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A Comparison of the Effect of Single-Sex Versus Mixed-Sex Classes on Middle School Student Achievement

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**A COMPARISON OF THE EFFECT OF SINGLE-SEX VERSUS MIXED-SEX
CLASSES ON MIDDLE SCHOOL STUDENT ACHIEVEMENT**

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Dissertation submitted to the Faculty of the
Marshall University Graduate College
in partial fulfillment of the
requirements for the degree of

Doctor of Education
in
Educational Leadership

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ABSTRACT

A Comparison of the Effect of Single-Sex Versus Mixed-Sex Classes on Middle School Student Achievement

The purpose of this study was to compare the effect of single-sex versus mixed-sex classes on middle school student achievement. It was a case study of Stonewall Jackson Middle School in Charleston, West Virginia, an inner-city school with approximately 600 students, of which 30% were minority (mostly black), 30% were special needs, and 70% were classified low socio-economic status (SES). Student WESTEST (West Virginia Educational Standards Test) scores in reading/language arts and math were collected and compared from the school years 2003-2004 and 2004-2005. Each student's scores from the first year were compared to that same student's scores from the second year. Each student in the first year (2003-2004) was in mixed-sex classes and each student in the second year (2004-2005) was in single-sex classes. Two hundred seventy nine matched pairs of scores were compared. An alpha level of .05 was set as the criterion for the level of significance. A paired-samples T-test was used to determine whether the difference between the means was statistically significant. Student groups studied were male/female; black/white; low/high SES; and general education/special education. An analysis of variance (ANOVA) was used to determine whether there were differences between groups. A .01 level of significance was found for both reading/language arts and math between mixed-sex and single-sex classes. No significance was found for the between group improvement scores. Results of this study provide support for using single-sex classes to improve the academic achievement of middle school students.

DEDICATION

This paper is dedicated to my Mom and Dad, Dorma Dell and Charles Thom. They were my first teachers, and Dad was my first coach. Mom was a high school secretary, and she first taught me about unconditional love, compassion, and hard work. Dad was a secondary teacher, and he taught me about respect, dedication, and perseverance, without which this paper would never have been completed. They instilled in me a love for life-long learning and their examples are what influenced me to enter the teaching profession. They raised me in a Christian home, and provided a safe, caring, and supportive environment. They loved each other, and they loved me, and that built a foundation on which I still stand.

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TABLE OF CONTENTS

Abstract.....	ii
Dedication.....	iii
Acknowledgements.....	iv
Table of Contents.....	vi
List of Tables	ix
CHAPTER ONE: THE EFFECT OF SINGLE SEX VERSUS MIXED SEX CLASSES ON MIDDLE SCHOOL ACADEMIC PERFORMANCE	1
Introduction.....	1
Statement of the Problem.....	4
Research Questions.....	5
Significance of Study.....	6
Limitations of the Study.....	6
Operational Definitions.....	7
CHAPTER TWO: REVIEW OF RELATED LITERATURE.....	8
Middle School Student Experience.....	8
Historical Approaches to Single-Sex Schooling.....	12
Evolving Themes in Single-Sex Schooling	14
Feminism and Girls’ Disadvantage.....	14
Achievement and the Gender Gap	15
Boys’ Educational Disadvantage	16
Brain Differences in the Structure and Function of Males and Females	19
Sex Differences and Learning.....	21
Sex Differences across Cultures	25
Multiple Intelligences and Learning Difference	28
Achievement: A Comparison of Single-Sex and Mixed-Sex Education.....	31
At-Risk Student Achievement	45
Low Socio-Economic Status (SES) Students	46
Black Students	47
Exceptional Students.....	50
Summary	51
CHAPTER THREE: METHODOLOGY	53
Population and Sample	53
Research Design.....	53
Data Collection	56

Data Analysis	56
CHAPTER FOUR: PRESENTATION AND ANALYSIS OF DATA	57
Demographic Data	57
Major Findings.....	61
Group Comparisons in R/LA and Math Achievement	62
Combined Group R/LA and Math Comparisons	62
Group 1 R/LA and Math Comparisons.....	63
Group 2 R/LA and Math Comparisons.....	63
Group Comparisons of R/LA and Math Achievement by Sex	65
Combined Group R/LA and Math Achievement.....	65
Group 1 R/LA and Math Achievement.....	66
Group 2 R/LA and Math Achievement.....	66
Group Comparisons of R/LA and Math Mean Score	
Differences by Sex.....	69
Combined Group R/LA and Math Mean Score Differences	69
Group 1 R/LA and Math Mean Score Differences	69
Group 2 R/LA and Math Mean Score Differences	70
Group Comparisons of R/LA and Math Achievement by Race	70
Combined Group R/LA and Math Achievement.....	70
Group 1 R/LA and Math Achievement.....	72
Group 2 R/LA and Math Achievement.....	72
Group Comparisons of R/LA and Math Mean Score	
Differences by Race.....	75
Combined Group R/LA and Math Mean Score Differences	75
Group 1 R/LA and Math Mean Score Differences	75
Group 2 R/LA and Math Mean Score Differences	76
Group Comparisons of R/LA and Math Achievement by	
Socio-Economic Status	76
Combined Group R/LA and Math Achievement.....	76
Group 1 R/LA and Math Achievement.....	78
Group 2 R/LA and Math Achievement.....	79
Group Comparisons of R/LA and Math Mean Score	
Differences by SES.....	81
Combined Group R/LA and Math Mean Score Differences	81
Group 1 R/LA and Math Mean Score Differences	81
Group 2 R/LA and Math Mean Score Differences	82
Group Comparisons of R/LA and Math Achievement by	
Special Education Status.....	82
Combined Group R/LA and Math Achievement.....	82
Group 1 R/LA and Math Achievement.....	84
Group 2 R/LA and Math Achievement.....	85
Group Comparisons of R/LA and Math Mean Score	
Differences by Special Education Status	85
Combined Group R/LA and Math Mean Score Differences	87
Group 1 R/LA and Math Mean Score Differences	87

Group 2 R/LA and Math Mean Score Differences	87
Summary	89
CHAPTER FIVE: SUMMARY, FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS	91
Purpose of the Study	91
Demographic Data	92
Methods.....	92
Summary of Findings.....	93
Conclusions.....	96
Discussion and Implications	96
Recommendations for Further Research.....	103
REFERENCES	106
VITAE.....	135

LIST OF TABLES

TABLE 1 Number and Percentage of Students by Group and Gender58

TABLE 2 Number and Percentage of Students by Group and Race59

TABLE 3 Number and Percentage of Students by Group and
Socio-Economic Status60

TABLE 4 Number and Percentage of Students by Group and
Special Education Status61

TABLE 5 Paired Samples T-Test for Group Comparisons of
R/LA and Math Achievement64

TABLE 6 ANOVA for Group Comparisons of R/LA and Math by Sex68

TABLE 7 ANOVA for Group Comparisons of Mean Score Differences
by Sex71

TABLE 8 ANOVA for Group Comparisons of R/LA and Math by Race74

TABLE 9 ANOVA for Group Comparisons of Mean Score Differences
by Race77

TABLE 10 ANOVA for Group Comparisons of R/LA and Math by SES80

TABLE 11 ANOVA for Group Comparisons of Mean Score
Differences by SES83

TABLE 12 ANOVA for Group Comparisons of R/LA and Math by
Special Education Status86

TABLE 13 Group Comparisons of Mean Score Differences by
Special Education Status88

CHAPTER ONE

THE EFFECT OF SINGLE SEX VERSUS MIXED SEX CLASSES ON MIDDLE SCHOOL STUDENT ACADEMIC PERFORMANCE

Introduction

Middle school students face a gauntlet of influences that affect academic achievement, including higher academic expectations, a larger, more diverse school population, and changing classes throughout the day (Ricken and Tere, 2004). In addition, middle school students must also learn to relate to many different teachers instead of continuing the elementary model of having just one or two teachers.

As middle school students mature, they become more peer dependent than parent/teacher dependent for decision-making (Portner, 2000).

Gurian (2001) quotes one middle school teacher describing the school experience as:

“[J]umping to conclusions, veiled threats, immense stubbornness, communication mess-ups, feeling as though we and our students live in a world of constant and daily potential for stress and even (more often than we’d like) confrontation...if middle school is not exactly a battlefield, it is certainly a place of stress and strain (p. 202).”

Adding to the turmoil for these students is the onset of puberty. An increasing interest in, curiosity about, and fascination with the opposite sex creates direct competition for a child’s academic focus (Reimer, 2002).

Studies indicate that there is a significant drop in academic achievement for both sexes at the middle school level (Sadker and Sadker, 1994; Sommers, 2001 ; Bradley and Manzo, 2000; Funk, 2004; Lipsitz, 2000; Brodhagen, 2000) and that there is a substantial achievement gap between the sexes (United States Department of Education, 2000; Dwyer and Johnson, 1997; Conlin, 2003; Newkirk, 2000; Sommers, 2000; Pomerantz,

Altermatt, and Saxon, 2002; Simpson, 1991). Girls outperform boys in reading and language skills, while boys outperform girls on math concepts and spatial skills (Salomone, 2003; Brown and Fletcher, 1995).

Boys are more likely than girls to be referred for special education services, particularly for learning and behavior disorders, and are more likely than girls to be referred to the principal's office for discipline violations (Gurian, 1996; United States Department of Education, 2004; Sax, 2005). Boys are also more likely than girls to be retained and/or drop out of school (United States Department of Education, 2004). According to the West Virginia Department of Education (2004), these differences in achievement and behavior are significantly greater for at-risk students (i.e., students who are defined as minority, low-socio-economic, and special education).

There is increasing evidence from brain research that points to a biological basis for these differences in academic performance and behavior (Gurian and Stevens, 2004). At all age levels, girls hear and listen better than boys (Cone-Wesson and Ramirez, 1997; Corso, 1959; Corso, 1963). Translating this fact to the classroom, Gurian and Henley (2001) state that:

“[G]irls are generally better listeners than boys are, hear more of what's said, and are more receptive to the plethora of details in a lesson or conversation. This gives them great security in the complex flow of conversation and thus less need to control conversation with dominant behavior or logical rules. Boys tend to hear less and more often ask for clear evidence to support a teacher's or other's claim. Girls seem to feel safe with less logical sequencing and more instructional meandering (p. 46).”

Girls are also able to interpret facial expressions better than most boys and men can. Boys are more interested in movement than girls. These differences have to do with sex differences in the anatomy of the eye (McClure, 2000). Since the majority of middle school teachers are female, one might conclude that female students would respond to

class activities in ways that are more familiar and acceptable to their teachers than will boys. According to Gurian and Henley (2001), girls receive approximately 60 percent of the A's, while boys receive approximately 70 percent of the D's and F's. Ninety percent of the discipline problems in schools come from boys, and boys constitute 80 percent of the dropouts. (Ibid., pp. 56-57)

Boys are more apt to engage in learning activities that are loud, competitive, movement-oriented, and geared to their interests (Gentry, 2002; Gardner, 1996; Lazear, 2001; Thompson and Ungerleider, 2004). Most girls flourish in low-pressure, non-confrontational, and non-time-constrained academic tasks (Sax, 2005; Gurian and Henley, 2001; Sadker and Sadker, 1994; Stabiner, 2002).

Traditional interpretation of the Federal Title IX law has until recently prohibited separating the sexes for educational purposes (Salomone, 2000), thus most of the research on single-sex schooling has come from the private school sector. Many of these studies, including those from outside the United States, have focused on brighter students with more privileged backgrounds (Salomone, 2003). Data collection for the last thirty years has also been primarily focused on the educational benefits of single-sex education for girls, with very little research devoted to the effect for boys (Gurian, 1996). However, with global attention now directed on the academic failure of boys, more recent studies address male achievement (Salomone, 2003; Australian Council for Educational Research (ACER), 2001; Martin, 2002; Gilbert and Gilbert, 1998 and 2001; Cortis and Newmarch, 2000). The majority of research studies on the effects of single-sex education has centered on high school and college age students, with very little attention

given to the middle school years (Bone, 1983; Newcome, 1973; Harwarth, Maline, and DeBra, 1997; Tidball, 1972, 1974, 1986; Goodlad, 1984; Daly, 1996).

Riordan (1990) is one of the few researchers to provide some insight into the effects of single-sex education on at-risk students. He found that black students of both sexes performed better academically and behaviorally in single-sex schools. Riordan's work supported Coleman's conclusion that disadvantaged students receive the greatest benefits from single-sex schools (Coleman, 1961).

Statement of the Problem

Most research to date on the effects of single-sex schooling has focused on private schools, high schools, and girls. In addition, very little of that research documents the relationship between single-sex classes and at-risk students.

Single-sex educational opportunities in public schools have increased over the last several years, predicated on the premise that it will improve achievement and behavior (Able, 2000; Spielhofer, O'Donnell, Benton, Schagen & Schagen, 2002; Viadero, 2001; NASSPE, 2005). More data are needed from the middle school level and from at-risk students than are now available to support or challenge this belief. Before informed decisions can be made about pursuing single-sex classes, questions need to be addressed about how separating the sexes for instruction relates to achievement.

As the previously cited research indicates, girls and boys see, hear, and experience the world differently. They learn and behave differently because their brains are biologically wired differently (Sax, 2005; Gurian and Henley, 2001). These differences are profound, and should be recognized and used to provide a more effective and efficient middle school education for both boys and girls. Ignoring these differences

results in a “one-size-fits-all” educational mentality that does not benefit either males or females.

The question to be addressed by this study is whether there is a difference in academic performance between students in single-sex middle school classes and students in mixed-sex middle school classes. Research in this area can contribute to the body of knowledge available on the effects of single-sex classes for boys and girls, and for at-risk students. It can also help determine whether separating the sexes for instruction will help close the achievement gap that now exists between girls and boys, white and black, low-SES and high-SES students, and general and special education students.

Research Questions

The following research questions will be explored:

1. Is there a significant difference in the reading/language arts performance of middle school students based on their assignment to single-sex or mixed-sex classes?
2. Is there a significant difference in the reading/language arts performance of middle school students, as disaggregated by sex, race, special education status, and socio-economic status, based on their assignment to single-sex or mixed-sex classes?
3. Is there a significant difference in the math performance of middle school students based on their assignment to single-sex or mixed-sex classes?
4. Is there a significant difference in the math performance of middle school students, as disaggregated by sex, race, special education status, and socio-economic status, based on their assignment to single-sex or mixed- sex classes?

Significance of Study

The increased expectations and accountability required by the No Child Left Behind legislation have provided additional motivation for public school educators to ensure the most academically rigorous and positive learning environment for all students (No Child Left Behind (NCLB), 2002). Middle school students experience a multitude of influences affecting their achievement and behavior, not the least of which are the raging hormonal urges of puberty. Separating the sexes for part of their school day could provide much needed relief from these physical and emotional stresses and promote the academic focus and behavioral structure that students need. This study will add to the understanding of how single-sex education can benefit middle school boys' and girls' academic achievement. It will also contribute to the understanding of how single-sex instruction can benefit at-risk students (i.e., minority students, low-SES students, and special needs students).

Limitations

Limitations of this study are as follows:

1. Because the study focuses on only one middle school, the data gathered and any conclusions generated will be applicable only to this particular school, or to schools that are very similar.
2. Because the study focuses on only two years of data, (one year of mixed- sex classes and one year of single-sex classes), any suggestions generated will be limited in scope to these two years.
3. Academic achievement has been found to be influenced by many factors including, but not limited to: the quality of instruction offered; the rigor of the

curriculum presented; time on task; and home environment. This study did not consider any of these factors.

Operational Definitions

1. Academic achievement was defined by student scaled scores on the WESTEST, the West Virginia Department of Education test that measures mastery level of the state-mandated Content Standards and Objectives in reading and math.
2. Math performance was defined as student scale scores on math computation and problem solving on the WESTEST.
3. Mixed-sex classes are those classes that have both male and female students.
4. Reading/language arts performance was defined as student scale scores in reading and writing on the WESTEST.
5. Single-sex classes are those classes that have only male or only female students.

CHAPTER TWO

REVIEW OF THE RELATED LITERATURE

This chapter provides a review of the literature related to the primary factors in this study. These factors include a description of the middle school student experience, historical approaches to single-sex schooling, evolving themes of single-sex education, brain differences in structure and function in middle school-age boys and girls, gender differences across cultures, a comparison of the effects of single-sex classes and mixed-sex classes on academic achievement, and a summary of the literature regarding the effect single-sex classes have on at-risk student achievement.

Middle School Student Experience

Middle school has been described as the weak link in today's performance-driven academic environment (Bradley & Manzo, 2000). Funk (2004) contends that the average academic performance for middle school students is not impressive, and educators are baffled over why elementary students who consistently improve their performance suddenly suffer significant declines in achievement after going to middle school. Schmidt (2000) states that "in math and science, the middle grades are an intellectual wasteland" (p. 3). The frustration of teaching at this level, according to Lipsitz (2000), is due to the overwhelming physical energies of the students and the fact that teacher attempts to keep them under control (i.e., quiet and still), saps students of their motivation to learn. Lipsitz further argues that by not appealing to student interests, teachers create discipline problems, and by ignoring what is important to students, teachers are ineffective in meeting both student academic and developmental needs.

Basic middle school concepts include teaming, integrated curriculum, advisor/advisee, common planning time for teachers, flexible scheduling, exploratory courses, and honoring student voice (National Middle School Association (NMSA) 2003; Jackson & Davis, 2000). These concepts have proven to be very difficult to implement, and have not been sufficient to bring about major improvement in student achievement (Fletcher, 2004; Manzo, 2000; Jackson & Davis, 2000). Brodhagen (2000) concludes:

“[M]ost people in the United States do not want to deal on a personal level with middle school kids...They are afraid of this group because they are going through tremendous changes. We’re trying to educate these kids while they are going through puberty...(and) some days that’s a pretty tall order (p. 4, 5).”

Positioned between elementary and high school, middle school students are in limbo between childhood and adolescence. Portner (2000) pointed out that they are “off kilter, out of place” (p. 39). Perlstein (2003) describes the experience as:

“Suddenly they go from striving for A’s to barely passing, from fretting about cooties, to obsessing for hours about ‘boyfriends’ they’ve scarcely spoken to. Former chatterboxes answer in monosyllables; freethinkers mimic their peers’ clothes, not to mention their opinions. Their bodies and psyches morph through the most radical changes since infancy, leaving them torn between anxiety and ardor, dependence and autonomy, conformity and rebellion. They are kids in the middle-school years, the age every adult remembers well enough to dread. Parents give up on them. Teachers can’t reach them. Often they can’t even love themselves. Instant-message them ‘Whassup?’ and they’ll type back ‘NMJC’— ‘not much just chillin’.’ But it’s a lie, a front, a shrug as old as adolescent angst. Everything happens in middle school. (Front cover)”

Parents are no longer the primary influence in their lives. Peers expose each other to drugs, alcohol, and sexual activity. Hormones create roller-coaster mood swings that are difficult, if not impossible for teachers and parents to recognize (Portner, 2000).

Burgeoning romantic and sexual feelings also drain students’ energy and attention from their academics and activities. As academic pressure begins to increase, schoolwork is the last thing on these students’ minds.

To illustrate this point, the number one reason middle school girls visit the counselor's office is to ask for help with relationships (Clark, 2000). Second and third on the list are parent problems and illnesses. Rarely do girls visit their counselor because they are stressed over schoolwork. On the other hand, middle school boys are clueless when it comes to romance and relationships: most boys are more interested in sports, band, or other activities and are not developmentally ready for the female attention (Clark, 2000).

Due to the massive hormonal changes in both boys and girls at this age, nearly insatiable hunger is the norm. However, it plays out in different behaviors. Although both boys and girls are very body-conscious at this age, girls sometimes barely eat or skip meals completely, and are more likely than boys to develop eating disorders (Gurian and Henley, 2001). "Boys do not experience a menstrual cycle, dominance by estrogen or progesterone, or so delicate a balance of serotonin cycles" (Ibid., p. 60).

One middle school principal suggested that supervising lunch was like "herding cats. It's like the Bermuda Triangle in there" (Rogers, 2000, p. 40). He went on to describe a definite order in the chaos, however. The students' need to belong creates very identifiable cliques: preppies, jocks, nerds, druggies, and Gothics all know their self-assigned places in the lunchroom. The sometimes real and sometimes imagined conflicts among these groups are far more interesting to students than their daily academic lessons. Ironically, because of this desperate desire to belong, many middle school students feel intense loneliness, which pushes them to risky behaviors regarding drugs, alcohol use, and sexual activity (Clark, 2000; Federal Bureau of Investigation (FBI), 2003).

Bullying is alive and well at the middle school level, as well. Boys and girls both bully and are bullied, and there is a very real gender difference in methods. “Boys are more upfront in their nastiness; girls are more covert” (Clark, 2000, p. 40).

Girls who bully typically have many friends, are socially skilled, act in groups to isolate a single girl, do well in school, and know the girl they are bullying (Sax, 2005). Boys who bully, on the other hand, typically have few friends, are socially inept, act alone, do poorly in school, and don’t know the children they bully. (Ibid., p. 75).

Middle school students between the ages of ten and fourteen develop faster than at any other stage, save infancy (NMSA, 1995). They are “eager to learn, full of energy, curious, ready for adventure, sociable, disarmingly honest, and ready to solve the problems of the world “(Ibid., p. 8). Scales (1996) points out that this rapid growth is erratic and uneven, and while a fourteen-year-old boy may appear physically mature, he may be quite immature socially and emotionally.

This developmental stage of young adolescence has been described as the “turning point” between childhood and adulthood (Carnegie Council on Adolescent Development, 1989). The typical young adolescent is uncertain about some things, but absolutely sure about others; wants to look tough on the outside, but is insecure on the inside; and possesses an ever-changing, diverse, and perplexing quality (At The Turning Point, 1995, p. 2).

The National Middle School Association (NMSA, 1995) has identified five key areas of adolescent development that affect academic performance:

1. Intellectual—curious, able to be motivated, capable of critical and complex thinking; moving from concrete to abstract thinking ; prefers active over passive learning experiences;
2. Social—intense need to belong, to be accepted by their peers while at the same time wanting to find their own place and identity in the world; immature behavior when social skills lag behind mental and physical maturity; overreacting to ridicule, embarrassment, and rejection;
3. Physical—mature at different rates, go through rapid and irregular growth, causing awkward and uncoordinated movements; restlessness and fatigue due to hormonal changes; developing sexual awareness, and often touching and bumping into others; a concern with changes in body size and shape;
4. Emotional/Psychological—vulnerable, self-conscious, unpredictable mood swings; self-consciousness and being sensitive to personal criticism; a belief that their personal problems, feelings, and experiences are unique to themselves;
5. Moral—idealistic with a strong desire to make the world a better place; impatience with the pace of change, and underestimating how difficult it is to make social changes; relying on parents and important adults for advice, but wanting to make their own decisions; judging others quickly, but acknowledging one’s own faults slowly (p. 9).

Historical Approaches to Single-Sex Schooling

“First generation” single-sex schools, like the Virginia Military Institute’s (VMI) all-male student body, were established at a time in the nation’s history when the

educational rights of blacks and women were not considered as important as those of white males. (Brighter Choice, 2005) The United States Supreme Court ruled in the decision U.S. v Virginia, (1996) (which has become known as the VMI Decision) that VMI's policy of only admitting males violated the United States Constitution, as there was no similar single-sex education available for women. Female cadets promptly marched into VMI and the Citadel in South Carolina, two previously all-male public colleges (Teicher, 2003).

Chief Justice William Rehnquist, as well as all the justices from Ruth Bader Ginsberg to Antonin Scalia, agreed that single-sex education offers positive benefits. It is "pedagogically beneficial for some students" (Brighter choice, 2003, p.2).

"Second generation" single-sex classes, like the New Harlem and Chicago all-girls schools, were created to serve as an affirmative remedy to discrimination and educational neglect. They offer single-sex instruction to just one sex (Brighter Choice, p.1).

"Third generation" single-sex schools, such as the Brighter Choice Charter School in Albany, New York, and single-sex classes in traditionally coeducational public schools, offer the opportunity for single-sex instruction to boys and girls on an equal basis. Third generation single-sex opportunities offer boys and girls the same high standards, taught by the same teachers, with the same course offerings, in the same building with the same access for educational materials, libraries, computers, and other resources (Salomone, 2003). Additionally, third generation single-sex opportunities increase public school options, diminish the inequity of private school status quo educational opportunity,(where access is limited to those who can afford it) and also

benefits at-risk students, where the research indicates the greatest academic improvement (Brighter Choice, 2003; Riordan, 1990; Coleman, 1961).

Evolving Themes in Single-Sex Schooling

Three general themes have evolved in regard to single-sex schooling: 1) feminism and girls' disadvantages; 2) achievement and the gender gap; and 3) boys' disadvantages (Thompson and Ungerleider, 2004). Each theme will be discussed in the context of the available research.

Feminism and Girls' Educational Disadvantage

Single-sex schools and single-sex classes have been explored by researchers (Yates, 1998; Lee, Marks, and Byrd, 1994) as a means of removing "perceived barriers to girls' academic success and to ameliorate the effects of a masculinized educational environment" (Thompson and Ungerleider, 2004, p. 4). The American Association of University Women (AAUW) has made significant contributions to the discussion on concerns about equality and access to education for women (AAUW, 1992; 1995; 1998; 1999).

One report (AAUW, 1999) asserted that girls are not receiving the same quality and quantity of public education as their brothers. Gender bias was seen as a major problem at all levels of schooling. The 1999 AAUW Report described classroom conditions in which girls receive significantly less attention from classroom teachers than boys.

Sadker and Sadker (1994) concur, observing that "teachers interact with males more frequently, ask them better questions, and give them more precise and helpful feedback" (Ibid., p. 1). From grade school through graduate school, girls are more likely

to be “invisible members of the classroom” (Ibid., p. 1). Over the years, this uneven distribution of teacher time, attention, energy, and talent, with boys getting the majority share, takes its toll on girls.

In addition, sexual harassment of girls by boys—from innuendo to actual assault—in the nation’s schools is increasing, and the contributions and experiences of girls and women are marginalized or ignored in many of the textbooks used in schools (Sadker and Sadker, 1994; Lee, Marks, and Byrd, 1994). When textbooks omit the experiences and contributions of women in society, and teachers fail to confront these omissions, girls learn they are the “absent partner in the development of our nation” (Sadker, and Sadker, 1994, p. 8).

The General Accounting Office of the United States Department of Education (USDE, 2000) reported that girls tend to defer to boys in coeducational classrooms, are called on less than boys, and are less likely than boys to study advanced mathematics and science. Overall, based on these research findings, the USDE has concluded “there is empirical support for the view that single-sex schools may accrue positive outcomes, particularly for young women” (Ibid, p. 18.).

Achievement and the Gender Gap

Some feminists suggest that single-sex schools will help “level the playing field” by providing girls with “safe, unthreatening learning environments where girls can thrive and develop their confidence” (Thompson and Ungerleider, 2004, p. 14). Others fear that the “hidden curriculum” which glorifies masculinity and patriarchy will continue to thrive in single-sex schools unless education policies address these issues in the coeducational setting.

Much of the research on this theme has focused on the gender gaps within certain subject areas which had been seen typically as “male” subjects: science, math, and computer science (AAUW, 1998; AAUW, 1992; James and Richards, 2003; McFarlane and Crawford, 1985; Harvey, 1985; Rowe, 1988; Leder and Forgasz, 1994). These studies all reported an achievement gap by gender, with higher performance by boys in these subjects. The 1992 AAUW report further points out that although differences in math achievement between girls and boys are declining, girls are still less likely to take the most advanced classes and that the gender gap in science scores is not decreasing, but may be increasing. The Third International Mathematics and Science Survey (TIMSS, 1995)), a survey which collects information on teaching and learning at both national and international levels, found that at age thirteen, there is a statistically significant advantage for boys in both math and science in New Zealand.

A concern about boys’ performance in typically “female” subjects (home economics, fine arts, music, and language arts) was also investigated, but to a far lesser extent (NFER, 2002; Sax, 2005; Gurian and Henley, 2001; Cortis and Newmarch, 2000; Sommers, 2000; Rowe, 2000). These studies reported an achievement gap by gender, with higher performance by girls in these subjects.

Governments in other countries, such as England, Wales, Australia, New Zealand, and Japan, have supported gender gap achievement research (Finn, 1980; Stables, 1990; Gordon, 2000; Hamilton, 1985; ACER, 2001; Rowe, 1988; and Wong, 2002), and with the Bush administration encouraging single-sex public school options, research in the United States is rapidly increasing (Phillips, 2003; Salomone, 2002; Jackson and Davis, 2000; Warrington and Younger, 2001; Younger and Warrington, 2002). The majority of

the research to date has been in private and independent schools and has shown consistent improvement over coeducational, public school results (Lee and Bryk, 1986; Lepore and Warren, 1997; Riordan, 1990; Salomone, 2003, U.S. Dept. of Ed., 1996; Tidball, Lee, Riordan, and Hawley, as found in U.S. Dept. of Ed., 2000).

Dee (2006) investigated the effect of teacher gender on student achievement. He found that when girls are taught by women and boys are taught by men, student achievement in science, English, and social studies increased for both groups. He states “Simply put, girls have better educational outcomes when taught by women, and boys are better off when taught by males” (p. 71).

Boys’ Educational Disadvantage

With the publication of the results of large scale student assessments favoring girls’ achievement over boys, a change in the focus of concern is slowly shifting from girls to boys (AAUW, 1999; Zill, et al., 1995; Younger, Warrington, and Williams, 1993; Sommers, 2000; Gurian, 2003). For example, a major Canadian report pointed out that girls do better than boys in 93% of Quebec high schools, and that after years of concern over girls’ achievement, it is the boys who are in trouble academically (Thompson and Ungerleider, 2004).

This change in the research focus to boys’ achievement appears to be presently more prevalent in England and Australia, but it is becoming more of an issue in the United States and Canada (Salomone, 2003). However, Gorard (1999) argued that boys’ underachievement data can be misinterpreted, that it is oversimplified, and that there is actually very little academic research to support this contention. Subsequent research disagrees with this conclusion. A 1999 New Zealand study found that girls outperformed

boys in high school achievement in English, while gender scores were similar in math and science.

Rowe and Rowe (2002) identified a declining order of achievement, with girls in single-sex schools achieving the highest, then girls in co-educational schools, then boys in single-sex schools, and finally boys in co-educational schools. Martin (2002) reported that Australian girls outperform boys in more subjects and that there are more girls among the highest achieving students (Collins, Kenway, and McLead, 2000). MacCann (1995) documented that the gender gap in achievement is increasing in most countries of the world.

The Adult Literacy in New Zealand Survey (1996) found young women outperformed young men in prose literacy. It is interesting to note that if one focuses on the TIMSS (1995) data previously cited, one might conclude that girls underachieve, but when focusing on examination scores in school, one might conclude that boys underachieve.

Although single-sex class research is just beginning in this country, the evidence to date suggests that it can improve performance of both boys and girls (Kruse, 1997). Biddulph (1997) further demonstrated that after two years of separate English classes, both boys and girls improved their academic performance.

Research has documented that boys in Australia experience less academic success than girls in both primary and secondary education (Masters and Forster, 1997a; Rowe, 2000; Slade, 2002). The evidence suggests that there is a widening gap between boys and girls, not only in Australia, but also in other English-speaking countries worldwide (ACER, 2002; Rowe, 2000; West, 1997). Findings from this research indicate that boys

are significantly more “disengaged” with schooling and more likely to be at risk of academic underachievement—especially in literacy (Browne and Fletcher, 1995). Boys exhibit significantly greater externalizing behavior problems in the classroom and at home (i.e., anti-social behavior, inattention, and restlessness) (Barkley, 1996; Collins et al., 1996; Rowe and Hill, 1996). Boys report significantly less positive experiences of schooling in terms of enjoyment of school, perceived curriculum usefulness and teacher responsiveness (Rowe and Rowe, 1999).

Marks et al (2000) noted that Australian boys are more likely to “drop out” of schooling prematurely. Recent estimates indicate that between 1994 and 1998, thirty percent of boys failed to complete their secondary schooling, compared to twenty percent of girls. Boys are subject to more disciplinary actions during schooling (including bullying behaviors and expulsions), are more likely to participate in subsequent delinquent behaviors, alcohol and substance abuse, and during adolescence, are four to five times more likely than girls to suffer from depression and commit suicide (Collins et al., 1996; Zubrick et al., 1997; Sawyer et al., 2000). Boys have a higher prevalence of auditory processing problems and unless appropriate classroom management strategies are instituted these problems negatively affect early literacy achievement and subsequent academic progress (Rowe, Pollard, Tan, and Rowe, 2000; Rowe and Rowe, 1999).

Brain Differences in the Structure and Function of Males and Females

Herbert Lansdale (1964) reported the existence of anatomical sex differences in how male and female brains are organized. According to Sax (2005), this began what is considered the modern era of research in gender differences. Since that time, numerous studies have documented the anatomical and functional differences in male and female

brains (McGlone, 1980; Gur, Turetsky, et. al, 1999; Arnold and Burgoyne, 2004; Caine, 1991; Standley, 1998; Corso, 1963; Elliott, 1971; Hall, 1985; Iijima, Arisaka, Minamoto, and Arai, 2001; Tuman, 1999, Saucier, 2002.).

Sax (2005) points to MRI scans that show the average boy's brain develops more slowly than the brain of the average girl. A 17-year-old boy's brain looks like the brain of a 13-year-old girl. Male brain development does not catch up with the female until about age 30 (Sax, 2005, Lansdale, 1964; McGlone, 1980; Kindlon and Thompson, 2000; Gurian and Henley, 2001).

Gurian and Henley (2001) have summarized some of the differences between male and female brains in structure and function and how these differences impact student learning. The amygdala, basal ganglia, hypothalamus, pituitary gland, right hemisphere, and testosterone in males are either larger, in more supply, or develop more rapidly. These differences help make males more aggressive, able to respond more quickly to physical demands, maintain a more constant sex drive, more quickly engage the "fight or flight" response, and be more competitive and self-reliant (Gurian and Henley, 2001).

For females, the arcuate fasciculus, Broca's area, cerebellum, cerebrum, estrogen, frontal lobe, hippocampus, temporal lobe, thalamus, and Wernicke's area are more active, develop more quickly, or have stronger connecting pathways. These differences help females learn and use language earlier and more effectively, multi-task better, be less aggressive, competitive, and self-assertive, and have better memory. Females are also more likely to be left-brain dominant, and males are more likely to be right-brain

dominant, which enables females to be superior in communication and fine-motor skills, and males to be superior in spatial tasks (Gurian and Henley, 2001).

Sex Differences and Learning

Sex differences in structure and function directly influence student leaning and academic performance. Some of these differences and how they can affect student learning and academic performance will now be discussed.

At all levels of the age span, females hear better than males (Corso, 1963; Elliott, 1971; Cone-Wesson and Ramirez, 1997; Cassidy and Ditty, 2001). These researchers demonstrated that eleven-year-old girls can be distracted by noise levels up to ten times softer than levels that distract boys. In the classroom, where, according to Gurian and Henley, (2001) almost 90% of public school teachers are female, a boy tapping a pencil on a desk does not distract the other boys in the room, but he does distract the girls and the teacher. When the female teacher speaks in a tone of voice that is comfortable to herself and the female students, many of the boys, who are already sitting in the back of the room by choice, cannot hear as well, lose track of the conversation, and proceed to tune out of the lesson, or more likely, act out in ways that will disrupt the class (Gurian and Henley, 2001). When a male teacher speaks in what to him is a normal tone of voice, the girls on the front row think he is yelling at them (Sax, 2005). In both instances, males and females, teachers and students, experience sound in two different ways (Sax, 2005).

Boys and girls not only hear the world differently, they also see the world differently. Most girls can interpret facial expressions better than most boys. (Hall, 1985; Connellan, Baron-Cohen, et al., 2000; Kaplan and Benardete, 2001). Girls are more interested in faces, while boys have been found to be more interested in moving objects

(Connellan, Baron-Cohen, et.al, 2000). These differences have to do with sex differences in the eye's anatomy (Sax, 2005; Wickham, 2000). The retina of the eye contains rods, which are sensitive to black and white; cones, which are sensitive to color; and ganglion cells. Some of the ganglia are large (magnocellular or simply, "m") and function basically as motion detectors, and some of them are small (parvocellular or "p") and provide information as to the texture and color of objects. The male retina has mostly the larger "m" cells while the female retina has mostly "p" cells (Kaplan and Bernardete, 1997).

In the classroom, evidence of these differences can be found in the preference of most girls to use a lot of color in their drawings, while boys tend to stick to basic black, white, and grays (Boyatzis and Eades, 1999; Iljima, Arisaka, Minamoto, and Arai, 2001; Tuman, 1999). Boys are more likely to draw pictures containing action, while girls are more likely to draw people, places, or things. Tuman (1999) describes this difference by saying, "Girls draw nouns, boys draw verbs" (p. 53).

Another difference in how male and female brains work is in the area of navigation. Saucier and associates (2002) found that men are more likely to use absolute direction such as north and south and absolute distance such as miles, while women are more likely to use landmarks that can be "seen or heard or smelled" (Sax, 2005, p. 25). These different strategies point to the use of different parts of the brain used by males and females to accomplish the same task: males use the hippocampus to navigate; females use the cerebral cortex to navigate (Gron, Riepe, et al., 2000; O'Keefe and Nadel, 1978).

Transferring this information to the classroom, it can be suggested that using different instructional strategies to teach males and females such subjects as geometry and higher order math classes would be warranted (Sax, 2005; Garland, 1987). Since

males use the hippocampus, an organ with no direct connection to the cerebral cortex, to work with math problems, they are more likely to enjoy “math for math’s sake”, than are girls (Sax, 2005). To get the same middle school age girls interested in math, it must be connected to the real world. The same concept could be taught to both boys and girls, but different strategies would be used to address the male preference for abstraction, and the female preference for real-world application. Sax states his belief that “there are no differences in what girls and boys can learn. But there are big differences in the best ways to teach them” (Ibid, p. 106).

Emotion is also processed differently in the male and female brain. Males deal with emotion in either the left hemisphere or the right hemisphere, but not both hemispheres (Wager, Phan, Liberzon, and Taylor, 2003). Female brains use a more global and bi-lateral approach (Ibid, 2003). Brain activity involving negative emotions in males activates the amygdala, a primitive nucleus at the base of the brain that makes few direct connections with the cerebral cortex (Schneider, Habel, et al., 2000). Teenage girls processing emotions use the cerebral cortex, the same part of the brain that is used for language (Taylor, 2002).

Classroom implications of these facts are relevant to instructional strategies. Asking middle school age girls to write or talk about how they “feel” is a relatively easier assignment for them than for boys, as both feeling and language skills are processed in the cerebral cortex. Asking middle school boys the same question is asking them to link the amygdala, for emotions, to the cerebral cortex, for language, which is a much more difficult task (Sax, 2005).

Selection of reading materials is also linked to male and female brain differences. Most boys prefer action novels. Ehrhardt states, “They see life as a battle, and war stories appeal to that side of their nature” (ASCD, 2001). Most girls prefer fiction, delving into a character’s motives and behaviors (Simpson, 1991).

Teachers can also vary how they teach the various content of reading assignments to enhance student engagement. Most girls enjoy role-playing and discussing the pros and cons of various situations in which the characters find themselves (McDonald, 2001). Most boys enjoy a “hands-on” activity to make sense of the reading material, for example, constructing a map of the various locations found in the story (ASCD, 2001).

Girls usually have better verbal skills and rely on these skills; boys usually rely on non-verbal communication, being less able to verbalize feelings as quickly as girls (Gurian and Henley, 2001). This has tremendous implications for the classroom and how teaching and learning are structured, presented, processed, and assessed (Pomerant, Altermatt, and Saxon, 2002; Valeski and Stipik, 2001; Gurian and Henley, 2001).

Since males have more development in the right hemisphere, they are usually more skilled at measuring, mechanical design, geography, and map reading. Eldon (2001) wrote that of the five million participants in the 1999 National Geography Bee, forty-five times more boys than girls were likely to be finalists. This tendency of boys’ performance to surpass girls’ performance in math concepts, geopolitical subjects, and natural science was supported by the work of other researchers (Lien, Downs, and Signorella, 1995; Zernike, 2000; Cole, 1997; Willingham and Cole, 1997).

There are fundamental differences in the learning styles with which most girls and boys feel comfortable, and these differences are based in physiological as well as higher-

level cortical functions (Sax, 2005). One significant physiological difference is the fact that, as documented previously, girls hear better than boys (Corso, 1959; Cassidy and Ditty, 2001; Cone-Wesson and Ramirez, 1997). Instructional implications for this gender difference include putting all the boys in the front of the classroom and all the girls in the back. According to Sax (2005), this is the exact opposite of how the students will usually seat themselves. In classrooms using circle seating arrangements or mixed-sex cooperative learning groups, there is no solution. Corso (1959; 1963) does suggest that boys' classrooms should be loud compared to girls' classrooms. Teachers who allow (if not encourage) movement, talking among students, competition, and game-like atmospheres enable boys to engage more thoroughly with the learning experience.

Sex Differences Across Cultures

Sex differences in personality traits across cultures have been documented and the results are unanimous. Cultures studied included China, sub-Saharan Africa, Malaysia, India, the Philippines, Indonesia, Peru, the United States, and Europe (specifically Croatia), the Netherlands, Belgium, France, Germany, Italy, Norway, Portugal, Spain, Yugoslavia, and western Russia (Costa, Terracciano, and McCrae, 2001).

Specific findings include the tendency for girls to have higher standards in the classroom, and that girls tend to evaluate their performance more critically (Feingold, 1994). Feingold reported that girls outperform boys in all subjects and at all age groups, as measured by report card grades, a finding that was supported by Dwyer and Johnson (1997); Gurian and Henley (2001); and Sax (2005).

Since girls perform better overall in school than boys, it could be assumed that boys would be less self-confident about their academic abilities than girls. But the exact

opposite has been found: girls are excessively critical of their own performance while boys tend to have “unrealistically high estimates of their own academic abilities and accomplishments” (Pomerantz, Albirmatt, and Saxton, 2002, p. 404). In the classroom, therefore, girls need to be encouraged, while boys need to be given a reality check (Sax, 2005).

There are also basic differences in the factors that motivate boys and girls. Girls are more interested in pleasing adults, both parents and teachers, no matter what the subject is, while boys are more motivated to study topics that are of interest to them (Higgins, 1991; Pomerantz and Saxon, 2001; Gurian and Henley, 2001; Sax, 2005).

Taylor (2002) identifies context as crucial for girls to become engaged in learning, so the classroom itself should be safe, comfortable, and welcoming. An instructional strategy for teaching literature or music, for example, would include exploring the background, characters, and environment. Boys are more task-oriented—they just want to focus on the “nuts and bolts” (Taylor, 2002).

Biddulph (1997) showed that boys tend to enjoy more oral work, more structure, and more short-term goals, while girls are better at working together on a task, for a longer period, but may need more encouragement to speak out in class. Newkirk (2000) pointed that education for boys must start with boys’ own interests, experiences, and opinions. Boys also prefer confrontations and direct challenges more than girls (Taylor, 2002; Wood and Shors, 1998; Shors, et.al, 2001). Tannen (2001) and Fisher (2004) describe this difference by pointing out that boys learn better “shoulder to shoulder”, while girls prefer “face to face”. Girls like to talk to each other, confiding secrets and self-disclosing personal information (Fisher, 2004, p. 83). Most boys, however, do not

want to hear each other's secrets. With boys, the important thing is the activity, not the conversation (Dindia and Allen, 1992).

Gurian and Henley (2001) have referred to ten areas of learning style gender differences that impact student achievement. These areas are drawn from brain-based research:

(1) Boys tend to use deductive reasoning, going from a general principle to specific cases, and, (2) they use deductive reasoning more quickly than girls. This means, in most cases, boys do better than girls on multiple choice tests. (3) Girls tend to move from specific examples to the general theory (Gurian and Henley, 2001; Mercer, Wegeuif, and Dawes, 1999). (4) Boys are better at not being able to see or touch an object and yet still be able to calculate it. When math is taught on a blackboard, for example, boys are usually better and faster at learning it than girls. (5) When math is taught using manipulatives and objects, (out of the abstract, into the concrete) girls learn easier (Gurian and Henley, 2001; Mercer, Wegeuif, and Dawes, 1999). (6) Females use more words than males, on the average. (7) Girls use words as they learn, while boys often learn silently. Girls explain things in everyday, usable language, complete with concrete details. (8) Boys tend to enjoy more coded language, as is evident in the male terminology of sports, the law, and the military (Gurian and Henley, 2001). (9) Girls for the most part are better listeners, hear more of what is said, and attend more to the details of a lesson or a conversation than do boys. (10) Boys do better with more logic and less verbal meandering.

Given the foregoing, boys get bored more easily than girls, therefore they need more and varying stimulants to keep them engaged in learning. This is crucial in all areas

of instruction. Once a child, boy or girl, gets bored, he or she disengages from the learning process and may act out to provide his/her own stimulation (Gurian and Henley, 2001).

Moreover, boys usually use more space than girls do when learning. They tend to encroach on others' space, not out of rudeness or lack of control, but out of a need to use their environment to help them learn. This fact is often misinterpreted by teachers. Boys are simply using their spatial strength (Gurian and Henley, 2001). In addition, movement seems to help boys stimulate their brains and manage impulsive behavior. Girls do not usually need to move around as much. Boys have lower serotonin and higher metabolism, which contributes to fidgeting behavior.

Furthermore, cooperative learning, while good for all students, is usually easier for girls. They are better at learning through social interaction than boys are. Boys focus on the task, and are not as sensitive to others around them (Gurian and Henley, 2001). Boys prefer symbolic texts, pictures, diagrams, and graphs while girls prefer written text. In literature, for example, boys focus on an author's symbolism and imagery, while girls tend to focus on a character's emotions. Both genders benefit from working in teams, but boys spend less time managing the process and getting right to the task. Girls spend more time getting organized.

Multiple Intelligences and Learning Differences

Almost one hundred years ago, Alfred Binet and his colleagues attempted to measure intelligence for the first time (Armstrong, 1994). Gardner (1983) contended that they made two critical mistakes: 1) they assumed that intelligence was a single entity; and

2) they assumed that intelligence could be measured by a single paper and pencil instrument.

Gardner (1983) described intelligence as being developed in the social and cultural context in which a person lives. Gardner defined intelligence as:

“[E]ntailing the ability to solve problems or fashion products that are of consequence in a particular cultural setting. The problem-solving skill allows one to approach a situation in which a goal is to be obtained and to locate the appropriate route to that goal. The creation of a cultural project is crucial to capturing and transmitting knowledge or expressing one’s views or feelings. The problems to be solved range from creating an end to a story to anticipating a mating move in chess to repairing a quilt. Products range from scientific theories to musical composition to successful political campaigns (Gardner and Walters, 1985, pp. 3-4).”

Gardner (1983, 1996) has identified eight intelligences targeting how people best learn: verbal/linguistic, musical/rhythmic, logical/mathematical, visual/spatial, bodily-kinesthetic, interpersonal, intrapersonal, and naturalist. He also identified several criteria for an intelligence to meet, two of which are relevant to this study: 1) biological origin—which describes the physiological tendency to act in a particular way to know and problem-solve, such as a brain’s sensitivity to phonics is an operation of verbal/linguistic intelligence; and 2) neurological base—an identifiable core in the brain that can be “activated or triggered by certain internal or external information,” such as body movement or communication with others (Ibid., p. 10).

According to Gurian and Henley (2001) there are significant gender differences in five of the eight intelligences. Both males and females possess all eight intelligences and both can benefit from developing all the intelligences, but from a very early age, children begin to show “proclivities” or inclinations, toward certain intelligences (Gardner, 1983). Gender preferences are due to brain structure and function (Gurian and Henley, 2001).

Lazear (1999) targeted education's responsibility to awaken, amplify, teach, and transfer intelligence.

Boys are dominant in the logical/mathematical and spatial intelligences, but girls are getting better in these areas with the last twenty years of effort focused specifically on their improvement (Delamont, 1998; Hayes and Flannery, 2000; AAUW, 1999; Daly, 1996; Riordan, 1990). Boys use the right side of the brain for abstract problems; girls use both hemispheres (Gurian and Henley, 2001). Boys also tend to dominate in the bodily-kinesthetic intelligences, due to the larger amygdala in male brains, the quicker response in males of the basal ganglia, and the greater incidence of testosterone in males (Gurian and Henley, 2001).

Girls tend to dominate in linguistic intelligence, due to the earlier development of the arcuate fasciculus, a more active Broca's area, stronger connections between brain parts from the cerebellum, and a more highly active frontal lobe (Gurian and Henley, 2001). Females also have a larger hippocampus, a better-developed left hemisphere, and stronger connections in the temporal lobe. These brain differences contribute to girls' superior communication, language, and memory skills (Gurian and Henley, 2001; Brown and Fletcher, 1995).

Gurian and Henley (2001) asserted that the school environment is female-dominated: almost 90 percent of teachers from kindergarten through sixth grade are female. The work environment is just the opposite—it is male-dominated. They contend that we do both our girls and boys a disservice, by not recognizing brain differences in learning styles and preferences and by not creating an educational environment that encourages students to learn in ways that are best for them.

Some of the effects of these inequities on boys and girls were identified by Sanders (2003) and other researchers (Leo, 1999; NASSPE, 2005; Viadero, 1998). They reported that: females consistently score lower on the math portion of many standardized tests, such as the SAT/ACT; girls are less likely to pursue careers in math, engineering, and physical sciences; and women make up only 18% of the U.S. Senate, 13% of the U.S. House of Representatives, and 11% of the Board of Directors of “Fortune 500” companies.

In contrast, the average 11th grade boy writes at the same level as the average eighth grade girl, and while boys score higher on standardized tests, girls actually earn higher grades in all disciplines (Thompson and Ungerleider, 2004). Boys in single-sex schools are more likely to study the arts, foreign languages, music and drama than boys who attend co-ed schools, while in co-educational schools, girls predominate in advanced English courses and in foreign-language and arts classes. (Riordan, 1990; Salomone, 2003) In middle and elementary school, girls outscore boys by wide margins on NAEP tests in reading and writing and Phillips (2003) reported that girls outperform boys in reading in 43 countries.

Achievement: A Comparison of Single-Sex and Mixed Sex Education

According to Haag (1998), several different and opposing ideological and social contexts have inspired single-sex learning. Single-sex environments are advocated by some feminists to minimize the deleterious effects of gender stereotypes, for example, that math is a masculine subject (Gill, 1996; Hildebrand, 1996; Grandese and Joseph, 1993; Mallam, 1993).

An opposing view holds that single-sex classes should be offered because they are seen to reinforce students in traditional gender roles (Ascher, 1992; Carpenter and Hayden, 1987; Yates, 1993). Single-sex classes provide appropriate role models of the same sex and include male and female initiation rites. (Ascher, 1992) Some parents and students prefer single-sex private schools for girls because they offer a more traditional mission (Carpenter and Hayden, 1987).

Each of these perspectives advocates the same practice—single-sex schooling—but for different purposes and goals. Yates (1993) states that the structure of single-sex education does not in and of itself guarantee any particular outcome.

The 2002 National Assessment of Educational Progress (NAEP) (2000) has shown that a gender gap exists which favors females at both the fourth and eighth grade levels. Sixty percent of fourth grade boys scored at or above proficiency levels, while 67% of girls scored at these levels. At the eighth grade level, 71% of boys scored at or above the proficient mark, while 80% of the girls scored at this level. On the international scene, the International Association for the Evaluation of Educational Achievement (IEA) found an eighteen point difference in reading comprehension favoring girls in 35 countries (IEA, 2003).

Costa, cited in the Forward to Lazear (1994), asserted that although diversity was the basis of survival, certain educational practices force individuals toward uniformity, for example, grading on a curve, I.Q. tests, and grade levels. Winston Churchill (as quoted in Lazear, 1994) may best illustrate this point:

I had scarcely passed my 12th birthday when I entered the inhospitable regions of examinations, through which for the next seven years, I was destined to journey. These

examinations were a great trial to me. The subjects which were dearest to the examiners were almost invariably those I fancied least. I would have liked to have been examined in history, poetry, and writing essays. The examiners, on the other hand were partial to Latin and mathematics. And their will prevailed. Moreover, the questions which they asked on both these subjects were almost invariably those to which I was unable to suggest the satisfactory answer. I should have liked to be asked to say what I know. They always tried to ask what I did not know. When I would willingly have displayed my knowledge, they sought to expose my ignorance. This sort of treatment had only one result, I did not do well in examinations (p. ix).

Stabiner (2003) insists that while we do not have all the answers, we do know more than we did three decades ago about how boys and girls learn best:

There is a physiological reason why most of the students in remedial reading classes are boys. There is a reason girls don't get called on first in math. And it's the same reason their grandmothers recover from strokes more successfully than their grandfathers do. Our brains are not politically correct; in many ways they develop differently. And single-sex public schools that take these things into account may be good for some girls (p. 2).

Thompson and Ungerleider (2004) caution that it is dangerous to assume that all girls learn a certain way, and all boys learn a different way, as the differences among males and females are just as vast as the differences between them (Sax, 2005; Gurian and Henley, 2001, Salomone, 2003). Haag (1998) suggests that while research can be used to support or oppose single-sex education, there are specific characteristics of the

single-sex environment that may contribute to the academic success of both boys and girls, and that these practices may be transferable to coeducational settings.

Haag (1998) wrote that there is very little research to date on single-sex classes but the available research is consistent in its findings: while girls believe single-sex classes are superior to coeducational classes, there is not a significant improvement in achievement. Most of the research comparing single-sex and mixed sex (coed) education has been conducted outside the United States. Historically, single-sex schools have been elite, private schools, making it very difficult to factor out other influences on student achievement (Bailey, 2002).

McFarland and Crawford (1985) found no significant achievement gains in high school girls' math scores in Ontario, Canada, even though the students reported better attitudes toward math. Harvey (1985) studied 2,900 students in seventeen high schools in England and found no significant differences in science achievement between boys and girls in single-sex or coeducational schools.

Rowe (1988) sampled 398 Australian middle-school students' scores in an attempt to determine the extent to which single-sex classes improved math achievement. He found that there was no difference in achievement between the single-sex classes and the coeducational classes. Another Australian study compared achievement data on approximately 160 middle school students, half of them male, half female, and found no differences for females across school type (Leder and Forgasz, 1994).

Webb (1984) investigated math reasoning ability in 77 students in two junior high schools. She validated one of the purposes for single-sex classes for girls in math and

science: girls were at a disadvantage for receiving help from teachers in mixed-sex groups.

Steedman (1985) controlled for parent educational levels, father's occupation, and pre-existing differences in academic achievement. She demonstrated that after these factors had been accounted for, any differences were not the result of single-sex or mixed sex classes.

Harker and Nash (1997) gathered achievement data on more than 5,000 eighth grade New Zealand students. They supported the conclusion that school type was not an important factor in improving math and science achievement by girls. A number of researchers (Young and Fraser, 1990; Marsh and Rowe, 1996; White, 1982; Carpenter and Hayden, 1987) contend that once prior academic achievement and SES are factored out there are no significant differences in achievement between single-sex classes and coeducational classes.

On the other hand, Hamilton (1985) studied 1,146 high school boys and girls in Jamaica and found that both performed better in single-sex schools than in coeducational schools. Parry (1996) studied Caribbean high school classrooms in Jamaica, Barbados, St. Vincent, and the Grenadines. He reported that females outperformed males at both the primary and secondary levels of school (World Bank, 1993). He compared these results to the educational performances in more developed countries, and asserted that the problem of male underachievement is now considered an international phenomenon (Parry, 1996, Parry, 1996a, Parry, 1996b). He cited Stockard and Wood, 1984; Klein, 1985; Mickleson, 1992; and Saltzman, 1994 as fellow researchers who support his position.

Jiminez and Lockheed (1998) investigated math performance in Thailand for both boys and girls and concluded that peer quality seemed to account for most of the differences between achievement levels in single-sex schools and coeducational schools. Carpenter and Hayden (1987) supported the importance of peer influence on achievement in their study of single-sex high schools in Queensland and Victoria, Australia. Their study suggested that social context (i.e., socio-economic status) and the variety of schooling available may maximize or minimize school type effects.

Lee and Lockheed (1990) measured math achievement for 1,012 ninth grade Nigerian students. They found no significant gender gap, but that girls in single-sex schools outperformed girls in coeducational schools. Lee (1997) has indicated that what she defines as “good” school practices that exist in most single-sex schools, for example, smaller school size, focused academic curriculum, and teachers’ high expectations for student success, could be incorporated into coeducational schools.

The National Foundation for Educational Research (NFER) studied 2,954 high schools throughout England. The 2002 report found that both boys and girls did significantly better in single-sex schools than in coed schools and that the benefits were greater for girls than for boys. Girls at all levels of academic ability did better in single-sex schools than in coeducational schools (Salomone, 2003; Riordan, 1990; Daley, 1996; Spielhofer, O’Donnell, Benton, Schagen and Schagen, 2002). For boys, the beneficial effect of single-sex schools was significant for boys at the lower end of the ability scale, but for higher-achieving boys, there was no statistically significant effect on school performance, positive or negative (Riordan, 1990).

The NFER (2002) report also found that girls at single-sex schools were more likely to take non-traditional classes, such as advanced math and physics. No such effect was seen for boys. For example, boys in single-sex schools were no more likely to take cooking classes than were boys in coed schools. This report differs from the conclusion of Graham Able, who studied 30 coeducational and single-sex schools and stated that “the advantage of single-sex schooling is even greater for boys in terms of academic results than for girls” (2000, p. 42).

The Australian Council for Educational Research (ACER) analyzed the performance of over 270,000 students in a six year study and found that both boys and girls in single-sex schools scored on average 15 to 22 percentile ranks higher than did boys and girls in coeducational schools. The report suggested that single-sex classrooms were better able to meet the needs brought on by the large differences “in cognitive, social, and development growth rates of boys and girls between the ages of 12 and 16” (2001, p. 18).

Marlene Hamilton (1985) studied students in Jamaica and found that students attending single-sex schools out-performed students in coed schools in almost every subject tested. Hamilton also noted the same pattern of results which has been found in most studies worldwide: girls at single-sex schools attain the highest achievement; boys at single-sex schools are next; boys at coed schools are next; and girls at coed schools do worst of all (p. 547).

At Fairhurst High School in Essex, England, three years after changing to single-sex classes, the proportion of boys achieving high scores in standardized tests had risen by twenty-six percent, and the girls’ scores had risen by twenty-two percent (O’Reilly,

2000). In Mill Hill, England, the high school was divided into a girls' wing and a boys' wing in 1994. Since that time, pupils scoring high on the General Certificate of Secondary Education (GCSE) exam have gone from forty percent to seventy-nine percent (Times Educational Supplement, 2000). The "before and after" results of schools changing from coed to single-sex classes have been so impressive that the then British Secretary of Education (David Blunkett) asked the Office for Standards in Education (OFSTED) to investigate whether this model should be applied throughout Britain (Pike, 2000).

Researchers at Manchester University in England tested the single-sex approach by assigning students at five public schools to either single-sex or coed classrooms. They found that sixty-eight percent of boys who were assigned to single-sex classes passed a standardized test of language skills, compared to thirty-three percent of boys assigned to coed classes. For the girls, eighty-nine percent assigned to single-sex classes passed the test, compared to forty-eight percent of girls assigned to coed classes (Henry, 2001).

Similar findings were reported by researchers at Cambridge University. They studied single-sex high school classrooms in four different neighborhoods, including rural, suburban, and inner-city schools. All of the schools raised educational achievement (Salomone, 2003).

Baker, et al. (1995) studied student math achievement and the proportion of single-sex schools in four countries. They used data from the International Educational Assessment's (IEA) Second International Mathematics Study (SIMS) and hypothesized that countries having the smallest proportion of single-sex schools would have the largest achievement differences. They found that in Belgium and New Zealand, which had 68

and 43 percent single-sex schools respectively, there was little achievement difference between boys and girls. However, in Thailand, with 19 percent single-sex schools, there was more of an achievement gap, which favored girls. In Japan, however, with 14 percent single-sex schools, the boys showed higher achievement. Baker et al. (1995) attributed this fact to the Japanese curriculum for girls, which was oriented toward traditional female roles. The authors contended that socio-economic status (SES) and school context should be considered when evaluating the effects of single-sex education.

To address the under-achievement of boys in Australia, the initiative to provide single-sex classes in English and math was studied by Mulholland et al. (2004). Both boys and girls in the single-sex classes showed significant achievement increases in English, and girls showed increased math performance.

Smith (1996) conducted a ten-year study of two single-sex high schools (one female, one male) in Australia, which switched to coeducational status. He found no effect on academic achievement for boys or girls after the change. Warrington and Younger (2003) and Younger and Warrington (2002) conducted a case study of one comprehensive coeducational high school where most classes were taught in single-sex classrooms. They found that both boys and girls achieved higher scores on the General Certificate of Secondary Education (GCSE) than the national average, and that the girls consistently outperformed the boys. Younger and Warrington (2002) caution against implementing single-sex classes without “coherent staff development... which address teaching and learning strategies...” (p. 371).

Wong, et al. (2002) investigated achievement and school type for 45,000 Hong Kong students. In Hong Kong, ten percent of public schools are single-sex, and in high

school, they practice gender streaming: girls are streamed into “female” areas of art and social science; boys are streamed into “male” areas of math and science. These authors found that girls benefited in English, science, and the arts in single-sex classes, whereas boys benefited in all subjects in single-sex classes.

Young and Fraser (1990) explored the differences in science achievement in independent, Catholic, and government single-sex and coeducational schools in Australia. They found no significant differences in boys’ or girls’ overall science achievement among the types of schools, although there were some significant sex differences on individual test questions, with girls scoring higher on some items, and boys scoring higher on others. However, once SES was controlled, the researchers found that girls and boys in single-sex schools outperformed their peers in the coeducational schools.

Additional international research from Australia (ACER, 2001, 20002) and the United Kingdom (Sukhandan, 1999) highlight the achievement gap between boys and girls. Cortis and Newmarch (2000) warn that the issues have been over-generalized into a “boy versus girl” debate. They see this approach as inadequate by labeling boys as problematic and neglected by schools, while girls are “over-catered-to at the expense of boys” (Ibid., p. 1).

Are boys and/or girls treated unfairly in the classroom? Historically it has been thought that girls have suffered by not receiving as much praise, attention, and help from their teachers (Streitmatter, 1994). More recent trends, however, show girls surpassing boys in academic excellence. Galley (2002) explains this trend by pointing to boys’ lower scores on the language arts sections of standardized tests, to the fact that more boys

are referred for special education, and that more boys are referred for discipline infractions than are girls.

Girls appear to be catching up in all advanced math and science classes, with the exception of physics. The number of girls enrolled in Algebra, trigonometry, precalculus, and calculus in the United States grew at a faster rate than boys' enrollment between 1990 and 1994 (Viadero, 1998). So, what are the reasons for these gender inequities in school? Gibbs (2001) asserts that society stereotypes what is appropriate behavior for boys and girls: boys are expected to be more aggressive and that aggressiveness is rewarded in schools.

Sanders (2003) contends that females are socialized to be passive and therefore do not participate academically as much as their male peers. He also points out that while teachers may have some training on diversity issues, they get no training on gender issues.

Baker and Jacobs (1999) investigated the effects of single-sex math and science classes on middle school students in Massachusetts. They concluded that girls fared better, but that ultimately both boys and girls suffered because the teachers did not make the changes in instruction that would have most benefited the students. Many of the students were English as Second Language (ESL) learners, some students spoke no English, and some were gang-members. The school was located in a low SES area with a highly transient population.

Gilson (1999) examined the effects of single-sex classes on girls' achievement and attitudes toward math by comparing single sex and coeducational math classes in private middle schools in the United States. These schools were all members of the

National Association of Independent Schools, which typically serve middle to upper income families. No significant differences were found. Gilson concluded that SES and parental support were more likely influences on achievement than single-sex classes.

Lepore and Warren (1997), using the National Educational Longitudinal Study, tested three hypotheses: 1) that boys and girls in single-sex Catholic secondary schools score higher on achievement tests than boys and girls in mixed-sex Catholic schools; 2) that females experience the greater benefit of single-sex classes; and 3) that these differences can be explained by pre-enrollment differences in student learning ability. They found no significant differences, once SES and prior achievement were controlled. They speculated that any advantage previously associated with single-sex Catholic schools (Riordan, 1985; Lee and Marks, 1990; Lee and Bryk, 1986) have diminished due to coeducational schools now addressing gender bias.

Manger and Gjestad (1997) took a slightly different approach by comparing achievement to the ratio of girls to boys in coeducational classes. They found that although achievement scores were usually higher for both boys and girls in classes that had a majority of girls, there was no significant relationship between achievement and the proportion of boys and girls in class. In an opposing view, Lazear (2001) found that having not only a smaller class size, but having a higher percentage of well-behaved girls in the classroom increased academic achievement for both boys and girls.

Marsh and Rowe (1996) reinvestigated previous studies by Rowe (1988) and Rowe, Nix, and Tepper (1986) comparing single sex and coeducational math classes in a coeducational school in Australia. The reanalysis found no support for the claim of

higher achievement by girls or boys but did show a significantly greater achievement by boys in single-sex classes compared to boys in coeducational classes.

In a Canadian study, Robinson and Smithers (1999) compared test scores to determine if any quantifiable differences existed, after matching schools for SES. They found that overall, single-sex classes produced students with higher average scores than coeducational schools. However, when schools matched on SES were compared, there were no significant differences. Robinson and Smithers also looked at academic differences between highly selective single-sex schools and found that boys did extremely well. They concluded that the academic performance had more to do with selections, SES, and school standing than with single-sex classes (p. 23).

Seitsinger et al. (1998) evaluated the results of one California school's single-sex math classes for seventh and eighth graders. The school was trying to increase girls' achievement in math. They found that both boys' and girls' scores increased in the single-sex classes.

Hopkins (2001) found mixed results when she evaluated a Virginia elementary school single-sex program. The students in both female and male single-sex classes had higher science and social studies scores than the coeducational classes, but there was no significant difference in math scores.

Workman (1990) studied single-sex classes in two California high school geometry classes and found no difference in achievement scores when compared with mixed sex classes. Finn (1980) described achievement differences between girls and boys in the United States, Sweden, and Britain. He found large achievement gaps in

verbal and math scores, with girls performing better in the verbal areas, and boys in the math areas, but did not feel confident in ascribing the difference to school type.

Riordan (1985, 1990, 1994, 2002) has done extensive work on single-sex education in the United States and has asserted that school type benefits certain student populations more than others. He compared Catholic private schools with public schools and demonstrated that single-sex Catholic school students scored consistently higher than public school students on all achievement indicators, and that girls in single-sex Catholic schools were the most “favored” in any comparison with public school students. He does not attribute the difference solely to school type, however. He contends that single-sex Catholic schools have a more focused academic atmosphere than the typical public school.

In 1994, Riordan focused on different student populations and concluded that African-American and Hispanic students, both males and females, scored higher in single-sex schools than in mixed-sex schools. He wrote that the benefits of any type of school are “virtually zero” for middle-class or otherwise advantaged students, but that the benefits are huge for minorities, low SES, and female students (1998, p. 53). Riordan goes on to state quite emphatically that coeducational schools are male-dominated and male controlled, and that equality of treatment is a scarce commodity in these schools. (p. 54)

Lee and Bryk (1986) examined 1,807 students in 75 Catholic high schools and confirmed their hypothesis that students in single-sex schools significantly outperformed students in coeducational schools. Marsh (1989) disputed Lee and Bryk's conclusions, in part due to no allowance for pre-existing academic differences. Lee and Marks (1990)

revisited the Riordan (1994) and the Lee and Bryk (1986) studies and concluded that “something of value appears to be going on in single-sex secondary schools” (p. 588).

In an experiment that parallels the current study, Thurgood Marshall Elementary School in Seattle, Washington changed from the traditional coed classrooms to single-sex classrooms in 2000. The effect on academic performance and behavior was dramatic: discipline referrals to the office dropped from an average of thirty per day to just one or two per day. In one year, the boys went from being in the 10 to 30 percent achievement level on the Washington Assessment of Student Learning to 73 percent, and from a 20 percent reading average to 66 percent, and from a 20 percent in writing to 53 percent (NASSPE, 2005).

At-Risk Student Achievement

The 1954 landmark Supreme Court decision *Brown vs. Board of Education of Topeka, Kansas* outlawed racial segregation in America’s public schools (Mendez, 2004). Then came Title IX, the 1972 law that declared sex discrimination as illegal in schools that received federal money (Ibid. 2004). Title IX is best known as the legislation that brought parity to athletic programs, but it also prohibited single-sex classes in public schools unless there was documented proof of inequity in coeducational classrooms (Stabiner, 2004). Both of these decisions supported integrated public schools in the United States.

Today the trend is to expand educational opportunities for all students by providing options through single-sex classrooms (Sax, 2005; Salomone, 2003). In 2001, the Bush administration made it easier to set up these opportunities through new regulations allowing same-sex classes and schools, as long as the same quality textbooks,

materials, and instruction was available to the other sex in coeducational settings (USDE, 2001) . Parallel separate classrooms and or schools are no longer required.

Reactions to the new government regulations are mixed, with Title IX supporters pointing out that what little research there is on single-sex public schools is inconclusive as to the effect on achievement, while civil rights groups fear a reversal of thirty year gains in gender equality (Mendez, 2004; AAUW, 2004; Williams, 2004). The National Organization for Women (NOW) vehemently opposes the new regulations. President Kim Gandy cites the following reasons the policy should be abandoned: it raises constitutional concerns; lacks supporting research; conflicts with current law; and undermines diversity. Gandy argues that the new regulations fail to ensure equal opportunity, perpetuate sex-stereotyping and feelings of superiority/inferiority, undermine workplace equality, and fail to adequately address harassment and discrimination (NOW, 2004). Salomone (2003) agreed that empirical support is needed, but that because single-sex programs have been outside legal boundaries for the past thirty years, there has not been a field for conducting research, so lower standards of evidence should be accepted for the time being.

Low Socio-Economic Status (SES) Students

Riordan (1990) categorically states that “single-sex schools work. They work for girls and boys, women and men, whites and non-whites... The effects of single-sex schools are greatest among black or Hispanic females from low socio-economic homes. Single-sex schools are places where students go primarily to learn; not to play [or to] meet their friends and have fun. Co-educational schools, except for those in affluent middle-class communities, are not at all about academics” (p. 54). In single-sex classes,

the girls are not vying for the boys' attention and the boys are not trying to impress the girls (Thompson & Ungerleider, 2004).

Riordan (1990) suggests that the beneficial effects of single-sex schooling are most impressive for children from underprivileged backgrounds. The National Foundation for Educational Research (2002) studied 2,954 high schools throughout England and they found that while girls at all levels of academic ability performed better in single-sex schools, only boys at the lower end of the ability scale received significant benefit from single-sex schools.

The ACER (2001) study in Australia found no evidence to support the theory that only children from affluent families were attracted to single-sex schools or that achievement was not due to the higher socio-economic status of these students. The British Office for Standards in Education (OFSTED, 1998) tested for socio-economic variables that might account for the superior performance of students in single-sex schools. The report found that the academic performance could not be linked to socio-economic factors, but was a direct result of single-sex education.

Black Students

Boyd (1994) described the young black male as an "endangered species" and reported that one out of four would end up incarcerated or dead. Garibaldi (1992) warned that "one of the most actively discussed and sometimes vigorously debated issues since the late 1980's has been the decline in the social, economic, and educational status of young, black males in our society, and he contended that their future was "hopeless and impossible to salvage" (p. 4). Reglin (1994) projected even more alarming statistics: 70 percent of black males may be imprisoned, awaiting trial, addicted to drugs, or killed;

57.5 percent of black children live in single-parent homes headed by a female; and 60 percent of black children live in poverty.

In most American inner cities, black males, at every level from kindergarten through 12th grade, are disproportionately failing and/or labeled as “behavior problems, slow learners, and truants” (Whittaker, 1991). Black males have dramatically higher suspension, expulsion, retention, and dropout rates, and significantly lower grade-point averages than their white counterparts (Ibid. 1991).

Murrell (1992) asserts that due to their poor academic performance, more black students, males in particular, are channeled into special education programs. McClusky (1993) wrote that negative stereotypes of black male students and lower teacher expectations characterize many coeducational settings. Singh, Vaugh, & Mitchell (1998) suggest a positive effect of single-sex classes on urban black girls, but point to a limited amount of evidence for a positive effect of single-sex classes on black male academic performance.

Salomone (2003) agrees with these authors by pointing out that black boys in particular often “fall victim to peer pressure, perceived social stigma, and low expectations at school. They increasingly identify with other aspects of self-concept, such as social popularity and athletics” (p. 3).

Salomone (2003) believes there is no doubt that single-sex programs remove the social distraction of the other sex. They place the “intellectual” above the “social”, which is vitally important in neighborhoods where students see very little worth in academic achievement (p. 3).

Salomone (2003) also documents the achievement gap between white and black students. She has shown that nearly two-thirds of black fourth graders are functionally illiterate, and that by the middle school years, these educational deficits reach critical levels. These students become far more likely to drop out, as evidenced by the black drop-out rate being almost double the rate for white students.

Singh, et al. (1998) compared the achievement of black students in two single-sex and two coeducational, inner-city schools. They were particularly interested in benefits for black males. They found that the girls outperformed the boys in all the schools in math, that the boys in coed math classes did better than the boys in single-sex classes and that girls in single-sex science classes did better than girls in coeducational science classes.

One Miami, Florida elementary school created all-boy classes with an all-male staff. It was considered a total success after one year, academically and socially, for the low SES students (Washington Times, 2003). Moten Elementary School in Washington, D. C. has a student population in which 98% qualify for low SES. One year after changing to single-sex classes, math scores for all students increased from 49% proficient or above to 88%, while the reading scores increased from 50% to 91.5% proficient or above. (Ibid)

The Young Women's Leadership Academy in East Harlem is a girls-only school that is often used to offer proof that school type has a positive effect on academic achievement and self-esteem. Although the school population consists primarily of black and Hispanic girls from low SES homes, it has a 95 percent attendance rate, almost no dropouts, and a one-year waiting list to attend. Over 90 percent of the students score

above grade level on statewide math and English tests, compared with a citywide average under 50 percent (Washington Times, 2003).

Booker (2006) listed identification, engagement, relatedness, and school belongingness as critical factors understanding the achievement gap between minority and majority students. He recommends additional research into these factors which affect student achievement. Part of the problem may be due to a lack of minority role models as teachers.

Exceptional Students

Single-sex education has been proposed as a means for meeting the academic needs of at-risk students (Datnow, Hubbard, and Conchas, 2001, Datnow and Hubbard, 2000; Streitmatter, 1997, 1999). However, the issue of single-sex education has rarely been explored for exceptional students.

Madigan (2002) described the experiences of Latina and black special education students in single-sex and coeducational classes. She reported increased school attendance and better grade point averages for students in the single-sex classrooms. Students in her study reported that they felt fewer inhibitions to ask questions and to participate in single-sex classes, whereas in coeducational classes, they feared ridicule by their opposite-sex peers and were reluctant to participate in class.

Streitmatter (1999) wrote that girls were more focused on content without boys in the classroom. Three reasons have been proposed to explain the greater disadvantage for females in special education classes: 1) Male students outnumber female students in special education classes by an average of six to one (Epstein, Cullias, & Bursuch, 1985); 2) Female students referred to special education have more severe learning disabilities

than boys, which increased their difficulty in class participation (Callahan, 1994); and 3) Male students tend to bully female students in special education classes (Madigan, 2002).

Armstrong (1994) identified several individuals with disabilities who were also high-achieving in one or more of the multiple intelligences. Some of them include Agatha Christie, Edgar Allen Poe, Rudyard Kipling, Albert Einstein, Charles Darwin, Thomas Edison, Leonardo Da Vinci, Vincent Van Gogh, Ludwig Von Beethoven, Nelson Rockefeller, Winston Churchill, Franklin Roosevelt, Harry Truman, General George Patton, and Helen Keller. Most of these talented people suffered through excruciating school experiences that did not meet their academic, much less, developmental, needs.

Summary

In summary of the research on single-sex educational environments and the effect on student achievement, conclusions are mixed as to whether or not single-sex schools or single-sex classes improve student performance. There are many extraneous variables which may influence achievement, including peer influence, SES, prior academic achievement, Catholic versus public school academic atmospheres, and parental and teachers' expectations.

The key benefit to single-sex schooling, according to the National Association for Single-Sex Public School Education (NASSPE) (2005) is that teachers can customize the learning environment to better address the different learning styles of both boys and girls.

Most of the studies on single-sex schools and academic achievement concede that the research results are inconclusive though generally supportive (Salomone, 2003). There are some conclusions, however, that can be made. Single-sex classes benefit certain students' academic achievement--low SES students, black students, exceptional

students, and female students (Riordan, 1990; Daley, 1996; USDE, 1998; Salomone, 2003). Second, there are some social and psychological benefits for girls in single-sex classes (Coleman, 1961; Sax, 2005; Salomone, 2003; Gurian and Henley, 2001). Girls usually prefer single-sex classes while boys usually prefer coeducational classes (Lee & Bryk, 1986; Lee & Marks, 1990). Finally, single-sex classes increase girls' comfort levels and academic engagement due to no intimidation and harassment by boys and increased teacher attention (Gurian and Henley, 2001; Sax, 2005; Thompson & Ungerleider, 2004).

CHAPTER THREE

METHODOLOGY

The purpose of this study was to examine middle school student achievement in single-sex classes and mixed-sex classes, and the purpose of this chapter was to describe the population and sample selected, the research design, the data collection procedures, and the statistical methods used for data analysis.

Population and Sample

The population studied consisted of the students at Stonewall Jackson Middle School (SJMS) in Charleston, West Virginia. The school enrollment at the time of the study was approximately 600 students, 70 percent of whom were on free or reduced lunch, 30 percent were in special education, and 30 percent were minority, primarily black.

From this group, a list of students was identified from the Kanawha County Schools student database that included all SJMS sixth and seventh grade students from the school year 2003-2004. Another list of students was identified as all SJMS students in the seventh and eighth grade for the school year 2004-2005. The Combined Group sample included all students who are on both lists, a total of 279 students. Group One (students who were 6th graders in 2003-2004 and 7th graders in 2004-2005) consisted of 125 students. Group Two (students who were 7th graders in 2003-2004 and 8th graders in 2004-2005) consisted of 154 students.

Research Design

The research design used in this study was a non-experimental case study (Johnson, and Christenson, 2000; Merriam, 1998), that examined the relationship

between the dependent variable, student achievement in math and reading, and the independent variable, type of classroom—single-sex or mixed-sex.

The instrument used to measure student achievement was the West Virginia Educational Standards Test (WESTEST), a customized, criterion-referenced test aligned with the West Virginia Content Standards and Objectives (CSO's). It is designed specifically for West Virginia students in grades three through eight, and 10 (West Virginia Department of Education (WVDE), 2005). The purpose of the WESTEST scores is to demonstrate student ability in mathematics, reading/language arts, science, and social studies in West Virginia. For the purpose of this study, the mathematics and reading/language arts scale scores were used.

An independent and external alignment study, conducted by Dr. Norman Web of the University of Wisconsin in 2003, provided evidence of the content and construct validity of the WESTEST. The scale on which the WESTEST scores are reported is based in part on a standardized achievement test (*TerraNova*) which makes it possible to report national percentile scores in addition to the criterion-referenced scale scores of WESTEST.

WESTEST cut scores are also documented, which provide well-articulated cut scores that increase within a performance level from grade to grade. All cut score decisions are based on committee recommendations from the 2003 field test and the first operational 2004 WESTEST. The cut scores are used to determine Adequate Yearly Progress (AYP) and the No Child Left Behind (NCLB) required trajectory from 2006-2014.

Under the leadership of the West Virginia Department of Education's (WVDE) Office of Student Assessment Services, the Offices of Instructional Services and Special Education Program and Services, groups consisting of parents, teachers, administrators, and business/community representatives participated in alignment and bias reviews. The groups were comprised of diverse ethnic, religious, special needs, gender, and socio-economic (SES) populations to include all the geographic regions in West Virginia (WVDE, 2005).

The Internal and External Bias Review Committees considered the following topics while evaluating assessment items: gender; race/ethnicity; religion; English as a Second Language; age; disability; SES, and other. This review attempted to verify that all WESTEST items were appropriate for all West Virginia students, and to ensure that quality test items were selected for the WESTEST (WVDE, 2005).

The review reflected community/state principles, and provided a system of checks and balances to verify that the WESTEST items were free of bias (WVDE, 2005). The Committee was composed of nine blacks; three Hispanic/Latino; 11 Caucasian; one Native American; four Asian; and two Indians.

The first content review was sponsored by CTB/McGraw-Hill and the West Virginia Department of Education in September 2002. The committee included retired teachers, curriculum coordinators, and classroom teachers. The second content review took place in October 2002. The review considered the following factors: appropriate grade level; alignment to the CSO's; thinking skill level; difficulty; item writing and content answer choices; art development; item specifications; scoring rubrics; and other

general considerations, for example, consideration of community standards (WVDE, 2005).

Data Collection

The sample student WESTEST scores were collected and compared from the school years 2003-2004 and 2004-2005. Each individual student's scores from the first year (when the student was either a 6th grader or a 7th grader) were compared to that same student's scores from the second year (when each student was either a 7th grader or an 8th grader) in Reading/Language Arts and math.

Data Analysis

Data were systematically recorded and tallied. Data were compiled according to the variables dictated by each of the research questions posed in Chapter 1. Frequencies and percentages were recorded for all items on the WESTEST. An alpha level of .05 was set as the criterion for the level of significance, as recommended by Johnson and Christenson (2000). A paired samples t-test was used to determine whether the difference between the means of student scores in mixed-sex classes and single-sex classes was statistically significant, as analyzed by the SPSS computer program. An analysis of variance (ANOVA) was used to examine the possibility of differences among the demographic variables in the study (sex, race, SES, and special education status).

CHAPTER FOUR

PRESENTATION AND ANALYSIS OF DATA

The purpose of this study was to determine if differences exist between the reading/language arts and math achievement of middle-school students based on their assignment to mixed-sex or single-sex classrooms. Another purpose of this study was to determine if differences exist between reading/language arts and math achievement of middle-school students in mixed-sex and single-sex classrooms based on sex, minority status, socio-economic status, and special education status. This chapter contains a presentation and analysis of data collected in the research. The chapter is divided into the following sections: (1) demographic data; (2) major findings; and (3) a summary of the chapter.

Demographic Data

The population for this study was the 6th, 7th, and 8th grade students of Stonewall Jackson Middle School in Charleston, West Virginia. A sample of 279 students was selected from the approximately 600 students in the school. The sample was determined by selecting those students who attended Stonewall during both years of the data collection and who participated in both mixed-sex and single-sex classes. This selection process provided for a set of matched pairs of students from one year to the next year. The 8th grade students in the year 2004 were not selected for the study because they went on to the high school in 2005 and did not participate in any single-sex classes. Students who attended Stonewall for only one year, either as 6th graders or as 7th graders in 2004, were not included in the study because they did not experience both mixed-sex and single-sex classrooms and therefore did not provide a matched pair.

The sample of 279 students was divided into three groups. Group 1 consisted of 125 students who were 6th graders in mixed-sex classes in the school year 2003-2004 and those same students as 7th graders in single-sex classes in the 2004-2005 school year. Group 2 consisted of 154 students who were 7th graders in mixed-sex classes in 2003-2004 and those same students as 8th graders in single-sex classes in 2004-2005. The Combined Group (125 6th graders and 154 7th graders) in 2003-2004 were in mixed-sex classes, and the Combined Group (125 7th graders and 154 8th graders) in 2004-2005 were in single-sex classes.

Table 1 contains the number and percentage of students in the three groups. There were 146 males (52.3%) and 133 females (47.7%) in the Combined Group. There were 69 males (55.2%) and 56 females (44.8%) in Group 1, and 77 males (50%) and 77 females (50%) in Group 2.

TABLE 1
Number and Percentage of Students by Group and Sex

Group	<u>Male</u>		<u>Female</u>	
	N	%	N	%
Combined Group* (N=279)	146	52.3	133	47.7
Group 1** (N=125)	69	55.2	56	44.8
Group 2*** (N=154)	77	50.0	77	50.0

*Combined Group—mixed-sex classes in '03-04; single-sex classes in '04-05

**2004 6th graders (mixed-sex classes) and 2005 7th graders (single-sex classes)

***2004 7th graders (mixed-sex classes) and 2005 8th graders (single-sex classes)

Table 2 contains the number and percentage of black and white students in the Combined Group and in Group 1 and Group 2. There were 107 (38.4%) black students and 172 (61.6%) white students in the Combined Group. There were 48(38.4%) black students and 77(61.6%) white students in Group 1, and 59(38.3%) black students and 95(61.7%) white students in Group 2.

TABLE 2
Number and Percentage of Students by Group and Race

Group	<u>Black</u>		<u>White</u>	
	N	%	N	%
Combined Group* (N=279)	107	38.4	172	61.6
Group 1** (N=125)	48	38.4	77	61.6
Group 2*** (N=154)	59	38.3	95	61.7

*Combined Group—mixed-sex classes in '03-04; single-sex classes in '04-05

**2004 6th graders and 2005 7th graders

***2004 7th graders and 2005 8th graders

Table 3 contains the number and percentage of students by socio-economic status (SES) level by group. SES was determined by whether or not a student qualified for free or reduced lunch, according to Federal guidelines. If a student qualified, he/she was considered low-SES. If a student did not qualify, he/she was considered high-SES. There were 173 students (69.5%) in the low-SES category and 76 students (30.5%) in the high-SES category in the Combined Group. There were 82 (74.5%) low-SES students and 28

(25.5%) high-SES students in Group 1, and 91 (65.5%) low-SES and 48 (34.5%) high-SES students in Group 2.

TABLE 3

Number and Percentage of Students by Group and Socio-Economic Status (SES)

Group	<u>Low-SES</u>		<u>High-SES</u>	
	N	%	N	%
Combined Group* (N=249)	173	69.5	76	30.5
Group 1** (N=110)	82	74.5	28	25.5
Group 2*** (N=139)	91	65.5	48	34.5

*Combined Group—mixed-sex classes in '03-04; single-sex classes in '04-05

**2004 6th graders and 2005 7th graders

***2004 7th graders and 2005 8th graders

Table 4 contains the number and percentage of students in general and special education by group. There were 37 (14%) special education students and 229 (86%) general education students in the Combined Group. There were 13 (11%) special education students and 108 (89%) general education students in Group 1 and 24 (16.6%) special education students and 121 (83.4%) general education students in Group 2.

TABLE 4

Number and Percentage of Students by Group and Special Education Status

Group	Special Education		General Education	
	N	%	N	%
Combined Group* (N=266)	37	14.0	229	86.0
Group 1** (N=121)	13	11.0	108	89.0
Group 2*** (N=145)	24	16.6	121	83.4

*Combined Group—mixed-sex classes in '03-04; single-sex classes in '04-05

**2004 6th graders and 2005 7th graders

***2004 7th graders and 2005 8th graders

Major Findings

The major findings from the data collection are presented in relation to the research questions posed in Chapter 1. The Combined Group comparisons are presented for reading/language arts and math, followed by the comparisons for the Combined Group, Group 1, and Group 2 based on sex, race, socio-economic status, and special education status.

A Paired Samples t-test for independent samples was used to determine whether the difference between the means of the student scores in mixed-sex classes were significantly different from the means of the student scores in single-sex classes. It is the appropriate test to use because it computes the difference between the 2 variables in each case, and tests to see if the average difference is significantly different from zero. It compared the student data which were matched, or paired, between mixed-sex classes and single-sex classes (Archambault, 2006). The t values reported in Table 5 are all

negative, due to the order of data input into the SPSS program. Mixed-sex scores were input first, and then compared to single-sex scores, which resulted in negative values.

This did not affect the significance level.

A one-way analysis of variance (ANOVA) was used to compare the group means between male and female, black and white, low and high-SES, and special education and general education students. It is the appropriate test to use as it tests the difference between the means of groups that are classified on one independent variable, and it reduces the probability of a Type I error, which is rejection of a true null hypothesis. (Patton, 2002).

Group Comparisons in Reading/Language Arts and Math Achievement

Table 5 contains the results of the reading/language arts (R/LA) and math achievement scale scores for students in the Combined Group, Group 1, and Group 2 when they were in mixed-sex classes and single-sex classes.

Combined Group R/LA and Math Comparisons

The Combined Group scale score mean for R/LA for mixed-sex classes was 660.2, with a standard deviation of 42.3. The mean scale score for R/LA for single-sex classes was 673.3, with a standard deviation of 34.7. The paired samples t-test resulted in a t value of -6.8 which was significant at the .01 level.

The math achievement scale score mean for the Combined Group in mixed-sex classes was 664.8, with a standard deviation of 32.8. The math scale score mean for single-sex classes was 677.7, with a standard deviation of 41.4. The paired samples t-test resulted in a t-value of -8.5 , which was significant at the .01 level.

Group 1 R/LA and Math Comparisons

The mean scale score in R/LA for Group 1 in mixed-sex classes was 658.6, with a standard deviation of 36.5. The mean scale score for R/LA in single-sex classes was 671.5, with a standard deviation of 32.5. The paired samples t-test resulted in a t value of -6.8 , which was significant at the .01 level.

The mean scale math score for Group 1 in mixed-sex classes was 660.1, with a standard deviation of 29.8. The mean scale math score in single-sex classes was 671.1, with a standard deviation of 36.4. The paired samples t-test resulted in a t-value of -5.3 , which was significant at the .01 level.

Group 2 R/LA and Math Comparisons

The R/LA scale score mean for Group 2 in mixed-sex classes was 661.4, with a standard deviation of 46.6. The R/LA scale score mean for Group 2 in single-sex classes was 674.8, with a standard deviation of 36.4. The paired samples t-test resulted in a t-value of -4.4 , which was significant at the .01 level.

The math mean scale score for Group 2 in mixed-sex classes was 668.8, with a standard deviation of 34.7. The math mean scale score for Group 2 in single-sex classes was 683.0, with a standard deviation of 44.4. The paired samples t-test resulted in a t-value of -6.6 , which was significant at the .01 level.

TABLE 5
Paired Samples T-Test for Group Comparisons of Reading/Language Arts and
Math Achievement

Group		<u>M</u>	<u>SD</u>	t
Combined Group (N=279)				
R/LA	Mixed-Sex Classes	660.2	42.3	-6.8**
	Single-Sex Classes	673.3	34.7	
Math	Mixed-Sex Classes	664.8	32.8	-8.5**
	Single-Sex Classes	677.7	41.4	
Group 1 (N=125)				
R/LA	Mixed-Sex Classes	658.6	36.5	-6.8**
	Single-Sex Classes	671.5	32.5	
Math	Mixed-Sex Classes	660.1	29.8	-5.3**
	Single-Sex Classes	671.1	36.4	
Group 2 (N=154)				
R/LA	Mixed-Sex Classes	661.4	46.6	-4.4**
	Single-Sex Classes	674.8	36.4	
Math	Mixed-Sex Classes	668.8	34.7	-6.6**
	Single-Sex Classes	683.0	44.4	

**p<.01

Group Comparisons of R/LA and Math Achievement by Sex

Table 6 presents the Combined Group, Group 1, and Group 2 differences in R/LA and math based on the sex of the students.

Combined Group R/LA and Math Achievement

The Combined Group male mean scale score for R/LA in mixed-sex classes was 652.5, with a standard deviation of 48.2. The Combined Group male mean scale score in R/LA in single-sex classes was 666.2, with a standard deviation of 39.0. The Combined Group female mean scale score in R/LA arts in mixed-sex classes was 668.5, with a standard deviation of 32.8. The Combined Group female mean scale score in R/LA in single-sex classes was 681.1, with a standard deviation of 27.3. The analysis of variance resulted in an F value of 10.3 in the mixed-sex classes, which was significant at the .00 level. The analysis of variance for R/LA in the single-sex classes resulted in an F value of 13.5, which was significant at the .00 level.

The Combined Group mean scale score for males in math in mixed-sex classes was 665.0, with a standard deviation of 35.5. The Combined Group mean scale score for males in math in single-sex classes was 675.8, with a standard deviation of 48.2. The Combined Group mean scale score for females in math in mixed-sex classes was 664.5, with a standard deviation of 29.7. The Combined Group mean scale score for females in math in single-sex classes was 679.8, with a standard deviation of 32.4. The analysis of variance for math in the mixed-sex classes resulted in an F value of .01, which was not significant. The analysis of variance for math in the single-sex classes was .64, which was not significant.

Group 1 R/LA and Math Achievement

The mean scale score of males in Group 1 in R/LA in mixed-sex classes was 654.0, with a standard deviation of 42.7. The mean scale score of males in single-sex classes was 667.0, with a standard deviation of 34.6. The mean scale score of females in Group 1 in mixed-sex classes was 664.3, with a standard deviation of 26.2. The mean scale score of females in single-sex classes was 677, with a standard deviation of 29.1. The analysis of variance for the mixed-sex classes resulted in an F value of 2.5, which was not significant. The analysis of variance for the single-sex classes resulted in an F value of 3.0, which was not significant.

The math scale score mean for males in Group 1 in mixed-sex classes was 664.9, with a standard deviation of 30.5. The math scale score mean for males in single-sex classes was 671.6, with a standard deviation of 42.1. The math scale score mean for females in Group 1 in mixed-sex classes was 654.1, with a standard deviation of 27.9. The math scale score mean for females in Group 1 in single-sex classes was 670.4, with a standard deviation of 28.3. The analysis of variance for the mixed-sex classes resulted in an F value of 4.2, which was significant at the .05 level. The analysis of variance for the single-sex classes resulted in an F value of .03, which was not significant.

Group 2 R/LA and Math Achievement

The mean scale score for males in Group 2 in R/LA in mixed-sex classes was 651.2, with a standard deviation of 53. The mean scale score for males in single-sex classes in R/LA was 665.4, with a standard deviation of 42.9. The mean scale score for females in Group 2 in R/LA in mixed-sex classes was 671.6, with a standard deviation of 36.7. The mean score for females in R/LA in single-sex classes was 684.1, with a

standard deviation of 25.6. The analysis of variance for mixed-sex classes in R/LA for Group 2 was 7.7, which was significant at the .01 level. The analysis of variance for single-sex classes in R/LA was 10.8, which was significant at the .01 level.

The mean scale score for males in math in Group 2 in mixed-sex classes was 665.1, with a standard deviation of 39.7. The mean scale score for males in single-sex classes was 679.5, with a standard deviation of 53.1. The mean scale score for females in math in Group 2 in mixed-sex classes was 672.1, with a standard deviation of 28.7. The mean scale score for females in single-sex classes was 686.6, with a standard deviation of 33.6. The analysis of variance for mixed-sex classes in math resulted in an F value of 1.59, which was not significant. The analysis of variance for single-sex classes in math was .97, which was not significant.

TABLE 6

ANOVA for Group Comparisons of Reading/Language Arts and Math by Sex

Group		Mixed-Sex Classes			Single-Sex Classes			F
		N	M	SD	F	M	SD	
Combined Group (N=279)								
R/LA	Male	146	652.5	48.2	10.3**	666.2	39.0	13.5**
	Female	133	668.5	32.8		681.1	27.3	
Math	Male	146	665.0	35.5	.01	675.8	48.2	.64
	Female	133	664.5	29.7		679.8	32.4	
Group 1 (N=125)								
R/LA	Male	69	654.0	42.7	2.5	667.0	34.6	3.0
	Female ⁵⁶	664.3	26.2	677.0		29.1		
Math	Male	69	664.9	30.5	4.2*	671.6	42.1	.03
	Female ⁵⁶	654.1	27.9	670.4		28.3		
Group 2 (N=154)								
R/LA	Male	77	651.2	53.0	7.7**	665.4	42.9	10.8**
	Female ⁷⁷	671.6	36.7	684.1		25.6		
Math	Male	77	665.1	39.7	1.59	679.5	53.1	.97
	Female ⁷⁷	672.1	28.7	686.6		33.6		

*p<.05

**p<.01

Group Comparisons of R/LA and Math Mean Score Differences by Sex

Table 7 presents the group comparisons in R/LA and math scale score differences by sex.

Combined Group R/LA and Math Mean Score Differences

The Combined Group male mean scale score difference in R/LA was 13.7, with a standard deviation of 40.0, and the female mean scale score difference was 12.6, with a standard deviation of 21.5. The analysis of variance (ANOVA) resulted in an F value of .08, which was not significant.

The Combined Group male mean scale score difference in math was 10.8, with a standard deviation of 30.7, and the female mean scale score difference was 15.2, with a standard deviation of 17.4. The ANOVA resulted in an F value of 2.16, which was not significant.

Group 1 R/LA and Math Mean Score Differences

The Group 1 male mean scale score difference in R/LA was 13.1, with a standard deviation of 30.4, and the female mean scale score difference was 12.8, with a standard deviation of 15.3. The ANOVA resulted in an F value of .01, which was not significant.

The Group 1 male mean scale score difference in math was 6.7, with a standard deviation of 27.4, and the female mean scale score difference was 16.3, with a standard deviation of 14.5. The ANOVA resulted in an F value of 5.6, which was significant at the .05 level.

Group 2 R/LA and Math Mean Score Differences

The Group 2 male mean scale score difference in R/LA was 14.2, with a standard deviation of 46.9, and the female mean scale score difference was 12.5, with a standard deviation of 25.2. The ANOVA resulted in an F value of .08, which was not significant.

The Group 2 male mean scale score difference in math was 14.4, with a standard deviation of 33.2, and the female mean scale score difference was 14.4, with a standard deviation of 19.3. The ANOVA resulted in an F value of 7.7, which was significant at the .01 level.

Group Comparisons of R/LA and Math Achievement by Race

Table 8 presents the comparison of mean scores for the Combined Group, Group 1, and Group 2 by race for R/LA and Math.

Combined Group R/LA and Math Achievement

The mean score for black students in R/LA in mixed-sex classes was 650.5, with a standard deviation of 36.8. The mean score for black students in single-sex classes was 665.4, with a standard deviation of 31.6. The mean score for white students in mixed-sex classes was 666.2, with a standard deviation of 44.4. The mean score for white students in single-sex classes was 678.3, with a standard deviation of 35.7. The analysis of variance resulted in an F value in R/LA in mixed-sex classes of 9.2, which was significant at the .01 level. The analysis of variance in single-sex classes resulted in an F value of 9.4, which was significant at the .01 level.

TABLE 7

ANOVA for Group Comparisons of Mean Score Differences by Sex

Group/Gender	Mean Difference	S.D.	F
Combined Group (N=279)			
R/LA	Male	13.7	40.0
	Female	12.6	21.5
Math	Male	10.8	30.7
	Female	15.2	17.4
Group 1 (N=125)			
R/LA	Male	13.1	30.4
	Female	12.8	15.3
Math	Male	6.7	27.4
	Female	16.3	14.5
Group 2 (N=154)			
R/LA	Male	14.2	46.9
	Female	12.5	25.2
Math	Male	14.4	33.2
	Female	14.4	19.3

*p<.05

**p<.01

The mean score for black students in math in mixed-sex classes was 656, with a standard deviation of 26.9. The mean score for black students in single-sex classes was 666.7, with a standard deviation of 41.3. The mean score for white students in math in mixed-sex classes was 670.2, with a standard deviation of 34.5. The mean score for white students in single-sex classes was 684.5, with a standard deviation of 40.0. The

analysis of variance for math in mixed-sex classes resulted in an F value of 12.9, which was significant at the .01 level. The analysis of variance for math in single-sex classes resulted in an F value of 12.6, which was significant at the .01 level.

Group 1 R/LA and Math Achievement

The mean score for black students in Group 1 in mixed-sex classes for R/LA was 646, with a standard deviation of 32.1. The mean for black students in single-sex classes was 666.1, with a standard deviation of 27.6. The mean for white students in R/LA in Group 1 in mixed-sex classes was 666.4, with a standard deviation of 37.0. The mean for white students in single-sex classes was 674.9, with a standard deviation of 35.0. The analysis of variance for R/LA in mixed-sex classes resulted in an F value of 9.9, which was significant at the .01 level. The analysis of variance for R/LA in single-sex classes resulted in an F value of 2.1, which was not significant.

The mean score for math for black students in mixed-sex classes was 650.5, with a standard deviation of 24. The mean score for black students in single-sex classes was 659.9, with a standard deviation of 39.8. The mean score for white students in math in mixed-sex classes was 666.1, with a standard deviation of 31.6. The mean score for white students in math in single-sex classes was 678, with a standard deviation of 32.5. The analysis of variance for math in mixed-sex classes was 8.5, which was significant at the .01 level. The analysis of variance for single-sex classes was 7.6, which was significant at the .01 level.

Group 2 R/LA and Math Achievement

The mean score for black students in R/LA in Group 2 in mixed-sex classes was 654.2, with a standard deviation of 40.0. The mean score for black students in single-sex

classes was 664.7, with a standard deviation of 34.7. The mean score of white students in mixed-sex classes was 665.9, with a standard deviation of 49.9. The mean score of white students in single-sex classes was 681, with a standard deviation of 36.2. The analysis of variance for R/LA in mixed-sex classes resulted in an F value of 2.3, which was not significant. The analysis of variance for R/LA in single-sex classes resulted in an F value of 7.5, which was significant at the .01 level.

The mean for black students in math in mixed-sex classes was 660.5, with a standard deviation of 28.5. The mean score for black students in single-sex classes was 672.2, with a standard deviation of 42.0. The mean score of white students in math in mixed-sex classes was 673.6, with a standard deviation of 37.3. The mean score of white students in single-sex classes was 689.7, with a standard deviation of 44.8. The analysis of variance for mixed-sex classes in math resulted in an F value of 5.3, which was significant at the .05 level. The analysis of variance for single-sex classes resulted in an F value of 5.8, which was significant at the .05 level.

TABLE 8

ANOVA for Group Comparisons of Reading/Language Arts and Math by Race

Group	Mixed-Sex Classes				Single-Sex Classes			
	N	<u>M</u>	<u>SD</u>	<u>F</u>	<u>M</u>	<u>SD</u>	<u>F</u>	
Combined Group (N=279)								
R/LA	Black	107	650.5	36.8	9.2**	665.4	31.6	9.4**
	White	172	666.2	44.4		678.3	35.7	
Math	Black	107	656.0	26.9	12.9**	666.7	41.3	12.6**
	White	172	670.2	34.5		684.5	40.0	
Group 1 (N=125)								
R/LA	Black	48	646.0	32.1	9.9**	666.1	27.6	2.1
	White	77	666.4	37.0		674.9	35.0	
Math	Black	48	650.5	24.0	8.5**	659.9	39.8	7.6**
	White	77	666.1	31.6		678.0	32.5	
Group 2 (N=154)								
R/LA	Black	59	654.2	40.0	2.3	664.7	34.7	7.5**
	White	95	665.9	49.9		681.0	36.2	
Math	Black	59	660.5	28.5	5.3*	672.2	42.0	5.8*
	White	95	673.6	37.3		689.7	44.8	

*p<.05

**p<.01

Group Comparisons of R/LA and Math Mean Score Differences by Race

Table 9 presents the group comparisons of R/LA and Math mean scale score differences by Race.

Combined Group R/LA and Math Mean Score Differences

The black students' mean scale score difference in the Combined Group in R/LA was 14.8, with a standard deviation of 35.9, and the white students' mean scale score difference was 12.1, with a standard deviation of 30.0. The ANOVA resulted in an F value of .46, which was not significant.

The Combined Group black student mean scale score difference in math was 10.7, with a standard deviation of 31.6, and the white student mean scale score difference was 14.2, with a standard deviation of 20.5. The ANOVA resulted in an F value of 1.30, which was not significant.

Group 1 R/LA and Math Mean Score Differences

The Group 1 black student mean scale score difference in R/LA was 20.1, with a standard deviation of 29.1 and the white student mean scale score difference was 8.5, with a standard deviation of 21.4. The ANOVA resulted in an F value of 6.8, which was significant at the .01 level.

The Group 1 black student mean scale score difference in math was 9.4, with a standard deviation of 29.4, and the white student mean scale score difference was 12.1, with a standard deviation of 18.1. The ANOVA resulted in an F value of .36, which was not significant.

Group 2 R/LA and Math Mean Score Differences

The Group 2 black student mean scale score difference in R/LA was 10.6, with a standard deviation of 41.0, and the white student mean scale score difference was 15.1, with a standard deviation of 35.3. The ANOVA resulted in an F value of .52, which was not significant.

The Group 2 black student mean scale score difference in math was 11.7, with a standard deviation of 33.4, and the white student mean scale score difference was 16.1, with a standard deviation of 22.2. The ANOVA resulted in an F value of .94, which was not significant.

Group Comparisons of R/LA and Math Achievement by Socio-Economic Status

Table 10 presents the Combined Group, Group 1, and Group 2 means for R/LA and math by socio-economic status (SES).

Combined Group R/LA and Math Achievement

The mean score for low-SES students in R/LA in mixed-sex classes was 653.7, with a standard deviation of 40.0. The mean score of low-SES students in single-sex classes was 667.5, with a standard deviation of 34.1. The mean score for high-SES students in R/LA in mixed-sex classes was 676.2, with a standard deviation of 44.9. The mean score for high-SES students in single-sex classes was 689.5, with a standard deviation of 30.8. The analysis of variance for R/LA in mixed-sex classes resulted in an F value of 15.5, which is significant at the .01 level. The analysis of variance for R/LA in single-sex classes resulted in an F value of 23.7, which was significant at the .01 level.

TABLE 9

ANOVA for Group Comparisons of Mean Scale Score Differences by Race

Group/Race	Mean Differences	S.D.	F
Combined Group (N=279)			
R/LA	Black	14.8	.46
	White	12.1	
Math	Black	10.7	1.30
	White	14.2	
Group 1 (N=125)			
R/LA	Black	20.1	6.8**
	White	8.5	
Math	Black	9.4	.36
	White	12.1	
Group 2 (N=154)			
R/LA	Black	10.6	.52
	White	15.1	
Math	Black	11.7	.94
	White	16.1	

**p<.01

The mean score for low-SES students in math in mixed-sex classes was 659, with a standard deviation of 28.5. The mean score for low-SES students in single-sex classes was 671.1, with a standard deviation of 38.6. The mean score for high-SES students in mixed-sex classes was 680.9, with a standard deviation of 37.0. The mean score for

high-SES students in single-sex classes was 697.7, with a standard deviation of 41.5. The analysis of variance for math in mixed-sex classes resulted in an F value of 25.7, which was significant at the .01 level. The analysis of variance for math in single-sex classes resulted in an F value of 23.7, which was significant at the .01 level.

Group 1 R/LA and Math Achievement

The mean for low-SES students in Group 1 in R/LA in mixed-sex classes was 651.4, with a standard deviation of 38.2. The mean for low-SES students in single-sex classes was 667.6, with a standard deviation of 32.3. The mean for high-SES students in R/LA in mixed-sex classes was 678.3, with a standard deviation of 28.1. The mean for high-SES students in single-sex classes was 685.6, with a standard deviation of 30.6. The analysis of variance for Group 1 in R/LA in mixed-sex classes for SES resulted in an F value of 11.7, which was significant at the .01 level. The analysis of variance in single-sex classes was 6.7, which was significant at the .01 level.

The mean score for low-SES students in math in Group 1 in mixed-sex classes was 657.4, with a standard deviation of 27.3. The mean score for low-SES students in single-sex classes was 669, with a standard deviation of 37.2. The mean score for high-SES students in mixed-sex classes was 671.4, with a standard deviation of 34.6. The mean score for high-SES students in single-sex classes was 682.4, with a standard deviation of 35.7. The analysis of variance for Group 1 in math in mixed-sex classes for SES resulted in an F value of 4.8, which was significant at the .05 level. The analysis of variance in single-sex classes resulted in an F value of 2.8, which was not significant.

Group 2 R/LA and Math Achievement

The mean score for low-SES students in Group 2 in R/LA in mixed-sex classes was 655.8, with a standard deviation of 41.7. The mean score for low-SES students in single-sex classes was 667.4, with a standard deviation of 35.9.

The mean score for high-SES students in R/LA in mixed-sex classes was 675, with a standard deviation of 52.6. The mean score for high-SES students in single-sex classes was 692, with a standard deviation of 31.0. The analysis of variance for Group 2 in R/LA in mixed-sex classes resulted in an F value of 5.5, which was significant at the .05 level. The analysis of variance for Group 2 in R/LA in single-sex classes resulted in an F value of 16.1, which was significant at the .01 level.

The mean for low-SES students in mixed-sex classes in math was 660.6, with a standard deviation of 29.6. The mean for low-SES students in single-sex classes was 673, with a standard deviation of 40.0. The mean score for high-SES students in mixed-sex classes was 686.5, with a standard deviation of 37.6. The mean score for high-SES students in single-sex classes was 706.6, with a standard deviation of 43.2. The analysis of variance for Group 2 in math in mixed-sex classes resulted in an F value of 19.9, which was significant at the .01 level. The analysis of variance for Group 2 in math in single-sex classes resulted in an F value of 21.0, which was significant at the .01 level.

TABLE 10

ANOVA for Group Comparisons of Reading/Language Arts and Math by SES

Group		Mixed-Sex Classes				Single-Sex Classes			
		N	M	SD	F	M	SD	F	
Combined Group (N=249)									
R/LA	Low	173	653.7	40	15.5**	667.5	34.1	23.7**	
	High	76	676.2	44.9		689.5	30.8		
Math	Low	173	659.0	28.5	25.7**	671.1	38.6	23.7**	
	High	76	680.9	37.0		697.7	41.5		
Group 1 (N=110)									
R/LA	Low	82	651.4	38.2	11.7**	667.6	32.3	6.7**	
	High	28	678.3	28.1		685.6	30.6		
Math	Low	82	657.4	27.3	4.8*	669	37.2	2.8	
	High	28	671.4	34.6		682.4	35.7		
Group 2 (N=139)									
R/LA	Low	91	655.8	41.7	5.5*	667.4	35.9	16.1**	
	High	48	675.0	52.6		692.0	31.0		
Math	Low	91	660.6	29.6	19.9**	673.0	40.0	21.0**	
	High	48	686.5	37.6		706.6	43.2		

*p<.05

**p<.01

Group Comparisons of R/LA and Math Mean Score Differences by SES

Table 11 presents the group comparisons of R/LA and math mean scale score differences by SES.

Combined Group R/LA and Math Mean Score Differences

The Combined Group low-SES mean scale score difference in R/LA was 13.8, with a standard deviation of 33.8, and the high-SES mean scale score difference was 13.4, with a standard deviation of 30.1. The ANOVA resulted in an F value of .01, which was not significant.

The Combined Group low-SES mean scale score difference in math was 12.1, with a standard deviation of 27.1, and the high-SES mean scale score difference was 16.8, with a standard deviation of 19.2. The ANOVA resulted in an F value of 1.89, which was not significant.

Group 1 R/LA and Math Mean Score Differences

The Group 1 low-SES mean scale score difference in R/LA was 16.2, with a standard deviation of 27.3, and the high-SES mean scale score difference was 7.3, with a standard deviation of 15.8. The ANOVA resulted in an F value of 2.63, which was not significant.

The Group 1 low-SES mean scale score difference in math was 11.6, with a standard deviation of 24.1, and the high-SES mean scale score difference was 11.1, with a standard deviation of 21.1. The ANOVA resulted in an F value of .01, which was not significant.

Group 2 R/LA and Math Mean Score Differences

The Group 2 low-SES mean scale score difference in R/LA was 11.6, with a standard deviation of 38.8, and the high-SES mean scale score difference was 17.1, with a standard deviation of 35.4. The ANOVA resulted in an F value of .64, which was not significant.

The Group 2 low-SES mean scale score difference in math was 12.5, with a standard deviation of 29.7, and the high-SES mean scale score difference was 20.1, with a standard deviation of 17.4. The ANOVA resulted in an F value of 2.7, which was not significant.

Group Comparisons of R/LA and Math Achievement by Special Education Status

Table 12 presents the comparison of mean scores for R/LA and Math for the Combined Group, Group 1, and Group 2 based on special education status.

Combined Group R/LA and Math Achievement

The mean score for special education students in mixed-sex classes in R/LA was 607.5, with a standard deviation of 49.8. The mean score for special education students in single-sex classes was 631.3, with a standard deviation of 40.4. The mean score for general education students in mixed-sex classes was 670.3, with a standard deviation of 31.7. The mean score for general education students in single-sex classes was 681.5, with a standard deviation of 27.3. The analysis of variance for mixed-sex classes in R/LA resulted in an F value of 104.4, which was significant at the .01 level. The analysis of variance for single-sex classes in R/LA was 92.6, which was significant at the .01 level.

TABLE 11

ANOVA for Group Comparisons of Mean Scale Score Differences by SES

Group/SES		Mean Difference	S.D.	F
Combined Group (N=249)				
R/LA	Low	13.8	33.8	.01
	High	13.4	30.1	
Math	Low	12.1	27.1	1.89
	High	16.8	19.2	
Group 1 (N=110)				
R/LA	Low	16.2	27.3	2.63
	High	7.3	15.8	
Math	Low	11.6	24.1	.01
	High	11.1	21.1	
Group 2 (N=139)				
R/LA	Low	11.6	38.8	.64
	High	17.1	35.4	
Math	Low	12.5	29.7	2.70
	High	20.1	17.4	

The mean score for special education students in math in mixed-sex classes was 626.2, with a standard deviation of 29.7. The mean score for special education students in single-sex classes was 628.4, with a standard deviation of 45.5. The mean score of general education students in mixed-sex classes was 671.9, with a standard deviation of 28.8. The mean score of regular education students in single-sex classes was 687.1, with a standard deviation of 33.6. The analysis of variance for mixed-sex classes in math

resulted in an F value of 79.2, which was significant at the .01 level. The analysis of variance for single-sex classes was 87.2, which was significant at the .01 level.

Group 1 R/LA and Math Achievement

The mean score for special education students in R/LA in Group 1 in mixed-sex classes was 621.5, with a standard deviation of 37.9. The mean score of special education students in single-sex classes was 635.2, with a standard deviation of 43.9. The mean score of general education students in R/LA in mixed-sex classes was 664.8, with a standard deviation of 30.8. The mean score of general education students in single-sex classes was 676.4, with a standard deviation of 28.4. The analysis of variance for R/LA in mixed-sex classes by special education status resulted in an F value of 21.8, which was significant at the .01 level. The analysis of variance for R/LA in single-sex classes was 21.4, which was significant at the .01 level.

The mean score for special education students in Group 1 in math in mixed-sex classes was 630.5, with a standard deviation of 34.1. The mean score for special education students in single-sex classes was 619.5, with a standard deviation of 53.2. The mean score of general education students in mixed-sex classes was 664.4, with a standard deviation of 27.0. The mean score of general education students in single-sex classes was 677.8, with a standard deviation of 28.8. The analysis of variance for math in mixed-sex classes by special education status resulted in an F value of 17.2, which was significant at the .01 level. The analysis of variance for math in single-sex classes resulted in an F value of 38.1, which was significant at the .01 level.

Group 2 R/LA and Math Achievement

The mean for special education students in Group 2 in R/LA in mixed-sex classes was 599.9, with a standard deviation of 54.4. The mean for special education students in single-sex classes was 629.2, with a standard deviation of 39.3. The mean score for general education students in mixed-sex classes was 675.2, with a standard deviation of 31.7. The mean for general education students in single-sex classes was 686, with a standard deviation of 25.6. The analysis of variance for mixed-sex classes for R/LA resulted in an F value of 86.0, which was significant at the .01 level. The analysis of variance for single-sex classes was 81.2, which was significant at the .01 level.

The mean score of special education students in math in Group 2 in mixed-sex classes was 623.9, with a standard deviation of 27.6. The mean score of special education students in single-sex classes was 633.3, with a standard deviation of 41.2. The mean score of general education students in mixed-sex classes was 678.6, with a standard deviation of 28.8. The mean score of general education students in single-sex classes was 695.4, with a standard deviation 35.4. The analysis of variance for mixed-sex classes for math resulted in an F value of 72.9, which was significant at the .01 level. The analysis of variance for single-sex classes was 58.3, which was significant at the .01 level.

Group Comparisons of R/LA and Math Mean Score Differences by Special Education Status

Table 13 presents the group comparisons of R/LA and Math mean scale score differences by special education status.

TABLE 12

ANOVA for Group Comparison of Reading/Language Arts and Math by Special Education Status

Group	Mixed-Sex Classes				Single-Sex Classes			
	N	<u>M</u>	<u>SD</u>	<u>F</u>	<u>M</u>	<u>SD</u>	<u>F</u>	
Combined Group (N=266)								
R/LA	Special Ed.	37	607.5	49.8	104.4**	631.3	40.4	92.6**
	General Ed.	229	670.3	31.7		681.5	27.3	
Math	Special Ed.	37	626.2	29.7	79.2**	628.4	45.5	87.2**
	General Ed.	229	671.9	28.8		687.1	33.6	
Group 1 (N=121)								
R/LA	Special Ed.	13	621.5	37.9	21.8**	635.2	43.9	21.4**
	General Ed.	108	664.8	30.8		676.4	28.4	
Math	Special Ed.	13	630.5	34.1	17.2**	619.5	53.2	38.1**
	General Ed.	108	664.4	27.0		677.8	28.8	
Group 2 (N=145)								
R/LA	Special Ed.	24	599.9	54.4	86.0**	629.2	39.3	81.2**
	General Ed.	121	675.2	31.7		686.0	25.6	
Math	Special Ed.	24	623.9	27.6	72.9**	633.3	41.2	58.3**
	General Ed.	121	678.6	28.8		695.4	35.4	

**p<.01

Combined Group R/LA and Math Mean Score Differences

The Combined Group special education mean scale score difference for R/LA was 23.9, with a standard deviation of 62.1, and the general education mean scale score difference was 11.3, with a standard deviation of 22.4. The ANOVA resulted in an F value of 5.2, which was significant at the .05 level.

The Combined Group special education mean scale score difference for math was 2.2, with a standard deviation of 48.7, and the general education mean scale score difference was 15.2, with a standard deviation of 17.3. The ANOVA resulted in an F value of 9.2, which was significant at the .01 level.

Group 1 R/LA and Math Mean Score Differences

The Group 1 special education mean scale score difference for R/LA was 13.8, with a standard deviation of 10.9, and the general education mean scale score difference was 11.7, with a standard deviation of 23.7. The ANOVA resulted in an F value of .10, which was not significant.

The Group 1 special education mean scale score difference for math was 11.0, with a standard deviation of 49.3, and the general education mean scale score difference was 13.4, with a standard deviation of 16.5. The ANOVA resulted in an F value of 14.1, which was significant at the .01 level.

Group 2 R/LA and Math Mean Score Differences

The Group 2 special education mean scale score difference for R/LA was 29.3, with a standard deviation of 76.5, and the general education mean scale score difference was 10.9, with a standard deviation of 21.4. The ANOVA resulted in an F value of 5.1, which was significant at the .05 level.

The Group 2 special education mean scale score difference for math was 9.3, with a standard deviation of 47.9, and the general education mean scale score difference was 16.8, with a standard deviation of 18.1. The ANOVA resulted in an F value of 1.73, which was not significant.

TABLE 13

ANOVA for Group Comparisons of Mean Scale Score Differences by Special Education Status

Group/Sp. Ed. Status	Mean Difference	S.D.	F
Combined Group (N=266)			
R/LA	Special Ed.	23.9	5.2*
	General Ed.	11.3	
Math	Special Ed.	2.2	9.2**
	General Ed.	15.2	
Group 1 (N=121)			
R/LA	Special Ed.	13.8	.10
	General Ed.	11.7	
Math	Special Ed.	11.0	14.1**
	General Ed.	13.4	
Group 2 (N=145)			
R/LA	Special Ed.	29.3	5.1*
	General Ed.	10.9	
Math	Special Ed.	9.3	1.73
	General Ed.	16.8	

*p<.05

**p<.01

Summary

A case study of Stonewall Jackson Middle School in Charleston, West Virginia was made to compare the effects of mixed-sex classes versus single-sex classes on middle school student achievement. A comparison was also made to determine if differences existed between student achievement in mixed-sex and single-sex classes based on sex, minority status, socio-economic status, and special education status. Student WESTEST scores were compared in reading/language arts (R/LA) and math for the 2003-2004 and 2004-2005 school years. The student scores from one year, when all students were in mixed-sex classes, were compared to the same student scores from the next year, when all students were in single-sex classes. The Combined Group contained 279 students. Group 1 (students who were 6th graders in 2003-2004 and 7th graders in 2004-2005) contained 125 students. Group 2 (students who were 7th graders in 2003-2004 and 8th graders in 2004-2005) contained 154 students.

Statistically significant differences between mixed-sex classes and single-sex classes were found in R/LA and math scores in the Combined Group, Group 1, and Group 2. Statistically significant differences were found by sex in the Combined Group and Group 2 R/LA mixed-sex and single-sex scores. Differences were not significant in Group 1's R/LA scores. Statistically significant differences were found in math by sex in the mixed-sex classes. The differences were not significant in the mixed-sex classes for the Combined Group or Group 2 by sex in math, and in the single-sex classes for the Combined Group, Group 1, or Group 2.

A comparison of the mean scale score differences by sex showed a statistically significant difference in Group 1's math and Group 2's R/LA, but not in the Combined Group R/LA and math, Group 1 R/LA, or Group 2 math.

Statistically significant differences were found by race in the mixed-sex classes for the Combined Group and Group 1 R/LA, but not Group 2's R/LA. Significant differences were found in the single-sex classes in R/LA for the Combined Group and Group 2, but not for Group 1. Significant differences were found in the Combined Group, Group 1, and Group 2 in both mixed-sex and single-sex classes in math. The mean scale score differences by race showed a statistically significant difference in Group 1's R/LA, but not in the Combined Group and Group 2's R/LA. No significant differences were found in the Combined Group, Group 1, or Group 2's math scores.

Statistically significant differences were found in the R/LA and math scores by SES in mixed-sex classes for the Combined Group, Group 1, and Group 2. Significant differences were found in the single-sex scores by SES in the Combined Group, Group 1, and Group 2 for R/LA. Significant differences were found in math in the Combined Group and Group 2, but not in Group 1. No significant differences were found in the comparison of mean scale score differences by SES.

Statistically significant differences were found in the R/LA and math scores by special education status in mixed-sex and single-sex classes for the Combined Group, Group 1, and Group 2. The mean scale score differences by special education status showed significant differences in the Combined Group's R/LA and math, Group 1's math, and Group 2's R/LA.

CHAPTER FIVE

SUMMARY, FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

This chapter summarizes the purpose, demographic data, and methods used. It also includes a summary of the findings and provides conclusions drawn from the findings. In addition, discussion, implications and recommendations for further study are presented.

Purpose of the Study

The purpose of this study was to investigate the effects of single-sex classes versus mixed-sex classes on the academic achievement of middle school students at Stonewall Jackson Middle School in Charleston, West Virginia. Another purpose was to investigate the effects of single-sex classes versus mixed-sex classes on the academic achievement of students based on the students' sex, minority status, socio-economic status, and special education status.

The following research questions guided this study:

1. Is there a significant difference in the reading/language arts performance of middle school students based on their assignment to single-sex or mixed-sex classes?
2. Is there a significant difference in the reading/language arts performance of middle school students, as disaggregated by sex, minority status, socio-economic status, and special education status, based on their assignment to single-sex or mixed-sex classes?
3. Is there a significant difference in the math performance of middle school students based on their assignment to single-sex or mixed-sex classes?

4. Is there a significant difference in the math performance of middle school students, as disaggregated by sex, minority status, socio-economic status, and special education status, based on their assignment to single-sex or mixed-sex classes?

Demographic Data

Stonewall Jackson Middle School was comprised of approximately 600 6th, 7th, and 8th grade students during the course of this study. A sample of 279 students was selected from the total population. The sample was determined by selecting those students who attended Stonewall during both years of data collection and who participated in both mixed-sex and single-sex classes. This selection process provided for a set of matched pairs of students from one year to the next.

The sample of 279 students was divided into three groups. Group 1 consisted of 125 students who were 6th graders in mixed-sex classes in the school year 2003-2004 and those same students as 7th graders in single-sex classes in the 2004-2005 school year. Group 2 consisted of 154 students who were 7th graders in mixed-sex classes in 2003-2004 and those same students as 8th graders in single-sex classes in 2004-2005. The Combined Group (125 6th graders and 154 7th graders) in 2003-2004 were in mixed-sex classes, and the Combined Group (125 7th graders and 154 8th graders) in 2004-2005 were in single-sex classes.

Methods

The research design used in this study was a non-experimental case study that examined the relationship between the dependent variable, student achievement in reading/language arts and math, and the independent variable, type of classroom—single-

sex or mixed-sex. The instrument used to measure student achievement was the WESTEST, a customized, criterion-referenced test aligned with the West Virginia Content Standards and Objectives.

The sample student WESTEST scores were collected and compared from the school years 2003-2004 and 2004-2005. Each individual student's scores from the first year were compared to that same student's scores from the second year in reading/language arts and math. Data were compiled according to the variables dictated by each of the research questions.

An alpha level of .05 was set as the criterion for the level of significance. A paired-samples t-test was used to determine if the difference between the means of student scores in mixed-sex classes and the means in single-sex classes was statistically significant. An analysis of variance (ANOVA) was used to determine if significant differences occurred among the demographic variables of sex, race, SES, and special education status. All data was analyzed by the Statistical Package for Social Science (SPSS) computer program.

Summary of Findings

Significant differences in student academic performance between single-sex and mixed-sex classes were found in R/LA and math scores in the Combined Group, Group 1, and Group 2.

Significant differences were also found by sex in the Combined Group and Group 2 R/LA scores. In both groups, females scored significantly higher than males. The mean scale score difference for R/LA was significant at the .01 level for Group 2, with the scores of male students significantly higher than the scores of female students.

Significant differences at the .01 level in math were found for Group 2 in both the mixed-sex classes' achievement means and in the mean scale score differences. Males scored significantly higher than females.

Significant differences were found by race in mixed-sex classes in R/LA in the Combined Group and Group 1. In both the Combined Group and Group 1, white students scored significantly higher than black students in R/LA. Significant differences were found in R/LA in single-sex classes by race in the Combined Group and Group 2. In both the Combined Group and Group 2, white students scored significantly higher than black students. The mean scale score differences were significant at the .01 level in Group 1. Black student score differences were significantly higher than white student score differences.

Significant differences were found in both mixed-sex and single-sex classes in math achievement by race. In the Combined Group, Group 1, and Group 2, white students scored significantly higher than black students. The differences in the mean scale score comparisons were not significant. While both white and black students increased their scores from mixed-sex to single-sex classes, the differences between the group means were not significant.

Significant differences were found in the Combined Group, Group 1, and Group 2 by SES in mixed-sex and single-sex classes in R/LA and math. In all three groups, high-SES students scored significantly higher than low-SES students. There was no significance between the mean scale score differences. While both low-SES and high-SES students increased their scores from mixed-sex to single-sex classes, the differences between the group means were not significant.

Significant differences by special education status were found between mixed-sex and single-sex classes in the Combined Group, Group 1, and Group 2 in R/LA and math. In all three groups, general education students scored significantly higher than special education students. The mean scale score differences were significant in the Combined Group and Group 2 in R/LA. The mean scale score differences were significant in the Combined Group and Group 1 in math. Special education student scale score differences, however, were significantly higher than general education student scale score differences. There was no significant difference in Group 1 in R/LA, or in Group 2 in math.

Conclusions

The findings of this study were sufficient to support the following conclusions to the research questions posed in Chapter 1.

1. Is there a significant difference in the reading/language arts performance of middle school students based on their assignment to single-sex or mixed-sex classes?

There was a significant difference in the reading/language arts performance of middle school students based on their assignment to single-sex or mixed-sex classes. Student achievement in reading/language arts was significantly higher for those students enrolled in single-sex classes.

2. Is there a significant difference in the reading/language arts performance of middle school students when disaggregated by sex, race, special education status, and socio-economic status, based on their assignment to single-sex and mixed-sex classes?

There were no significant differences in the reading/language arts performance of middle school students based on their assignment to single-sex or mixed-sex classes,

when disaggregated by sex, race, or SES. There was a significant difference in reading/language arts performance in middle school students, however, when disaggregated by special education status. The mean difference score for special education students was significantly higher than the mean difference score for general education students.

3. Is there a significant difference in the math performance of middle school Students based on their assignment to single-sex or mixed-sex classes?

There was a significant difference in the math performance of middle school students based on their assignment to single-sex or mixed-sex classes. Student achievement in math was significantly higher for those students enrolled in single-sex classes.

4. Is there a significant difference in the math performance of middle school students when disaggregated by sex, race, special education status, and socio-economic status, based on their assignment to single-sex or mixed-sex classes?

There were no significant differences in the math performance of middle school students based on their assignment to mixed-sex or single-sex classes, when disaggregated by sex, race, or SES. There was a significant difference, however, in math performance in middle school students when disaggregated by special education status. The mean difference score for general education students was significantly higher than the mean difference score for special education students.

Discussion and Implications

The results of this study indicate that the use of single-sex classes to deliver instruction at Stonewall Jackson Middle School significantly improved student achievement in reading/language arts and math. Based on the results of this study,

Stonewall should continue to offer single-sex classes in the core subjects of English, math, science, and social studies, and explore expanding single-sex instruction in the related arts classes.

The finding that student achievement improved in single-sex classes supports the previous work of Kruse (1997), Biddulph (1997), Hamilton (1985), Lee and Lockheed (1990), The National Foundation for Education Research (NFER) (2002), the Australian Council for Educational Research (ACER) (2001), Younger and Warrington (2001, 2002), O'Reilly (2000), Henry (2001), Wong (2002), Seitsinger et al. (1998), Lee and Bryk (1986), Lee and Marks (1990), Riordan (1990,1994), Sax (2005), and Gurian (2001,2003). This research found that student achievement increases when the students are assigned to single-sex classes or single-sex schools.

The findings in this study are in conflict with the previous work of Steedman (1985), Haag (1998), Smith (1996), White (1982), Carpenter and Hayden (1987), Smith (1996), Jiminez and Lockheed (1998), and Lepore and Warren (1997), who concluded that school type was not an important factor in student achievement. Some of the inconsistency between the findings of this study and the findings of these previous works may be explained by the fact that the previous studies controlled for parent educational levels, parent occupations, and pre-existing student achievement differences. This study did not attempt to control for these factors.

Overall, females outperformed males in R/LA in mixed-sex and single-sex classes. This supports the previous work of NFER (2002), Sax (2005), Gurian (2001, 2003), Cortis and Newmarch (2000), Sommers (2000), and Rowe (2000), Thompson and Ungerieider (2004), Masters and Forster (1997a), and Slade (2002) which reported that

females score higher than males in R/LA. Although female student achievement was significantly higher than male student achievement in both mixed-sex and single-sex classes, the overall mean scale score differences between the sexes was not significantly different. This finding does not appear to support the conclusion by Riordan (1990, 1994), Henry (2001), and Baker et.al (1995) that males benefit more than females from single-sex classes. One possible explanation for the inconsistency in this study's findings and the findings of these previous studies may relate to the influence of more male discipline referrals at Stonewall. Even though the overall number of incidences was reduced during the course of this study, there was still a 4-1 ratio of male to female behavior problems. One could infer that the time spent out of class in the office away from instruction has the potential to reduce male achievement.

Overall, this study did not find significant differences in the achievement or improvement scores between males and females in math. This does not support the previous work by McFarlane and Crawford (1985), Lee and Lockheed (1990), Baker et.al (1995), and Lepore and Warren (1997) which concluded that boys perform better than girls in math. It also does not show strong support for the conclusions by Riordan (1990, 1994), Salomone (2003), and Baker et.al (1995) that boys benefit more than girls do from single-sex classes, as Group 2 was the only group that showed male improvement scores to be significantly greater than female improvement scores. Five of the six math teachers at Stonewall were female. It could be suggested that female students responded more favorably to the instructional practices of their teachers than did the male students. One suggestion would be for Kanawha County Schools and higher education institutions to

recruit and train more male math teachers. The finding of this study does support the contention by Sax (2005) that boys and girls can learn equally well.

One implication for the lack of significant differences in the mean scale scores between boys and girls in R/LA and math was that most teachers taught both groups with the same instructional strategies. Available research (Sax, 2005, Gurian, 2001, 2003, Salomone, 2003, Riordan, 1990, 1994, and others) is clear that boys and girls learn differently. There had been no training for SJMS teachers on specific instructional strategies to use with each sex. Few teachers in any school receive such training. If the achievement gap between boys and girls is to be significantly reduced, such professional development is essential.

Another implication would be for higher education institutions to include teacher preparation classes in sex-specific instructional strategies. The researcher found no evidence that such courses currently exist.

White students scored higher than black students in both mixed-sex and single-sex classes in R/LA and math. This supports the previous work of Singh, Vaugh, and Mitchell (1998), Salomone (2003), Whittaker (1991), Murrell (1992), McClusky (1993), Riordan (1990, 1994), Salomone (2003), Boyd (1994), Murrell (1992), and Whittaker (1991). However, there was no significant difference in the improvement between black and white students when performance in mixed-sex and single-sex classes was compared. (Only Group 1 showed significant improvement in R/LA.) This does not support the conclusion by Riordan (1990, 1994), Singh, Vaugh, and Mitchell (1998), Salomone (2003) that black students benefit more than white students from single-sex classes.

Although both black and white student scores improved in single-sex classes, there is still a significant achievement gap between the races. If schools are to close the achievement gap between black and white students, it is suggested that additional training for teachers in culturally-relevant instructional strategies be provided, to better meet the needs of black students. Although SJMS teachers have participated in some diversity training, with the turnover of teachers each year, it is crucial that ongoing training be sustained and reinforced. Another factor that may have influenced these findings is that while approximately 40% of the SJMS students are black, only approximately 15% of the teachers are black. Kanawha County Schools could benefit from an extensive effort to recruit minority teachers to staff inner-city schools. Higher education institutions could actively recruit minority students for their teacher preparation programs.

High-SES students outperformed low-SES students in both mixed-sex and single-sex classes. This supports the ACER report (2001), the OFSTED report (1998) and the previous work of Riordan (1990, 1994), and Salomone (2003).

There were, however, no significant differences in the improvement scores between low-SES and high-SES students when performance in mixed-sex and single-sex classes was compared. This does not support the conclusions by Riordan (1990, 1994), Salomone (2003), and the NERF report (2002) that low-SES students benefit more from single-sex classes than high-SES students.

Most teachers at SJMS (90%) are in the middle to high-SES category, while the majority of students (70%) at SJMS are in the low-SES category. Increased teacher understanding of the culture of poverty through professional development would increase teacher ability to better meet the academic needs of the low-SES students

In all groups, general education students scored significantly higher than special education students in both mixed-sex and single-sex classes. This supports the work of Datnow, Hubbard, and Conshas (2001), Datnow and Hubbard (2000), Streitmatter (1997, 1999), Madigan (2002).

However, there were significant differences between the improvement scores of special education and regular education students, with special education students showing the overall greatest improvement in R/LA. Only Group one in R/LA did not show a significant difference favoring special education students. This supports the previous work of Riordan (1990, 1994) and Salomone (2003) that special education students benefit more from single-sex classes than do general education students.

In contrast, general education students showed the most significant improvement in math scores in two of the three groups. One possible explanation for this finding is the lack of qualified math special education teachers. Of the six resource teachers at Stonewall, none of them majored in math, and four of the six were long-term substitutes. It would benefit Kanawha County Schools to require math certification as well as special education certification for teachers at all grade levels. The West Virginia Department of Education is currently developing just such a content certification requirement for special education teachers. In addition, ongoing, extensive professional development in math instructional strategies could benefit special, as well as general, education teachers.

The research findings (Streitmatter, 1999, Epstein, Cullias, and Bursuch, 1985, Callahan, 1940, and Madigan, 2002) also support single-sex education for special education students as a way to reduce the amount of boy-to-girl bullying, the dominance of boys over girls in interactions with teachers, and to reduce the effect of more severe

learning disabilities found in females. The current study results of special education student achievement support the previous findings. One possible explanation for the lack of a significant difference in the mean scores between special education and general education students in Group 1's R/LA could have been the low number (13) of special education students in that group. However, even with the low number of students, there was still a significant difference in the math scores. Further research involving a larger number of special education students is warranted.

Stonewall staff had no prior training in how to differentiate instruction for boys and girls before implementing single-sex classes. The research indicates that it works in some schools, but not in others, with the deciding factor being intensive and extensive staff development (Gurian, 2003, Sax, 2005, Salomone, 2003, Taylor, 2002, Younger and Warrington, 2002). The researcher believes that Stonewall's success was due in large part to the near unanimous consent and commitment of the faculty to try single-sex classes, and the student, parent, and community support for such classes. If single-sex instruction is to be successful in other schools and locations, teachers should be equipped with the knowledge and skill to work with both boys' and girls' differing learning styles. The same content can be taught, but there are different ways to teach it, depending on the specific needs of the learner (Sax, 2005). Ideally this would occur in all classrooms, not just single-sex classrooms.

As has been previously stated, most of the research to date has studied high school students in elite and/or private, Catholic schools located outside the United States. It is difficult to compare Stonewall Jackson, an inner-city, public middle school with a

high percentage of minority, low-SES, and special education student populations to these other schools.

Other public schools in Kanawha County and across West Virginia are considering, or have already begun, offering single-sex classes. Dunbar Middle, East Bank Middle (Kanawha County) and Beckley Stratton Middle School (Raleigh County) started this past year, with Glenwood Elementary, Anne Bailey Elementary (Kanawha County) and Sherrard Junior High in Marshall County starting this school year. The implication is that if it worked at Stonewall, it could perhaps work at other schools with similar contextual dimensions to benefit student achievement.

Recommendations for Further Research

It is hoped that the results of this study will encourage others to explore the applications and implications of single-sex classes at all educational levels. Little research has been done involving public elementary, middle, and high schools in the United States, yet the number of single-sex schools/classes is increasing each year. The latest count by the National Association for Single-Sex Public Schools (NASSPE, 2006) was 223.

This study focused on reading/language arts and math achievement. Future studies could involve science, social studies, and related arts achievement. Another approach would be to study what specific instructional strategies are most successful for boys, girls, black, white, (and other ethnic groups), low and high-SES, and special education and general education students. Although a caring, knowledgeable, dedicated teacher can reach most students, it would be helpful if that teacher had a repertoire of

“best practices” (Zemelman, Daniels, and Hyde, 1998) for instruction for boys, girls, minority, low-SES, and special education students from which to choose.

One of the limitations of this study was the fact that the students had one set of teachers for mixed-sex instruction, and a different set of teachers for single-sex instruction. Quality of instruction varies from teacher to teacher, and some of the differences (or lack of differences in the subgroup mean scale scores) may have been due to teacher quality. One study that could control for teacher quality would be to explore whether or not students having a National Board Certified Teacher would make a difference in student achievement. Several studies comparing student achievement between non-certified and certified teachers have been done, but none involving single-sex classes, to date.

An area of universal concern to educators is student conduct. Although not reported in this study, the researcher noticed an immediate drop in the number of discipline referrals to the office when single-sex classes started at Stonewall. Is this a consistent pattern, or just an anomaly? Additional research from other schools would help answer this question.

Do boys and girls learn better from a teacher of the same sex? Considering the fact that 90% of all teachers are female, as reported in Chapter 2, how does this affect boys’ learning? Much has been written about the achievement gap between boys and girls, so this would be an area for useful research.

The qualitative aspect of single-sex education is another area that lends itself to various avenues of research. Informally speaking with students at Stonewall, the researcher heard girls say they liked the single-sex classes because they were not “picked

on” by the boys. Do single-sex classes affect the incidences of harassment and bullying in schools? Boys commented that they were not afraid to speak up and possibly give a wrong answer when girls were not in the same classroom. How do single-sex classes affect student motivation to learn and student engagement in class activities?

The researcher found no studies on how single-sex classes affected teachers. Questions that could be explored include teacher perceptions of student achievement and behavior, is there a difference in how male and female teachers teach and do any instructional differences affect student achievement, and do male and female teachers experience different successes/concerns with single-sex classes than with mixed-sex classes?

Finally, the current study was a case study, focusing on one middle school for a two year period. Additional studies could involve multiple schools over an extended time period.

REFERENCES

Able, Graham (2000, January). British A-level results and single-sex education.

International Boys' School Coalition, series 2, no. 2.

Adult Literacy in New Zealand (1996). Results from the International Adult

Literacy Survey. Ministry of Education.

American Association of University Women (1992). How schools shortchange girls: a study of major findings on girls and education. Washington, DC: AAUW Educational Foundation.

American Association of University Women (1995). Growing smart: what's working for girls in schools. Washington, DC: AAUW Educational Foundation.

American Association of University Women (1998). Separated by Sex: A Critical Look at Single-Sex Education for Girls. Washington, DC: AAUW Educational Foundation.

American Association of University Women (1999). Gender Gaps: Where Schools Still Fail Our Children. New York: Marlowe.

American Association of University Women (2004, March). Public Policy and Government Relations Department.

http://www.aauw.org/takeaction/policyissues/single_sex.cfm.

Archambault, Susan (2006).

www.wellesley.edu/Psychology/Psych205/pairttest.html.

Armstrong, Thomas (1994). Multiple Intelligences in the Classroom. Alexandria, VA: ASCD.

- Arnold, Arthur, and Burgoyne, Paul (2004). Are XX and XY brain cells intrinsically different? Trends in Endocrinology and Metabolism, 15:6-11.
- Ascher, Carol (1992). School programs for African American males...and females. Phi Delta Kappa, 73(10):779.
- Association for Supervision and Curriculum Development (2001, summer). How teachers can develop boys' interests in literature. Arlington, Virginia: ACSD.
- At The Turning Point: The Young Adolescent Learner (1995). Abstract from Turning Points Guide to School Structures that Support Learning and Collaboration. www.turningpts.org.
- Australian Council for Educational Research (2001). Academic performance of students at single-sex and coeducational schools. <http://www.acer.edu.au/>.
- Australian Council for Educational Research (2002). Boys in school and society. Camberwell, Victoria. <http://www.acer.edu.au/>.
- Bailey, Susan (2002). Gender in Education. San Francisco: Jossey-Bass.
- Baker, D. (2002). Good intentions: an experiment in middle school single-sex science and mathematics classrooms with high minority enrollment, Journal of Women and Minorities in Science and Engineering, 8: 1-23.
- Baker, D. and Jacobs, K. (1999). Winners and Losers in Single-Sex Science and Mathematics Classrooms. Paper presented at the Annual Meeting of the National Association for Research in Science Teaching, Boston, MA.
- Baker, D. P., and Riordan, C., et al. (1995). The effects of sex-grouped schooling on achievement: the role of national context. Comparative Education Review, 39(4):468.

- Barkley, R.A. (1996). Attention deficit hyperactivity disorder. In Mash, E.J. and Barkley, R.A. (Eds.). Child Psychopathology. New York: Guilford.
- Biddulph, S. (1997). Raising Boys. Leicestershire, England.
- Bone, Ann (1983). Girls and Girls-Only Schools. Manchester, England: Equal Opportunities Commission.
- Booker, Keonya C. (2006). School belonging and the African American Adolescent: What do we know and where should we go? The High School Journal. Chapel Hill, North Carolina: The University of North Caroline Press.
- Boyatzis, Chris, and Eades, Julie (1999). Gender differences in preschoolers' and kindergartners' artistic production and preference. Sex Roles, 41:626-38.
- Boyd, Sr., Frederick D. (2000). Non-verbal behaviors of effective teachers of at-risk African-American male middle school students. A dissertation submitted to the Faculty of the Virginia Polytechnic Institute and State University, Blacksburg, Virginia.
- Bradley, Ann, and Manzo, Kathleen Kennedy (2000, October 4). The weak link, Education Week.
- Brighter Choice Schools (2005). <http://www.brigherchoice.org/singlesex.htm>.
- Brodhagen, Barbara L. (2000, October 4). In Bradley, Ann, and Manzo, Kathleen Kennedy, The weak link. Education Week, p.4, 5.
- Brown, R., and Fletcher, R. (Eds.). (1995). Boys in Schools. Sidney, Australia: Finch.
- Caine, Janel (1991). The effects of music on the selected stress behaviors, weight, caloric and formula intake, and length of hospital stay of premature and low birth weight neonates in a newborn intensive care unit. Journal of Music Therapy, 28: 180-92.

- Callahan, K. (1994). Wherefore art thou, Juliet? Causes and Implications of male-dominated sex ratio in programs for students with emotional and behavioral disorders. Education and Treatment of Children, 17(3):228-243.
- Carnegie Council on Adolescent Development (1989). Turning Points: Preparing American Youth for the 21st Century. The report of the task force on education of young adolescents. New York: Carnegie Corporation of New York.
- Carpenter, Peter, and Hayden, Martin (1987). Girls' academic achievement: single-sex versus co-educational secondary schools in Australia. Sociology of Education, 60:156.
- Cassidy, Jane, and Ditty, Karen (2001). Gender differences among newborns on a transient otoacoustic emissions test for hearing. Journal of Music Therapy, 37:28-35.
- Clarke, Vicki (2000, October 4). In Portner, Jessica, Competing forces. Education Week.
- Collins, C., Kenway, J., and McLeod, J. (2000). Factors influencing the educational performance of males and females in school and their initial destinations after leaving school. Canberra: DETYA.
- Cole, Nancy (1997). The ETS gender study: how females and males perform in educational settings. Princeton: Educational Testing Service.
- Coleman, James S. (1961). The Adolescent Society: The Social Life of the Teenager and Its Impact on Education. New York: Free Press of Glencoe.
- Cone-Wesson, Barbara and Ramirez, Glendy (1997). Hearing sensitivity in newborns estimated from ABRs to bone-conducted sounds, Journal of the American Academy of Audiology, 8:299-307.

- Conlin, Michelle (2003, May 26). The new gender gap, Business Week, pp.74- 84.
- Connellan, Jennifer, Baron-Cohen, Simon, et al. (2000). Sex differences in human neonatal social perception. Infant Behavior and Development, 23:113-18.
- Corso, John (1959). Age and sex differences in thresholds. Journal of the Acoustical Society of America, 31:489-507.
- Corso, John (1963). Aging and auditory thresholds in men and women. Archives of Environmental Health, 6:350-356.
- Cortis, Natasha, and Newmarch, Eileen (2000, December). Boys in school: what's happening? A paper prepared for Mining the Next Millennium, an International Interdisciplinary Masculinities Conference hosted by the School of Humanities and Social Science, Queensland University of Technology.
- Costa, Arthur L., (Ed.). (1991). Developing Minds. (Revised edition), ASCD, Alexandria, Virginia.
- Costa, Paul, Terracciano, Antonio, and McCrae, Robert (2001). Gender differences in personality traits across cultures: robust and surprising findings. Journal of Personality and Social Psychology, vol. 81(2): 322- 331.
- Daly, Peter (1996). The effects of single-sex and coeducational secondary schooling on girls' achievement. Research Papers in Education, II, no. 3: 289-306.
- Datnow, A., Hubbard, L., and Conchas, G. (2001). How context mediates policy: the implementations of single gender public schooling in California. Teachers College Record, 103(2).

- Datnow, A., and Hubbard, L. (2000). The meaning of equity in single gender public schooling. A paper presented at the annual meeting of the American Sociological Association, Washington, D. C.
- Dee, Thomas S. (2006). The why chromosome: How a teacher's gender affects boys and girls. Education Next. www.educationnext.org.
- Delamont, S. (1998). Educating the other: gender, power, and schooling. British Educational Research Journal, 24(5):35.
- Dindia, Kathryn, and Allen, Mike (1992). Sex differences in self-disclosure: a meta-analysis. Psychological Bulletin, 112:106-24.
- Dwyer, Carol, and Johnson, Linda (1997). Grades, accomplishments, and correlates. Gender and Fair Assessment, (Willingham, Warren and Cole, Nancy, Ed.). Mahwah, N.J., pp. 127-56.
- Educational Equity for Girls and Women (2000). United States Department of Education, Washington, DC: U.S. Government Printing Office, p. 18.
- Eldon, Mary L. (2001). As quoted in Salomone, Rosemary C. (2003). Same, different, equal: rethinking single-sex schooling. London: Yale University Press.
- Elliott, Colin (1971). Noise tolerance and extraversion in children. British Journal of Psychology, 62(3): 375-80.
- Epstein, M., Cullinan, D., and Bursuci, W.D. (1985). Prevalence of behavior problems among learning disabled and non-handicapped students. Mental Retardation and Learning Disability Bulletin, 213:30-39.

Federal Bureau of Investigation (2003). Ten year arrest trends.

www.FBI.gov/ucr.cius_o2/4sectionfour.pdf. P. 239.

Feingold, Alan (1994). Gender differences in personality: a meta-analysis. Psychological Bulletin, vol. 116: 429-456.

Fisher, Helen (2004). Why We Love: The Nature and Chemistry of Romantic Love. New York: Henry Holt.

Fletcher, Adam (2004, September 4). Broadening the Bounds of Involvement: Transforming Schools With Student Voice, New Horizons for Learning, <http://www.newhorizons.org/voices/fletcher.htm>.

Funk, John (2004, September). Middle school, middling scores, The Wichita Eagle, <http://www.kansas.com/mid/eagle/news/local/7781902.htm>.

Galley, Michelle (2002, January 23). Research: Boys to Men. Education Week.

Garden, R. (Ed.). (1996). Mathematics and science performance in middle primary school. Results from New Zealand's participation in the Third International Mathematics and Science Survey.

Gardner, Howard (1983). Frames of Mind: The Theory of Multiple Intelligences, New York, Basic Books.

Gardner, Howard (1996). Are There Additional Intelligences? Harvard Graduate School of Education, Cambridge, Mass.

Gardner, Howard, and Walters, J.M. (1985). The development and education of intelligences. Essays on the Intellect. Alexandria, Virginia: ASCD.

Garibaldi, A. (1992). Education and motivating African American males to succeed. Journal of Negro Education, 61(1).

- Garland, Trudi Hammel (1987). Fascinating Fibonacci: Mystery and Magic in Numbers. Parsippany, New Jersey: Pearson.
- Gentry, Marcia, Gable, Robert, and Rizza, Mary (2002, September). Students' perceptions of classroom activities: are there grade-level and gender differences? Journal of Educational Psychology, vol. 94(3): 539-544.
- Gibbs, J. (2001). Tribes: A New Way of Learning and Being Together. CenterSource Systems: Windsor, CA.
- Gilbert, R., and Gilbert, P. (1998). *Masculinity goes to school*. St. Leonards: Allen and Unwin.
- Gilbert, R., and Gilbert, P. (2001, November). Education of boys: what special challenges are there? Paper presented at the Educational attainment and labour market outcomes: Factors affecting boys and their status in relation to girls.
- Gill, Judith (1996). Different contexts, similar outcomes. Paper presented at the American Educational Research Association annual meeting, New York.
- Gilson, J.E. (1999). Single-Gender Education versus Coeducation for Girls: A Study of Mathematics Achievement and Attitudes toward Mathematics of Middle-School Students. Paper presented at the Annual Meeting of the American Educational Research Association, Montreal, Quebec.
- Gorard, S. (1999). Keeping sense of proportion: the politician's error in analyzing school outcomes. British Journal of Educational Studies, 47(3): 235-246.
- Goodlad, John (1984). A Place Called School. New York: McGraw-Hill.

- Gordon, Alison (2000, June 11). In a class of their own: boys benefit even more than girls from single-sex schools, A-level grades study reveals. The Mail on Sunday. (UK):42.
- Granleese, J. and Joseph, S. (1993). Self-perception profile of adolescent girls at a single-sex and a mixed-sex school. Journal of Genetic Psychology, 154(4):525-530.2.
- Gron, Georg, and Riepe, Matthias, et al. (2000). Brain activation during human navigation: gender-different neural networks as substrate of performance. Nature Neuroscience, 3:404-8.
- Gur, Ruben, Turetsky, Bruce, and associates (1999). Sex differences in brain gray and white matter in healthy young adults: correlations with cognitive performance. Journal of Neuroscience, 19:4065-407
- Gurian, Michael (1996). The Wonder of Boys: What Parents, Mentors, and Educators Can Do to Raise Boys into Exceptional Men. New York: Tarcher/Putnam.
- Gurian, Michael (2003). The Wonder of Girls. New York: Atria Books.
- Gurian, Michael, and Henley, Patricia (2001). Boys and Girls Learn Differently. San Francisco: Jossey-Bass.
- Gurian, Michael, and Stevens, Kathy (2004, November). With boys and girls in mind. Educational Leadership. ASCD.
- Haag, Pamela (1998). Single-sex education in grades K-12: what does the research tell us? In Bailey, Susan (2002). Gender in Education. San Francisco: Jossey-Bass.
- Hall, Judith (1985). Nonverbal Sex Differences. Baltimore: Johns Hopkins University Press.

- Hamilton, Marlene (1985). Performance levels in science and other subjects for Jamaican adolescents attending single-sex and coeducational high schools. International Journal of Science Education, 69(4):535-547.
- Harker, Richard, and Nash, Roy (1997). School type and the education of girls: co-ed or girls only? Paper delivered at the American Educational Research Association annual meeting. Chicago.
- Harvey, T.J. (1985). Science in single-sex and mixed teaching groups. Educational Research 27, no. 3, pp. 179-182.
- Harwarth, I., Maline, M., and DeBra, E. (1997). Women's Colleges in the United States. Washington, DC: U.S. Department of Education.
- Hayes, E., and Flannery, D. (2000). Women as Learners: The Significance of Gender in Adult Learning. San Francisco: Jossey-Bass.
- Henry, Julie (2001, June 1). Help for the boys helps the girls. Times Educational Supplement. London, UK.
- Higgins, E.T. (1991). Development of self-regulatory and self-evaluative processes: costs, benefits, and trade-off. In M.R. Gunnar and L.A. Stoufe (Eds.) Self Processes and Development. Minneapolis: University of Minnesota Press.
- Hildebrand, Gaell (1996). Together or apart? Organization, policy and practice in co-educational and single-sex education. Paper presented at the American Educational Research Association annual meeting, New York.
- Hopkins, Angeline (2001, April 24). Evaluation of outcomes of a single-sex educational program at an elementary school. Dissertation submitted to the Faculty of the Virginia Polytechnic Institute and State University, Blacksburg, Virginia.

- Iijima, Megumi, Arisake, Osamu, Minamoto, Fumie, and Arai, Yasumase (2001). Sex differences in children's free drawings. Hormones and Behavior, 40:99-104.
- International Association for the Evaluation of Educational Achievement (IEA) (2003). International comparisons in 4th grade reading literacy. <http://nces.ed.gov'pubs2003/2003073.pdf>.
- Jackson, Anthony, and Davis, Gayle (2000). Turning Point 2000: Educating Adolescents in the 21st Century. New York: Teachers College Press.
- James, Abigail Norfleet, and Richards, Herbert (2003). Escaping stereotypes: educational attitudes of male alumni of single-sex and coed schools. Psychology of Men and Masculinity, 4:136-148.
- Jimenez, E., and Lockheed, M.E. (1989). Enhancing girls' learning through single-sex education: evidence and a policy conundrum. Educational Evaluation and Policy Analysis, 11(2): 117-142.
- Johnson, Burke, and Christensen, Larry (2000). Educational Research: Quantitative and Qualitative Approaches. Boston: Allyn and Bacon.
- Kaplan, Ehud, and Benardete, Ethan (2001). The dynamics of primate retinal ganglion cells. Progress in Brain Research, 134:17-34.
- Kindlon, Daniel, and Thompson, Michael (2001). Raising Cain: Protecting the Emotional Life of Boys. New York: Ballantine.
- Klein, S. (Ed.) (1995). Handbook for Achieving Sex Equity through Education. Baltimore: John Hopkins University Press.
- Kruse, R. (1997). A study of pre-sixth form students in Denmark. Quoted in Epstein, D., Failing Boys: Issues in Gender and Achievement.

- Lansdale, Herbert (1964). Sex differences in hemispheric asymmetries of the human brain, Nature, 203:550.
- Lazear, David (1994). Seven Pathways of Learning. Tucson, Arizona: Zephyr Press.
- Lazear, David (1999). Eight Ways of Knowing. Arlington, Heights, Illinois: Skylight Training and Publishing, Inc.
- Lazear, David (2001, August). Educational production. Quarterly Journal of Economics, 116(3), pp. 777-803.
- Leder, Gilah, and Forgasz, Helen (1994). Single-sex mathematics classes in a co-educational setting: a case study. Paper presented at the American Educational Research Association annual meeting, New Orleans.
- Lee, Valerie E. (1997). Gender equity and organization of schools. Gender, Equity and Schooling: Policy and Practice. New York: Garland Publishing.
- Lee, Valerie E., Bryk, Anthony S. (1986). Effects of single sex secondary schools on student achievement and attitudes. Journal of Educational Psychology. Vol. 78, No. 5.
- Lee, Valerie E., and Lockheed, Marlaine (1990). The effects of single-sex schooling on achievement and attitudes in Nigeria. Comparative Education Review, 34(2):225.
- Lee, Valerie, and Marks, Helen (1990). Sustained effects of the single-sex secondary school experiences on attitudes, behaviors, and values. Journal of Educational Psychology, 82(3): 578-92.

- Lee, Valerie E., Marks, Helen M., and Byrd, Tina (1994, April). Sexism in single-sex and coeducational independent secondary school classrooms. Sociology of Education, 67: 92-120.
- Leo, J. (1999). Gender wars redux. U.S. News & World Report, vol. 126:24.
- Lepore, P. C., and Warren, J. R. (1997). A comparison of single-sex and coeducational Catholic secondary schooling: evidence from the national educational longitudinal study of 1988. American Education Research Journal, 34(3): 485-511.
- Lien, Lynn S., Downs, Roger M., and Signorella, Margaret L. (1995). Sex differences in adolescents' success on an academic competition in geography: explanations and implications, unpublished paper. As cited in Salomone, Rosemary (2003). Same, different, equal: rethinking single-sex schooling. London: Yale University Press.
- Literacy skills for the knowledge society (1997). Second Report of the International Adult Literacy Survey.
- Lipsitz, Joan (2000). Growing Up Forgotten. New Brunswick, New Jersey: Transaction Books.
- MacCann, R. (1995). A longitudinal study of sex differences at the Higher School certificate and school certificate: trends over the last decade. Sydney: NSW Board of Studies.
- MacFarlane, James, and Crawford, Pat (1985, September). The effect of sex-segregated mathematics classes on student attitudes, achievement, and enrollment in mathematics. Evaluation for the North York Board of Education, Willowdale, Ontario.

- Madigan, Jennifer C. (2002). Experiences and perceptions of Latina students attending single-gender and coeducational classrooms. Paper written as part of Grant #3243010037 of the United States Department of Education, Office of Special Education Programs.
- Mallam, Winifred (1993). Impact of school-type and sex of the teacher on female students' attitudes toward mathematics in Nigerian secondary schools. Educational Studies in Mathematics, 24: 227.
- Manger, T., and Gjestad, R. (1997). Gender differences in mathematical achievement related to the ratio of girls to boys in school classes. International Review of Education/Internationale Zeitschrift fuer Erziehungswissenschaft/Revue Internationale de l'Education, 43(2-3): 193-201.
- Manzo, Kathleen Kennedy (2000, October 4). Missed Opportunities. Education Week.
- Marks, G., Fleming, N., Long, M., and Mc Milan, J. (2000). Patterns of participation in Year 12 and higher education in Australia: an update and examination of some contemporary issues. ACER. Melbourne, Australia.
- Marsh, H.W. (1989). Effects of attending single-sex and coeducational high schools on achievement, attitudes, behaviors, and sex differences. Journal of Educational Psychology. 81:70-85.
- Marsh, H.W., and Rowe, K.J. (1996). The effects of single-sex and mixed-sex mathematics classes within a coeducational School: a reanalysis and comment. Australian Journal of Education, 40(2): 147-162.

- Martin, Andrew (2002). Improving the educational outcomes of boys. Final report to ACT Department of Education, Youth, and Family Services.
- Masters, G.N., and Forster, M. (1997b). Mapping literacy achievement: results of the 1996 National School English Survey. A report on behalf of the Management Committee for the National School English Literacy Survey. Canberra, ACT: Department of Employment, Education, Training and Youth Affairs.
- McClure, Erin (2000). A meta-analytic review of sex differences in facial expression processing and their development in infants, children, and adolescents. Psychological Bulletin, 126:424-53.
- McCluskey, A. T. (1993). The historical context of the single-sex schooling debate among African-Americans. Western Journal of Black Studies, 17(4).
- McDonald, William (2005). As quoted in Sax, Leonard (2005). Why Gender Matters: What Parents and Teachers Need to Know About the Emerging Science of Sex Differences. New York: Doubleday, p. 107.
- McGlone, Jeannette (1980). Sex differences in human brain asymmetry: a critical survey. Behavioral and Brain Sciences, 3:215-263.
- Mendez, Teresa (2004). Separating the sexes: a new direction for public education? The Christian Science Monitor. <http://www.csmonitor.com/2004/0525/plls02-legn.htm>
- Mercer, N., Wegerif, R., and Dawes, L. (1999). Children's talk and the development of reasoning in the classroom. British Educational Research Journal, 25(1).
- Merriam, Sharan B. (1997). Qualitative Research and Case Study Applications in Education. San Francisco: Jossey-Bass.

- Mickelson, R.A. (1992). Why Does Jane Read and Write So Well: The Anomaly of Women's Achievement. In J. Wriggley (Ed.) Education and Gender Equality. London: Falmer Press.
- Mulholland, J., Hansen, P., et al. (2004). Do single-gender classrooms in coeducational settings address boys' underachievement? An Australian study. Educational Studies, 30(1): 19-32.
- Murrell, P. (1992). Afrocentric immersion: Academic and personal development, in T. Perry and J Fraser (Ed.), Freedom's plow: teaching for a multicultural democracy, London: Routledge.
- National Assessment of Educational Progress: The Nation's Report Card (2000). National Center for Education Statistics. Washington, D.C: U.S. Department of Education.
- National Association for Single Sex Public Education (2005). <http://www.singlesexschool.org>.
- National Foundation for Educational Research (2002). Effect of school size and school type on academic performance.
- National Middle School Association (1995). This We Believe. Columbus, OH: Author.
- National Middle School Association (2003). <http://nmsa.org>.
- National Organization for Women (NOW) (2004). Single-Sex Proposed Regulations Comments. <http://www.now.org/issues/education/single-sex-education-comments.html>
- Newkirk, Thomas (2000, March). Misreading masculinity. Language Arts, vol. 77, no. 4.

The Achievement of Boys (1999). New Zealand: Education Review Office, as viewed at
<http://www.ero.govt.nz/eers1999/Boys/boys1.htm>.

No Child Left Behind (2002). United States Department of Education.
<http://www.ed.gov/nclb/landing.jhtml>.

Office for Standards in Education (OFTSED) (1998). As cited in Dean, Clare (1998,
October 9). Inspectors say girls' schools are the best. Times Educational
Supplement.

O'Keefe, John, and Nadel, Lynn (1978). The Hippocampus as a Cognitive Map. London:
Oxford University Press.

O'Reilly, Judith (2000, August 20). Mixed school hits new heights with single-sex
classes. Sunday Times, London.

Parker, Lesley H. and Rennie, Leonie J. (2004). Teachers' implementation of gender
inclusive instructional strategies in single-sex and mixed-sex classrooms.
International Journal of Science Education, Vol. 24, No. 9.

Parry, O. (1996). In One Ear and Out the Other: Unmasking Masculinities in the
Caribbean Classroom. Sociological Research Online, vol. 1, no. 2,
<http://www.socresonline.org.uk/socresonline/1/2/2.html>.

Parry, O. (1996a). Equality, gender and the Caribbean classroom. 21st Century Policy
Review Special Issue: Institutional Development in the Caribbean: Acting on
Changing Structures, vol. 3, no. 12.

Parry, O. (1996b). Schooling is fooling: why do Jamaican boys underachieve in school?
Gender and Education, Forthcoming.

- Patton, Mildred L. (2002). Understanding Research Methods: An Overview of The Essentials (3rd ed.). Los Angeles: Pyrczak.
- Perlstein, Linda (2003). Not much, just chillin': the hidden lives of middle schoolers. New York: Farrar, Straus, and Giroux.
- Phillips, Michael, Lowe, Mark, Lurito, Joseph T., Dziedzic, Mario, and Matthews, Vincent (2001). Temporal lobe activation demonstrates sex-based differences during passive listening. Radiology, 220:202-207.
- Pike, Nicholas (2000, August 20). Blunkett plans single-sex classrooms. The Independent, London.
- Pomerantz, Eva, Altermatt, Ellen, and Saxon, Jill (2002). Making the grade but feeling distressed: gender differences in academic performance and internal distress. Journal of Educational Psychology, 94 (2): 396-404.
- Pomerantz, Eva, and Saxon, Jill (2001). Conceptions of ability as stable and self-evaluative processes: a longitudinal examination. Child Development, vol. 72: 152-173.
- Portner, Jessica, (2000). Competing Forces. Education Week, Supplement to the October 4 issue, pp.39-42.
- Reimer, Michelle S. (2002, January). Gender, risk, and resilience in the middle school context. Children & Schools, 24(1): 35.
- Reglin, G. (1994). Promoting success for the African-American male student: a blueprint for action. Solutions and Strategies, 8; National Dropout Prevention Center.

- Ricken, Robert, and Terc, Michael (2004). The Middle School Principal's Calendar. Thousand Oaks, California: Corwin Press.
- Riordan, Cornelius (1985). Public and Catholic schooling: the effects of gender context policy. American Journal of Education, 5:533.
- Riordan, Cornelius (1990). Girls and Boys in School: Together or Separate. New York: Teachers College Press.
- Riordan, Cornelius (1994). The future of single-sex schools. In AAUW Educational Foundation (1998). Separated By Sex. Washington, D.C.
- Riordan, Cornelius (2002). What do we know about the effects of single-sex schools in the private sector? Implications for public schools. In Datnow, Amanda and Hubbard, Lee (Eds.). Gender in Policy and Practice: Perspectives on Single-Sex and Coeducational Schooling. New York: Routledge Falmer.
- Robinson, P., and Smithers, A. (1999). Should the sexes be separated for secondary education? Comparisons of single-sex and co-education schools. Research Papers in Education: Policy and Practice, 14(1):23-49.
- Rogers, Andrew (2000, October). In Portner, Jessica, Competing forces. Education Week.
- Rowe, Kenneth J. (1988). Single sex and mixed sex classes: the effects of class type on student achievement, confidence and participation in mathematics. Australian Journal of Education, 32, no. 2.
- Rowe, Kenneth J. (2000, April 17). Boys and girls perform better at school in single-sex environments. ACER. Second National Conference on Co- Education.

- Rowe, K.J., and Hill, P.W. (1996). Assessing, recording and reporting students' educational progress: the case for "subject profiles". Assessment in Education, 3(3).
- Rowe, K.J., Nix, P.J., and Tepper, G. (1986). Single-sex and mixed-sex classes: the joint effects of gender and class type on student performance in the attitudes towards mathematics. Paper presented at the Annual Conference of the Australian Association for Research in Education. Melbourne, Australia.
- Rowe, K.S., Pollad, J., Tan, L., and Rowe, K.J. (2000). Auditory processing effects on early literacy and behavior: evidence for the value of auditory screening of children on school entry. An invited paper-poster presented at the Second International Conference on Child and Adolescent Mental Health at the Renaissance Hotel, Kuala Lumpur, Malaysia.
- Rowe, K.J., and Rowe, L.S. (1999). Investigating the relationship between students' attentive-inattentive behaviours in the classroom and their literacy progress. International Journal of Educational Research, 31:1-138.
- Rowe, K.J., and Rowe, K.S. (2002). What matters most: evidence-based findings of key factors affecting the educational experiences and outcomes for girls and boys throughout their primary and secondary schooling. Supplementary submission to House of Representatives Standing Committee on Education and Training: Inquiry into the Education of Boys.
- Sadker, Myra, and Sadker, David (1994). Failing at Fairness: How Our Schools Cheat Girls, New York: Touchstone.

- Salomone, Rosemary C. (2003). Same, different, equal: rethinking single-sex schooling. London: Yale University Press.
- Salomone, Rosemary C. (2000). Rich Kids, poor kids, and the single-sex education debate, *Akron Law Review*: 34, 209-229.
- Saltzman, A. (1994, November 7). Schooled in failure. US News and World Report.
- Sanders, J. (2003). Teaching gender equity in teacher education. Education Digest, vol. 68: 25-29.
- Saucier, Deborah, et al. (2002). Are sex differences in navigation caused by sexually dimorphic strategies or by differences in the ability to use the strategies? Behavioral Neuroscience, 116: 403-10.
- Sawyer, M.G., Arney, F.M., Baghurst, P.A., Clark, J.J., Graet, B.W. Kosky, R.J., Newcomb, B., Patton, G.C., Prior, M.R., Raphael, B., Rye, J., Whites, L.C. and Zurich, S.R. (2000). Child and adolescent component of the National Survey of Mental Health and Wellbeing: The mental health of young people in Australia. Canberra: Commonwealth Department of Health and Aged Care (ISBN 0 642 44686 5).
- Sax, Leonard (2005). Why Gender Matters: What Parents and Teachers Need to Know About the Emerging Science of Sex. New York: Doubleday.
- Scales, P.C. (1996). Boxed in and bored: how middle schools continue to fail young adolescents—and what good middle schools do right. Minneapolis: Search Institute.
- Schmidt, William H. (2000, October 4). In Bradley, Ann, and Manzo, Kathleen Kennedy, The weak link. Education Week.

- Schneider, Frank, Habel, Ute, et al. (2000). Gender differences in regional cerebral activity during sadness. Human Brain Mapping, 9:226-38.
- Seitsinger, A., Barboza, H., et al. (1998). Single-Sex Mathematics Instruction in an Urban Independent School, a paper presented at the Annual Meeting of the American Educational Research Association, San Diego, CA.
- Shors, Tracey, et.al (2001). Sex differences and opposite effects of stress on dendritic spine density in the male versus female hippocampus. Journal of Neuroscience, 21(16): 6292-97.
- Simpson, A. (1991). Fictions and facts: an investigation of the reading practices of girls and boys. English Education, 28: 268-79.
- Singh, Kusom, Vaught, Claire, and Mitchell, Ethel (1998). Single-sex classes and academic achievement in two inner-city schools. The Journal of Negro Education, http://www.findarticles.com/p/articles/miqa3626/is_04/ai n873338.
- Slade, M. (2002). Listening to boys. Boys in School Bulletin, 4: 10-18.
- Smith, I.D. (1996). The Impact of Coeducational Schooling on Student Self-Concept and Achievement. Paper presented at the Biennial Meeting of the International Society for the Study of Behavioural Development, Quebec, Canada.
- Sommers, Christine (2000). The War Against Boys: How Misguided Feminism Is Harming Our Young Men. New York: Simon and Schuster.
- Sommers, C.H. (2001, September 26). Give same-sex schooling a chance. Education Week, 02774232, Vol. 21, Issue 4.
- Sommers, C.H. (2001). War on Boys. San Francisco, CA: Jossey-Bass.

- Spielhofer, Thomas, O'Donnell, Lisa, Benton, Tom, Schagen, Sandie, and Schagen Ian (2002). The impact of school size and single-sex education on performance. National Foundation for Educational Research, Slough, England: Local Government Association.
- Stabiner, Karen (2002, November/December). No boys allowed. Principal, vol. 82, no. 2.
- Stabiner, Karen (2004). Can separate ever be equal? For girls, answer isn't simple. Los Angeles Times, March 14. <http://www.singlesexschools.org/stabiner.htm>.
- Stables, A. (1990). Differences between pupils from mixed and single-sex schools in their enjoyment of school subjects and in their attitudes to science and to school. Educational Review, 42(3):221-231.
- Standley, Jayne (1998). The effect of music and multimodal stimulation on physiologic and developmental responses of premature infants in neonatal intensive care. Pediatric Nursing Journal, 21: 532-39.
- Steedman, Jane (1985). Examination results in mixed and single-sex schools. Reynolds, David (Ed.) Studying School Effectiveness. London: Falmer.
- Stockard, J., and Wood, J.W. (1984). The myth of female underachievement: a pre-examination of sex differences in academic underachievement. American Educational Research Journal, Vol. 21, No. 40.
- Streitmatter, L.L. (1994). Toward Gender Equity in the Classroom: Everyday Teachers' Beliefs and Practices. New York: State University of New York Press.
- Streitmatter, L.L. (1997). An exploratory study of risk-taking and attitudes in a girls-only middle school math class. Elementary School Journal, 98(1): 15- 26.

Streitmatter, L. L. (1999). For girls only: Making a case for single-sex schooling. New York: State University of New York Press.

Sukhnandan, L. (2000). An Investigation into Gender Differences in Achievement, Phase 1: A Review of Recent Research and LEA Information on Provision. Slough: National Foundation for Education Research.

Tannen, Deborah (2001). You Just Don't Understand: Women and Men in Conversation. New York: HarperCollins.

Taylor, Shelley, and Cousino, Klein, et al. (2000). Biobehavioral responses to stress in females: tend-and-befriend, not fight-or-flight. Psychological Review, 107: 411-429.

Taylor, Shelley (2002). The Tending Instinct. New York: Henry Holt.

Teicher, Stacy A (2003, July 1). The case for single-sex schools. The Christian Science Monitor.

Third International Mathematics and Science Survey (1995). Education Review Office, New Zealand.

Thompson, Terri, and Ungerleider, Charles (2004, November). Single Sex Schooling: Final Report. The Canadian Centre for Knowledge Mobilization, the University of Columbia.

Tidball, M. Elizabeth (1972, December 27). Educating women for achievement. Paper presented at the annual meeting of the American Association for the Advancement of Science, Section on Education, Washington, D.C.

Times Educational Supplement (2000, August 25). News and Opinion. London.

Tuman, Donna (1999). Sing a song of sixpence: an examination of sex differences in the subject preference of children's drawings. Visual Arts Research, 25:51-62.

Turning Points: Transforming Middle Schools (1989). Carnegie Council on Adolescent Development, Boston.

United States Department of Education (1998). Office for Civil Rights.
www.ed.gov/office/OCR.

United States Department of Education (2000). Educational equity for girls and women. Washington, DC: United States Government Printing Office, p. 18.

United States Department of Education (2001). National Center for Education Statistics.
<http://nces.ed.gov/pubs2001/proj01/chapter4.asp>.

United States Department of Education (2004). National Center for Education Statistics, Projection of Education Statistics to 2011, Earned Degrees Conferred.
<http://nces.ed.gov/pubs2004/proj01/chapter4.asp>.

United States v. Virginia (1996). 518 U.S. 515, docket no: 94-1941.
<http://www.oyez.org/oyez/resource/case/654/>.

Valeski, Tricia, and Stipek, Deborah (2001). Young children's feelings about school.
Child Development, 72:1198-1213.

Viadero, Debra (1998, October 14). AAUW study finds girls making some progress, but gaps remain. Education Week.

Viadero, Debra (2001, May 30). Study cites flaws in single-sex public schools.
Education Week.

- Wager, Tor, Phan, Luan, Liberzon, Israel, and Taylor, Stephan (2003). Valence, gender, and lateralization of functional brain anatomy in emotion: a meta-analysis of findings from neuro-imaging. Neuro-Image, 19: 513-31.
- Warrington, M., and Younger, M. (2003). We decided to give it a twirl: single-sex teaching in English comprehensive schools. Gender and Education, 15(4): 339-350.
- Warrington, M., and Younger, M. (2001). Single-sex classes and equal opportunities for girls and boys: perspectives through time from a mixed comprehensive school in England. Oxford Review of Education, 27(3).
- Washington Times (2003).
<http://kqed.org/topics/news/perspectives/youdecide/pop/singlesexed/4no.html>.
- Webb, Noreen (1984). Sex difference in interaction and achievement in cooperative small groups. Journal of Educational Psychology, 76(1):39.
- West, T.G. (1997). In the mind's eye: visual thinkers, gifted people with dyslexia and other learning difficulties, computer images and the ironies of creativity. Amherst, New York: Prometheus Books.
- West Virginia Department of Education (2004). http://wvde.state.wv.us/policy_2520.
- Whitaker, Charles (1991, March). Do Black males need special schools? Ebony.
http://www.findarticles.com/p/articles/mi_m1077/is_n5_v46ao_10405322.
- White (1982) cited in Young, D. and Frasier, B. (1990). Science achievement of girls in single-sex and coeducational schools. Research in Science and Technological Education, 8(1):9.

- Wickham, Alexandra et al. (2000). Identification of androgen, estrogen, and progesterone receptor mRNAs in the eye. Acta Ophthalmologica Scandinavica, 78: 146-53.
- Williams, Verna L. (2004). Reform or retrenchment? Single sex education and the construction of race and gender. Wisconsin Law Review.
<http://ssrn.com/abstract=460362>.
- Willingham, Warren W., and Cole, Nancy B. (1997). Gender and Fair Assessment. Mahwah, New Jersey: Lawrence Erlbaum Associates.
- Wong, K. C., Lam, Y. R., et al. (2002). The effects of schooling on gender differences. British Educational Research Journal, 28(6): 827-843.
- Wood, Gwendolyn, and Shors, Tracey (1998). Stress facilitates classical conditioning in males, but impairs classical conditioning in females through activational effects of ovarian hormones. Proceedings of the National Academy of Sciences, 95: 4066-71.
- Workman, Mary B. (1990, May). The effects of grouping patterns in a cooperative learning environment on student academic achievement. Thesis presented at Dominican College.
- World Bank (1993). Access Quality and Efficiency in Education. World Bank Country Study: Washington, DC.
- Yates, L. (1993). The education of girls: policy, research and the question of gender. Australia Council for Educational Research, 96.

- Yates, L. (1998). Constructing and deconstructing girls as a category of concern. Education into the 21st Century: Dangerous Terrain for Women? A. Mackinnon, Elgquist-Saltman and A. Prentice. London: Falmer Press.
- Young, D.J., and Fraser, B. J. (1990). Science achievement of girls in single-sex and coeducational classes. Research in Science and Technological Education, 8(1): 5-19.
- Younger, M. and Warrington, M. (2002). Single-sex teaching in a co-educational comprehensive school in England: an evaluation based upon students' performance and classroom interactions. British Educational Research Journal, 28(3): 353-374.
- Younger, Michael, Warrington, Molly, and Williams, Jacquetta (1999). The gender gap and classroom interactions: reality and rhetoric? British Journal of Sociology of Education, 20(3):325-41.
- Zemelman, S., Daniels, H., & Hyde, A. (1998). Best practices: New standards for teaching and learning in American's schools. Portsmouth, NH: Heinemann.
- Zernike, Kate (2001, June 1). Girls a distant 2nd in geography gap among U.S. pupils. New York Times.
- Zill, Nicholas, Collins, Mary, West, Jerry, and Hausken, Elvie Germino (1995). Approaching kindergarten: a look at preschoolers in the United States. Washington, D.C.: U.S. Department of Education, National Center for Education Statistics: 95-280.
- Zubrich, S.R., Silburn, S.R., Gurrin, L., Teoh, H., Shephard, C., Carltin, J., Lawrence, D. (1997). Western Australian Child Health Survey: Education

health and competence. Australian Bureau of Statistics and the TVW
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CERTIFICATION

State of West Virginia, Secondary Teacher, 7-12, Permanent
Specialization: Physical Education and Health
State of West Virginia, Secondary School Administrator, Permanent
Principal Jr. Sr. Major 7-12
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PROFESSIONAL EXPERIENCE

1972-73 Coach, Purdue University JV Women's Basketball Team
1973-1977 Teacher/Coach, Washington Junior High, Parkersburg, West Virginia
1977-1988 Teacher/Coach/Athletic Director, South Charleston High School, South Charleston, West Virginia
1989-1996 Assistant Principal, Stonewall Jackson Middle School, Charleston, West Virginia
1997-1998 Assistant Principal, Dupont High School, Dupont, West Virginia
1999-2005 Principal, Stonewall Jackson Middle School, Charleston, West Virginia
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HONORS AND RECOGNITION

1977	Wood County Coach of the Year
1985	WVAHPER Presidential Citation
1985	West Virginia Physical Education Teacher of the Year
1997, 1999	WVSSAC Recognition Award
1996, 1997	President, Kanawha County Assistant Principals' Association
1998	President, West Virginia Assistant Principals' Association
2003	President, Kanawha County Schoolmasters' Association