and have fueled the movement towards creating single-sex programs. The argument of some researchers advocating for single-sex schools is that the brains of girls and boys are structurally and developmentally different (Gurian, 2006), therefore, they require educational settings that adjust to gender differences which for them means single-sex schooling is preferential. Sax (2005) describes these differences as being hard-wired. There are several researchers who refute Sax's hard-wired brain theory. Eliot (2009), for example, suggests that just because there are differences in brain anatomy and physiology, which explains behavioral differences between boys and girls, does not mean that they are hard-wired. Hyde (2005), in her gender similarities hypothesis,

argues that males and females are more psychologically alike than they are different and the claims of difference are not consistent with available scientific data.

As long as research into the efficacy of single-sex education is limited there will be those who oppose the implementation of single-sex education for reasons ranging from gender equity to a lack of scientific data that support gender brain differences.

Summary

The implementation of single-sex programs taking place in many school systems across the nation has gained prominence as a possible solution to the achievement and gender gap. Although the intent is to improve the educational outcomes for all students and particularly for African American boys who are falling behind, there is very little evidence that this reform initiative fosters better results than coeducational schooling.

The 2006 revision of Title IX legislation loosened the legal restraints that once prohibited the creation of single-sex programs, thus leading to a renewed interest in this educational structure. With relaxed regulations school systems are considering implementing this reform initiative in great numbers even though positive results are inconclusive. Although there has been some research conducted to evaluate the efficacy of single-sex education, this research is in its formative stages. Most programs have been developed at the middle school and high school levels with very few programs being initiated at the elementary school level. Although the lack of research on single-sex education at the elementary level is evident, some parallels may be drawn from research findings of secondary programs.

This study evaluates the single-sex programs in Dayton, Ohio, specifically areas affecting students' overall performance and achievement in reading and mathematics, attendance, and discipline. The intent is to close the gap of information that exists regarding whether or not single-sex education is a viable option to improve reading and math achievement, increase attendance and decrease the number of discipline infractions that occur in schools. Since this study focuses on elementary schools the findings can be of use to those school systems that are considering implementing single-sex schools.

CHAPTER III

METHODOLOGY

This chapter will describe the procedures used in this study to determine if single-sex education has a significant effect on the academic achievement, discipline, and attendance of boys and girls. The setting, population and samples, research design, data collection methods, and the procedures for the analysis of the data collected, will be outlined.

Setting

Dayton Public Schools (DPS), in Dayton, Ohio, was the setting for the study. DPS is a medium size, urban school district with a total enrollment during the 2007-08 school year of approximately 15,000 students. The ethnic breakdown was as follows: 70.5% African American, 23.9% White (mostly Appalachian), 3.1% Multi-Racial, 2.1% Hispanic, and 0.4% Asian. Approximately 20% of the population was comprised of students with disabilities. About 65% of the students were economically disadvantaged and 1.6% were limited English proficient.

The district was comprised of one kindergarten through Grade 4 school (single-sex girls school), one prekindergarten through Grade 4 school (single-sex boys school), 7 prekindergarten through Grade 6 schools, 3 prekindergarten through Grade 7 schools (including a dual school which is coeducational with single-sex classrooms), 10 prekindergarten through Grade 8 schools, one middle school (Grades 7 and 8), 6 high schools, 1 early childhood center and 3 special centers.

Population and Samples

Data were collected from 9 schools, 3 schools with single-sex programs and 6 schools with coeducational programs. The single-sex schools were school # 180, a single- sex girls school, school #181, a single-sex boys school and school #112, a dual school which was coeducational with single-sex classrooms. The six comparison coeducational schools were schools #103, #106, #109, #129, #138, and #146. These comparison schools had similar demographics to the schools with single-sex programs.

School #180, the single-sex girls school, had a population of 207 students in Grades kindergarten through 4. It was a choice option in DPS which opened in August 2005, with Grades kindergarten through 2. The grade span currently extends to Grade 4 with a grade being added each year until Grade 8. There were two classes on each grade level except Grade 4, which had only one class. According to the Ohio Department of Education state report card, 90.6% of the girls were African American and 5.6% were Caucasian. All of the girls were economically disadvantaged. The average class size was 22. Parents could choose this setting for their daughters by simply requesting it. The only enrollment limitation was space availability. The girls resided in various neighborhoods throughout the school district and for the most part were bussed to the school. The principal at school #180 was an African American female. It is important to note that the curriculum focus of the school was math and science. This emphasis was the result of a concern that girls did not perform well academically in these areas. The belief was that if girls were exposed to content in a

manner that met their learning styles they could achieve in math and science at high levels.

Table 1 indicates the gender and ethnicity of the staff. Since the student population in the school is predominantly African American and female it is important to consider how the gender and ethnicity of the faculty could impact student achievement, attendance, and discipline.

Table 1

Single-Sex Girls School #180 – Gender and Ethnicity of School Staff – 2007-08

Staff	Gender	Ethnicity
Principal	female	African American
Kg. teacher #1	female	Caucasian
Kg. teacher #2	female	African American
1 st gr. Teacher #1	female	Caucasian
1 st gr. Teacher #2	female	Caucasian
2 nd gr. Teacher #1*	male	African American
2 nd gr. Teacher #2	female	Caucasian
3 rd gr. Teacher	female	Caucasian
3 rd gr. Teacher	female	Caucasian
4 th gr. Teacher	female	African American
LD tutor**	male	African American
Art teacher**	male	Caucasian
Band teacher**	female	Caucasian
P. E. teacher**	male	Caucasian
Math intervention**	female	African American
Reading intervention**	female	Asian

*Denotes a substitute teacher

** Denotes these staff members are shared with another school

School #181, the single-sex boys school, had a population of 149 students in Grades prekindergarten through 4. The principal was an African American male. It was also a choice option that parents could select for their sons. The school opened in August 2006, with Grades prekindergarten through 3. According to the state report card 83.8% of the boys were African American and 8.7% were Caucasian. All of the boys were economically disadvantaged. There was one prekindergarten class and two classes on each of the other grades. A grade will be added to the school each year up to Grade 8. As with school #180 there were no entrance criteria and parents could select this school as an option with boys attending from across the district. Average class size increased from 18 students to 25. Table 2 indicates the gender and ethnicity of the staff at the boys school. It is important to note that although the principal is a male, only 6 of the 17 teachers are male.

School #112 was a "dual" setting, a coed school with 334 students in single-sex classrooms. The principal was an African American female. According to the state report card, 95.5% of the students were African American and 100% were economically disadvantaged. The grade configuration was prekindergarten through Grade 7. In August 2005, the principal made the decision to create single-sex classrooms as a reform concept due to the low academic performance of the students. This model was implemented because the principal believed that it would improve student performance. Table 3 indicates the gender and ethnicity of the staff, as well as the sex of the students they taught. All of the students were African American.

The comparison schools, #103, #106, #109, #129, #138, and #146, were all coeducational with mixed-gender classrooms. They were selected because they

Table 2

Single-sex Boys School #181 – Gender and Ethnicity of School Staff – 2007-08

Staff	Gender	Ethnicity
Principal	male	African American
PreK teacher	female	African American
Kg. teacher #1	female	African American
Kg. teacher #2	female	African American
1 st gr. Teacher #1	female	African American
1 st gr. Teacher #2	female	Caucasian
2 nd gr. Teacher #1	male	African American
2 nd gr. Teacher #2	female	African American
3 rd gr. Teacher #1	female	African American
3 rd gr. Teacher #2	female	African American
4 th gr. Teacher	male	African American
LD tutor*	female	African American
Art teacher*	male	Caucasian
Band teacher*	female	Caucasian
Vocal teacher*	male	African American
P. E. teacher*	male	Caucasian
Math intervention	female	African American
Reading intervention	female	African American

*Denotes these staff members are shared with School #180

Table 3

**Dual School #112 - Gender and Ethnicity of School Staff - 2007-08*

Staff	Gender	Ethnicity
Principal	female	African American
PreK teacher	female	African American
Kg. teacher #1	female	Caucasian
Kg. teacher #2	female	African American
1 st grade teacher #1	(Split with kg. teacher #2)	African American
1 st grade teacher #2	female	Caucasian
2 nd grade teacher #1	female	African American
2 nd grade teacher #2	female	African American
3 rd grade teacher #1	female	Caucasian
3 rd grade teacher #2	female	Caucasian
4 th grade teacher #1	female	Caucasian
4 th grade teacher #2	female	African American
5 th grade teacher #1	female	African American
5 th grade teacher #2	female	Caucasian
6 th grade teacher #1	male	African American
6 th grade teacher #2	female	Caucasian
7 th grade teacher #1	male	African American
7 th grade teacher #2	female	Caucasian

(table continues)

Table 3 (continued)

Staff	Gender	Ethnicity
Special ed. teacher #1	female	Caucasian
Special ed. teacher #2	female	Caucasian
Special ed. teacher #3	female	Caucasian
Special ed. teacher #4	female	Caucasian
Special ed. teacher #5	female	Caucasian
L. D. tutor	female	African American
Math intervention	male	African American
Reading intervention #1	female	African American
Reading intervention #2	female	African American
Band/music teacher	female	Caucasian
General music teacher	male	African American
P. E. teacher	male	Caucasian
Art teacher	female	African American

*Dual school is a coed school with single-sex classrooms.

represented the diversity inherent in the school district in terms of academic achievement, attendance and discipline. They were similar to the three single-sex program schools and to other schools in the district in terms of the socio-economic status of the students, the race of the students and the academic achievement of the students. These schools varied in size and grade span. Table 4 outlines the demographic information of the 6 comparison schools and the schools with single-sex structures. Due to the nature of how the single-sex programs were created and developed, it was difficult to identify schools with identical demographics.

Table 4

Demographic Data of Single-sex, Dual Programs and Comparison Schools – 2007-08

School	Grade span	# of students	% African American	% White	% SES
#180*	K-4	207	90.6	5.6	100.0
#181*	PreK-4	149	83.8	8.7	100.0
#112**	PreK-7	334	95.5	NC	100.0
#103	PreK-8	440	93.0	2.6	100.0
#106	PreK-6	385	91.0	6.8	100.0
#109	PreK-8	434	97.7	NC	100.0
#129	1-8	495	95.3	2.0	100.0
#138	PreK-8	538	90.3	5.2	100.0
#146	PreK-8	419	90.9	7.0	100.0

*Single-sex programs

**Dual Program

NC = Not calculated; displayed when fewer than 10 students in student group

SES = Socio-Economic Status (100% indicates that all students are economically disadvantaged)

All the schools, the single-sex program schools as well as the six comparison schools, have implemented the same standards-based curriculum program across all subject areas indicating that students have been exposed to the same content. Teachers have received varying degrees of professional development in the core curriculum areas, reading and mathematics, standards-based instruction, data analysis and the delivery of instruction. Additionally, staffs at schools with single-sex structures have also received training in brain-based differences between boys and girls, the differences in how boys and girls learn, and instructional strategies specific to girls and boys. All teachers were required to provide a minimum of 120 minutes of literacy instruction and 60 minutes of mathematics instruction every day. Reading intervention teachers worked with students who are the lowest performing.

Each school is assigned one reading and one mathematics intervention teacher to work with students needing additional support. Each school is also supported with a literacy instructional specialist and a mathematics instructional specialist who work with teachers to improve the quality of instruction in the classroom. School #112 has the additional resources of a psychologist, a social worker, and a student support specialist due to the challenged nature of the student population in terms of poverty, troubled home life, and lack of parental support.

For the purposes of this study, students in Grades 3 and 4 at the schools with single-sex structures and the 6 comparison schools were the sample population. Table 5 shows the sample population by school and grade level. These grade levels were selected because all the schools in the study had these grade levels and they were also grades where assessment tests were administered. The grade configuration of the

single-sex boys school and the single-sex girls school only extended to Grade 4 which is unlike the comparison schools where the grade configuration extended to Grade 8 in some schools. Each single-sex school will, in the future, add Grades 5 through 8, adding a grade each year.

Single-sex Program Description

The school board and administration of Dayton Public Schools decided to create single-sex schools as a choice option in 2004. Providing choice became a necessity for the school district because it competed for students with the over 40 charter schools that operated within the city of Dayton. Providing choice to parents who might want alternative educational opportunities for their children was a strategy used by DPS to limit the number of students who left the district to attend charter, parochial and private schools.

Working with an external consulting group, it took a year to develop a plan, conduct research, identify staff, train staff, inform parents, and implement the plan focused on single-sex schools. The school board decided to initiate the single-sex program by opening the girls school first. School #180, the girls school, would open in August 2005, and School #181, the boys school, would follow in August 2006.

The consultants visited single-sex schools across the country, developed relationships with researchers in the field, and provided feedback about the program components. The researcher, in her role as deputy superintendent, visited single-sex schools in Toledo, Ohio, became familiar with the research, interviewed and hired staff, designed the classroom spaces, purchased furniture, supplies, and instructional materials, and provided overall supervision to the schools. Both the girls and boys

Table 5

Sample Population by School Type and Grade Level

School	Grade 3 # students		Grade 4 # students		Total
	M	F	M	F	
#180 – Single-sex	0	36	0	27	63
#181- Single-sex	21	0	27	0	48
#112 – Dual	23	16	18	20	77
#103 – Coed	18	12	17	23	70
#106 – Coed	18	15	18	19	70
#109 – Coed	19	20	24	20	83
#129 – Coed	20	18	24	18	80
#138 – Coed	23	21	19	23	86
#146 – Coed	30	15	23	25	93
Total	172	153	170	175	670

school principals reported directly to the deputy superintendent.

Parents could enroll their children in the single-sex schools based on the availability of seats. There were no entrance requirements other than that students must live in the Dayton city school district. Both schools implemented the district's standards-based curricula. Teachers were trained by researchers in the field of single-sex education on the differences in the ways in which boys and girls learn. Each school received an instructional binder compiled by the deputy superintendent that included journal articles, instructional strategies, and Internet resources to be used to guide the implementation of the program. The principals attended single-sex conferences that were held in various locations around the country and even visited schools in other countries (e.g., the principal of the girls school traveled to Iceland and visited single-sex schools there).

School #112, the dual school with single-sex classes began its program in August 2005. This school previously had all coeducational classes. The principal (school #112) decided on the single-sex configuration as a potential remedy for low student achievement. This principal felt that this change would improve student performance and reduce behavior referrals. She assigned teachers to the classes rather than have them voluntarily select whether they wanted to teach boys or girls or even whether they wanted a single-sex configuration. In some instances there were teachers who did not believe in the concept of single-sex education and did not want to teach the sex they were assigned. Although the principal participated in the same professional development as the principals of schools #180 and #181, teachers were not trained to the extent that teachers in the single-sex schools were.

Coeducational Program Description

The comparison schools #103, #106, #109, #129, #138, and #146 had coeducational classrooms. They all implemented the same standards-based curricula as schools #180, #181, and #112. Although the school district was moving towards neighborhood schools, parents could select any of these schools as options for their children. Some parents selected schools based on the academic standing and reputation of the school. Other parents selected schools due to the proximity to home, work or child care availability.

Table 6 provides a description of the academic performance of each school in the study according to data from the Ohio Department of Education.

Table 6

Description of the Academic Performance of Single-sex Programs and Comparison Schools – 2007-08

School	State designation	# Indicators	AYP	Grade 3 reading % proficient	Grade 3 math % proficient	Grade 4 reading % proficient	Grade 4 math % proficient	Value added	Performance index
#180* Single-sex girls	Continuous improvement	2/6	Not met	60.5	60.5	74.1	74.1	Below	89.5
#181* Single-sex boys	Continuous improvement	1/6	Met	63.2	52.6	70.4	74.1	Below	85.0
#112* Dual (coed w/single-sex classes)	Academic emergency	1/15	Not met	52.3	38.6	33.3	23.8	Below	64.2
#103 Coed	Continuous improvement	2/19	Not met	67.6	50.0	56.8	50.0	Above	72.1
#106 Coed	Academic watch	1/12	Not met	76.1	52.2	52.5	35.0	Below	71.9
#109 Coed	Academic emergency	0/19	Not met	48.8	44.2	37.0	15.2	Below	61.0
#129 Coed	Academic emergency	1/19	Not met	49.1	39.6	34.1	7.1	Below	63.7
#138 Coed	Academic emergency	0/12	Not met	67.4	27.9	52.1	10.4	Below	63.8
#146 Coed	Continuous improvement	4/19	Met	82.2	86.7	49.0	32.7	Below	79.9

*Single-sex Programs

State designation is comprised of four measures: State Indicators, Adequate Yearly Progress, Performance Index and Value Added. State indicators are based on the number of state assessments given over all tested grades. To earn an indicator a district or school needs to have a certain percentage of students reach proficient or above on a given assessment.

Adequate Yearly Progress (AYP) is a measure representing the federal mandate that holds schools accountable for the performance of students in reading and mathematics. Attendance rate, graduation rate, participation in testing are calculated into the measure. Performance Index (PI) is a calculation that measures achievement of every student enrolled for the full academic year. Value Added rating represents the progress a school has made with its students since the last school year.

Research Design

The purpose of this study was to determine whether or not girls and boys achieve and perform significantly better in single-sex settings than their counterparts in coeducational settings. The results of this study may provide school district policymakers with a pattern of findings to determine if they should continue to support the operation of current single-sex programs, to create additional single-sex classrooms and programs, or to totally abandon the initiative. These findings may inform instructional practices and the content of professional development regarding gender-based learning. Additionally, this study could provide a context that informs the discussion of and consideration for how a focus on gender may play a part in closing the gap. Finally, the information provided in this study may provide educators with strategies to create school and classroom environments that meet the unique needs of both girls and boys and enhance their learning, thus improving academic achievement for all students across all curriculum areas.

Quantitative Data

The quantitative data collected include results from: Ohio's Assessment System Grade 3 and 4 Reading Practice Tests; Ohio's Assessment System Grade 3 and 4 Mathematics Practice Tests; Ohio's Achievement Tests Grade 3 and 4, March 2005 Previously Released Reading Tests; Ohio's Achievement Tests Grade 3, March 2005, Previously Released Mathematics Test; and Ohio's Achievement Tests Grade 4, March 2006, Previously Released Mathematics Test (see Appendix). The practice tests were used as the pretest and were administered in August 2007. The previously released tests were used as the posttest and were administered in February 2008.

Additionally, attendance and discipline data were collected and analyzed because attendance and behavior were operationally defined in this study as indicators of student motivation and satisfaction. Students who attend school on a regular basis and do not have discipline issues are able to receive instruction that is continuous and consistent. Poor attendance and poor behavior impact student achievement negatively. Attendance and discipline records were retrieved from the school district's data warehouse. These areas for analysis are organized in the theoretical framework in Figure 2.

Data Collection

The target group for this study was the boys and girls in Grades 3 and 4 in the 9 schools used in the study, 3 schools with single-sex programs and 6 schools that are coeducational. These two grade levels were identified because both single-sex boys and girls schools extended to Grade 4 at the time of data collection. Therefore, for comparison purposes, the study examined these grades for all 9 schools. Also, the assessments were only available beginning at Grade 3.

These assessments were administered by teachers under strict testing conditions. The assessments were machine scored except for the open-ended questions which were scored by each teacher and the data were sent to the accountability department for distribution throughout the district.

Attendance data were collected from the district's data warehouse and disaggregated and analyzed at the school level. Discipline data were also collected from the district's data warehouse but a statistical analysis could not be conducted.

The target group that was assessed was 670 students. Student identities were confidential and participants were guaranteed anonymity.

Analysis of the Data

The researcher used a causal comparative method since preformed groups of students were used. Assessment data, culled from standardized test results, were compared to determine whether or not students in single-sex settings achieve at significantly higher levels than students in coeducational settings. Also, attendance and discipline data were analyzed to determine if a single-sex setting significantly affects student attendance and behavior, which are factors in student achievement.

The paired-samples *t* test was the statistical procedure used to determine if there were significant differences between the experimental schools (single-sex girls, single-sex boys and single-sex classes in a coeducational school) which were treated as a group and the comparison schools which were also treated as a group. The effect of setting, single-sex or coeducational, in regard to achievement in reading and mathematics, attendance and discipline were measured and analyzed.

The assessments (pretest and posttest) that were administered to the students had face validity because they were developed and administered by the Ohio Department of Education to all students in Grades 3 through 8 across the state and used to measure student achievement and progress. The previously released posttests were reliable because they had reliability values above .7, ranging from .85 to .89. The items on these tests were field tested and item difficulty estimates were taken.

The results from the pretest and posttest were compared by grade level, gender, and grouping single-sex versus coeducational. Upon analysis of the data, it was

determined if students achieve at significantly higher levels in single-sex settings in comparison to coeducational settings. Additionally, a determination was made as to whether or not a single-sex configuration is significantly more advantageous to girls or to boys.

Table 7 explains the statistical analysis that was conducted.

Table 7

Statistical Analysis for Research Questions

Research Question	Analysis
1. Is the academic achievement (reading and mathematics) of students, by gender, significantly different in schools with single-sex settings compared to coeducational schools?	<ul style="list-style-type: none"> Paired-samples <i>t</i> tests were performed to compare reading and math pretest and posttest mean score percentages to determine if student achievement improved significantly. Independent-samples <i>t</i> tests were performed to determine if there were significant differences in achievement for students in single-sex or coed settings.
2. Is the attendance of students, by gender, significantly different in schools with single-sex settings compared to coeducational schools?	<ul style="list-style-type: none"> Compare mean attendance percentage rates by grade level, gender and school type. Use an independent-samples <i>t</i> test to compare mean attendance percentage rates of students assigned to single-sex and coed settings and determine if there are significant differences.
3. Is the discipline of students, by gender, significantly different in schools with single-sex settings compared to coeducational schools?	<ul style="list-style-type: none"> Discipline data were collected by the type (suspensions, expulsions and other) and number of incidents by school and not by individual student. Data can only be reported by building level and not by individual student level because they were not collected or disaggregated in a way that a good statistical analysis could be completed. This is a limitation.

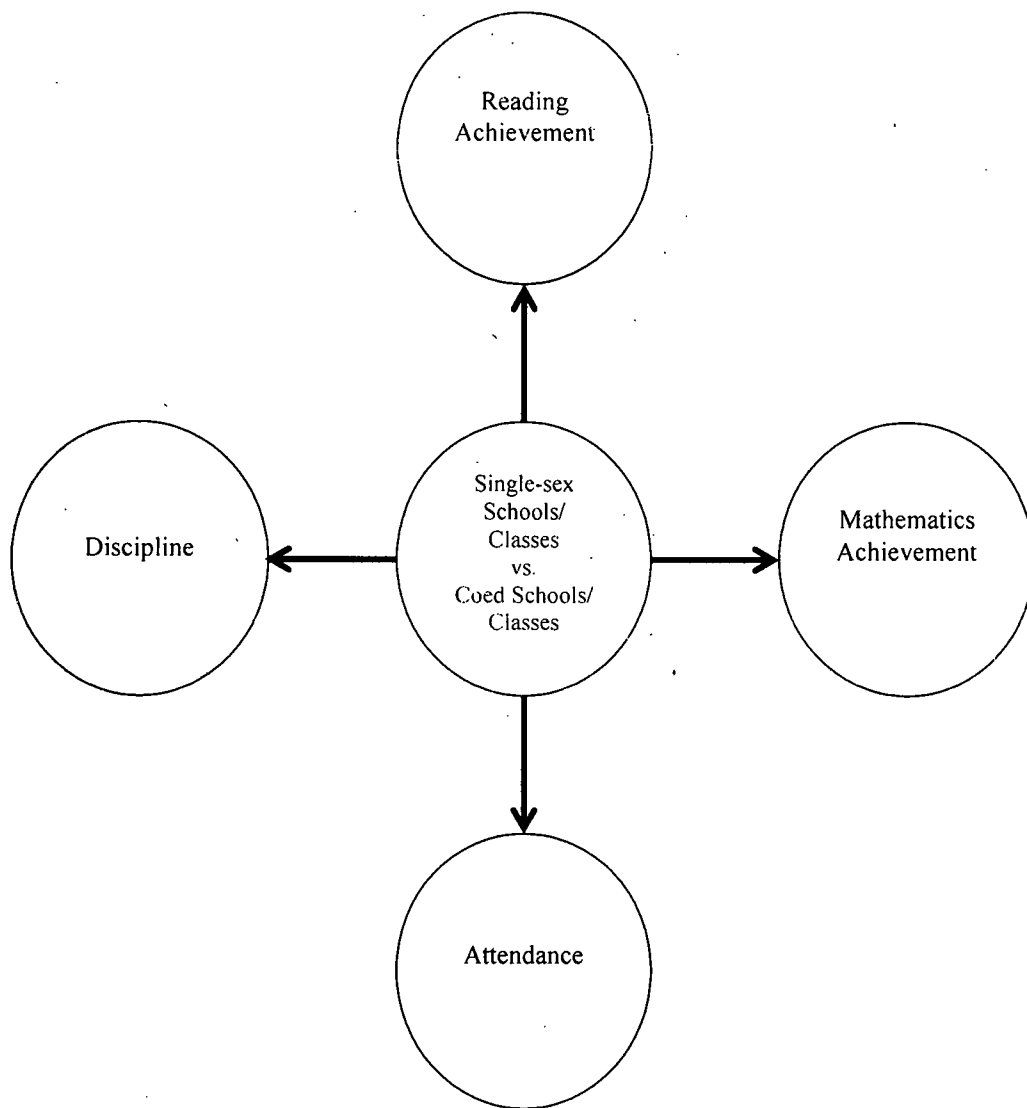


Figure 2. Effects of the Single-Sex Configuration versus Coeducational Configuration

Academic Achievement, Attendance and Discipline:

A Theoretical Framework

CHAPTER IV

REPORT OF FINDINGS

Introduction

The purpose of this study was to determine whether or not girls and boys in Dayton Public Schools achieve better academically, have fewer discipline issues and attend school more regularly in single-sex settings than students in coeducational settings. This chapter will describe the types of data that were collected and analyzed, the data set and the findings. Research questions and the analyses of academic achievement (reading and math), student attendance and student behavior are presented.

Research Questions

The three research questions addressed in this study were:

1. Is the academic achievement (reading and mathematics) of students, by gender, significantly different in schools with single-sex settings compared to coeducational schools?
2. Is the attendance of students, by gender, significantly different in schools with single-sex settings compared to coeducational schools?
3. Is the discipline of students, by gender, significantly different in schools with single-sex settings compared to coeducational schools?

Statistical Analyses

Several statistical analyses were performed to respond to the research questions. Descriptive statistics were completed to provide information about the data set including a description of the characteristics of the sample. Independent-samples *t*

tests were conducted to compare improvement in reading and math of students in single-sex settings with students in the coed setting. The chi-square test was run to determine if there was an association between gender and school type. Finally, paired-samples *t* tests were performed to assess improvement in reading and math from pretest to posttest for the different school types. Attendance was also analyzed with these statistical tests.

In this study the sample includes 670 Dayton public school students in Grades 3 and 4 from 9 elementary schools, 3 schools with single-sex programs, including a single-sex boys school, a single-sex girls school and a dual school that is coed with single-sex classes, and 6 schools with coeducational programs.

Table 5, which was previously introduced, describes the sample population by school, grade level and gender. Fifty-one percent of the total sample are males and 49% are females. The total number of students in the 3 single-sex program schools is 188 which is 28% of the total sample. Fifty-three percent of the students in the single-sex programs are females and 47% are males.

Tables 8 and 9 show the results of a chi-square test. This test was performed to determine if the distribution of genders across school types was disproportionate. Table 8 is the crosstabulation of gender and school type examining male and females in coed, dual and single-sex settings. Table 9 is the crosstabulation of gender and the single-sex school setting. The results of both comparisons indicate that the distribution of genders across school types was not significantly related.

Table 8

Chi-Square Test – Crosstabulation of Gender and School Type

Gender	School type			df	χ^2	Sig.
	Coed	Dual	Single-sex			
Female	229	36	63	2	3.26	0.1964
Male	253	41	48			

Table 9

Chi-Square – Crosstabulation of Gender and Single-sex School

Gender	Single-sex school		df	χ^2	Sig.
	No	Yes			
Female	229	99	1	1.44	0.2309
Male	253	89			

Table 10 describes the number of males and females in the sample population by school type. The dual school type refers to the coeducational school with single-sex classes which is school #112. This table shows that males and females are fairly equally distributed across the total sample with $N = 342$ males and $N = 328$ females. Therefore, 51.04% of the sample represents males and 48.95% represents females. Of all the males 73.97% are in coed schools and of all the females 69.81% are in coed schools. Girls outnumber boys in the single-sex school because the girls school was in operation one year prior to the opening of the boys school. Boys in the coed program outnumber boys in the single-sex and dual program by three to one. Girls in the coed program outnumber girls in the single-sex and dual programs by two to one.

Table 10

Number of Students by Gender for Sample Population by School Type

	Males	% Male	Females	% Female	Total
	Gr. 3 & 4	Pop.	Gr. 3 & 4	Pop.	
SS males	48	14.00	0	0.00	48
SS females	0	0.00	63	9.40	63
Dual	41	12.00	36	5.40	77
Coed	253	73.97	229	69.81	482
Total	342	51.00	328	49.00	670

Note: SS indicates single-sex schools, Gr. indicates grade level, pop. indicates population and dual indicates coed school with single- sex classes.

Mathematics and Reading Performance

To determine if the academic achievement (reading and mathematics) of students, by gender, is significantly different in schools with single-sex settings compared to coeducational schools both paired-samples t tests and independent-samples t tests were performed to examine performance in both mathematics and reading. The paired-samples t test examined pretest and posttest mean test scores to determine improvement.

The independent-samples t test tests group differences on the gain scores (post-pre). The value for the independent-samples t test was derived by subtracting the pretest scores from the posttest scores and arriving at a difference, which is the dependent variable.

Mathematics Performance

The tables that follow, Tables 11, 12, 13, and 14, outline the mean score percentages, as well as the paired-samples t values (which show a change from the pre to posttest) in math for males and females in Grades 3 and 4.

Table 11 indicates that third grade males in the dual configuration showed no improvement in their performance in math from the pretest to the posttest, in fact, their scores decreased. Boys in the coed setting scored significantly higher on the posttest when compared with the pretest. At the .001 level the difference in scores is very strong. The pre and posttest results for the single-sex boys and the coed boys were very similar, both significant at the .001 level.

Table 11

*Differences in Math Pretest-Posttest Scores among Grade 3 Boys in a Single-sex School, a Dual School and Coed Schools: Results of Paired-samples *t* tests*

Setting <i>df</i>	Pretest			Posttest			Mean <i>diff.</i>	<i>t</i>
	<i>M</i>	<i>SD</i>	(<i>N</i>)	<i>M</i>	<i>SD</i>	(<i>N</i>)		
Single-sex 20	36.86	12.02	(21)	53.02	16.03	(21)	16.16	5.73***
Dual 21	40.09	9.31	(23)	34.79	14.41	(21)	-5.30	-1.65
Coed 119	36.95	15.16	(128)	51.39	18.73	(120)	14.44	9.87***

Note: * = $p < .05$ *** = $p < .001$, superscript 'a' = equal variances not assumed.

Math scores are mean percentages. *SD* = the standard deviation. *N* = the number of students who took the test. Mean *diff.* = the difference between pre and posttest scores. *t* = if the mean difference between the pretest and posttest scores is significant. *df* = the degrees of freedom.

Table 12 shows that fourth grade males in all settings had a significant improvement in posttest scores in math at the .001 level. Boys in the single-sex setting had mean gains of almost 25 points. Boys in the coed setting had mean gains of over 22 points. Boys in the dual setting had mean gains of over 21 points.

Table 12

Differences in Math Pretest-Posttest Scores among Grade 4 Boys in a Single-sex School, a Dual School and Coed Schools: Results of Paired-samples t tests

Setting	Pretest			Posttest			Mean diff.	t	df
	M	SD	(N)	M	SD	(N)			
Single-sex	23.82	11.93	(27)	48.56	17.94	(26)	24.74	8.46***	25
Dual	17.59	9.48	(18)	39.27	17.65	(18)	21.68	7.33***	17
Coed	20.24	11.98	(125)	42.62	22.42	(118)	22.38	12.73***	117

Note: * = $p < .05$ *** = $p < .001$, superscript 'a' = equal variances not assumed. Math scores are mean percentages. *SD* = the standard deviation. *N* = the number of students who took the test. Mean diff. = difference between pre and posttest scores. *t* = if the mean difference between pretest and posttest scores is significant. *df* = the degrees of freedom.

Table 13 shows that third grade girls in all settings had significant improvement in their scores between the pre and posttests at the .001 level. Girls in the coed setting had mean gains of almost 15 points. Girls in the single-sex setting had mean gains of about 18 points. Girls in the dual setting had gains of almost 45 points.

Table 14 indicates that fourth grade girls in the single-sex and dual settings also showed significant improvement in their scores between the pre and posttests at the .001 level. Girls in the single-sex setting had mean gains of over 12 points. Girls in the dual setting had mean gains of over 20 points. Girls in the dual setting increased their mean gains by over 23 points.

Table 13

Differences in Math Pretest-Posttest Scores among Grade 3 Girls in a Single-sex School, a Dual School and Coed Schools: Results of Paired-samples t tests

Setting	Pretest			Posttest			Mean diff.	t	df
	M	SD	(N)	M	SD	(N)			
Single-sex	38.99	9.59	(36)	57.05	16.99	(36)	18.06	6.71***	35
Dual	31.25	9.06	(16)	75.84	24.87	(16)	44.59	7.84***	15
Coed	35.95	13.95	(101)	50.92	16.57	(96)	14.97	11.24***	95

Note: * = $p < .05$ *** = $p < .001$, superscript 'a' = equal variances not assumed. Math scores are mean percentages. *SD* = the standard deviation. *N* = the number of students who took the test. Mean diff. = the difference between pre and posttest scores. *t* = if the mean difference between pretest and posttest scores is significant. *df* = the degrees of freedom.

Table 14

*Differences in Pretest-Posttest Math Scores among Grade 4 Girls in a Single-sex School, a Dual School and Coed Schools: Results of Paired-samples *t* tests*

Setting	Pretest			Posttest			Mean diff.	<i>t</i>	<i>df</i>
	<i>M</i>	<i>SD</i>	(<i>N</i>)	<i>M</i>	<i>SD</i>	(<i>N</i>)			
Single-sex	28.27	8.44	(27)	40.56	14.18	(27)	12.2	5.26***	26
Dual	24.16	11.07	(20)	44.76	20.48	(20)	20.60	5.86***	19
Coed	20.44	9.43	(128)	43.68	20.67	(125)	23.24	14.13***	124

Note: * = $p < .05$ *** = $p < .001$, superscript 'a' = equal variances not assumed.

Math scores are mean percentages. *SD* = the standard deviation. *N* = the number of students who took the test. Mean diff. = the difference between pre and posttest scores. *t* = if the mean difference between pretest and posttest scores is significant. *df* = the degree of freedoms.

Tables 15, 16 and 17 outline the results of the independent-samples t test in math for girls and boys in Grades 3 and 4. This statistical test compares improvement from the pre to posttest across groups and determines if there are significant differences between math score gains between students in single-sex and coed settings. Improvement (gain scores) is computed by subtracting the pretest scores from the posttest scores.

Table 15 shows that third grade boys in the coed setting had greater improvement in math than boys in the single-sex setting. This improvement was statistically significant at the .05 level. Improvement for fourth grade boys in the single-sex setting was slightly greater than for boys in the coed setting; however the difference in improvement was not statistically significant. Math results for all boys show that boys in the coed setting had greater improvement than did boys in the single-sex setting, but the improvement was not statistically significant.

Table 15

Differences in Math Pre-Post Gain Scores of Boys in Single-sex Schools and Coed Schools: Results of Independent-samples t tests

Grade 3	<i>M</i>	<i>SD</i>	<i>df</i>	<i>t</i>
Boys in single-sex schools and classes	5.19	17.60		
Boys in coed schools	14.20	15.75	161	3.12*
Grade 4	<i>M</i>	<i>SD</i>	<i>df</i>	<i>t</i>
Boys in single-sex schools and classes	23.71	14.08	102.13 ^a	-.64
Boys in coed schools	21.95	18.73		
All boys Grades 3 and 4	<i>M</i>	<i>SD</i>	<i>df</i>	<i>t</i>
Boys in single-sex schools and classes	14.56	18.36		
Boys in coed Classes	18.04	17.69	323	1.56

Note: * = $p < .05$, superscript 'a' = equal variances not assumed.

Pre and post gain score results in math for girls in Grades 3 and 4 are outlined on Table 16. Third grade girls in the single-sex setting had greater improvement than did girls in the coed setting. The improvement was statistically significant at the .05 level. Fourth grade results indicate that girls in the coed setting had greater improvement than girls in the single-sex setting. Their improvement was statistically significant. Math results for all girls indicate that girls in the single-sex setting had greater improvement than did girls in the coed setting, but the difference in improvement was not statistically significant.

Table 16

*Differences in Math Pre-Post Gain Scores of Girls in Single-sex Schools and Coed**Schools: Results of Independent-samples *t* tests*

Grade 3	<i>M</i>	<i>SD</i>	<i>df</i>	<i>t</i>
Girls in single-sex schools and classes	26.22	21.99	71.948 ^a	-3.23*
Girls in coed schools	15.42	13.38		
Grade 4	<i>M</i>	<i>SD</i>	<i>df</i>	<i>t</i>
Girls in single-sex schools and classes	15.83	14.24		
Girls in coed schools	23.28	18.42	170	2.51*
All girls Grades 3 and 4	<i>M</i>	<i>SD</i>	<i>df</i>	<i>t</i>
Girls in single-sex schools and classes	21.29	19.34	318	-.67
Girls in coed Classes	19.87	16.85		

Note: * = $p < .05$, superscript 'a' = equal variances not assumed.

Table 17 compares math improvement of boys and girls in the single-sex setting. Third grade girls had greater improvement in their math scores than did third grade boys. The difference was statistically significant at the .001 level. Fourth grade boys in the single-sex setting had greater improvement than did girls in the single-sex setting. The difference in improvement was statistically significant.

Overall, results for all girls in the single-sex setting, compared to all boys in the single-sex setting showed statistically significant group differences at the .05 level with girls showing the greater improvement.

Table 17

*Differences in Math Pre-Post Gain Scores of All Boys and All Girls in Single-sex**Schools and Classes: Results of Independent-samples t tests*

Grade 3	<i>M</i>	<i>SD</i>	<i>df</i>	<i>t</i>
Girls in the single-sex school and classes	26.22	21.99	93	5.07***
Boys in the single-sex school and classes	5.19	17.60		
Grade 4	<i>M</i>	<i>SD</i>	<i>df</i>	<i>t</i>
Girls in the single-sex school and classes	15.83	14.24		
Boys in the single-sex school and classes	23.71	14.08	89	- 2.65*
All girls and boys Grades 3 and 4	<i>M</i>	<i>SD</i>	<i>df</i>	<i>t</i>
Girls in the single-sex school and classes	21.29	19.34	184	-2.43*
Boys in the single-sex school and classes	14.56	18.36		

Note: * = $p < .05$. *** = $p < .001$, superscript 'a' = equal variances not assumed.

Reading Performance

The tables that follow, Tables 18, 19, 20, and 21, outline the mean score percentages, as well as, the paired-samples *t* values (which show improvement from the pre to posttest) in reading for males and females in Grades 3 and 4.

Table 18 shows that in reading third grade boys in the single-sex setting scored significantly higher on the posttest when compared with the pretest at the .001 level. The mean difference in scores from the pretest to posttest was 35.83 points. Boys in the coed setting also scored significantly higher on the posttest with a mean score difference of 23.31 points. This difference was also significant at the .001 level. Boys in the dual setting scored higher on the posttest but the difference was small at 7.6 points. Although all boys improved on the posttest the improvement for boys in the single-sex and coed settings was significant.

Table 19 indicates that fourth grade boys in all settings scored higher on the posttest when compared with the pretest. Boys in the dual setting scored significantly higher on the posttest compared with the pretest with a mean difference in scores of 14.31 points. They had higher gains than boys in the single-sex and coed settings. Boys in the single-sex setting had smaller gains than boys in the other settings with a mean score difference of 2.75 points

Table 18

*Differences in Reading Pretest-Posttest Scores among Grade 3 Boys in a Single-sex School, a Dual School and Coed Schools: Results of Paired-samples *t* tests*

Setting	Pretest			Posttest			Mean diff.	<i>t</i>	<i>df</i>
	<i>M</i>	<i>SD</i>	(<i>N</i>)	<i>M</i>	<i>SD</i>	(<i>N</i>)			
Single-sex	21.11	12.43	(20)	56.94	19.62	(21)	35.83	9.17***	19
Dual	29.58	14.92	(23)	37.26	17.78	(23)	7.6	1.63	22
Coed	34.49	17.42	(122)	57.80	19.56	(121)	23.31	14.61***	114

Note: * = $p < .05$. *** = $p < .001$, superscript 'a' = equal variances not assumed.

Reading scores are mean percentages. *SD* = the standard deviation. *N* = the number of students who took the test. Mean diff. = the difference between pre and posttest scores. *t* = if the mean difference between pretest and posttest scores is significant. *df* = the degrees of freedom.

Table 19

*Differences in Reading Pretest-Posttest Scores among Grade 4 Boys in a Single-sex School, a Dual School and Coed Schools: Results of Paired-samples *t* tests*

Setting	Pretest			Posttest			Mean diff.	<i>t</i>	<i>df</i>
	<i>M</i>	<i>SD</i>	(<i>N</i>)	<i>M</i>	<i>SD</i>	(<i>N</i>)			
Single-sex	43.20	21.02	(27)	45.95	20.11	(25)	2.75	1.47	24
Dual	36.83	17.25	(18)	51.14	12.69	(17)	14.31	3.80*	16
Coed	34.91	18.31	(122)	43.91	23.45	(120)	9.00	5.17***	116

Note: * = $p < .05$. *** = $p < .001$, superscript 'a' = equal variances not assumed.

Reading scores are mean percentages. *SD* = the standard deviation. *N* = the number of students who took the test. Mean diff. = the difference between pre and posttest scores. *t* = if mean difference between pretest and posttest scores is significant.

df = degrees of freedom.

Table 20 shows that in reading third grade girls in all settings scored significantly higher on the posttest when compared with the pretest at the .001 level. Girls in the dual setting had higher gains than did girls in the single-sex and coed settings with a mean score difference from pre to post of 44.37 points. Girls in the single-sex setting had slightly higher gains than did girls in the coed setting. Overall, there was mean score improvement from pre to posttest for all girls.

Table 21 shows that fourth grade girls in the coed setting scored significantly higher on the posttest compared with the pretest at the .001 level. They had better improvement than did girls in the other settings with mean gains of over 10 points. Girls in the single-sex setting and dual setting had mean score differences from pre test to posttest but they were not significant. Girls in the single-sex setting had a mean score difference of almost 5 points and girls in the dual setting had a mean score difference of almost 3 points.

Table 20

*Differences in Reading Pretest-Posttest Scores among Grade 3 Girls in a Single-sex School, a Dual School and Coed Schools: Results of Paired-samples *t* tests*

Setting	Pretest			Posttest			Mean diff.	<i>t</i>	<i>df</i>
	<i>M</i>	<i>SD</i>	(<i>N</i>)	<i>M</i>	<i>SD</i>	(<i>N</i>)			
Single-sex	34.33	16.80	(36)	63.32	16.88	(36)	28.99	10.64***	35
Dual	34.20	15.70	(16)	78.57	20.07	(16)	44.37	9.25***	15
Coed	36.08	16.85	(99)	62.91	17.25	(100)	26.83	17.15***	97

Note: * = $p < .05$. *** = $p < .001$, superscript 'a' = equal variances not assumed.

Reading scores are mean percentages. *SD* = the standard deviation. *N* = the number of students who took the test. Mean diff. = difference between pre and posttest scores.

t = if the mean difference between pretest and posttest scores is significant. *df* = the degrees of freedom.

Table 21

*Differences in Reading Pretest-Posttest Scores among Grade 4 Girls in a Single-sex School, a Dual School and Coed Schools: Results of Paired-samples *t* tests*

Setting	Pretest			Posttest			Mean diff.	<i>t</i>	<i>df</i>
	<i>M</i>	<i>SD</i>	(<i>N</i>)	<i>M</i>	<i>SD</i>	(<i>N</i>)			
Single-sex	53.77	21.53	(27)	58.65	14.11	(27)	4.88	1.45	26
Dual	43.51	23.23	(20)	46.22	23.56	(20)	2.71	.70	19
Coed	36.86	18.57	(127)	47.26	19.14	(125)	10.40	5.94***	123

Note: * = $p < .05$. *** = $p < .001$, superscript 'a' = equal variances not assumed.

Reading scores are mean percentages. *SD* = the standard deviation. *N* = the number of students who took the test. Mean diff. = difference between pre and posttest scores.

t = if the mean difference between pretest and posttest scores is significant.

df = degrees of freedom.

Tables 22, 23 and 24 outline the results of the independent-samples t test in reading for girls and boys in Grades 3 and 4. This statistical test compares improvement from the pre to posttest across groups and determines if there are significant differences between the gain scores in reading of students in single-sex and coed settings. Improvement (gain scores) is computed by subtracting the pretest scores from the posttest scores.

Table 22 indicates that third grade boys in the coed setting showed improvement that was slightly better than the gains made by boys in the single-sex setting. The difference in gain scores was about 2 points. Fourth grade boys in the single-sex setting showed improvement that was slightly better than the gains made by boys in the coed setting. The difference was not significant. Reading results for all boys show that none of the hypothesized group comparisons showed statistically significant group differences.

Table 22

*Differences in Reading Pre-Post Gain Scores of Boys in Single-sex Schools and Coed Schools: Results of Independent-samples *t* tests*

Grade 3	<i>M</i>	<i>SD</i>	<i>df</i>	<i>t</i>
Boys in single-sex schools and classes	20.34	24.26		
Boys in coed schools	22.46	16.49	57.13 ^a	.53
Grade 4	<i>M</i>	<i>SD</i>	<i>df</i>	<i>t</i>
Boys in single-sex schools and classes	8.73	16.91	157	-.32
Boys in coed schools	7.79	16.28		
All boys Grades 3 and 4	<i>M</i>	<i>SD</i>	<i>df</i>	<i>t</i>
Boys in single-sex schools and classes	14.60	21.64		
Boys in coed schools	15.06	17.93	128.6 ^a	.17

Note: Superscript 'a' = equal variances not assumed.

Table 23 shows that third grade girls in the single-sex setting had greater improvement in reading than did their counterparts in the coed setting. The difference in pre-post gain scores was more than 6 points. Improvement was significant at the 0.5 level. Fourth grade girls in the coed setting showed greater improvement in reading than did girls in the single-sex setting, but the improvement was not statistically significant. The difference in pre-post gain scores was more than 6 points.

When comparing mean improvement for all girls in all grades, girls in the single-sex setting had slightly better improvement as evidenced by the difference in pre-post gain scores of almost 2 points. This difference was not statistically significant.

Table 23

*Differences in Reading Pre-Post Gain Scores of Girls in Single-sex Schools and Coed Schools: Results of Independent-samples *t* tests*

Grade 3	<i>M</i>	<i>SD</i>	<i>df</i>	<i>t</i>
Girls in single-sex schools and classes	33.72	18.52	148	-2.23*
Girls in coed schools	27.30	15.76		
Grade 4	<i>M</i>	<i>SD</i>	<i>df</i>	<i>t</i>
Girls in single-sex schools and classes	3.96	17.22		
Girls in coed schools	10.30	19.33	169	1.97
All girls Grades 3 and 4	<i>M</i>	<i>SD</i>	<i>df</i>	<i>t</i>
Girls in single-sex schools and classes	19.59	23.26	319	-.71
Girls in coed Classes	17.80	19.71		

Note: * = $p < .05$, superscript 'a' = equal variances not assumed.

Table 24 compares the improvement in reading of all girls in the single-sex program with all boys in the single-sex program. In the third grade, girls experienced greater improvement than boys. The difference in gain scores was 7 points. The difference was statistically significant at the .05 level. Fourth grade boys had slightly greater improvement than did fourth grade girls, but the difference was not statistically significant.

Overall, comparisons of girls in the single-sex program with boys in the single-sex program did not show statistically significant group differences.

Table 24

Differences in Reading Pre-Post Gain Scores of All Boys and All Girls in Single-sex Schools and Classes: Results of Independent-samples t tests

Grade 3	<i>M</i>	<i>SD</i>	<i>df</i>	<i>t</i>
Girls in the single-sex school and classes	33.72	18.52	93	3.05*
Boys in the single-sex school and classes	20.34	24.26		
Grade 4	<i>M</i>	<i>SD</i>	<i>df</i>	<i>t</i>
Girls in the single-sex school and classes	17.22	2.51		
Boys in the single-sex school and classes	16.92	2.61	87	- 1.32
All girls and boys Grades 3 and 4	<i>M</i>	<i>SD</i>	<i>df</i>	<i>t</i>
Girls in the single-sex school and classes	23.26	2.34	182	1.50
Boys in the single-sex school and classes	21.64	2.35		

Note: * = $p < .05$, superscript 'a' = equal variances not assumed.

Attendance

Table 25 outlines the attendance performance for the single-sex, dual, and coed school types. The data are reported by comparing school percentages and not individual student attendance. The percentages represent the average attendance for the entire school year. All schools had attendance rates over 93%. It should be noted that based on Ohio's accountability system one of the requirements to make Adequate Yearly Progress (AYP) on the state report card is to maintain an attendance rate of 93%. Schools strive to meet this requirement; therefore it is not surprising that all school types have attendance rates over 93%.

The single-sex girls school had the highest mean attendance rate at over 96%. The coed schools had the lowest mean attendance rate at just over 93%.

Table 25

*Mean Attendance Percentage Rates and Total Number of Students by School Types
(Single-sex, Dual and Coed)*

	Single-sex boys	Single-sex girls	Dual	Coed
<i>N</i>	48	63	77	482
Att.	.953	.965	.943	.935

Note: *N* = the number of students in each school type. Att. is the attendance rate in percent.

Table 26 outlines the results of the independent-samples *t* test of differences in mean attendance percentages for boys in the single-sex and coed settings. The table indicates that there were statistically significant group differences at the .05 level of mean attendance percentages when comparing all boys in the single-sex setting to all boys in the coed setting. Boys in the single-sex setting had the higher attendance percentage at over 94%.

Table 26

*Differences in Mean Attendance Percentages of Boys in Single-sex Schools and Coed Schools: Results of Independent-samples *t* tests*

Grade 3	<i>M</i>	<i>SD</i>	<i>df</i>	<i>t</i>
Boys in single-sex schools and classes	.9446	.05811	170	-1.22
Boys in coed Schools	.9302	.07024		
Grade 4	<i>M</i>	<i>SD</i>	<i>df</i>	<i>t</i>
Boys in single-sex schools and classes	.9467	.04159	124.14 ^a	-1.87
Boys in coed Schools	.9306	.06616		
All boys Grades 3 and 4	<i>M</i>	<i>SD</i>	<i>df</i>	<i>t</i>
Boys in single-sex schools and classes	.9456	.05016	208.58 ^a	-2.23*
Boys in coed Classes	.9304	.06812		

Note: * = $p < .05$, superscript 'a' = equal variances not assumed. *df* = degrees of freedom.

Table 27 outlines the results of the independent-samples t test of differences in mean attendance percentages for girls in the single-sex and coed settings. The table indicates that there were statistically significant group differences at the .001 level of mean attendance percentages when comparing all girls in the single-sex setting to all girls in the coed setting. Girls in the single-sex setting had the higher attendance percentage at over 96%.

Table 27

*Differences in Mean Attendance Percentages of Girls in Single-sex Schools and Coed Schools: Results of Independent-samples *t* tests*

Grade 3	<i>M</i>	<i>SD</i>	<i>df</i>	<i>t</i>
Girls in single-sex schools and classes	.9579	.04091	130.88 ^a	-2.02*
Girls in coed schools	.9420	.05443		
Grade 4	<i>M</i>	<i>SD</i>	<i>df</i>	<i>t</i>
Girls in single-sex schools and classes	.9673	.04039	115.8 ^a	-2.91*
Girls in coed schools	.9411	.05713		
All girls Grades 3 and 4	<i>M</i>	<i>SD</i>	<i>df</i>	<i>t</i>
Girls in single-sex schools and classes	.9607	.05583	251.73 ^a	-3.48***
Girls in coed classes	.9415	.04056		

Note: * = $p < .05$, *** = $p < .001$, superscript 'a' = equal variances not assumed.

df = degrees of freedom.

Table 28 outlines the results of the independent-samples *t* test of differences in mean attendance percentages for all girls in the single-sex and all boys in the single-sex setting. The table indicates that there were statistically significant group differences at the .05 level of mean attendance percentages when comparing all girls in the single-sex setting to all boys in the single-sex setting. Girls in the single-sex setting had the higher attendance percentage at over 96%.

Table 28

*Differences in Mean Attendance Percentages of All Boys and All Girls in Single-sex**Schools: Results of Independent-samples *t* tests*

Grade 3	<i>M</i>	<i>SD</i>	<i>df</i>	<i>t</i>
Girls in the single-sex school and classes	.9579	.04091	75.441 ^a	127
Boys in the single-sex school and classes				
Grade 4	<i>M</i>	<i>SD</i>	<i>df</i>	<i>t</i>
Girls in the single-sex school and classes	.9637	.04039	90	1.99*
Boys in the single-sex school and classes	.9467	.04159		
All girls and boys grades 3 and 4	<i>M</i>	<i>SD</i>	<i>df</i>	<i>t</i>
Girls in the single-sex school and classes	.9607	.04056	169.33 ^a	2.24*
Boys in the single-sex school and classes	.9456	.05016		

Note: * = $p < .05$. *** = $p < .001$, superscript 'a' = equal variances not assumed.

df = degrees of freedom. Single-sex combines students in the single-sex setting with students in the dual setting.

Discipline

A limitation of this study is that discipline data were not collected or reported by individual student but collected and reported by building level. Table 29 outlines the number of suspensions, expulsions and other discipline types per 100 students.

The information presented on Table 29 indicates that most of the coed schools had more discipline incidents than the single-sex and dual schools except in the case of coed school #106 which had no reported discipline incidents. Coed school #138 had the most discipline incidents at 25.5 per 100 students. Since there are more discipline problems in larger schools than smaller schools, this finding is not surprising (Borland & Howsen, 2003; Deutsch, 2003; Winbinger, Katsiyannis, & Archwasmety, 2000).

Table 29

*Number and Percent of Discipline Infractions Including Suspensions and Expulsions
for Single-sex, Dual and Coed Schools*

School	Type	#Stud.	#Susp. 07/08	#Expul. 07/08	Total	Disc. per 100
#180	Single- sex girls	207	0	0	0	0.0
#181	Single- sex boys	150	1	1	2	0.7
#112	Dual	334	0	5	5	1.5
#103	Coed	440	7	3	10	2.3
#106	Coed	385	0	0	0	0.0
#109	Coed	434	7	8	15	3.5
#129	Coed	495	79	14	93	18.8
#138	Coed	538	130	7	137	25.5
#146	Coed	419	0	4	4	1.0

Note: Stud. = student. Susp. = suspensions. Expul. = expulsions.

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

This chapter presents a summary of the study, a discussion of the findings and conclusions related to the three research questions based on the analysis of data in chapter 4. Recommendations for school and district administrators and policymakers who may be interested in establishing single-sex programs will be presented. Also included are suggestions for additional research.

Summary of Study

Single-sex education is an initiative that is taking root in the United States and in many countries around the world as a possible solution to closing the racial and gender gap that has emerged where boys lag behind girls academically and minority boys are falling even further behind their counterparts (Clark, 2004; Gurian, 2006; King & Gurian, 2006; Kafer, 2007; Machin & McNally, 2005; Sommers, 2000a; Warrington & Younger, 2000). Single-sex education refers to school structures where boys and girls attend school exclusively with members of their own gender in order to enhance opportunities to maximize their academic and social strengths. The gender separation can occur in self-contained schools where an entire school is dedicated to teaching boys or girls in a separate environment. The dual school structure is a coeducational setting where classes are separated by sex.

Although there have been several research studies conducted on single-sex education, findings are inconclusive about the benefits of single-sex education, thus fueling the debate about the effectiveness of educating boys and girls separately (Mael, Alonso, Gibson, Rogers, & Smith, 2005; Bracey, 2006). Advocates exist on

both sides of the debate; those favoring single-sex programs and those favoring the traditional structure of coeducation are both prominent in the literature.

The purpose of this quantitative study was to determine whether or not girls and boys achieve better academically, have fewer discipline issues, and attend school more regularly in single-sex settings than students in coeducational settings. This study examined and evaluated the single-sex program that was created and developed in Dayton Public Schools with the opening of a girls school and the conversion of a coed school to a dual setting in August 2005 and continuing in August 2006 with the opening of a boys school. The impetus for creating these schools stemmed from the declining achievement of minority students who for the most part lived in poverty. The school board and administration considered various reform initiatives and in fact implemented such programs as the prekindergarten through eighth grade configuration, Montessori and programs in the arts in order to provide choice for parents and alternative educational opportunities. Although these choice options had some degree of success the goal was to experiment with a structure that might provide more systemic and widespread academic improvement. The school board and administration believed that single-sex education could be a viable option to improve the academic achievement of many more students.

The school board and administration decided to implement single-sex programs at the elementary school level because it was their belief that it was necessary to provide a strong foundation for students. This was quite different from other school systems nationally that chose to implement single-sex education at the middle and high school levels as a response to growing achievement and gender gaps. The goal

in Dayton was to establish the single-sex schools early in the child's education career so the "achievement gap" could be mitigated if not eliminated.

The opening of the first single-sex girls school in August 2005 with kindergarten, first and second grades generated a lot of excitement and hope in Dayton. The school's principal was selected by a committee and, in turn, the principal was able to handpick her staff. Professional development was provided that focused on how girls learn with some emphasis on the content of reading, math and science since one of the goals of the girls school was to create interest in math, science and technology areas where girls did not traditionally excel. Parents who selected the girls school for their daughters were in effect pioneers because this was such a new and innovative idea for the school district and for the region. The parents were drawn to the academic possibilities and an environment free of boy distractions.

A boys school opened the following school year, also with considerable enthusiasm. The principal was also selected by a committee. He had the opportunity to select staff for the school, but found it difficult to attract male teachers. As a result, the boys school was staffed mostly with a female faculty even though it was difficult to find female teachers who wanted to teach boys. Parents who chose the boys school were mostly single mothers who wanted their sons exposed to male role models and a disciplined environment. In their minds education was important, but the promise of positive male role models, structure and discipline were even more important. The boys school was established with grades prekindergarten through Grade 3 to be on par with the girls school. Professional development was offered but not with the

consistency it was offered at the girls school. The focus was on how boys learn and less on teaching content initially.

Both the boys school and the girls school had the full support of the school board and administration since they were part of the original plan to provide these schools as a choice option for parents. Support included providing additional instructional materials, facilities upgrades and funding to support professional development.

The dual school provided a coeducational setting with single-sex classes. The inception of this structure was very different from that of the girls and boys schools although the intent to improve educational outcomes for students was the same. The dual school was originally a coed school. Based on a review of assessment data the principal felt that the single-sex configuration would be beneficial to students in the school. She made this decision after participating in all the professional development sessions afforded to the girls school faculty. She bought into the concept and decided that she would move her school to single-sex classrooms during the same school year that the girls school opened in August 2005; however, the change took place later in the fall. The difficulty with implementing a single-sex program at the dual school was that the faculty did not buy in immediately to the concept nor did the parents. The administration supported the principal's efforts by making professional development available and by suggesting that there be a coed class on every grade so that parents still had the opportunity to choose a coed class for their children. Initially, there were coed classes on each grade in addition to the single-sex classes but soon all classes transitioned to the single-sex structure. Teachers were assigned to classes. In some instances teachers were not pleased with their assignments.

In this study, these three single-sex programs, the single-sex girls school, the single-sex boys school and the dual school, were compared to six similar coed schools from the Dayton city school district to determine if there were significant differences in student achievement and performance between the single-sex setting and the coed setting. It was difficult to identify schools similar to the experimental schools because the single-sex schools were so different in structure and size from the coed schools; however, this was not the case for the dual school. The dual school was probably more similar to the coed schools than it was to the single-sex schools since when the study was initiated the innovation was so new.

Single-sex education in its current form is a relatively new initiative in the public sector spurred on by the changes in Title IX legislation and the call for innovation brought on by NCLB. The literature review (chapter 2) in this study summarized the most current research examining the efficacy of single-sex education. History, legislation and gender equity issues were explored in relationship to the gender gap and student achievement (Bracey, 2006; Brown & Russo, 1999; Lee & Bryk, 1986; Wiens, 2006). The effectiveness of single-sex programs was compared to coed programs in the literature (Trickett, Trickett, Castro, & Schaffner, 1982; Younger & Warrington, 2006). In addition, the new science of brain-based and cognitive gender differences was reviewed (Gurian, 2006; Sax, 2005; Wiens, 2006). Finally, the effects of single-sex education on behavior, discipline, and attendance were examined (Fjortoft, 2005; Vail, 2002; van der Westhuizen, Oosthuizen, & Wolhuter, 2008).

The literature review provides a variety of viewpoints regarding the effects of single-sex settings on the academic achievement, attendance and behavior of boys and girls. At the very least the reviews are mixed. Some researchers find the structure to be beneficial to students (Gurian, 2006; Sax, 2005) while others found both benefits and drawbacks to the single-sex environment (Kruse, 1996; Marks, 2002; Van de gaer et al., 2004).

To determine if the single-sex structure benefitted students in the 3 experimental schools in Dayton Public Schools, academic achievement (reading and mathematics), attendance and discipline were the factors studied to determine if there were significant differences in single-sex and coed settings. Data were collected and compared to determine if males or females performed and achieved better in a single-sex setting.

To evaluate and measure improved achievement and performance students in both the single-sex and coed schools were administered a pretest and posttest in reading and mathematics. The tests that were used were practice and previously released tests from the Ohio Department of Education. These tests were used district wide to measure improvement in reading and math. The paired-samples *t* test was the statistical analysis used to compare the mean differences of the pretest and posttest scores within groups. The independent-samples *t* test was the statistical analysis used to compare improvement across groups.

Behavior, discipline and attendance play a critical role in students' motivation and academic success (Fjortoft, 2005; van der Westhuizen, Oosthuizen, & Wolhuter, 2008). The number and type of discipline infractions and whether or not students

attend school regularly are factors that can impact, either positively or negatively, the performance and achievement of students. These factors may also indicate whether or not students have built positive relationships with other students and staff in their school settings (Davies & Lee 2006; Hubbard & Datnow, 2005). For this study, both discipline and attendance data were included as measures of program effectiveness. The independent-samples *t* test was used to determine if there were statistically significant group differences. Comparisons were made between single-sex and coed schools to determine which setting had fewer discipline infractions.

Findings

Three questions were addressed in this study:

1. Is the academic achievement (reading and mathematics) of students, by gender, significantly different in schools with single-sex settings compared to coeducational schools?
2. Is the attendance of students, by gender, significantly different in schools with single-sex settings compared to coeducational schools?
3. Is the discipline of students, by gender, significantly different in schools with single-sex settings compared to coeducational schools?

Academic Achievement in Math

Two statistical analyses were performed to determine if academic achievement in math was significantly different for students, by gender, in single-sex settings compared to the coed setting. The paired-samples *t* test was the statistical analysis used to compare the mean differences of the pretest and posttest scores within groups in math. The independent-samples *t* test was the statistical analysis used to compare

improvement across groups in math. Table 30 summarizes the statistically significant findings of the paired-samples *t* test performed on math results.

Table 30

Summary of Statistically Significant Mean Pretest-Posttest Differences in Math
($p < .001$) by Setting and Grade Level

Setting	Grade 3	Grade 4
Single-sex boys	***	***
Dual boys		***
Coed boys	***	***
Single-sex girls	***	***
Dual girls	***	***
Coed girls	***	***

Note: *** statistically significant findings at the $p < .001$ level from paired-samples *t* tests

The results of the paired-samples t tests in math indicated that third grade boys in the single-sex and coed settings scored significantly higher ($p < .001$) on the posttest when compared with the pretest. The pre-post results for boys in the single-sex setting and boys in the coed setting were similar.

Fourth grade boys in the single-sex, dual, and coed settings scored significantly higher ($p < .001$) on the posttest in math when compared with their pretest scores. The math results for third and fourth grade boys show that none of the hypothesized group comparisons showed statistically significant group differences with the exception of the third grade boys in the dual setting who had a 5 point mean score decrease. All other groups of boys had significant increases in mean scores in math from the pre to post test. There may be no clear advantage to being in a particular setting since all students realized increased achievement in math.

The results of the paired-samples t test in math indicated that third grade girls in all settings scored significantly higher ($p < .001$) on the posttest in math when compared with the pretest so they all experienced improvement. Girls in the dual setting had the greatest gains.

Significance levels for fourth grade girls were also at the .001 level for all groups. All fourth grade girls had mean score gains on the posttest as compared with the pretest. Girls in the coed setting made the greatest gains. Third and fourth grade girls in all settings experienced significant mean score gains in math based on the results of the posttest as compared to the pretest.

Since there were mean score gains for boys and girls in all settings there may be factors other than school setting responsible for the improvement. Students'

familiarity with the test format and types of questions on the test could lead to improvement. The use of a common curriculum, pacing guides and adherence to state standards and indicators which were used by teachers to provide instruction could also be responsible for an increase in mean score gains across the board. Maturation could also be a factor, meaning that during the passage of time between the pretest and posttest certain biological or psychological processes varied that could affect performance which is not associated with the setting.

The independent-samples *t* test was performed on math results. It compared improvement across groups. This test indicated that there were no statistically significant differences in improvement between boys in the single-sex and coed settings or between girls in the single-sex and coed settings. Comparing improvement between girls and boys the results indicated that girls in the single-sex setting had greater improvement in math than did boys in the single-sex setting, but the difference in improvement was only significant at the .05 level.

In summary, all groups, boys and girls in single-sex, dual and coed settings, improved their mean score gains in math. Additionally, girls in the single-sex setting had greater improvement than boys in the single-sex setting. This is an interesting finding since it may be contrary to some research found in the literature (Gurian, 2006). Some researchers believe that because the right side of boys' brains develops faster than girls', they have stronger visual-spatial skills and as a result of this, they perform better in the area of mathematics.

Academic Achievement in Reading

As with math results the paired-samples *t* test and the independent-samples *t* test were performed on reading data to determine if academic achievement was significantly different for students in single-sex settings compared to students in coed settings. Mean differences of pretest and posttest scores were compared. Improvement in achievement across groups was also compared. Table 31 summarizes the statistically significant findings of the paired-samples *t* test performed on reading results.

The results of the paired-samples *t* tests in reading indicated that third grade boys in all settings had mean score differences that were higher on the posttest compared with the pretest. Boys in the single-sex setting had the greatest mean difference. Third grade boys in both the single-sex and coed settings had significant mean score differences ($p < .001$) from the pre to posttest.

Although all fourth grade boys had mean score differences that were higher on the posttest compared with the pretest, boys in the coed setting had a difference between pre and posttest scores that was statistically significant ($p < .001$).

Overall, boys in all settings had mean score increases from the pretest to posttest in reading. There was a range of mean score increases that could have been influenced by several factors. The quality and type of direct reading instruction students received was a factor that could influence results. The amount of reading students did in school and independently could affect reading performance and achievement. Whether or not students viewed the testing situation as being important could affect how students approached the task and if they did their best. Finally

students' level of familiarity with the test format and items could be responsible for how well they performed on the test.

Table 31

Summary of Statistically Significant Mean Pretest-Posttest Differences in Reading ($p < .001$) by Setting and Grade Level

Setting	Grade 3	Grade 4
Single-sex boys	***	
Dual boys		
Coed boys	***	***
Single-sex girls	***	
Dual girls	***	
Coed girls	***	***

Note: *** statistically significant findings at the $p < .001$ level from paired-samples t tests

The results of the paired-samples *t* tests in reading indicated that third grade girls in all settings scored significantly higher ($p < .001$) on the posttest in reading when compared with the pretest so they all experienced improvement. Girls in the dual setting had the greatest gains. The reading performance of third grade girls was similar to their math performance where they had significant improvement from the pretest to posttest ($p < .001$).

The pretest-posttest mean score differences in reading of fourth grade girls showed some improvement. Girls in the coed setting had the greatest mean score gains on the posttest as compared with the pretest which was statistically significant ($p < .001$).

A surprising finding is that fourth grade girls had greater mean score increases from the pretest to posttest in math than they had in reading. This finding is contrary to the literature that suggests that girls perform better with language activities than with math activities (Gurian, 2006; Ping & Weiling, 2002). The expectation would be that girls would have greater improvements, pre to posttest, in reading. A possible explanation for this result is that there was a focus in the school district to improve math performance across all schools and all grades. There was a particular emphasis on improving students' math skills and performance at both the single-sex and dual schools because historically in the district and also in the literature girls did not perform well mathematically, often failing to meet established grade level goals. The purpose of the schools was to improve student outcomes particularly in the areas that had been traditionally viewed as lacking.

The independent-samples *t* test was performed on reading results. It compared improvement across groups. This test indicated that for all the boys and girls in the study there were no statistically significant differences in improvement.

Comparing improvement in reading between girls and boys the results indicated that there were no statistically significant differences in improvement.

In summary, all groups, boys and girls in single-sex, dual and coed settings, improved their mean score gains in reading. Improvement was not as statistically significant as the improvement in math. Additionally, girls in the single-sex setting did not have statistically significant improvement in reading compared to boys in the single-sex setting. This finding may be contrary to research that suggests that girls read better than boys because the left side of their brain develops faster and is stronger than boys (Gurian, 2006). It would be expected that girls would perform significantly better than boys in reading but that was not the case.

Attendance

The results of the independent-samples *t* test performed on attendance data indicated that schools with single-sex programs in Dayton Public Schools had a higher mean attendance percentage than the comparison coed schools. Schools with girls in the single-sex setting were the only ones that had a statistically significant mean attendance percentage at the .001 level.

Comparing the differences in mean attendance percentages of all boys with all girls in schools with single-sex settings the finding is that at the .001 level there were no statistically significant differences.

The single-sex setting appeared to have a positive effect on student attendance, especially for girls. The findings would suggest that it may be beneficial to attend a single-sex program in terms of attendance. This finding was consistent with some research: Single-sex school officials reported a rise in attendance and an improvement in attitude for students attending single-sex schools (Vail, 2002).

Discipline

Discipline data could not be disaggregated in order to perform statistical analyses. What is reported in this study is the number, percent per 100 students and types of discipline infractions reported by school rather than by individual students. School-wide data indicated that there were fewer infractions in the schools with single-sex programs than in the coed schools with one exception. Coed school #106 had no discipline infractions. This may be the case because this school was involved in a positive behavior project for a number of years which contributed to a decline in discipline infractions and referrals. Overall, the researcher's findings suggest that incidents of student misbehavior may decline in single-sex classrooms; however, it is difficult to know where the significant variable was, single-sex schooling or smaller student population. More research is needed on this topic.

Although statistical analyses were not performed on discipline data, what can be noted is that there were more discipline infractions in the coed schools. There may be several explanations for this phenomenon. For example, the coed schools are larger and school size does influence the number of discipline infractions. Schools with single-sex programs usually have fewer students and smaller class size.

Conclusions

Single-sex education is an innovation that is relatively new in the public sector. There has been limited research conducted to find out if single-sex education can make a difference in student achievement, attendance and discipline as compared to the coeducational setting. This is especially true at the elementary school level. Findings from the research have been mixed with no evidence that single-sex education is either beneficial or harmful (Bracey 2006; Marks, 2002).

This study sought to determine if single-sex education in Dayton Public Schools made a difference in student achievement, attendance and discipline advanced the hypothesis that this reform initiative does make a positive difference for students as compared to the coed setting. The findings of this study did not support the hypothesis in regard to student academic achievement in math and reading. The findings indicated that there was no clear relationship or advantage between the single-sex setting and improved achievement and performance as compared to the coed setting. The results were mixed as evidenced by the fact that there were some statistically significant results that favored the single-sex setting in some areas, some that favored the coed setting and some that showed no difference. Van de gare et al. (2004) had a similar hypothesis for a study they conducted and had findings that were similar to those in this study.

The results of the paired-samples *t* test in math showed that at the .001 level boys and girls in both the third and fourth grade had significant improvement from the pre to posttest in all settings except in the instance of third grade boys in the dual setting who had a slight decrease from the pre to posttest. In reading, third and fourth grade

boys and girls in the coed setting had significant improvement from the pre to posttest at the .001 level, as did third grade boys in the single-sex setting and third grade girls in the single-sex and dual settings. Again, findings were mixed.

The independent-samples *t* tests showed that all groups improved in math and reading, but the improvements were not significant. The only exception was that third grade girls had significant improvement in math at the .001 level. There were no significant differences in improvement comparing boys and girls in math and reading. These findings were consistent with studies that suggest that single-sex configurations may not be beneficial to everyone (Marks, 2000; Signorella, Frieze, & Hershey, 1996).

Attendance findings suggested that students in single-sex settings have higher mean attendance rates than students in coed settings with girls in single-sex settings having a higher mean attendance rate than boys in single-sex settings.

As reported previously, statistical analyses were not performed on discipline data since they were not collected at the student level but school-wide data suggest that there were fewer discipline infractions in schools/classrooms that had single-sex programs.

The single-sex education approach did appear to have positive influence on student attendance and even student behavior, factors that are related to enhanced achievement (e.g., Fjortoft, 2005; Vail, 2002).

There may be several factors that are possible explanations for why the single-sex setting compared with the coed setting did not produce the expected outcomes or show statistically significant group differences in achievement (math and reading).

One explanation may be that the single-sex program was studied for only one year, which might not have been enough time for the program to take root before it was evaluated. Also, the pretest was administered in August of 2007 and the posttest in February 2008. This may not have been enough time to measure improvement.

There are many variables that can affect student achievement and performance on tests; namely, student test anxiety, testing conditions, comprehensiveness of test preparation, any physical limitations that students may have, and the seriousness with which students and teachers approached the testing situation. The degree to which any of these variables were in place could affect math and reading test results.

Teachers are an integral part of developing a single-sex program that is successful. First, teachers must commit to wanting to teach in a single-sex environment. In the case of the dual school teachers did not have an option. They were placed with either a boy or girl class. Assignments were not based on teacher preference. Secondly, professional development would be key to ensuring that teachers understood the nuances of teaching boys and girls (Bracey, 2006) and structuring classroom settings conducive to their learning. Although professional development was provided, there may not have been enough opportunities available to teachers prior to the inception of the single-sex program. Without enough preparation teachers may not have been able to make substantive curricula modifications needed in single-sex classrooms. An ongoing, comprehensive training program would help teachers to understand how to structure their classrooms, develop lesson plans, differentiate instruction and use a variety of strategies and delivery

techniques in a single-sex setting. The ultimate goal would be to help teachers understand how to provide single-sex education.

A more concerted effort needed to be made to attract male teachers to the boys school. In the literature review the feminization of schools was a problem for boys. Having an all boys school with a mostly female staff could be a detriment to the boys.

Due to the nature of schooling it was not possible to randomly assign students to single-sex schools for two reasons. First, the boys school and girls schools were "choice" options. Secondly, it would be illegal to assign the students to a single-sex school. Without random assignment it is difficult to separate the effects of single-sex education from other variables such as, family background, motivation, teacher quality, school climate, and prior learning (Bracey, 2006).

Finally, single-sex education is an innovative reform model that still needs refinement. Implementation of such an initiative requires thoughtful, long-term planning, research, collaboration with stakeholders, and continuous support.

Implications for Practice

Dayton Public Schools implemented a single-sex program as a reform initiative with the intent to improve the academic outcomes of students and to respond to the growing achievement and gender gap that is becoming more prevalent for students of color and males in particular. Although findings of this study indicated mixed results, there are several implications for practice that could be useful to teachers, parents, administrators and policymakers.

The realization that there are many factors that affect student achievement is important to how strategies are identified to close the existing achievement/gender

gap. It is critical that all options are considered since students learn differently and choice must be available to respond to these differences. At the same time all options are not necessarily beneficial to all students. Before any innovation is attempted in a school system, it is important to identify the goals, expected outcomes, resources, training needs, and how success would be measured.

The results of this study suggested a need to improve the content of professional development offered to administrators and teachers whether they are in single-sex or coeducational schools. Teachers must be required to use a variety of strategies and delivery techniques to reach every child. They must understand the role that gender differences may have on students' strengths and weaknesses in order to provide diverse learning opportunities. Administrators must also be knowledgeable about these differences so that they can ensure that the necessary resources are available that support student learning.

Study findings suggested that students, both boys and girls, made greater gains in math than reading. More research needs to be conducted to find out what made the difference. Curricula modifications may be necessary to adapt the sequence of skills development based on when boys and girls are maturationally ready. Also, schools need to do a review of materials to ensure that there is a variety that will meet the specific needs of girls and boys.

Any new innovation requires time to take hold and single-sex education is no exception. Implementing single-sex initiatives may require a culture shift. All involved must become knowledgeable about the initiative, embrace the possibilities, and be open to experimentation.

The mixed results of this study might suggest that perhaps increased student achievement is not what should be measured in the short-term to determine if single-sex education is successful. For this reason quantitative methods together with qualitative methods might lead to a more robust study.

Recommendations for Future Research

Four recommendations for future study come to mind. The first of these is to conduct a longitudinal study using both qualitative and quantitative methods examining the benefits of the single-sex setting. There is some indication from previous research that students in single-sex settings tend to be more motivated, have better attitudes about school, have fewer distractions and build more positive relationships with their peers and teachers. Using qualitative methods would capture the affective aspects of single-sex programming. Studying students over time, specifically during the elementary school years, could reap valuable benefits by providing a roadmap for schools to follow in order to close the achievement/gender gap. Conducting interviews with students, teachers and parents, observing classroom instruction and examining student work in single-sex schools, and reviewing test scores could provide evidence of whether or not single-sex education makes a significant difference in student achievement.

A second recommendation is to study the teaching methods and strategies employed by teachers who instruct in single-sex girls schools, single-sex boys schools and coed schools to determine if there are significant differences in "delivery" techniques. Are teachers adjusting their teaching methods based on what they know about how boys and girls learn? Are they differentiating the curriculum and

identifying what strategies work for which group of students? These types of questions need to be addressed more directly by researchers.

Third, since school systems are implementing single-sex education in either of two ways (i.e., self-contained schools with either boys or girls or dual schools which are coed with classes separated by sex), it would be important to know if there are better results within the self-contained or dual setting contexts. Conducting a study comparing the two settings might provide more insight into how best to educate boys and girls.

The final recommendation which is derived from the findings of this study is that before any school system embarks on implementing a single-sex program whether that is single-sex schools or single-sex classes it must give thoughtful consideration to the following questions in shaping its program:

- What are the goals of the program and expected outcomes?
Specifically: Improved academic achievement? Gender equity?
Adjusting to brain differences?
- What challenges could prevent a single-sex program from being successful?
- Is there buy-in and support for the single-sex education approach from administrators, faculty, parents, and students?
- What would be the components of a comprehensive professional development program for single-sex programming? How will it be implemented and how would success be measured?

- What scientifically-based research informs the development of single-sex programs?
- Can the same goals and outcomes be achieved in a differentiated, learner-focused coeducational environment? If they can, what is the rationale for implementing a single-sex program?

Although the results of this study were mixed regarding achievement in math and reading as evidenced by the fact that there were some statistically significant results that favored the single-sex setting in some areas, some that favored the coed setting and some that showed no difference, there was evidence that the approach did appear to have a positive influence on student attendance and behavior. Because student attendance and behavior are related to enhanced achievement (e.g., Fjortoft, 2005; Vail, 2002), it would appear efficacious to continue to explore the single-sex school option for students.

Single-sex education will continue to have advocates and detractors until more research is conducted to answer the question "Do single-sex schools improve student achievement and performance significantly more than coed schools?"

Appendix

Description of Ohio Department of Education Assessments

The tests used to assess students in math and reading were obtained from the Ohio Department of Education Assessment System. Practice tests were used for the pretest administered in August 2007. Previously released tests were used for the posttest which were administered in February 2008.

Math

The third grade practice test, *Ohio Assessment System Mathematics Practice Test, March, 2005*, used as the pretest had 20 items including 17 multiple choice questions and three short answer questions. The fourth grade test, *Ohio Assessment System Mathematics Practice Test, March 2005*, had 19 multiple choice items and 1 extended response item.

The *Ohio Achievement Test Grade 3, March 2005, Previously Released Mathematics Test*, was used as the posttest. It had 28 multiple choice items and three extended response items on the third grade test. The *Ohio Achievement Test Grade 4, March 2006, Previously Released Mathematics Test*, used as the posttest had 40 items including six short answer questions and two extended response questions.

Reading

The *Ohio Assessment System Grade 3 Reading Practice Test*, used as the pretest, had 20 questions, 17 of which were multiple choice and three were short answer. The *Ohio Assessment System Grade 4 Reading Practice Test*, had 20 questions including four short answer questions.

The *Ohio Achievement Test Grade 3 March 2005 Previously Released Reading Test*, used as the posttest had 42 questions including 32 multiple choice, eight short answer questions and two extended response questions. The *Ohio Achievement Test Grade 4 March 2005 Previously Released Reading Test*, had a total of 37 items with 29 multiple choice questions, six short answer questions and two extended response questions.

Access to the Tests

All of the tests used in this study are available at the Ohio Department of Education website: www.ode.oh.us

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