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# The Impact of Single-Sex Education on the Performance of First and Second Grade PUBLIC School Students

## Abstract

In this article, I present the findings of a single-sex public education experiment adapted from a dissertation study. The rationale for conducting this research focuses on the renewed and unprecedented interest in single-sex *public* education as a strategy for increasing student performance. According to various educational theorists and researchers, single-sex education is an effective instructional strategy for improving student performance. However, little is known about the impact of single-sex *public* education. This quantitative ex post facto research analyzes the impact of single-sex education on academic achievement, discipline referral and attendance for public school first and second grade students. The findings suggest that single-sex education may be an effective instructional strategy for facilitating math and reading improvement for female students. Also, based upon the findings of this study, single-sex education may have a positive impact on attendance for males and females.

## Keywords

Single-sex education, Public schools, First graders, Second graders, Student performance, Gender

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## The Impact of Single-Sex Education on the Performance of First and Second Grade PUBLIC School Students

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**Abstract:** This article focuses on the findings of a single-sex public education experiment, adapted from a dissertation study. The rationale for conducting this research focuses on the renewed and unprecedented interest in single-sex *public* education as a strategy for increasing student performance. According to various educational theorists and researchers, single-sex education is an effective instructional strategy for improving student performance. However, little is known about the impact of single-sex *public* education. This quantitative ex post facto research analyzes the impact of single-sex education on academic achievement, discipline referral and attendance for public school first and second grade students. The findings suggest that single-sex education may be an effective instructional strategy for facilitating math and reading improvement for female students. Also, based upon the findings of this study, single-sex education may have a positive impact on attendance for males and females.

### Introduction

Some educational researchers have identified single-sex education as a way to facilitate the educational experience for all students. Single-sex education refers to the education of students in an environment that consists of a single gender, either all-male or all-female environments (NASSPE, 2008). This single-sex environment may take the form of a single-sex class, consisting of either males or females within a coeducational school setting, or a single-sex school.

Within any educational framework there are physical, social, emotional and intellectual variables that impact learning. Single-sex education may provide each sex with environments that enhances gender related learning variables for each sex specifically. Tailoring of the reading subject matter to the traditional male/female interest categories and structuring classroom activities either competitively or collaboratively are just two of the many instructional concerns that are manipulated in the single gender environment.

Today, there is a renewed interest in investigating single-sex education as a viable strategy for maximizing student achievement, providing opportunities for leadership roles, minimizing risks of sexual harassment and opportunity for sexual experimentation, enhancing career aspirations, minimizing sex stereotypes and increasing course selection of non-traditional courses for both sexes. However, the existing research on single-sex education that focuses on these diverse variables stems from international, private, and religious educational institutions.

Single-sex research that focuses on public school populations in the United States is lacking (Datnow, Hubbard, & Woody, 2001).

In order for the public school system to consider single-sex education as a possible strategy for providing educational benefits, an investigation into single-sex education within the public school arena must be conducted (Bradley, 2008).

Evidence of the credibility of this newly legalized instructional strategy, through well-conducted scholarly research methodologies, is necessary for implementation of this strategy and for the receipt of promised federal funds as allocated by NCLB. Continued reference to parochial, private or international studies to make generalizations about single-sex education the public sector is evidence of poor research analysis. Researchers and educational leaders simply cannot continue to make comparisons to dissimilar populations regarding the implementation of new instructional strategies.

### **History of Single-Sex Education in the United States**

Before 1900, education in America was contained largely within a single-sex framework (Bracey, 2007). That structure was the result of societal views, expectations, and opportunities for each gender. As a rule, males required greater formalized education to facilitate their expected worldly occupations, and females received a much less formalized education, rich in the practical skills necessary for their anticipated domestic life. Males and females required such different educational experiences and subject matter that they were educated separately (Cohen, 2000).

As societal expectations and opportunities for males and females changed over time, so did their educational experiences (Bracey, 2007). In the early 20<sup>th</sup> century, the evolution of the American educational system from a single-sex to a coeducational model became not only evident, but necessary. Aside from Bracey's notion that perhaps a female presence in the classroom might help to compose the rowdy male, females needed a more equitable educational experience in light of their emergence into the working world outside the home (Bracey, 2006). It was also more fiscally prudent to educate both genders together so the coeducational system began to take shape by the beginning of the twentieth century (Riordan, 2002).

As recently as the 1950s and 1960s, males were frequently favored in terms of availability and quality of facilities, programs, and the opportunity for extracurricular activities (Cohen, 2000). Females, although educated in the same buildings and classes as males, did not have equal opportunities in academics or extracurricular activities. Although some of the inequality was overt, some was discernible only to those with vested interests in the education of females (Cohen, 2000).

Some single-sex institutions originating before the turn of the century still operated even after coeducation became the norm (Bracey, 2007; Schmitt, 1997). The Virginia Military Institute and the Citadel were devoted solely to the education of males. Females were not allowed to attend regardless of aptitude. Advocates for these single-sex institutions claimed that other *equal* institutions were available for females. The opposing view held that these presumed 'equal' institutions were far from equal in terms of the quality of programs, facilities, teachers, and opportunities (Schmitt, 1997).

In 2001, the Bush administration once again sought to review ESEA and in 2002, the newly reauthorized ESEA fell under a new name, *No Child Left Behind Act* (NCLB) (Georgia Department of Education, 2001). In 2006, further reviewing and reauthorizing led to the

tweaking of *Title IX*, which made the formation and operation of a single-sex school legal under particular circumstances (Nahmias, 2008).

As mandated by NCLB, instructional strategies that might increase student achievement in every population sector within public education must be research-based (U.S. Department of Education, 2008). It is obvious that high quality scientific research investigating recent single-sex education within the United States public school systems is scant at best, as evidenced by the comprehensive review of literature conducted by Mael, Alonso, Gibson, Rogers, and Smith in 2005. Although some studies in this comprehensive review were well conducted and followed acceptable research standards, virtually none of the studies were conducted on public school populations in the United States. The fact that most research to date utilizes parochial, private, or international samples has been cited by various researchers regarding the need for public sector research in single-sex education (Bracey, 2006; Datnow, Hubbard, & Conchas, 2001; Salomone, 2006).

As mandated by NCLB, instructional strategies that might increase student achievement in every population sector within public education must be research-based (U.S. Department of Education, 2008). The educational leader, in order to make sound judgments in the allocation of funds and selection strategies aimed at increasing student achievement, must have the research to make informed decisions. It is vital to the ultimate educational goals of schools and society in general that effective strategies are identified via scholarly research methods and implemented so that the educational needs of all students are adequately met (Salomone, 2006).

The recent, unprecedented effort by educators and educational leaders across the nation to increase student achievement has sparked an investigation into possible instructional strategies that could positively impact student performance. This concerted effort in search of effective strategies is not only fueled by an eagerness to produce high functioning and better qualified students, but also is the result of No Child Left Behind mandates. NCLB requires that innovative strategies with the potential to increase student achievement must be research based (United States Department of Labor, 2008). Educational leaders need evidence of strategies, in the form of high quality, well-conducted research, in order to make decisions with regard to selection and implementation of programs.

### **Focus On Single-Sex Education**

With NCLB and its ensuing amendments, administrators, and educational policy makers, within the public sector, have picked up the tempo and increased their attempts to identify the most effectual instructional approaches that will benefit all students despite categorical membership related to gender, ethnicity, or other educational grouping. A huge controversy surrounds the broad array of procedural approaches that might lead to exceptional educational experiences for each and every student enrolled in public education (Bracey, 2006; Salomone, 2003).

The rationales that have been presented for implementing single-sex education are numerous. Claims have been made that single-sex education can benefit one or both genders in academic achievement and in psycho-social issues (Riordan, 1990). Unfortunately, at this time, research that can validate those claims is anecdotal, inconclusive and inconsistent (Mael, et al, 2005; Riordan, Faddis, Beam, Seager, Tanney & DiBiase, 2008).

All of these proposed outcomes of single-sex education, if they indeed do exist, might be considered beneficial to specific populations or all population in general. With the increased

urgency to make average yearly progress (AYP) innovative strategies that target specific points of the NCLB assessment plan are of particular interest to educators. NCLB mandates and specific components of AYP are all inclusive as related to the school setting (i.e. academic achievement, attendance, drop-out rate, graduation rate, success of special education students, students who are not English language learners, etc.). Any instructional strategy that has the potential to positively impact student performance must be investigated.

A major problem associated with single-sex education is that the research based is weak and the public school research base is virtually non-existent. Since public school single-sex education has been illegal in this country for almost 40 years, almost no single-sex public school research has been conducted. The United States Department of Education commissioned two comprehensive reviews (Mael, Alonso, Gibson, Rogers, & Smith, 2005; Riordan, Faddis, Beam, Seager, Tanney & DiBiase, 2008) of all single-sex education research and related citations in search of evidence to support single-sex education as a viable instructional strategy. These two groups of researchers reviewed over 2,000 citations devoted to single-sex education. However, most of these citations were excluded from the final review due to deficiencies in research methodology or other problems with the research that prohibited them from a quality rating. Additionally, virtually none of these research studies were conducted on public school populations in the United States.

Some researchers have identified single-sex education as being instrumental in elevating academic student achievement for all students (Mael, Alonso, Gibson, Rogers, & Smith, 2005; Taylor & Lorimer, 2003). Conflicting findings were reported by Howard and Sansted (2003) in research which included two single-sex high school classes. These researchers reported that the single-sex and coeducational environments differed little in terms of academic performance. Similar findings were reported by Ferrara (2005) in her investigation of single-sex middle school students. Yet other researchers have published findings supporting the assertion that single-sex education is a viable strategy for not only maximizing student academic achievement, but also in increasing attendance frequency and reducing discipline referral frequency (Ainley & Daly, 2002; Ferrara (2005); Hall & Barnes, 2006).

Much of the research and anecdotal literature that focuses on single-sex education is conflicting, although consistencies in the literature also exist. There is evidence that single-sex education might provide some academic benefit to females and to minority students (Riordan, 2002). Additionally, non-academic benefits for at risk or minority students can be found in the literature (Riordan, 2008, Wills, 2007). Nonetheless, contradictory or inconsistent research also exists regarding specific populations that might benefit from single-sex education and the likelihood that single-sex education would effectively close the gender gap in academic disciplines (Mael et al., 2005).

The investigation of single-sex education within a public school, in the United States, has brought to light a common research issue in education, random assignment. Random assignment in educational research has been a controversial topic among educational researchers in the United States for some time. The ethical issue often noted in random assignment educational research is that of potentially disadvantaging one group of students by not providing an equivalent program of treatment to all students. If an educational strategy is found to be effective, the window of opportunity for providing that strategy to the control group has passed by the time the research is complete. For instance, a treatment provided to half of fifth graders in one year is found to be superior at the conclusion of the research. In essence, the control group for the research year did not receive the superior treatment. Simply repeating the fifth grade and

being exposed to the superior treatment, could not remedy that disadvantage because doing so would further disadvantage the original control group. In effect, one group of students was advantaged, while the other group, by not having received the effective treatment, disadvantaged.

Riordan and his colleagues (2008) state that without being able to randomly assign participants in a single-sex research study, the researcher cannot address possible variables which might bias research findings such as: the motivational level of students, family background, the quality and motivation of teachers and school climate. He also alludes to additional non-research problems related to randomization that might plague a public school single-sex research initiative such as negative political and community reaction and violation of employment laws that prohibit the assignment of teachers based upon gender. No doubt, there are ethical and legal considerations that pose a major roadblock to randomization in single-sex public education research within the United States.

The history of single-sex educational research has been well documented and spans at least five decades, including the work of Coleman, in 1959, to the more recent research efforts of Riordan, in 2008. Scholarly research has produced evidence in support of single-sex education and against single-sex education. These research efforts have included the investigation of a wide variety of outcome variables, populations, educational levels, and research protocols. However, single-sex research conducted on public school populations, where the teachers have had the benefit of professional development on single-sex education prior to implementation is almost non-existent.

This researcher's comprehensive review of literature reveals many potential outcome variables that have been associated with single-sex education. These variables can be divided into two categories, academic and non-academic. Some academic outcomes that have been investigated are increases in: test scores of subjects or standardized tests, careers aspirations, and enrollment in non-traditional gender classes and careers. Some researchers contend that these potential benefits of single-sex education are manifest for either males or females or both genders.

Non-academic variables that have been researched to date include increases in attendance frequency, self-esteem, the development of leadership skills and social skills, and reductions in discipline referral frequency, dropout rate, premarital sex, sex stereotyping and sexual harassment. Single-sex education has even been identified by some researchers as a method of benefiting specific populations within the educational system, i.e. at-risk students and minority students.

The vast majority of literature focusing on single-sex education has been conducted in private, parochial or international educational settings. Though much of the research focuses on outcome variables that are components of major educational issues, the existing research focuses on dissimilar populations and therefore, cannot be used to make general assumptions about the public school environment. In light of the inconsistencies in the small existing research base and the use of dissimilar populations for public school comparisons, additional research is necessary to determine the impact of single-sex education in the United States. This study focused on implementing a methodology in the investigation of single-sex education that utilized a public school population in the United States.

## **Methodology**

This researcher used a quantitative, ex post facto design to examine archival data obtained on first and second grade students in public education single-sex classes and coeducational classes. Archival data from the 2007-2008 school year were used in this investigation. Two single-sex first and second grade male classes, one single-sex first and second grade females' class and three coeducational first and second grade classes from a public elementary school in the southeastern United States were the source of this archival data. The data consisted of measures of academic achievement (math and reading), discipline referral frequency, and attendance.

Academic achievement was measured via improvement in math and reading performance. The assessment instrument was the measures of academic progress (MAP) for math and reading. The MAP is a criterion based, diagnostic assessment administered by teachers at the beginning of the year, at mid-year and end-of-the-year for second grade students and at the beginning of the year and end of the year for first grade students.

Examination of this archival academic achievement data consisted of a comparative analysis between single-sex students and that of coeducational students in math and reading improvement. Also conducted was a comparative analysis between the improvement in reading and math of single-sex males and that of coeducation males and finally, between the reading and math improvement of single-sex females and the improvement of coeducation females.

The discipline referral frequency, relative to gender and sector, was recorded from the school discipline referral database from the 2007-2008 school year. A comparison of discipline referral frequency between three coeducational classes and three single-sex classes for the 2007-2008 school year was conducted. Additionally, the researcher compared discipline referral frequency between male single-sex students and male coeducation students and discipline referral frequency between female single-sex students and female coeducation students.

A comparison of attendance between three coeducational classes and three single-sex classes for the 2007-2008 school year was conducted. Also, a comparison of attendance between single-sex males and that of coeducation males and a comparison of attendance between single-sex females and coeducation females was conducted.

All single-sex students in the study were experiencing their first year of single-sex education. The rationale for the implementation of single-sex classes at this particular elementary school was to more effectively meet the needs of all students. School administrators determined the student assignment to class based upon teacher and administrator recommendation and parent request. Those students not assigned based upon these two criteria were arbitrarily assigned.

### *Data Collection and Analysis*

Data collection involved the retrieval of archival data from the study site. All data used in this study were generated and collected by teachers and administrators at the study site. Test data collection involved retrieval of the results of the MAP assessment results from the testing coordinator of the school. Collection of data on discipline referral frequency and attendance involved gaining access to the data collected and maintained throughout the school year from the principal.



The number of discipline referrals was collected by the principal and reported in a format that includes information involving class origin, nature of referral and frequency. The school enacted policies and procedures for handling discipline referrals by category. Minor discipline within the classroom that did not require the involvement of the administration was not included in the discipline referral data. Only discipline that required administrative intervention and removal from the classroom for any amount of time was reported as discipline referral data.

During the 2007-2008 school year, the frequency of attendance was collected by teachers and reported to the attendance office. The attendance report was made available to the researcher at the conclusion of the school year. This collection and tabulation of daily attendance data are the result of compliance with state guidelines. Strict accuracy was emphasized in the collection of these data and sanctions for non-compliance or inaccuracy were outlined. The principal was ultimately responsible for the collection, accuracy and reporting of data to the State Department of Education.

Data analyses were conducted using SPSS to determine if academic or non-academic differences could be found between three groups: all single-sex students and the all coed students; single-sex females and coed females; and single-sex males and coed males. An ANOVA was conducted to determine if there existed a difference between the three groups on the pretest measure. A test for homogeneity of variance was conducted prior to the in depth analysis to determine the variability of the scores. The academic data were analyzed to determine if the data satisfied all of the assumptions of the ANOVA (normality, independence and equality of variances). Math and reading improvement data were generated by subtracting the pretest in each subject from the posttest. Table 1 contains the descriptive statistics for single-sex and coed students on math pretest, posttest and improvement. Table 2 contains the descriptive statistics for single-sex and coed students on reading pretest, posttest and improvement. Alpha was set at .05.

Table 1  
*Descriptive Statistics for Single-Sex and Coed Students on Math Pretest,  
 Posttest and Improvement*

	<i>n</i>	<i>x</i>	<i>sd</i>
Pretest			
All Single-Sex	60	176.33	12.01
SSG	24	175.08	12.04
SSB	35*	176.83	12.08
All Coed	54	173.72	12.83
Coed G	27	175.3	13.79
Coed B	27	172.12	11.84
Posttest			
All Single-Sex	60	183.9	11.04
SSG	24	184.42	10.37
SSB	35*	183.31	11.67
All Coed	54	179.83	13.09
Coed G	27	180.44	13.74
Coed B	27	179.22	12.64
Improvement			
All Single-Sex	60	7.57	7.83
SSG	24	9.33	5.98
SSB	35*	6.49	8.85
All Coed	53*	6.57	7.54
Coed G	26*	6.04	5.41
Coed B	27	7.07	9.22

\*missing data

Table 2  
*Descriptive Statistics for Single-Sex and Coed Students on Reading Pretest, Posttest and Improvement*

	<i>n</i>	<i>x</i>	<i>sd</i>
Pretest			
All Single-Sex	59	171.58	13.32
SSG	24	172.75	14.75
SSB	35	170.77	12.41
All Coed	54	170.31	14.35
Coed G	27	174.74	14.9
Coed B	27	165.89	12.53
Posttest			
All Single-Sex	59	178.25	13.44
SSG	24	182.17	14.17
SSB	35	175.57	12.41
All Coed	54	175.57	15.27
Coed G	27	177.63	16.7
Coed B	27	173.52	13.71
Improvement			
All Single-Sex	59	6.68	8.47
SSG	24	9.41	6.47
SSB	35	4.8	9.22
All Coed	53*	5.83	8.72
Coed G	26	3.96	8.7
Coed B	27	7.63	8.52

\*missing data

An ANOVA was conducted to determine if there were significant differences between the groups (single-sex and coed, single-sex females and coed females and single-sex males and coed males) in math and reading performance. A chi square test was conducted to determine if there were significant differences between groups (single-sex and coed, single-sex females and coed females and single-sex males and coed males) in the frequency of attendance. A chi square test was initially planned to investigate the frequency of discipline referral. During the exploratory data analysis it was determined that the data set was composed of too few frequencies to conduct a chi square test. Therefore, referral frequency was tabulated for each group and reported.

## Participants

The focus of this research was archival academic achievement data, discipline referral frequency data, and attendance data gathered at the end of the 2007-2008 school year on first and second grade students. The population of interest in this study was public school first and second grade students. The sample used in the study consisted of 115 first and second grade students at a public elementary school in the southeastern part of the United States.

## Results

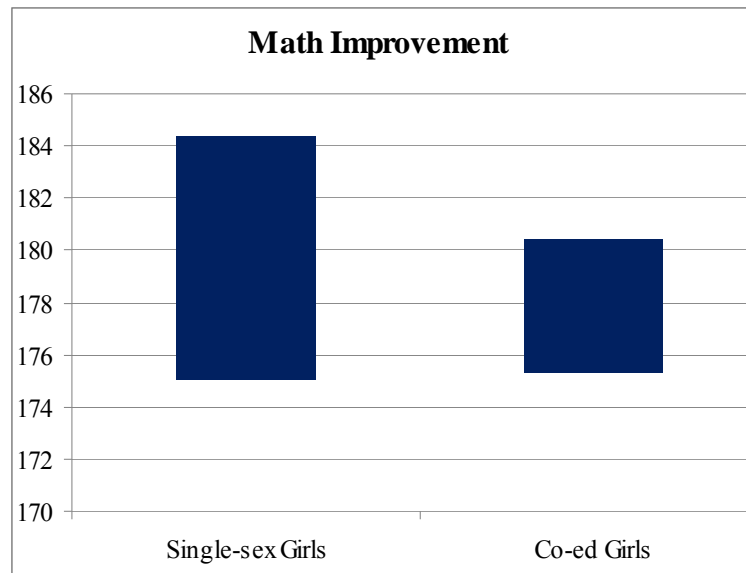
The grouping of students by sex within an educational environment yielded mixed results regarding improvement in math or reading. This researcher found statistical significance for math and reading improvement for single-sex females compared to coeducational females. In the investigation of academic outcomes, the findings of this study support single-sex education for females, but not for males. This researcher found evidence to support gender-based grouping as a strategy for increasing attendance frequency.

### Math Improvement

A one way ANOVA was conducted to determine if there was a statistically significant difference in math improvement of all students in a single-sex setting and all students in a coed setting. Data analysis revealed that there was no difference in the math improvement of males in a single-sex class and males in a coed class. The same finding was the result in the investigation of math improvement for males in single-sex classes and males in coed class. Math improvement for males in either sector was not statistically significant.

However, data analysis of the math improvement of on the math portion of the MAP test for females revealed a much different result. At  $\alpha = .05$ , the ANOVA results,  $F_{(1, 48)} = 4.18$ ,  $p = .04$ , indicated a statistically significant difference in math improvement for females. Therefore, the researcher concluded that the difference in the mean improvement in math performance of first and second grade single-sex public education females ( $m = 9.33$ ,  $sd = 5.97$ ) was statistically significant when compared to the improvement in math performance of first and second grade public coeducation females ( $m = 6.03$ ,  $sd = 5.41$ ).

In this study, single-sex females improved in math performance more than the coed females. The floating bar graph in **Figure 1** (math improvement of single-sex girls and coed girls) provides a clear visual of the significant improvement in math for females in single-sex classes compared with females in coed classes. The lower rim of the bar reflects the group mean on the pretest, the upper rim of the bar reflects the group mean on the posttest and the bar itself is an accurate indication of the magnitude of math improvement.



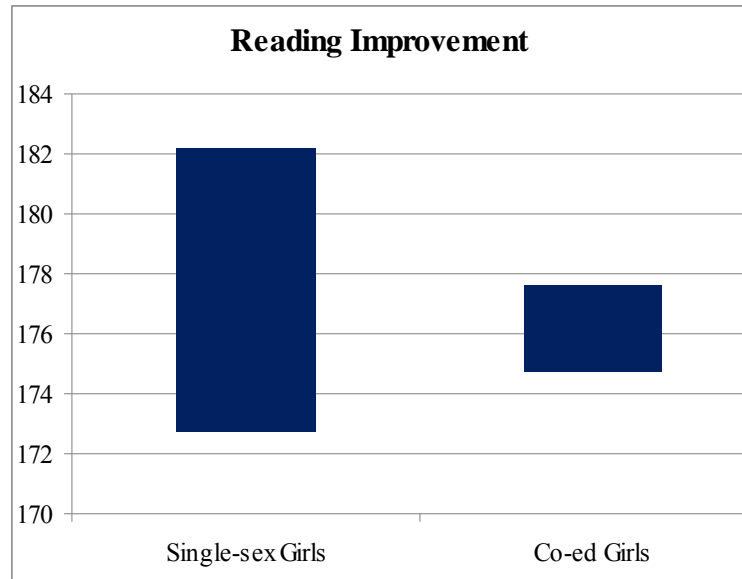
**Fig. 1** Math Improvement of Single-Sex Girls and Co-ed Girls

### *Reading Improvement*

A one way ANOVA was conducted to determine if there was a statistically significant difference in reading improvement of all students in a single-sex setting and all students in a coed setting. Data analysis revealed that there was no difference in the reading improvement of males in a single-sex class and males in a coed class. The same finding was the result in the investigation of reading improvement for males in single-sex classes and males in coed class. Reading improvement for males in either sector was not statistically significant.

A one way ANOVA was conducted to determine if there was a statistically significant difference in mean reading improvement of females educated in a single-sex setting and those educated in a coeducational setting. At  $\alpha = .05$ , the ANOVA results,  $F_{(1, 48)} = 6.24, p = .01$ . Therefore, the researcher concluded that there was a statistically significant difference in the improvement in reading performance of first and second grade single-sex public education females ( $m = 9.41, sd = 6.47$ ) when compared to the mean improvement in reading performance of first and second grade public coeducation females ( $m = 3.96, sd = 8.69$ ). Females in the single-sex classes improved in reading performance more than females in the coeducational setting.

In this study, single-sex females improved in reading performance more than the coed females. The floating bar graph in **Figure 2** (reading improvement of single-sex girls and coed girls) provides a clear visual of the significant improvement in reading for females in single-sex classes compared with females in coed classes.



**Fig. 2** Reading Improvement of Single-Sex Girls and Co-ed Girls

### *Discipline Referral Frequency*

This researcher did not determine if there existed a significant difference in the frequency of students referred for administrative discipline between single-sex students and coeducational students. Only a reporting of the frequencies associated with discipline referral for each group was conducted. Single-sex males were referred with greatest frequency and single-sex females were not referred at all. Coed males and females were referred at the same frequency. Discipline referral frequencies by sector are contained within **Table 3**.

**Table 3**

### *Discipline Referral Frequencies by Sector*

	Referred	Not Referred	Total
Single-Sex Girls	0	24	24
Single-Sex Boys	2*	34	36
Coed Girls	3	25	28
Coed Boys	3	24	27
Total	11	107	115

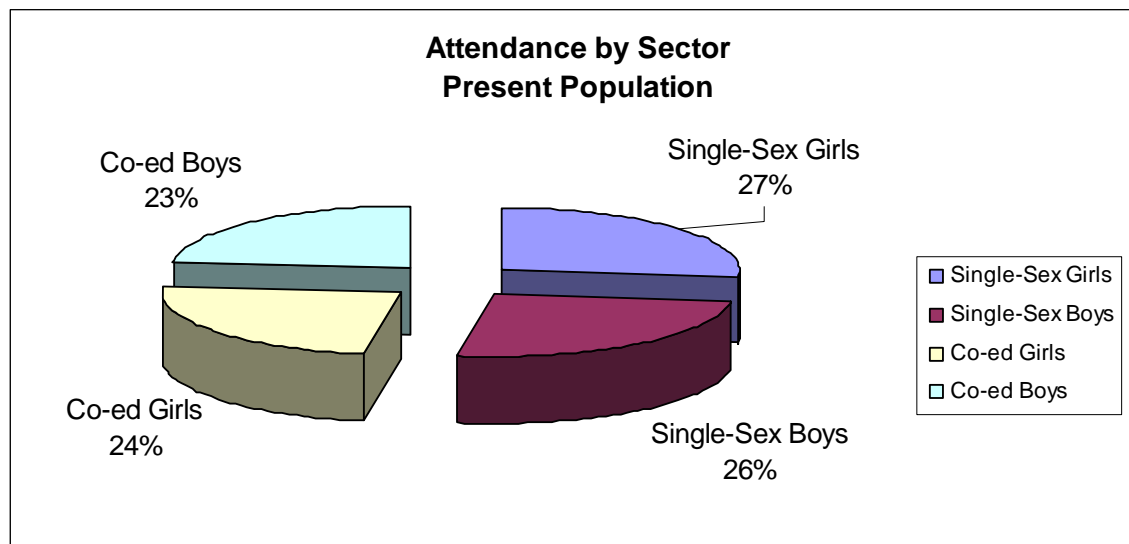
\*2 students referred for a total of 5 referrals

### *Attendance Frequency*

The Chi Square analysis of attendance data revealed that attendance frequency was significantly different for some groups. The Chi Square results for the investigation of attendance frequency indicated that difference in attendance frequency was statistically significant between the single-sex group and the coed group ( $p < .05$ ). Also, a statistically significant difference was detected between single-sex females and coed females ( $p < .05$ ). However, no statistically significant differences in attendance frequency were found between single-sex males and coed males. **Table 4** contains attendance frequency by sector and gender. **Figure 3** provides a visual representation of the attendance frequency of sectors and genders relative to total percentage of possible days present.

**Table 4**  
*Attendance Frequency by Sector and Gender*

	Not Present	Present	Total
Single-Sex Girls	19	161	180
Single-Sex Boys	26	154	180
Coed Girls	34	146	180
Coed Boys	40	140	180
Total	119	601	720



**Fig. 3** Attendance by Sector, indicating percent of total days present

In summary, based upon the findings of statistical significance for females in both math and reading improvement, classification of females by gender in an attempt to facilitate the learning process appears to be a viable strategy. However, for males, this same effect was absent.

Single gender boys, as a group, improved less in both math and reading than did the coeducational boys in math and reading. Second only to the girls' single-sex classes, the boys' coeducational classes recorded the next largest improvement in both math and reading.

## Discussion

This researcher's findings are consistent with the findings of Spielhofer, O'Donnell, Benton, Schagen and Schagen (2002) who found statistical significance for females in all academic subjects evaluated, but no statistical significance for the male students in their investigation. Similar results were found by Mulholland, Hansen and Kaminski (2004). These researchers found statistical significance for females in English improvement. Although English improvement for males was not significant, the single-sex males scored higher than did the coeducational males in the study. However, it should be noted that the findings in both of these studies were based on an international populations of students at secondary schools.

Other researchers have published findings that conflict with this researcher's findings. In their investigations of single-sex education and academic achievement Howard and Sansted (2003) and Baker (2002) determined that single-sex education does not significantly impact academic performance. Neither of these research efforts produced support for single-sex education for males or for females.

This researcher's findings do not reflect statistically significant improvement for males with respect to academic achievement in math or reading. Similar findings for non-significance for males have been reported by other researchers investigating the impact of single-sex education (Mulholland, Hansen and Kaminski, 2004; Spielhofer, O'Donnell, Benton, Schagen and Schagen, 2002).

The finding of lack of support for single-sex education, specifically for males, has been reported by other researchers (Baker, 2002). In his investigation, Baker found that the males-only environment had a negative impact on the achievement of males. His findings closely parallel those of Van Houte (2004) who determined the single-sex environment was not beneficial for males. Van Houte reported that males were more likely to thrive in a coeducational environment.

This researcher was unable to determine if there was a difference in the referral frequency of single-sex students and coeducational students. The planned statistical analysis of discipline referral rate was not conducted because the dataset violated the expected frequencies assumption of the Chi Square test. This low frequency count would have yielded inaccurate results. However, through a more sophisticated statistical procedure that simulates data (Monte Carlo), it was determined that there was no statistically significant difference ( $p > .05$ ) in the referral frequency of students in single-sex classes compared with students in coeducational classes.

In single-sex research that included discipline referral data, Ferrara (2005) and Howard and Sansted (2003) found that students in single-sex classes were referred for administrative discipline less often than students in coeducational classes. It is important to note that both of these reports were based upon numbers of discipline referrals, not statistical significance. Conflicting reports about lower discipline referrals for single-sex students have been reported by principals of newly implemented single-sex schools (NASSPE, 2007).

The results of this researcher's study indicate that single-sex education may impact attendance. In this study, females attended school with greater frequency than did coeducational males. Some researchers who have investigated single-sex education have reported that that



there is a connection between single-sex education and improved school attendance (Hall & Barnes, 2006, Hulette, 2006). The NASSPE has compiled data collected from single-sex schools indicating that single-sex implementation will positively impact attendance (NASSPE, 2007). Other researchers have been unable to determine the impact of single-sex education on attendance (Ainley & Daly, 2002). In their investigation of single-sex education, Mael et al., (2005) concluded that single-sex education does not impact school attendance.

### **Recommendations for future research**

One of the mandates regarding the implementation of single-sex public education is that before implementation can occur, a statement regarding the condition that single-sex implementation is intended to remedy must be in place. The irony is that many districts are implementing single-sex education while listing a wide range of conditions (low test scores, disadvantage of females within the coeducational setting, disadvantage of at risk students) that are to be remedied, yet without research-based evidence. To date, very little public single-sex education research has been conducted to support any of these connections between single-sex education and the remedies outlined.

In order to debate and accurately make judgments on the effectiveness of single-sex education, it must first be determined whether the implementation of single-sex public education does, in fact, provide benefits to at least some subgroups within the public school population. Additional single-sex research that focuses on public school populations of varying levels and subpopulations is essential before the questions of effectiveness can be answered.

Research involving analysis of large datasets may help to further our understanding of single-sex education. Using only isolated and small datasets in our investigation of single-sex education tends to reduce the integrity of research findings produced due to the absence of continuity among variables investigated across individual datasets and the variability of study populations. Small datasets that focus only on subpopulations present skewed findings and therefore cannot provide a comprehensive understanding of the impact of single-sex education.

Additional research on public single-sex education and its potential to positively impact subpopulations such as at risk students and minority students is fertile ground for future research. Research to date on this topic is scant and conflicting at best. International research (Wills, 2006) and some parochial research currently serve as the research base for the assertions that single-sex education will benefit at-risk (Cooper, 2006; Riordan, 2002) and minority students (Wills, 2007). Is the perceived benefit for at-risk and minority students the result of a cultural connection between a minority teacher and a minority student or is it the result of single-sex education is a question that additional research should address?

Additionally, research that focuses on public coeducational and single-sex schools of comparable demographic makeup and in close proximity to each other may provide an excellent arena for investigation. If researchers could orchestrate this comparison between such schools, where appropriate teacher training and inter-school collaboration could be in place; an excellent research study would no doubt take form. Researchers would then have the opportunity to conduct single-sex research that focuses on coeducation and single-sex for comparison, public school datasets and identical program missions. This comparative and comprehensive analysis between public coeducational schools and public single-sex schools is paramount to our understanding of the impact of single-sex education in the United States.

Further research on single-sex education may focus on different educational levels, outcome variables and/or target populations. Multilevel or longitudinal research would increase our understanding of single-sex education by providing evidence of long-term effects. Evidence of some outcome variables investigated in single-sex research may not be made manifest until long after the research window is closed. For instance, it would be difficult to measure the effects of single-sex education for one semester or one year to determine if it is a viable strategy for increasing the graduation rate or improving social skills and leadership skills.

Multilevel evidence on the impact of single-sex education is essential to a comprehensive understanding. The importance of the attainment of some proposed outcome variables may be more essential at one level compared to another. For example, a development of a joy for learning and the learning environment is of paramount importance as a child begins elementary school and is formulating his/her personal perspective of education. As a child enters middle school that perspective is formed and the development of social skills and healthy esteem becomes higher priorities. Once the student enters high school, increased career goals and aspirations begin to move closer to the top of the priority list of proposed single-sex education outcome variables. Longitudinal research and the evidence that it provides will be needed to fully determine the impact of single-sex education.

Additional research on outcome variables perhaps less well suited to quantitative research would strengthen the research base on single-sex education. The improvement of self-esteem, the formation of a healthy self-concept, the acquisition of heightened social and leadership skills, and the development of a joy for learning are outcome variables that may well be better suited to qualitative investigations.

## **Summary**

In summary, in terms of academic achievement, this researcher's findings support single-sex education for females and but not for males. Improvement in math and in reading was statistically significant for females, but not for males. In this study, the impact of school sector on discipline referral frequency could not be ascertained. However, this researcher found support for single-sex education with respect to attendance. In practical terms, this means that students who attend single-sex classes are apt to be in the instructional environment with greater frequency than if they attended coeducational environments.

There are many obstacles to overcome before the debate over the effectiveness of single-sex education can be settled. This study addressed some of the issues that need consideration before educational researchers can arrive at a conclusion about the effectiveness of single-sex education. First and foremost, single-sex education research must be conducted in the public educational setting. Simply conducting single-sex research with dissimilar populations and in dissimilar environments will not provide accurate information for public school single-sex.

Since there are legal constraints that prevent educational researchers from orchestrating the ideal research setting (random assignment research), researchers must be diligent in standardizing educational research methodologies that will be instrumental in obtaining solid data for analysis. Every effort possible should be made to control all components of the research environment so that results obtained will be useful in expanding the understanding of educational researchers and theorists.

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