A STUDY OF SINGLE-GENDER GROUPING FOR SIXTH GRADE MATH AS A STRATEGY FOR IMPROVING STUDENT ACHIEVEMENT.

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ABSTRACT

Purpose of the study. The purpose of this study was to examine single-gender groupings for sixth grade mathematics classes as a strategy to improve student achievement. The method of research was quantitative, with MAP mathematics test data being used to determine if any relationship exists between the strategy and student achievement.

Findings. From this study a firm conclusion about the value of single-gender classes is problematic. While the experimental group appeared to make a difference in the basic statistical analyses, the fact that the findings were not significant when a proxy measure for poverty (free and reduced lunch) and gender are both added to the statistical formulae raise substantial concerns about the value of single-gender classes. Further research is needed to better clarify the true value of single-gender classes compared to mixed-gender issues.
# Table of Contents

Acknowledgements................................................................. ii
Abstract................................................................................... iii
Table of Contents........................................................................ iv
List of Tables............................................................................... vii
List of Figures............................................................................. ix
Chapter 1: Background to the Study................................. 1
   Introduction................................................................. 1
   Purpose of the Study................................................... 7
   Research Questions...................................................... 7
   Hypotheses................................................................. 8
   Limitations and Delimitations................................. 9
   Definitions................................................................. 9
Chapter 2: Review of Research........................................... 11
   Introduction................................................................. 11
   The Middle School Child........................................... 12
   Brain and Academic Research................................. 15
   Gender and Self Image............................................... 19
Gender and Class Research

Chapter 3: Method

Purpose of the Study

Research Questions

Null Hypotheses

Population

Procedure

Instrumentation

Data Collection

Data Analysis

Chapter 4: Presentation of Analysis of Data

Research Questions

Null Hypothesis

Descriptive Findings

Demographic Data

Hypothesis Testing

Hypothesis One

Hypothesis Two

Hypothesis Three

Summary of Results

Chapter 5: Discussion of Findings

Statement of Hypothesis
Summary of Descriptive Data.......................... 84
Summary of Hypothesis Testing..................... 90
Implications.............................................. 91
Theory and Future Research...................... 91
Recommendations for Future Research.......... 92
Closing Comments.................................... 93
References............................................... 97
Appendix A: Institutional review Documents.......... 104
Vita.......................................................... 105
List of Tables

1. Overall Data: Three Academic Years........................................... 52
2. Number of Students Participants by Year and Gender........... 54
3. Numbers of Students Participating in FRL Program by
   Single-Gender and Mixed-Gender........................................ 55
4. Fifth Grade Mathematics MAP Mean ScoresShown by
   Grouping........................................................................... 56
5. Sixth grade Mathematics Mean Scores.................................. 57
6. Fifth and Sixth Grade MAP Mean Test Scores....................... 58
7. FRL/NonFRL Sixth Grade MAP Mathematics Test Score
   Mean.................................................................................. 59
8. Sixth grade MAP Mathematics Scores and FRL............... 61
9. Gender Totals........................................................................ 62
10. MAP Mathematics Mean Scores by Gender......................... 63
11. Group and Cohort Year 6th Grade MAP Mathematics Mean
    Scores................................................................................ 64
12. Three Years of Male Single-Gender MAP Mathematics
    Means............................................................................... 65
13. Three Years of Female Single-Gender MAP Mathematics
    Means............................................................................... 66
14. Three Years of Male Mixed-Gender MAP Mathematics

vii
15. Three Years of Female Single-Gender MAP Mathematics Means

16. Sixth grade MAP Mathematics Mean Scores

17. Fifth grade MAP Mathematics Mean Scores

18. Cohort Year Mean Scores and Differences

19. 6th Grade MAP Mean Scores by Cohort Year and Grouping

20. Collective Group as a Whole, Controlling for 5th Grade MAP

21. Cohort Years Controlling for Group and 5th Grade MAP

22. Difference in Single-gender and Mixed-Gender when Controlling for 5th Grade MAP, FRL and Gender
List of Figures

1. Control and Experimental Group Data........................................... 47
2. FRL Sixth Grade Map Mathematics Test Scores Means and FRL Statuses..................................................................................... 60
Chapter 1

Background of the Study

In this era of No Child Left Behind (NCLB, 2002), educators are being held accountable by federal, state and local agencies. Tensions arise among teachers, students, parents, and policymakers because NCLB assessments are used to rank students and districts on local, state, and nation levels (Sloane & Kelly, 2003). Educators no longer have the luxury of sitting back and assuming that student learning will just work out. Educators cannot assume that yesterday’s classroom meets the needs of today’s children. School reformers have discussed change in the terms of leverage points, especially in relation to the value they bring to the educational enterprise (Dufour, Dufour, Eaker, & Karhanek, 2004; Fullan, 2003; Senge, 2005). Leverage points are policies and practices on which educators have the most direct impact. Prominent leverage points are curricula, instruction, professional development, and the use of assessment data. Challenging our own assumptions about who is being served by our schools drives us to achieve deeper, transformational initiatives. As educators, we are challenged to leave no child behind and ensure that all students attain equal success at the same rate. Educators who examine their own assumptions about education, students, and related topics are in turn better prepared to affect change and transform the system.
Four teachers in a small Midwestern city decided that they needed to challenge their assumptions about students and the educational system. They spent much of their time engaging in discussions about how they could address the trends they saw in their classrooms. “We were seeing more girls seemingly afraid to speak up or ask questions in math and science class”, one teacher stated. Another teacher commented that “it seemed like the boys didn’t want to share their writing works in class. Instead the boys and the girls would just sit there looking at each other.” The four teachers agreed that it is a fact of life that boys and girls become more aware of each other as they get older, but one teacher explained that “we would really like for them to be more aware of what we are doing in class”. These feelings and assumptions led them to begin educating themselves about gender differences in the classroom.

**Gender Differences**

Many educators know instinctively that boys and girls do not learn the same way or at the same rate. “Males and females are equal in their common membership of the same species, humankind, but to maintain that they are the same in aptitude, skill or behavior is to build a society based on a biological and scientific lie” (Moir, 1993, p. 22 ). “Boys and girls are different. They just come out of the womb that way,” explained a parent of four. A teacher reflected that “I’ve
learned that while boys and girls are the same in a lot of ways, they are definitely different. Every year I change the way I teach to accommodate that one fact” (Gurian, 2001, p. 14). Many educators will tell that you they can see and sense differences between boys and girls from the moment the students walk in the door on the first day of school. One teacher described that boys and girls “express emotion differently. They speak differently. They interact with the world differently. Boys tend to be more aggressive and girls more passive”.

Throughout our careers, educators have witnessed a gamut of changing theories in and about education (Fullan, 2006; Marzzano, 2003). One of the primary focuses in recent years is the area of brain research and how the brain processes knowledge:

There are studies being conducted about brain development in infants, teenagers, adults and the elderly. There is research being done on how the right and left sides of the brain develop.

There are also studies being done on how the brain learns. (Kay, 2008, p. 1)

Teachers are engaging in continuing education coursework to study the development of the brain and to explore developmental differences between boys and girls. This development is in stark contrast to Gurian’s (2001) finding that in a sample of 200 teachers, none received formal training in this arena while in college.
Gurian (2001), author of *Boys and Girls Learn Differently*, suggests that the differences between boys and girls can significantly impact on how educators choose to set up and deliver instruction in their classrooms. Gurian studied brain research and synthesized ideas on the numerous ways that girls’ and boys’ brains function and learn differently. One difference he noted was in maturity: “In most cases and in most aspects of developmental chronology, girl’s brains mature earlier than boys” (p. 19). This maturity tends to allow girls to acquire complex verbal skills earlier than boys. Gurian’s work supports the findings of researchers, Hanlon, Thatcher and Cline from Virginia Tech (Hanlon, 1999) who found that the areas of the brain involving language and fine-motor skills matured about four years earlier for girls than for boys. The areas in the brain involving geometry and spatial relations mature four years earlier for boys than for girls. Other noted gender differences are that girls take in more sensory data and tend to have better verbal abilities, whereas boys tend to rely heavily on nonverbal communication and spatial abilities. Gurian summarized that “theses noted differences in different gender brains can have immense ramifications in our culture, which relies heavily on talk and conversation” (p. 27).

Differences in girls’ and boys’ brains are visible in Magnetic Resonance Imaging and Positron Emission Tomography scans, which
show how certain areas of the brain, are structured differently and how blood and neurotransmissions vary by gender (Gurian, 2001). Sax (2005) expressed the importance of linking these findings to educational practice:

> With this research on how brains develop in different order and at different times in girls compared to boys there may be a risk in having a curriculum that teaches the same subjects in the same sequence to both boys and girls. Girls and boys behave differently because their brains are wired differently. (p. 74)

Sax also noted that because gender plays a role in the way the brain functions, it is important for parents and teachers to know and understand these differences. Sax illuminated his argument with examples of the ways boys and girls assess risk. That is, boys tend to overestimate their abilities and girls tend to underestimate their abilities; also, boys tend to be more aggressive and girls tend to be more passive. These differences in aggression are also noted in how boys and girls fight. Boys can be mean, but their aggression is usually on the surface and is generally short-lived, whereas tension between girls can simmer and build for weeks or months, undermining friendships until relationships fall apart.

> The differences between girls and boys and the roles those differences play in school have garnered the attention from a variety
of scholars. Publication of the book *In a Different Voice: Psychological Theory and Women's Development* (Gilligan, 1993) triggered an academic revolution. Gilligan theorized that girls think, interact, display leadership and make decisions in psychologically and developmentally unique ways. As such, Gilligan argued that the male-based model for learning simply did not fit the way girls learn (1993).

Gilligan's work (1982, 1993), coupled with a growing professional awareness among teachers of educational disparities between girls and boys, led to a closer examination of what actually occurs in co-educational classrooms. In a 1992 report entitled *Shortchanging Girls, Shortchanging America*, the American Association of University Women (AAUW) found that girls routinely were called upon less often in class than boys. Sadker and Sadker (1995) echoed those findings in *Failing at Fairness: How Schools Shortchange Girls*, a compendium of 10 years of their research at American University. They found that girls did not receive their fair share of attention in the classroom because despite their best intentions, teachers respond to boys and teach them more actively than girls. Sadker and Sadker also found that boys called out eight times more often in class than girls, a practice teachers frequently rewarded with praise. When girls answered questions in class, teachers normally nodded or said "okay", yet when boys responded, teachers offered them more attention.
through praise, corrections, assistance, or criticism. Sadker and Sadker also noted that, in a mixed-gender classroom, inconsistent treatment of boys and girls had the potential to create climate issues.

Sommers (2000) asserted that after reviewing studies on gender differences in the classroom, it is clear that "boys not girls are on the weak side of the educational gender gap." On average, boys are a year and a half behind girls in reading and writing; also, they are less likely to go to college. This discrepancy was described by the president of AAUW in an interview with Women magazine: "Both girls and boys are being shortchanged in education" (Woods, 2002).

Gender differences in the classroom and related assumptions, along with the call to improve student performance, led to the following research question: If boys and girls learn and interact differently, what effect will gender-based classes have on mathematics student achievement?

Purpose of the Study

The purpose of this study was to examine single-gender groupings for sixth grade mathematics classes as a strategy to improve student achievement.

Research Questions

To fulfill the purpose of this study, the following research questions were developed:
1. Are there differences in achievement over the course of the three years of data for students randomly assigned to single-gender sixth grade mathematics classes and students randomly assigned to mixed-gender sixth grade mathematics classes, when controlling for 5th grade achievement?

2. Are there differences in achievement for each cohort year of students randomly assigned to single-gender sixth grade mathematics classes and students randomly assigned to mixed-gender sixth grade mathematics classes, when controlling for 5th grade MAP mathematics scores?

3. Are there differences in achievement for single-gender and mixed-gender classes when controlling for 5th grade MAP mathematics scores, FRL and gender?

Hypotheses

Three hypotheses guided this study:

1. There are no significant differences in achievement for all students, experimental and control groups, over the course of the three years of data for students when controlling for fifth grade achievement.

2. There are no significant differences in achievement for each cohort year of students randomly assigned to single-gender sixth grade mathematics classes and students randomly assigned to
mixed-gender sixth grade mathematics classes when controlling for gender.

3. There are no significant differences in achievement for students randomly assigned to single-gender sixth grade mathematics classes and students randomly assigned to mixed-gender sixth grade mathematics classes when controlling for, prior year achievement, Free and Reduced Lunch (FRL) status and gender

Limitations

Two limitations were identified at the outset of this study:

1. The findings of this study are limited to the work of four teachers and their teaching styles, personalities, and experiences.

2. The findings of this study are limited to the methodology and methods used to examine student and teacher perceptions relevant in this study.

Definitions

Climate: The sense in a classroom setting that one can ask questions, listen without distractions, and work collaboratively without fear of humiliation, rejection or pressure (Gurian, p. 227).

Single-gender classroom: A learning environment at school that specifically meets the needs of boys and girls (Gurian, p. 5).
Student achievement: Students’ academic progress as measured by grades and formal and informal testing data.
Chapter 2

Review of Related Literature

There are a number of transitions in adolescence, each representing a "rite of passage." One that does not get the attention it deserves is the transition from elementary to middle school. Depending on the community, this usually occurs between the fourth and seventh grade. Regardless of when it occurs, the transition to middle school tends to destabilize many students, requiring them to re-establish a sense of their identity in a more mature and demanding environment (Schumacher, 1992).

It is a transition that often signals increased referrals to mental health services; the failure of previously successful methods for academic success to match up with more rigorous workloads; the start of more severe peer pressures like smoking, alcohol, drug, violence, and attendance problems. It is a time that can create damage to self-esteem as young people begin to focus much their attention on those of the opposite sex (Anderman & Kimweli, 1997; Arowosafe & Irvin, 1992; Odegaard & Heath, 1992).

It is against this backdrop that virtually every adolescent looks for answers on how to develop a new and positive identity, along with worrying about what others think. Because much of adolescent behavior revolves around that search, middle school educators must
take time to understand and help students find those answers while guiding them toward opportunities, relationships, and skills that allow them to develop a strong sense of self. During this difficult time it would be wise for educators to understand the challenges and help avoid or minimize a number of problems that a middle school student could face in the areas of academics, social/emotional and physical development. Are there challenges different for boys and girls? Would they be lessened or increased in gender specific classes? What can be learned from a study of student achievement in gender specific classes compared to mixed gender classes?

*The Middle School Child*

Middle school children are attempting in their own rather clumsy way to grow up and be independent; specifically, independent of parents and other adults. Peers at this time are the most important people in their lives. It is, for example, difficult for them to believe that they will ever appreciate their brothers, sisters, parents, and teachers.

These students are past the consistent ages in which behavior was quite predictable; ages when they wanted to please parents and teachers more than anything. Pleasing peers becomes most important. It begins to happen with different children at different times. Although there are children who go through the adolescent years without a great deal of difficulty, for many adolescents and their parents and
teachers, these years may be described as the troublesome, exciting, changing, turbulent, unsettling, fidgety, and boisterous years (Marsh, 2003).

Some researchers (Anderman, Eric M., Hicks, Lynley H., & Maehr) would agree that most of the problems at this age are not academic, but instead social and organizational. Middle school students may do their homework and then forget to hand it in, but they won't forget when they need to telephone a friend. It seems as if the brain stops growing while the body takes off and the hormones kick in. Students are so concerned with peers that school and families take a back seat. Problems that we adults pass off as silly are often considered "life and death" matters to students this age (Anderman, Eric M., Hicks, Lynley H., & Maehr).

The struggles that a middle school student faces coincide with several major changes for young adolescents. Most are in the throes of puberty; they're becoming more self-aware and self-conscious, and their thinking is growing more critical and more complex. At the same time, adolescents are often "in a slump" when it comes to academic motivation and performance (American Psychological Association, 2004).

Researchers at the University of Michigan have studied middle school students and have found that, on average, children's grades
drop dramatically during the first year of middle school compared to their grades in elementary school (American Psychological Association, 2004).

Researchers also found that after moving to middle school, children become less interested in school and less self-assured about their abilities. It was also found that, compared to elementary schools, middle schools are more controlling, less cognitively challenging and focus more on competition and comparing students' ability (APA, 2004).

Through this and other similar research, psychologists have discovered a "developmental mismatch" between the environment and philosophy of middle schools and the children they attempt to teach. At a time when children's cognitive abilities are increasing, middle school offers them fewer opportunities for decision-making and lower levels of cognitive involvement, but a more complex social environment (APA, 2004). At the same time, numerous teachers have replaced the single classroom teacher and students often face larger classes and a new group of peers.

These factors all interact to make middle school difficult for many youngsters. Researchers at the University of Michigan found that decreased motivation and self-assuredness contribute to poor
academic performance; poor grades trigger more self-doubt and a downward spiral can begin (Anderman, 1994).

**Brain and Academic Research**

In the middle school classroom, students must adapt to new ways of preparation and learning. Unfortunately, the social aspects of their identity are often more important to them than academic success. This may explain why it is not uncommon to see students "play dumb," trading off success in the classroom for peer approval (Covington, 2000).

Many students are simply not well prepared for the academic demands of middle school (Covington, 2000). They need explicit instruction, coaching, and support with regard to organizing time and resources for homework; responding to work that is more challenging and requires more effort; understanding and addressing the varying expectations of teachers in different subject areas; and accomplishing such basic tasks as studying, taking notes, and taking tests. Gender may also play a key role in academic struggles.

Brain development research has helped shed light on the difference in the male and female brain. Dr. JoAnn Deak, psychologist and author of *Girls Will Be Girls: Raising Confident and Courageous Daughters*, puts it this way: "Girls and boys are as different from the neck up as the neck down" (p37). She says our brains, because they
are influenced in their development by hormones, are differentiated along gender lines when it comes to our learning styles (Deak, 2000).

"In most cases the aspect of brain development takes place earlier in a female brain than in the male brain "(Gurian p.28). Research has shown that the female brain can acquire considerably more complex verbal skills as much as a year earlier than a male brain. This earlier brain development starts to be more pronounced in the right hemisphere of the brain and then gradually continues to shift over to the left hemisphere. On average girls take in more sensory data than boys. In general they hear better, smell better and take in more information through touch than boys (Gurian,2000).

Girls tend to be better at verbal abilities and boys better at nonverbal. Leonard Sax in his book, Why Gender Matters, puts it this way. The difference in the amount and the way that girls take in information has major implications on student learning. Since girls are much more sensitive to noise, the boy who is tapping his pencil may not be bothering the other boys but it is a large distraction for most girls. A teacher who talks in a loud voice will be more likely viewed as yelling or mean by girls than by boys (Sax 2005).

Lynn Liben (2000) did a study on the data from the 1999 National Geography Bee. It attracted five million participants. Of these five million, girls were forty-five times less likely to be a finalist than
boys. They concluded that the difference stemmed from boys being better at spatial concepts than girls.

A 2005 joint study by the University of California-Irvine (UCI) and the University of New Mexico showed that boy's brains have more gray matter, while girl's brains have more white matter (National Coalitional of Girl’s Schools, 2005). Gray matter represents areas where information is processed, while white matter represents the connections between these areas. Think of one large computer, versus a series of smaller computers networked together to work as one. (*NeuroImage, 2005*). This could be a link to the success that males experience in mathematics and science. Behavioral and neuroimaging studies of human cognition and cognitive development suggest that our species' talent for mathematical and scientific thinking has a considerable genetic basis (NCGS, 2005). These core systems are equally available to males and females. They provide the biological foundation for a set of cognitive capacities that men and women share," (American Psychologist, 2005). Jung said the research sheds light on why males tend to excel at tasks requiring localized processing, like mathematics, while females tend to excel at integrating and assimilating information from throughout the brain: 'whole-brain' tasks such as language skills.
Many overseas countries have significant portions of their student populations enrolled in single-sex schools. In Great Britain, the National Foundation for Educational Research examined 2002 student performance data from 979 primary and 2,954 secondary schools. Among its objectives was to test assertions that single-sex education can be beneficial for girls and boys alike. The study concluded that girls' schools help counter gender-stereotyping in subject choices. Also, girls in single-sex schools perform better than girls in co-ed schools, regardless of socio-economic and ability levels. The study also indicated that boys with low prior academic achievement score better on the GCSE standardized test in boys' schools than in co-ed schools. Boys in single-sex grammar schools perform better than those in co-ed grammar schools (2002).

A similar conclusion comes out of Australia. Dr. Ken Rowe, Principal Research Fellow at the Australian Council for Educational Research, summarized the findings of several studies involving more than 270,000 students. Dr. Rowe presented the results of his research to The Second National Conference on Co-Education, held in Australia in April of 2000, telling the audience, "Co-educational settings are limited in their capacity to accommodate the large differences in cognitive, social and developmental growth rates of girls and boys between the ages of 12 and 16. In contrast... evidence suggests that
during these key adolescent years, single-sex settings better accommodate the specific developmental needs of students.” (Rowe 2000).

Finally, Educational researcher Cornelius Riordan, the author of *Girls and Boys in School: Together or Separate?*, has spent years examining educational outcomes based on various school settings. He sums up his findings this way: "Having conducted research on single-sex and co-educational schools for the past two decades, I have concluded that single-sex schools help to improve student achievement. My conclusions are based on high quality national data gathered by the National Center for Education Statistics, as well as on studies conducted around the globe."(Riordan 1992 p.1)

*Gender and Self Image*

The development of a positive self-image is critical in the middle grades. Adolescence is a period of intensified self-consciousness with individuals being very concerned about their outward appearance. Facial expressions, hair arrangements, posture, dress, weight and height all become magnified and put to the test of scrutiny. In general, the adolescent is only able to see him or herself through the haze of an idealized image. Often the adolescent will focus on the ways in which he or she fails to meet this ideal, which is
associated with low self-esteem and unhappiness about one's self-image (Parents, 1993).

Adolescence is also a time of intensified sensitivity to reflections from the environment. How one stands with one's peers in adolescence is particularly important in determining how one stands with oneself. Adolescents actively try out roles and manners and test these out through social interaction. Any negative response from peers is met with concern (Parents, 1993).

“Many educators report a general decline in school performance among students as they enter adolescence” (Orenstein, 1994). Some results support that girls may actually have lower performance than boys especially in the areas of science and mathematics because of self-image. For example, as a group, girls exhibit a general decline in science achievement not observed for boys, and this gender gap may be increasing (Backes, 1994). The National Assessment of Educational Progress (NAEP) results indicate that for 9 - 13-year-olds, gender differences in science achievement increased between 1978 and 1986, with females' academic performance declining (Mullis & Jenkins, 1988). The relationship between a decline in self-concept and a decline in achievement indicates that identifying the special needs of female students at school and at home should be a high priority for parents.
and teachers. Another study (Roberts, 1987) tested the hypothesis that the relationship between self-image and achievement would show different developmental patterns for boys and girls, particularly with regard to the relationship between self-image and mathematics and science achievement. Subjects were selected from two successive sixth grade cohorts in two predominantly white, middle class suburban school districts, and followed through the eighth grade. Two-hundred fifty-three students were included in the study. Covariance structure (LISREL) analysis was performed to examine gender relationships between academic achievement (as measured by course grades) and self-image (as measured by the Self-Image Questionnaire for Young Adolescents). The results of cross-sectional tests revealed that there was a significantly stronger relationship between self-image and academic achievement for boys than for girls in sixth and seventh grade, particularly with regard to mathematics and science achievement. Longitudinal tests, within gender, showed that the relationship between self-image and achievement increased for boys and decreased for girls when they moved from sixth to seventh grade. A series of repeated measures revealed a positive relationship between self-image and high mathematics achievement among boys, and a negative relationship among girls (Roberts 1987).
Researchers have observed other consequences associated with a general loss of self-esteem in preadolescent girls in addition to a decline in actual academic achievement. They have found, for example, that, "compared to boys, adolescent girls experience greater stress, are twice as likely to be depressed, and attempt suicide four or five times as often," (Debold, 1995, p. 23).

Other research points out the increased awareness of the opposite sex as reasons for academic decline and that by separating the genders gains can be made. Dr. Rosemary C. Salomone examined the research surrounding single-sex education, ranging from developmental psychology perspectives to studies on the classroom environment and teacher-student interaction. She found that, "Drawing from that research, one of the key arguments supporting single-sex programs is that they create an institutional and classroom climate in which female students can express themselves freely and frequently, and develop higher-order thinking skills." (Salomone 2006)

Other researchers (Riordan, Hawley and Lee, 1998) found that girls were more eager to answer questions and to work together in groups as they reviewed for their test, without having to worry about what the boys would think about them. In an all-boys class, the boys also seemed to excel. Boys more readily volunteered to answer and
seemed especially happy to march up to the white erasable board to write their answers in markers of many colors.

Educators also see the impact of self-image on students and behavior. One seventh-grade teacher, in his seventh year of teaching, said, "I spend most of my time monitoring behavior. We see too much note-passing and we have major distractions with all that boy-girl strife. I have to deal with increasing numbers of violations with the dress code. Some girls were literally falling out of their clothes last year trying to wear the latest trends or to get a boys attention." By establishing single gender classrooms can the burden of self-image be lessened?

**Gender Class Research**

More researchers are beginning to believe that boys and girls can get through the awkward middle school years better when they're separated, learning in classrooms tailored to the learning styles of each gender. "There is a good deal of gawking, speculating, and general preoccupation with those of the opposite sex who are most proximate." (Brighter Choice Charter Schools, 1997) Single-sex schools, by eliminating this factor, enable a more single-minded focus on academics. Put another way, "students may pursue their studies, classroom discussions, and school activities without needing to be
confronted on a daily basis with male-female socialization issues” (Salmone, 2000). The theory is that by separating girls and boys, especially during middle school years typically marked by burgeoning hormones, self-doubt and peer pressure, lessons can be more effective because they are in unique classroom settings. Research shows boys don't hear as well as girls, so teachers of all-boys classes often use microphones and because boys' attention spans tend to wander, incorporating movement in a lesson, like throwing a ball to a student when he's chosen to answer a question, can keep them focused (Salmone, 2000).

Jill Rojas, principal of the first public middle school in the country that offers single-sex instruction for boys and girls (a “third generation” single-sex school), has seen first-hand the impact of eliminating these social distractions. “We have seen many students start to focus heavily on academics. They no longer clown or try to impress the opposite sex. Girls are more apt to answer questions aloud in class as well as ask them. Girls are learning to be more academically competitive and boys are learning to collaborate” (Rojas 2000). In one boys' class researched in South Carolina, a group of gangly seventh-graders sprawled on the floor around a giant vinyl chart, using skateboard parts and measuring tape to learn pre-algebra. In a different school a few miles away, middle school girls
interviewed each other, and then turned their surveys about who's shy and who has dogs for a pet, into fractions, decimals and percentages while classical music played softly in the background.

The federal government has allowed, through The No Child Left Behind law, districts to use public school funds for single-gender education and directed the U.S. Education Department to update its rules, which it did last year. The regulations, released in 2006 by the Department of Education, mark a major shift in the interpretation of Title IX, approved 34 years ago to bar sex discrimination in schools. It's a change that has intensified a long-running debate over whether boys and girls learn better in a single-sex environment, with critics warning the regulations may roll back years of hard-won ground. Even the Department of Education, in announcing the rules, acknowledged research is mixed and backed away from endorsing single-sex classrooms. The new rules made it easier to implement same-sex education anytime schools think it will improve students' achievement, expand the diversity of courses, or meet kids' individual needs. With the change in regulations, schools have been investigating the possible positive outcomes. At least 363 public schools across the country now offer single-sex educational opportunities, according to the single-sex education association (2007).
Separating the sexes in public schools has mixed reviews. Kim Gandy, president of the National Organization for Women, believes states should not advocate educational experiments involving gender (Feminist Law, 2007). Segregating boys and girls could damage students if boys come away with sexist ideas of being superior, or if students are boxed into learning a certain way, she said. She also questioned whether single-gender programs' successes are due to good teachers and smaller classes, not sex segregation. "There are ways to appeal to interests and learning styles and abilities without lumping people based on gender, which is not a good measure of anything," Gandy said (2007). "At what point is it OK to make judgments of entire groups of human beings based on race or sex?"

Boys also say that being separated from girls helps them learn. "I like it because I can focus and study more here," said an eighth-grader who started making the honor roll after entering an all-boys program. "Everybody's more focused on their work, and it's easier to learn." (Adcox, 2007)

The state department of education in South Carolina released the results from their voluntary, online survey conducted in April, 2007 which showed 66 percent of youths who responded said single-gender classes helped them in school, while 75 percent of parents and 80 percent of teachers agreed. About 2,200 students, 181 parents and
178 teachers participated in the poll (NASSPE, 2007). Others echo the praise. The Winder-Barrow Middle School students don't yet have standardized test scores to prove whether a pair of single-gender classes is helping them learn, but teachers, students and parents say the experiment is a success. "It's like a normal class, but it's just girls," said Laquana Peppers, a student in Winder-Barrow's all-girl eighth-grade math class. "I think we get more done. There's more group work, more talking about math and more of my questions get answered." (National Association for Single Sex Public Education, NASSPE, 2007)

There are other advocates with statistics to back up their claims. Advocates of single-sex public education can point to several success stories. Seattle’s Thurgood Marshall Elementary School used to be a failing school in one of that city’s poorest neighborhoods. Then the school’s energetic principal, Benjamin Wright, reinvented the school as a dual academy: girls in all-girls classrooms, boys in all-boys classrooms. The results have been encouraging. Boys’ test scores on the reading portion of the Washington Assessment of Student Learning, or WASL, exam have increased from the 10th percentile to the 66th percentile. Girls have benefited as well. In the year before the change, when the school was coed, not a single girl passed the math portion of the WASL. In the year after the change, 53 percent of the
girls passed. And the improvement has not been limited to grades and test scores: Student behavior has also improved. Discipline referrals dropped from 30 referrals per day to fewer than two a day—“overnight,” according to Mr. Wright. All these improvements occurred without any additional funding, and without any change in class size. The program at Thurgood Marshall has now achieved consistently high results for four consecutive years. (NASSPE, 2007)

Similar stories of improvement in neighborhood schools, with slightly less spectacular results, can be told about other public schools, in Columbus, Ohio, and Odyssey Middle School in the middle-class community of Boynton Beach, Fla.

More research is being conducted on the subject of single gender classes. One such study was done by Researchers at Stetson University. Researchers have completed a three-year pilot project comparing single-sex classrooms with coed classrooms at Woodward Avenue Elementary School, a nearby neighborhood public school. For example, students in the 4th grade at Woodward were assigned either to single-sex or coed classrooms. All relevant parameters were matched: the class sizes were all the same, the demographics were the same, all teachers had the same training in what works and what doesn't work, etc. On the FCAT (Florida Comprehensive Assessment Test), here were the results: boys in coed classes: 37% scored
proficient, girls in coed classes: 59% scored proficient, girls in single-sex classes: 75% scored proficient and boys in single-sex classes: 86% scored proficient (NASSPE 2007). The research pointed out that these students were all learning the same curriculum in the same school. And, that this school "mainstreams" students who are learning-disabled, or who have ADHD, etc. Many of those boys who scored proficient in the all-boys classes had previously been labeled "ADHD" or "ESE" in coed classes.

Another major study was conducted in June 2005. Researchers at Cambridge University (Sax, 2005) released results of a four-year study of gender differences in education. The researchers investigated hundreds of different schools, representing a wide variety of socioeconomic and ethnic backgrounds, seeking to identify strategies which improved performance of both girls and boys while narrowing the gender gap between girls and boys. What makes this study really unique is that the researchers did not merely observe and document what they found; they then intervened, and attempted to graft those strategies onto other, less successful schools. A total of 50 schools were involved either as "originator schools" (schools which had successfully improved student performance while narrowing the gender gap) or "partner schools" (less successful schools onto which the "originator" strategies were grafted). One of those strategies was
single-sex education. These researchers found that the single-sex classroom format was remarkably effective at boosting boys' performance particularly in English and foreign languages, as well as improving girls' performance in math and science (NASSPE 2005).

Single-gender classes have been in use for numerous years in other countries. They also have conducted several studies. The National Foundation for Educational Research was commissioned to study the effect of school size and school type (single-sex vs. coed) on academic performance. The Foundation studied 2,954 high schools throughout England, where single-sex public high schools are widely available. They released their report on July 8, 2002. Some of their findings are as follows; “even after controlling for students' academic ability and other background factors, both girls and boys did significantly better in single-sex schools than in coed schools” (Sax, 2002). In this age group (senior high school), the benefits were larger and more consistent across the board for girls than for boys. Specifically, girls at all levels of academic ability did better in single-sex schools than in coed schools; whereas for boys, the beneficial effect of single-sex schools was significant only for boys at the lower end of the ability scale. For higher-achieving boys, there was no statistically significant effect of school type on performance, positive or negative. The research did point out that this study only examined
students in grades 9 through 12; other evidence suggests that single-sex education is most effective for boys in kindergarten and elementary school.

Girls at single-sex schools were more likely to take non-traditional courses -- courses which run against gender stereotypes -- such as advanced math and physics (Sax, 2002). The researchers concluded that girls' schools are "helping to counter rather than reinforce the distinctions between 'girls' subjects' such as English and foreign languages and 'boys' subjects' such as physics and computer science" (p. 43). No such effect was seen for boys: for example, boys at single-sex schools were no more likely (actually somewhat less likely) to take courses in cooking than were boys at coed schools.

A large Australian study was conducted in 2000 by The Australian Council for Educational Research (ACER). This study compared performance of students at single-sex and coeducational schools. Their analysis, based on six years of study of over 270,000 students, in 53 academic subjects, demonstrated that both boys and girls who were educated in single-sex classrooms scored on average 15 to 22 percentile ranks higher than did boys and girls in coeducational settings. The report also documented that "boys and girls in single-sex schools were more likely to be better behaved and to find learning more enjoyable and the curriculum more relevant"
(ACER, 2000). The report concludes: "Evidence suggests that coeducational settings are limited by their capacity to accommodate the large differences in cognitive, social and development growth rates of boys and girls aged between 12 and 16" (ACER, 2000).

Gender studies have been going on for years. There was a classic study done in Jamaica by Marlene Hamilton in 1985. Ms. Hamilton was studying students in Jamaica, and found that students attending single-sex schools outperformed students in coed schools in almost every subject tested. At the time of the study, public single-sex schools were still widely available in Jamaica, so that there were few if any socioeconomic or academic variables which distinguished students at single-sex schools from students at coed schools. Hamilton 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.

Overseas, more extensive studies have been done in countries where single-sex education is more common. Researchers in England found, in a study of nearly 3,000 high schools, that gender segregated classes achieved higher overall testing scores. An even larger study in Australia, which encompassed more than 250,000 students, found that
those enrolled in single-sex classes consistently earned marks 15 to 22 percent higher than their co-ed classroom peers (ACER, 2003).

Numerous similar cases have been documented in the United Kingdom. For example: John Fairhurst, principal in Essex, England decided to reinvent his school as two single-sex academies under one roof. The students would take the same courses from the same teachers, but boys and girls would attend separate classes. Three years after making the change, the proportion of boys achieving high scores on standardized tests had risen by 26%. The girls performance improved only slightly less, by 22%, and they still outperformed the boys (O'Reilly, 2000).

A similar experiment in Mill Hill, also in England, achieved similar results. In Mill Hill, the county high school was divided up into a girls' wing and a boys' wing in 1994. Since that time, the number of pupils scoring high on the GCSE exam has risen from 40 percent to 79 percent. Dr. Alan Davison, the principal, comments that "boys’ and girls’ brains are different. It is crucial that we in education recognize that" (Wilce, 2000).

There is other research that goes further in recognizing some type of difference in boys and girls and their achievement. Researchers
at Manchester University in England tested this approach more formally. They assigned students at five public schools either to single-sex or to coed classrooms. The research found that 68 percent of boys who were assigned to single-sex classes subsequently passed a standardized test of language skills, vs. 33 percent of boys assigned to coed classes. Among the girls, 89 percent assigned to single-sex classes passed the test, vs. 48 percent of girls assigned to coed classes (Henry, 2001).

Similar findings were reported by researchers at Cambridge University, who examined the effects of single-sex classrooms in schools in four different neighborhoods, including rural, suburban and inner-city schools. They found that using single-sex groups was a significant factor in establishing a school culture that would raise educational achievement (Sax, 2005). For example, at Morley High School in Leeds, only one-third of boys had been earning passing grades in German and French prior to institution of the program. After the change to single-sex classes, 100% of boys earned passing grades.

The research finds that not only are there academic improvements but improvements in self-image and social adaptation as well. Single-sex education has been shown to broaden students' horizons, to allow them to feel free to explore the own strengths and
interests, not constrained by gender stereotypes. In response to those who oppose gender segregation in schools, many proponents of the idea believe single-sex classes actually negate gender stereotypes. In mixed classrooms, boys often avoid tasks related to the arts while girls shy away from science and technology. However, in single-sex environments, there is no existing bias that “this is for boys” or “that is for girls.” In fact, a 2005 study released by Cambridge University showed that in single-sex rooms, as compared to traditional settings, girls are more interested in math and science while boys score higher on language tasks. (The "Gender Gap in Education" study is part of Cambridge's "Geographies of Gender" research program).

Others have had similar findings; a British researcher compared the attitudes of 13 and 14 year-old pupils toward different subjects. Students at coed schools tended to have gender-typical subject preferences: boys at coed schools liked math and science and did not like drama or languages, whereas boys at single-sex schools were more interested in drama, biology and languages. Likewise, girls at girls-only schools were more interested in math and science than were girls at coed schools. (Stables, 1990)

A University of Virginia study published in 2003 found that boys who attended single-sex schools were more than twice as likely to
pursue interests in subjects such as art, music, drama, and foreign languages, compared to boys of comparable ability who attended coed schools. **Single-sex schools break down gender stereotypes.** Coed schools reinforce gender stereotypes (Norfleet and Richard, 2003).

Andrew Hunter, principal of Merchiston Castle School in Edinburgh, Scotland, agrees. Having taught in both coed schools and single-sex schools, Mr. Hunter observes that there is "a subtle and invidious pressure towards gender stereotyping in mixed schools. Girls tend to be cautious about going into subjects or activities which are thought of as essentially boys' things, but in boys' schools boys feel free to be themselves and develop, to follow their interests and talents in what might be regarded as non-macho pursuits: music, arts, drama” (NASSPE, 2006).

Not all schools achieve good results when they venture into single-sex education. Some schools such as Newport Middle School in Newport, Kentucky and Eagle Rock Junior High School in Idaho Falls, Idaho, abandoned single-sex classrooms after just one year (Sax, 2005). In each case, there was no significant improvement in grades or test scores; at Newport Middle School, discipline referrals for the boys soared. Becky Lenihan, a teacher at Newport Middle School with 14 years of teaching experience, said that she wrote up more boys for discipline problems during the one year the single-sex program was in
place than in all of her previous years in education combined.

Teenagers who attend single-sex schools do no better in exams than those in co-ed schools, according to research from the Institute of Education in London, but they are twice as likely to study subjects not traditionally associated with their gender (National Literacy Trust, 2006). The researchers found that 22% of pupils in all-girls' schools gained math, chemistry or physics A-levels, nearly twice as many as in co-ed schools. Boys in single-sex schools were similarly more likely to take English and modern language A-levels. The findings come from a long-term study on the lives of nearly 13,000 people who were teenagers in 1974 and are now in their 40s. The study found pupils in single-sex schools were also more confident in their ability to do well in these subjects and girls were more likely to gain qualifications in male-dominated subjects. However, the research, which was funded by the Economic and Social Research Council, showed single-sex education made almost no difference to exam results. Boys did no better once their family background and previous ability were taken into account. Girls did fractionally better at O-level than girls in mixed schools but did no better in further and higher education.

Single sex schooling no longer offers middle-class girls any academic advantages according to new research conducted in America. During the 1970s and 1980s, several US studies found that
most girls benefited if they were taken out of male dominated classrooms. But today only girls and boys from disadvantaged families show "significant gains" from single-sex education. And even for poorer children, the type of school attended is much less important than either home background or the school's curriculum (Riordan, 2000).

Recent US studies of elite independent schools and the Catholic education sector have confirmed that girls now do equally well in single-sex and co-educational schools. Riordan does not say whether his findings could also be applicable to Britain. But he points out that a 1995 study - involving researchers in Japan, Belgium, New Zealand and Thailand, revealed that the impact of single sex schools varies from one country to another. The effect seems to be limited to those national education systems in which single-sex schools are relatively rare. When they are rare, there is a more selective student body that will bring with them a heightened degree of academic demands (Hubard, 2001).

Girls' schools do well in exam league tables because they have clever pupils, not because they are single-sex, according to a new review of research evidence. These are the findings of researchers at London University's Institute of Education. The findings came just
before the publication of A-level and GCSE results tables in which girls have excelled for many years. Since the introduction of league tables, girls' schools have used their exam results to argue the case for single-sex education. But researchers Janette Elwood and Caroline Gipps found that social class (National Literacy Trust, 1999), ability and the history and tradition of the schools had a much greater impact on the results girls achieve. They concluded that girls' schools in both the independent and state sectors are well-placed in the performance tables because girls do better than boys generally in examinations at the end of compulsory schooling. Nor is there any conclusive evidence that the popular practice of teaching boys and girls in separate classes for some subjects raises achievement. They reviewed research evidence on single-sex education for the past 20 years both in this country and abroad. The findings, drawn from an Equal Opportunities Commission study in the early eighties to a later study by Smithers and Robinson (National Literacy Trust, 1999), suggest that single-sex education has little impact on girls' academic achievement. Most studies in Australia, the United States and Ireland have reached similar conclusions.
No Child Left Behind (NCLB 2002) has placed requirements on school districts and teachers that have many in education challenging the “normal” practices of educating students. However, thanks to a clause added to the national No Child Left Behind Act, it is now easier for school districts to adopt the approach of gender differentiated classrooms. Single-sex education, long a fixture in the private sector, is moving into public schools. Five years ago, fewer than a dozen public schools in this country offered single-sex educational options. At least 156 public schools offer single-sex classrooms, with many more planning to offer that format for the upcoming academic year. That’s more than a tenfold increase in just five years (Sax, 2005).

Advocates of single-sex public education can point to several success stories. Seattle’s Thurgood Marshall Elementary School used to be a failing school in one of that city’s poorest neighborhoods. Then the school’s principal reinvented the school as a dual academy: girls in all-girls classrooms, boys in all-boys classrooms. The results have been encouraging. Boys’ test scores on the reading portion of the Washington Assessment of Student Learning, or WASL, exam have
increased from the 10th percentile to the 66th percentile. Girls have benefited as well. In the year before the change, when the school was coed, not a single girl passed the math portion of the WASL. In the year after the change, 53 percent of the girls passed. And the improvement has not been limited to grades and test scores: Student behavior has also improved. Discipline referrals dropped from 30 referrals per day to fewer than two a day. All these improvements occurred without any additional funding, and without any change in class size. The program at Thurgood Marshall has now achieved consistently high results for four consecutive years (Sax, 2005).

Similar stories of improvement in neighborhood schools, with slightly less spectacular results, can be told about other public schools, in Columbus, Ohio, and Odyssey Middle School in the middle-class community of Boynton Beach, Fla.

Despite a spike in public schools adopting gender-specific classrooms in the United States, not all schools achieve good results when they venture into single-sex education. A study in 2006 found that such efforts in England had produced no noticeable improvements among schools that split their classrooms according to sex (Coats, 2008). Newport Middle School in Newport, KY., and Eagle Rock Junior High School in Idaho Falls, Idaho, each abandoned single-sex classrooms after just one year. In each case, there was no significant
improvement in grades or test scores. At Newport Middle School, discipline referrals for the boys soared. Becky Lenihan, a teacher at Newport Middle School with 14 years of teaching experience, said that she wrote up more boys for discipline problems during the one year the single-sex program was in place than in all of her previous years in education combined (Sax, 2005).

**Purpose of the Study**

The purpose of this study was to investigate the difference between single-gender classrooms as compared to mixed gender classrooms in the areas of student achievement in the area of math. Student achievement was measured by formal assessments.

**Research Questions**

To accomplish the purpose of this study, the following research questions were developed:

1. Are there differences in achievement over the course of the three years of data for students randomly assigned to single-gender sixth grade mathematics classes and students randomly assigned to mixed-gender sixth grade mathematics classes, when controlling for 5th grade achievement?

2. Are there differences in achievement for each cohort year of students randomly assigned to single-gender sixth grade mathematics classes and students randomly assigned to mixed-
gender sixth grade mathematics classes, when controlling for 5th grade MAP mathematics scores?

3. Are there differences in achievement for single-gender and mixed-gender classes when controlling for 5th grade MAP mathematics scores, FRL and gender?

Hypotheses

\[ H_{01} \]: There are no significant differences in achievement for all students, experimental and control groups, over the course of the three years of data for students when controlling for fifth grade achievement.

\[ H_{02} \]: There are no significant differences in achievement for each cohort year of students randomly assigned to single-gender sixth grade mathematics classes and students randomly assigned to mixed-gender sixth grade mathematics classes when controlling for gender.

\[ H_{03} \]: There are no significant differences in achievement for students randomly assigned to single-gender sixth grade mathematics classes and students randomly assigned to mixed-gender sixth grade mathematics classes when controlling for, prior year achievement, Free and Reduced Lunch (FRL) status and gender.
Population

This study examined the relationship between single gender and mixed math and science students to determine the influence each form of instructional organization had on student achievement in the area of mathematics. The study was conducted in one middle school with 527 sixth grade students. The students were randomly placed in eight classes. Four classrooms received math instruction in the traditional mix-gender classroom. While the remaining four classes received single-gender instruction in math and science.

Procedures

In the development of this study, the following procedures were implemented. These procedures are sequenced in the order of their implementation.

- School district decided to pilot single gender math and science instruction in the 6th grade, in the spring of 2006.
- Parent informational meetings were held in the spring prior to piloting.
- Fall of 2006 Students were placed in classrooms randomly. There were no changes to the normal placement procedures. Students were evenly mixed based on gender, ethnicity, special education and socio economics.
• Once students were placed, letters were sent home explaining the pilot and options if they chose not to have their child involved in the pilot. No parents or students opted out of the pilot.

• MAP data were collected on each student from the prior year in the area of math. It was also gathered for the year of the pilot. This information came from student cumulative folders and was gathered by the researcher.

*Instrumentation*

Student achievement data were analyzed using reported test results from the Missouri Assessment Program (MAP). The MAP test is a performance-based assessment system used to measure student achievement, which is administered annually to all students in all middle level grades in Missouri Public schools. Missouri’s State Board of Education (1997) designated the purposes of the assessment program as: improving students’ acquisition of important knowledge, skills, and competencies monitoring the performance of Missouri’s educational system empowering students and their families to improve their educational prospects supporting the teaching and learning process.

Students in all middle level schools are administered a Mathematics assessment. Test items fall in three categories: multiple-
choice, constructed-response, and a performance event. Multiple-choice questions require selecting the correct answer while short-answer, constructed response questions ask the student to supply the appropriate response. The performance event requires students to focus on an issue with problem solving as the focus for assessment (Missouri Department of Elementary and Secondary Education, 2006). The dependent data, student achievement, were obtained from the web site of the Missouri Department of Elementary and Secondary Education and for the individual student records. The achievement data used for this study were from the state assessment administered in the spring of 2006, 2007 and 2008.

Data Collection

MAP test scores from the spring of 2006 to the spring of 2009 were gathered for each student. The data was collected from student cumulative folders and from district electronic files.

Data Analysis

To answer the quantitative research questions and related hypotheses, tests of differences were made between the academic achievements. Using the Statistical Package for Social Sciences (SPSS) the differences between students in the experimental groups (gender separated classes) and the control groups (co-ed classes) were analyzed. The tests for differences were conducted using one-way
analysis of variance across the eight classrooms. Tukey’s *post hoc*

tests were used to identify statistically different cells. See the following

figure which shows the statistical areas to be tested Math MAP for

cohort years 06-07, 07-08 and 08-09.

**FIGURE 1.** Control and experimental group data.

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</table>

C: Control (Mixed-gender)

E: Experimental (Gender-specific)
Chapter 4

Analyses and Presentation of Data

Schools across the United States are implementing a different style of classroom organization – the single-sex classroom. In such environments, teachers work solely with classes that are all-boys or all-girls. While many parents and researchers are skeptical of this approach, research shows some promise for gender-segregated classes, particularly at the middle school level (Hersch, 2009). The primary rationale supporting the single-sex education movement is the belief that boys and girls learn differently. Researchers (e.g., Gurian, 2001; Sax, 2005) assert that at middle school levels, girls learn best with visual and oral information, while boys learn best by actively moving and doing. Some of these learning differences are linked to biology; for example, girls develop hearing more quickly and acutely than boys (Hersch). There are also emotional differences between the genders. Educational psychologists (e.g., Higgins 1991) suggest that girls are motivated by a desire to please others while boys are motivated by personal interest in a subject. Currently, more than 200 public schools in the U.S. operate gender-segregated classrooms (Hersch).
The single-sex format creates opportunities that do not exist in coeducational classrooms. Teachers can employ strategies in all-girls and all-boys classrooms that do not work as well (or do not work at all) in coed classrooms (Sax, 2005). If teachers have appropriate training and professional development, great learning experiences can, and often do, occur in single-sex classrooms. Schools that have realized positive experiences with single-sex classrooms include Woodward Avenue Elementary in Deland, Florida; Foley Intermediate School in Foley, Alabama; Jefferson Middle School in Springfield, Illinois; and the Cunningham School for Excellence in Waterloo, Iowa (Sax). These schools reported dramatic improvement in students’ grades and test scores after adopting single-sex classrooms.

Research Questions

This study employed the following research questions to determine the impact of single-gender and mixed-gender classes on student achievement in the area of mathematics:

1. Are there differences in achievement over the course of the three years of data for students randomly assigned to single-gender sixth grade mathematics classes and students randomly assigned to mixed-gender sixth grade mathematics classes, when controlling for 5th grade achievement?
2. Are there differences in achievement for each cohort year of students randomly assigned to single-gender sixth grade mathematics classes and students randomly assigned to mixed-gender sixth grade mathematics classes, when controlling for 5th grade MAP mathematics scores?

3. Are there differences in achievement for single-gender and mixed-gender classes when controlling for 5th grade MAP mathematics scores, FRL and gender?

Null Hypotheses

The following hypotheses were tested in this study:

\( H_{01} \): There are no significant differences in achievement for all students, experimental and control groups, over the course of the three years of data for students when controlling for fifth grade achievement.

\( H_{02} \): There are no significant differences in achievement for each cohort year of students randomly assigned to single-gender sixth grade mathematics classes and students randomly assigned to mixed-gender sixth grade mathematics classes when controlling for fifth grade achievement.

\( H_{03} \): There are no significant differences in achievement for students randomly assigned to single-gender sixth grade mathematics
classes and students randomly assigned to mixed-gender sixth grade mathematics classes when controlling for, fifth grade achievement, Free and Reduced Lunch (FRL) status, and gender

The following section of this chapter provides descriptive findings about student variables and student achievement associated with the research questions.

Descriptive Findings

Demographic Data

This study of single-gender and mixed-gender classroom achievement included three cohorts of students from the same school with the same teachers during academic years 2006-2007, 2007-2008, and 2008-2009. Data were gathered based on control and experimental groups, gender, Free and Reduced Lunch (FRL) status, fifth grade mathematics Missouri Assessment Program (MAP) test achievement, and sixth grade mathematics MAP test achievement.

The control group is represented by students who were randomly selected and placed in the mixed-gender classes. The experimental group is comprised of students who were randomly selected and placed in the single-gender classes. The overall data for the areas of attendance and fifth and sixth grade MAP mathematics index scores for the three years of the study, including minimums, maximums,
means, standard deviations, variances, skewness, and kurtosis are presented in Table 1. Five hundred and twenty-six students were included in the study; The MAP mathematics index scores ranged from 534 to 830 during the fifth grade year, with a mean index score of 667.74. In the sixth grade year, the same 526 students had MAP mathematics index scores that ranged from 569 to 845, with a mean index score of 679.02. The scores and the increases in the minimums and maximums, coupled with an overall mean increase of almost 12 points.

Table 1

Overall Data: Three Academic Years

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<th></th>
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<th>Min.</th>
<th>Max</th>
<th>Mean</th>
<th>Std. Dev</th>
<th>Variance</th>
<th>Skewness</th>
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<td>37.873</td>
<td>1434.35</td>
<td>.296</td>
<td>1.663</td>
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<tr>
<td>GR6 MAP</td>
<td>526</td>
<td>569</td>
<td>845</td>
<td>679.02</td>
<td>36.245</td>
<td>1313.67</td>
<td>.045</td>
<td>.857</td>
</tr>
</tbody>
</table>

\( ^d \)Attendance: Data were based on students’ overall attendance percentages.

\( ^e \)Mathematics MAP Test Scores: Index scores.

Cohort Gender Grouping

Single-gender and mixed-gender classroom assignments and their impact on student achievement were the primary focus of this study. In order to help determine if the variables included in the study were reliable, the consistency of several variables was considered. For
each year, the sixth grade students were randomly assigned to either single-gender or mixed-gender classrooms. The numbers of male students, female students, and total students for the single-gender and mixed-gender classes are listed in Table 2.

The total number of students enrolled in single-gender classes was 254 and the total number of students enrolled in mixed-gender classes was 272. The numbers were close to consistent each year for both of the groupings. Males enrolled in single-gender mathematics classes during each of the three years numbered 42, 42, and 41 respectively, for a total of 125. The number of males enrolled in mixed-gender classes during the same period numbered 44, 50, and 48 for a total of 132.

The number of females enrolled in single-gender classes during each of the three years numbered 41, 45, and 43 respectively, for a total of 129. The number of females enrolled in mixed-gender classes during the same period numbered 42, 42, and 56 for a total of 140. The consistency of group numbers assisted in the identification of variables with potential impact on the study’s validity. By having consistent group numbers the other variable impact was skewed less. Meaning other variables could be more reliably measured without interference of N fluctuation.
Table 2

*Numbers of Student Participants by Year and Gender*

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<td>87</td>
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<td>42</td>
<td>92</td>
<td>179</td>
</tr>
<tr>
<td>2008-2009</td>
<td>41</td>
<td>43</td>
<td>84</td>
<td>38</td>
<td>56</td>
<td>94</td>
<td>178</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>students per category</td>
<td>125</td>
<td>129</td>
<td>254</td>
<td>132</td>
<td>140</td>
<td>272</td>
<td>526</td>
</tr>
</tbody>
</table>

*Free and Reduced Lunch*

Free and Reduced Lunch (FRL) data provided information about students’ economic standings. The number of students who were in single-gender classes and mixed-gender classes and whether they participated in the FRL program are listed in Table 3. Of the 526 students, 109 students participated in FRL, 51 of whom were in single-gender classes and 58 of whom were in mixed-gender classes. The remaining 417 students did not receive FRL, 203 of whom were in the single-gender classes and 214 of whom were in the mixed-gender classes. These data were consistent each year for both of the
groupings. The consistency of group numbers assisted with the identification of variables with potential impact on the study’s validity.

Table 3

*Number of Students Participating in FRL Program by Single-Gender and Mixed-Gender Classrooms*

<table>
<thead>
<tr>
<th>Free and Reduced Lunch Program</th>
<th>Single-gender Students</th>
<th>Mixed-Gender Students</th>
<th>Total Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Receiving FRP</td>
<td>51</td>
<td>58</td>
<td>109</td>
</tr>
<tr>
<td>Not Receiving FRL</td>
<td>203</td>
<td>214</td>
<td>417</td>
</tr>
<tr>
<td>Total students</td>
<td>254</td>
<td>272</td>
<td>526</td>
</tr>
</tbody>
</table>

*MAP Mathematics Scores*

MAP mathematics index scores are the main source of student achievement information for this study. All 526 of the students included in this study took the MAP mathematics test during their fifth grade years; as a result, effects resulting from discrepancies or trends in the data prior to the intervention years were considered. In the fifth grade year, students were randomly placed in traditional, mixed-gender fifth grade classes. The overall MAP mean index score for all students was 667.74 (see Table 4). As sixth graders, the same students were randomly placed into single-gender or mixed-gender classes; a comparison of the students’ fifth grade MAP index scores
followed (see Table 4). The fifth grade students who were later placed in the single-gender classes had a mean MAP index score of 670.28, which is 4.90 points higher than the students who were placed in the mixed-gender classes, whose mean MAP index score was 665.38. The baseline data support this study by determining if there were significant differences in the students’ achievement prior to the intervention year. Using the mean MAP mathematics index scores for both groups was compared. The single-gender grouped students had a mean score of 670.28 and the mixed-gender grouped students had a mean score of 665.38. The difference between the two groups was 4.90 higher for the single-gender grouped students (Table 4).
Table 4

Fifth Grade Mathematics MAP Mean Scores Shown by Grouping

<table>
<thead>
<tr>
<th></th>
<th>Mean Score</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>All students combined</td>
<td>667.74</td>
<td>526</td>
</tr>
<tr>
<td>Single-gender classes</td>
<td>670.28</td>
<td>254</td>
</tr>
<tr>
<td>Mixed-Gender classes</td>
<td>665.38</td>
<td>272</td>
</tr>
</tbody>
</table>

MAP mathematics test data are also presented for the students’ sixth grade years and are sorted by single-gender and mixed-gender classes (see Table 5). Students who were in the single-gender classes for their sixth grade years had a mean MAP index score of 683.17, and students in the mixed-gender classes had a mean MAP mathematics index score of 675.15. The single-gender classroom students’ mean index score was 8.02 points higher than their mixed-gender classroom peers.

Table 5

Sixth Grade Mathematics Mean Scores

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single-Gender Classes</td>
<td>683.17</td>
<td>35.461</td>
<td>254</td>
</tr>
</tbody>
</table>
Data for the 526 students’ fifth and sixth grade mean test scores are presented in Table 6. The data are separated by the single-gender and mixed-gender groups the students were placed in during their sixth grade years. The 254 students who were in single-gender classes during the sixth grade years realized an average increase of 12.90 between their fifth and sixth grade MAP mathematics mean scores. The 272 students who were in the mixed-gender classes during the sixth grade years realized an average increase of 9.78 between their fifth and sixth grade mean MAP mathematics test scores. When considering the overall mean and difference of all 526 students, there was an average increase of 11.28 between their fifth and sixth grade MAP mathematics mean test scores. Students in the single-gender classes outperformed the overall average increase of all students and the mixed-gender students by 1.62 index points and 3.12 index points respectfully.

Table 6

_Fifth and Sixth Grade MAP Mathematics Mean Test Scores_

<table>
<thead>
<tr>
<th>Group</th>
<th>Experimental</th>
<th>Control</th>
<th>Grade 5 Math MAP Index scores</th>
<th>Grade 6 Math MAP Index scores</th>
<th>Difference in MAP Mean Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mixed-Gender</td>
<td>675.15</td>
<td>36.603</td>
<td>272</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>679.02</td>
<td>36.245</td>
<td>526</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
MAP Mathematics Scores and Free and Reduced Lunch

The 526 students’ sixth grade MAP mathematics scores were compared to their FRL program statuses (see Table 7); 109 students participated in the FRL program and 417 did not participate. The average MAP mathematics index score for students who did not participate in the FRL program was 683.19; the average MAP mathematics index score for students who participated in the FRL program was 20.11 points lower at 663.08.

Table 7
FRL/Non-FRL Sixth Grade MAP Mathematics Test Score Means

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean Score</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>No FRL</td>
<td>417</td>
<td>683.19</td>
<td>574</td>
<td>845</td>
</tr>
</tbody>
</table>
The mean scores for the students’ sixth grade MAP mathematics test scores by FRL status are depicted in Figure 2.

Figure 2

*FRL Sixth Grade MAP Mathematics Test Score Means and FRL Statuses*

The differences in mean MAP index scores when FRL status was considered led to additional examination of the FRL data, which were further, studied with regard to MAP mathematics test score means and placement in either single-gender or mixed gender classes. Of the 417 students who did not participate in the FRL program, 203 were in the single-gender classes and 214 were in the mixed-gender classes. In the single-gender classes, 51 students participated in the FRL program; in the mixed-gender classes, 58 students participated in the
FRL program. Table 8 provides students' mean MAP mathematics test scores during the sixth grade years separated by FRL status. The students who were in the single-gender classrooms and did participate in the FRL program outperformed their peers in the mixed-gender classrooms with mean MAP mathematics index scores of 686.10 and 680.43 respectively, which is a difference of 5.67 points. Students who participated in the FRL program also showed a difference in performance. FRL students enrolled in single-gender classes had a mean score of 671.51, whereas FRL students enrolled in mixed-gender classes had a mean score of 655.67, which is a difference of 15.84.

Table 8

*Sixth Grade MAP Mathematics Scores and FRL*

<table>
<thead>
<tr>
<th>Group</th>
<th>Experimental Control</th>
<th>Free/Reduced Lunch</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single-Gender Classes</td>
<td>Not Free/Reduced</td>
<td>686.10</td>
<td>34.730</td>
<td>203</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Receives Free/Reduced</td>
<td>671.51</td>
<td>36.280</td>
<td>51</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>683.17</td>
<td>35.461</td>
<td>254</td>
<td></td>
</tr>
<tr>
<td>Mixed-Gender Classes</td>
<td>Not Free/Reduced</td>
<td>680.43</td>
<td>34.306</td>
<td>214</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Receives Free/Reduced</td>
<td>655.67</td>
<td>38.489</td>
<td>58</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>675.15</td>
<td>36.603</td>
<td>272</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>Not Free/Reduced</td>
<td>683.19</td>
<td>34.588</td>
<td>417</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Receives Free/Reduced</td>
<td>663.08</td>
<td>38.135</td>
<td>109</td>
<td></td>
</tr>
</tbody>
</table>
Table 8

*Sixth Grade MAP Mathematics Scores and FRL*

<table>
<thead>
<tr>
<th>Group Experimental Control</th>
<th>Free/Reduced Lunch</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single-Gender Classes</td>
<td>Not Free/Reduced</td>
<td>686.10</td>
<td>34.730</td>
<td>203</td>
</tr>
<tr>
<td></td>
<td>Receives</td>
<td>671.51</td>
<td>36.280</td>
<td>51</td>
</tr>
<tr>
<td></td>
<td>Free/Reduced</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>683.17</td>
<td>35.461</td>
<td>254</td>
</tr>
<tr>
<td>Mixed-Gender Classes</td>
<td>Not Free/Reduced</td>
<td>680.43</td>
<td>34.306</td>
<td>214</td>
</tr>
<tr>
<td></td>
<td>Receives</td>
<td>655.67</td>
<td>38.489</td>
<td>58</td>
</tr>
<tr>
<td></td>
<td>Free/Reduced</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>675.15</td>
<td>36.603</td>
<td>272</td>
</tr>
<tr>
<td>Total</td>
<td>Not Free/Reduced</td>
<td>683.19</td>
<td>34.588</td>
<td>417</td>
</tr>
<tr>
<td></td>
<td>Receives</td>
<td>663.08</td>
<td>38.135</td>
<td>109</td>
</tr>
<tr>
<td></td>
<td>Free/Reduced</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>679.02</td>
<td>36.245</td>
<td>526</td>
</tr>
</tbody>
</table>

*MAP mathematics scores and gender*

The role of gender in MAP mathematics achievement was also considered. The numbers of male and female students included in the study are presented in Table 9. Of the 526 students in the study, 257 were male and 269 were female.

Table 9

*Gender Totals*

<table>
<thead>
<tr>
<th>Gender</th>
<th>N</th>
</tr>
</thead>
</table>
The mean mathematics MAP scores for male and female students in the single-gender and mixed-gender classes are presented in Table 10. The average score for males in the single-gender classes was 684.47, and the average score for males in the mixed-gender classes was 676.86. The average score for females in the single-gender classes was 681.91, and the average score for females in the mixed-gender classes was 673.54. There was an overall trend of positive increases in MAP mathematics index scores for students in the single-gender classes when compared to students in the mixed-gender classes. However, further tests were conducted to determine the significance of the difference.

Table 10

*MAP Mathematics Mean Scores by Gender*

<table>
<thead>
<tr>
<th>Group Description</th>
<th>Gender</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single-Gender Classes</td>
<td>Male</td>
<td>684.47</td>
<td>35.525</td>
<td>125</td>
</tr>
<tr>
<td>(treatment)</td>
<td>Female</td>
<td>681.91</td>
<td>35.491</td>
<td>129</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>683.17</td>
<td>35.461</td>
<td>254</td>
</tr>
<tr>
<td>Mixed-Gender</td>
<td>Male</td>
<td>676.86</td>
<td>38.227</td>
<td>132</td>
</tr>
</tbody>
</table>

Male 257
Female 269
Total 526
MAP mathematics scores and single-gender male classes

The study measured the possible impact of gender on student achievement as it related to MAP mathematics index scores. The data represented in Table 11 show the total collection of students broken down by their cohort year and group, either single-gender or mixed gender. The 254 single-gender students had means scores that ranged from 689.65 in 2006-7 to a low of 676.02 in 2008-09. While the 272 mixed-gender students had mean scores that ranged from 676.09 in 2006-07 to 674.65 in cohort year 2008-09.

Table 11

<table>
<thead>
<tr>
<th>Group</th>
<th>Cohort Year</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single-Gender</td>
<td>2006-07</td>
<td>689.65</td>
<td>35.906</td>
<td>83</td>
</tr>
<tr>
<td></td>
<td>2007-08</td>
<td>683.90</td>
<td>34.487</td>
<td>87</td>
</tr>
<tr>
<td></td>
<td>2008-09</td>
<td>676.02</td>
<td>35.109</td>
<td>84</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>2006-07</td>
<td>2007-08</td>
<td>2008-09</td>
</tr>
<tr>
<td>----------------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
</tr>
<tr>
<td>Mixed-Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2006-07</td>
<td>683.17</td>
<td>676.09</td>
<td>674.78</td>
<td>674.65</td>
</tr>
<tr>
<td>2007-08</td>
<td></td>
<td>47.558</td>
<td>27.782</td>
<td>32.870</td>
</tr>
<tr>
<td>2008-09</td>
<td></td>
<td>86</td>
<td>92</td>
<td>94</td>
</tr>
<tr>
<td>Total</td>
<td>676.09</td>
<td>47.558</td>
<td>27.782</td>
<td>32.870</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>2006-07</th>
<th>2007-08</th>
<th>2008-09</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006-07</td>
<td>682.75</td>
<td>679.75</td>
<td>675.30</td>
<td>675.30</td>
<td>679.02</td>
</tr>
<tr>
<td>2007-08</td>
<td></td>
<td>42.660</td>
<td>31.466</td>
<td>33.856</td>
<td>36.245</td>
</tr>
<tr>
<td>2008-09</td>
<td></td>
<td>169</td>
<td>179</td>
<td>178</td>
<td>526</td>
</tr>
<tr>
<td>Total</td>
<td>679.02</td>
<td>36.245</td>
<td>36.245</td>
<td>36.245</td>
<td>526</td>
</tr>
</tbody>
</table>

The data were further sorted by gender (Table 12). The male single-gender classes’ mean scores on the MAP mathematics test for their fifth and sixth grade years, along with the difference between the scores over the three years of the study. The 42 male single-gender classroom students had a 19.88 increase in the means of their fifth and sixth grade MAP mathematics test scores. The second group of 42 male single-gender classroom students had a 5.83 increase in the means of their fifth and sixth grade MAP mathematics test scores. The third year group had 41 male single-gender classroom students and a 3.49 increase between the means of their fifth and sixth grade MAP mathematics test scores. Again, there was an overall trend of positive differences in MAP mathematics index scores for those students in the
single-gender classes when compared to students who were in the mixed-gender classes.

Table 12

*Three Years of Male Single-Gender MAP Mathematics Means*

<table>
<thead>
<tr>
<th>Year in 5th grade</th>
<th>5th Grade MAP Mathematics Mean</th>
<th>6th Grade MAP Mathematics Mean</th>
<th>Difference</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006-2007</td>
<td>675.02</td>
<td>694.88</td>
<td>19.88</td>
<td>42</td>
</tr>
<tr>
<td>2007-2008</td>
<td>677.93</td>
<td>684.76</td>
<td>5.83</td>
<td>42</td>
</tr>
<tr>
<td>2008-2009</td>
<td>670.02</td>
<td>673.51</td>
<td>3.49</td>
<td>41</td>
</tr>
</tbody>
</table>

*MAP mathematics scores and single-gender female classes*

The same information on gender and MAP mathematics mean scores for females is provided in Table 13. The 41 female first-year single-gender classroom students had a 21.59 increase in the means of their fifth and sixth grade MAP mathematics test scores. The 45 female second-year single-gender classroom students had a 12.02 increase in the means of their fifth and sixth grade MAP mathematics test scores. The 43 female third-year single-gender classroom students had a 13.63 increase in the means of their fifth and sixth grade MAP mathematics test scores. There was a positive difference in the gains in MAP mathematics index scores, but further testing helped to determine the significance of the differences.
Table 13

*Three Years of Female Single-Gender MAP Mathematics Means*

<table>
<thead>
<tr>
<th>Year in 5\textsuperscript{th} grade</th>
<th>5\textsuperscript{th} Grade Map Mathematics Mean</th>
<th>6\textsuperscript{th} Grade Map Mathematics Mean</th>
<th>Difference</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006-2007</td>
<td>662.71</td>
<td>684.29</td>
<td>21.59</td>
<td>41</td>
</tr>
<tr>
<td>2007-2008</td>
<td>671.07</td>
<td>683.09</td>
<td>12.02</td>
<td>45</td>
</tr>
<tr>
<td>2008-2009</td>
<td>664.79</td>
<td>678.42</td>
<td>13.63</td>
<td>43</td>
</tr>
</tbody>
</table>

*MAP mathematics scores and mixed-gender classes*

The number of male students per school year who were in the mixed-gender classes, their mean MAP mathematics index scores for the fifth and sixth grades, and the difference between the two scores are presented in Table 14. In the first year of the study, 44 male students were enrolled in the mixed gender classes, and they had a 14.18 increase in the means of their fifth and sixth grade MAP mathematics test scores. In the second year of the study, 50 male students were enrolled in the mixed-gender classes, and they had a 15.95 increase in the means of their fifth and sixth grade MAP mathematics test scores. In the third year of the study, 38 male students were enrolled in the mixed-gender classes, and they had a 1.84 increase in the means of their fifth and sixth grade MAP mathematics test scores.
Table 14

*Three Years of Mixed-Gender Male MAP Mathematics Means*

<table>
<thead>
<tr>
<th>N</th>
<th>5th Grade Mean</th>
<th>6th Grade Mean</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>44</td>
<td>666.25</td>
<td>680.43</td>
<td>14.18</td>
</tr>
<tr>
<td>50</td>
<td>665.52</td>
<td>676.16</td>
<td>10.54</td>
</tr>
<tr>
<td>38</td>
<td>671.82</td>
<td>673.66</td>
<td>1.84</td>
</tr>
</tbody>
</table>

Comparable data for females in the mixed-gender classes are presented in Table 15. During the first year of the study, the 42 females enrolled in the mixed-gender classes had a 15.95 increase in the means of their fifth and sixth grade MAP mathematics test scores. In the second year, 42 females enrolled in the mixed gender-classes had a 6.86 increase in the means of their fifth and sixth grade MAP mathematics test scores. In the third year, 56 girls enrolled in the mixed-gender classes had an 8.57 increase in the means of their fifth and sixth grade MAP mathematics test scores.

Table 15

*Three Years of mixed-gender female MAP mathematics means*

<table>
<thead>
<tr>
<th>N</th>
<th>5th Grade Mean</th>
<th>6th Grade Mean</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>42</td>
<td>655.60</td>
<td>671.55</td>
<td>15.95</td>
</tr>
<tr>
<td>42</td>
<td>666.29</td>
<td>673.14</td>
<td>6.86</td>
</tr>
</tbody>
</table>
MAP Mathematics Scores and Cohort Data

Each cohort year was examined to highlight trends in MAP mathematics achievement. The data in Table 16 summarize the cohorts’ MAP mean scores for their sixth grade years.

Table 16

Sixth Grade MAP Mathematics Mean Scores

<table>
<thead>
<tr>
<th>Cohort by year</th>
<th>Mean</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006-07</td>
<td>682.75</td>
<td>169</td>
</tr>
<tr>
<td>2007-08</td>
<td>679.21</td>
<td>179</td>
</tr>
<tr>
<td>2008-09</td>
<td>675.30</td>
<td>178</td>
</tr>
<tr>
<td>Total</td>
<td>679.02</td>
<td>526</td>
</tr>
</tbody>
</table>

The same cohort years’ MAP mathematics mean test scores for the fifth grade, prior to the intervention of single-gender classes are presented in Table 17.

Table 17

Fifth Grade MAP Mathematics Mean Scores

<table>
<thead>
<tr>
<th>Cohort by year</th>
<th>Mean</th>
<th>Std. Dev</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006-07</td>
<td>664.92</td>
<td>42.490</td>
<td>169</td>
</tr>
<tr>
<td>2007-08</td>
<td>670.03</td>
<td>36.082</td>
<td>179</td>
</tr>
</tbody>
</table>
The data from Tables 16 and 17 were compared and the differences in MAP mathematics mean scores were generated (see Table 18). The cohort year 2006-2007 classes had a difference of 17.83 in MAP mathematics mean scores from the fifth to the sixth grade. The following year’s cohort of 2007-2008 realized a difference of 9.18 in MAP mathematics mean scores. The final cohort year, 2008-2009, had a difference of 7.19 in MAP mathematics mean scores.

Table 18
Cohort Year Mean Scores and Differences

<table>
<thead>
<tr>
<th>Cohort by Year</th>
<th>5th Grade Mean</th>
<th>6th Grade Mean</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006-2007</td>
<td>664.92</td>
<td>682.75</td>
<td>17.83</td>
</tr>
<tr>
<td>2007-2008</td>
<td>670.03</td>
<td>679.21</td>
<td>9.18</td>
</tr>
<tr>
<td>2008-2009</td>
<td>668.11</td>
<td>675.30</td>
<td>7.19</td>
</tr>
</tbody>
</table>

The data in Table 19 breaks the cohort year’s 6th grade MAP mathematics scores down by individual cohort years and by grouping. One thing to be noted is that both groups had a decrease in MAP scores over the three years of this study. Single-gender goes from a mean score 689.65 in 2006-07 to 676.17 in 2008-09. While during
that same time mixed-gender goes from a mean score of 676.09 to 675.15.

Table 19

6th Grade MAP Mean Scores by Cohort year and Grouping

<table>
<thead>
<tr>
<th>Group</th>
<th>Year</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single -Gender</td>
<td>2006-07</td>
<td>689.65</td>
<td>35.905</td>
<td>83</td>
</tr>
<tr>
<td></td>
<td>2007-08</td>
<td>683.90</td>
<td>34.487</td>
<td>87</td>
</tr>
<tr>
<td></td>
<td>2008-09</td>
<td>676.02</td>
<td>35.109</td>
<td>84</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>683.17</td>
<td>35.461</td>
<td>254</td>
</tr>
<tr>
<td>Mixed-Gender</td>
<td>2006-07</td>
<td>676.09</td>
<td>47.558</td>
<td>86</td>
</tr>
<tr>
<td></td>
<td>2007-08</td>
<td>674.78</td>
<td>27.782</td>
<td>92</td>
</tr>
<tr>
<td></td>
<td>2008-09</td>
<td>674.65</td>
<td>32.870</td>
<td>94</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>675.15</td>
<td>36.603</td>
<td>272</td>
</tr>
</tbody>
</table>

Hypotheses Testing

Three hypotheses were tested in this study. Hypothesis One was tested by using univariate analysis of variance with 6th grade MAP mathematics scores for all students over the three years of the study as the dependent variable using grouping and 5th grade MAP mathematics scores as independent variables. Hypothesis Two was also tested using univariate analysis of variance. The 6th grade MAP mathematics scores were the dependent variable with grouping and the data for students from each individual cohort year as the independent variables. Univariate analysis of variance was also used for Hypothesis Three. Sixth grade MAP mathematics scores were the dependent variable with grouping, 5th grade mathematics
achievement, Free and Reduced Lunch (FRL) status, and gender as the independent variables.

**Hypothesis One**

The first hypothesis tested in this study was: There are no significant differences in achievement for all students, experimental and control groups, over the course of the three years of data for students when controlling for fifth grade achievement. Univariate analysis of variance (ANOVA) was used to explore this possibility; the dependent variable was the sixth grade MAP mathematics mean index scores and the independent variables were fifth grade MAP mathematics mean index scores and grouping for the collective group as a whole. The level of significance was less than .0001 (see Table 20). The hypothesis was rejected.

Table 20

*Collective Group as a Whole, Controlling for 5th Grade MAP*

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum</th>
<th>df</th>
<th>Mean Squares</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected Model Intercept</td>
<td>476023.770</td>
<td>2</td>
<td>238011.885</td>
<td>582.634</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Group 1 exp2cont Gr5 MAP Error</td>
<td>385662.676</td>
<td>1</td>
<td>38562.676</td>
<td>94.398</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Corrected Total</td>
<td>476023.770</td>
<td>2</td>
<td>238011.885</td>
<td>582.634</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Total</td>
<td>213650.909</td>
<td>523</td>
<td>408.510</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>243214895.0</td>
<td>526</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>689674.679</td>
<td>525</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Hypothesis Two

The second hypothesis tested in this study was: There are no significant differences in achievement for each cohort year of students randomly assigned to single-gender sixth grade mathematics classes and students randomly assigned to mixed-gender sixth grade mathematics classes when controlling for 5th grade MAP mathematics scores. Univariate analysis of variance (ANOVA) was used to explore this probability; the dependent variable was the sixth grade MAP mathematics mean index scores and the independent variables were fifth grade MAP mathematics mean index scores and grouping for each cohort year. Each annual group test had a significance level of <.0001 when accounting for prior-year achievement (see Table 21). The hypothesis was rejected.

Table 21
Cohort Years Controlling for Group and 5th Grade MAP

<table>
<thead>
<tr>
<th>Cohort Year</th>
<th>Source</th>
<th>Type III Sum</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006-07</td>
<td>Corrected Model</td>
<td>235544.246</td>
<td>2</td>
<td>117772.123</td>
<td>278.527</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td></td>
<td>Intercept</td>
<td>7193.463</td>
<td>1</td>
<td>7193.463</td>
<td>17.012</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td></td>
<td>Group1exp2cont</td>
<td>235544.246</td>
<td>2</td>
<td>117772.123</td>
<td>278.527</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td></td>
<td>Gr5 mathMAP</td>
<td>70191.316</td>
<td></td>
<td>422.839</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Error</td>
<td>79085015.00</td>
<td>166</td>
<td>422.839</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>305735.562</td>
<td>169</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2007-08</td>
<td>Corrected Total</td>
<td>305735.562</td>
<td>168</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Corrected Model</td>
<td>110711.858</td>
<td>2</td>
<td>55355.929</td>
<td>148.688</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td></td>
<td>Intercept</td>
<td>24851.309</td>
<td>1</td>
<td>24851.309</td>
<td>66.752</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td></td>
<td>Group1exp2cont</td>
<td>110711.858</td>
<td>2</td>
<td>55355.929</td>
<td>148.688</td>
<td>&lt;.0001</td>
</tr>
</tbody>
</table>
Hypothesis Three

The third hypothesis tested in this study was: There are no significant differences in achievement for students randomly assigned to single-gender sixth grade mathematics classes and students randomly assigned to mixed-gender sixth grade mathematics classes when controlling for prior year achievement, Free and Reduced Lunch (FRL) status and gender. Univariate analysis of variance (ANOVA) was used to explore this possibility; the dependent variable was the sixth grade MAP mathematics mean index scores and the independent variables were fifth grade MAP mathematics mean index scores, Free and Reduced Lunch (FRL) status and gender (see Table 22).

Table 22

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III</th>
<th>df</th>
<th>Mean</th>
<th>F</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gr5 mathMAP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Error</td>
<td>65524.075</td>
<td>176</td>
<td>372.296</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>82754187.00</td>
<td>179</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>176235.933</td>
<td>179</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2008-09</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Model</td>
<td>139433.609</td>
<td>2</td>
<td>69716.805</td>
<td>192.304</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Intercept</td>
<td>9209.691</td>
<td>1</td>
<td>9209.691</td>
<td>25.404</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Group1exp2cont</td>
<td>139433.609</td>
<td>2</td>
<td>69716.805</td>
<td>192.304</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Gr5 mathMAP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Error</td>
<td>63443.610</td>
<td>175</td>
<td>362.535</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>81375693.00</td>
<td>178</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>202877.219</td>
<td>177</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sum</td>
<td>Square</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------------------------</td>
<td>--------------</td>
<td>--------------</td>
<td>---------</td>
<td>---------</td>
<td></td>
</tr>
<tr>
<td>Intercept Hypo Error</td>
<td>17377.898</td>
<td>32.966</td>
<td>.169</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group1exp2cont Hypo</td>
<td>425.134</td>
<td>4.948</td>
<td>.269</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FRLstd1frlred2 Error</td>
<td>85.915</td>
<td>.383</td>
<td>.001</td>
<td>.975</td>
<td></td>
</tr>
<tr>
<td>Group1exp2cont Hypo</td>
<td>5.784</td>
<td>.067</td>
<td>.838</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender1m2f Error</td>
<td>85.915</td>
<td>.383</td>
<td>.001</td>
<td>.975</td>
<td></td>
</tr>
<tr>
<td>Group1exp2cont Hypo</td>
<td>85.915</td>
<td>405.839</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group1exp2cont Hypo</td>
<td>85.915</td>
<td>405.839</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frl1std2frlred Gender1m2f Error</td>
<td>206978.010</td>
<td>405.839</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group1exp2cont Hypo</td>
<td>545.103</td>
<td>181.701</td>
<td>.448</td>
<td>.719</td>
<td></td>
</tr>
<tr>
<td>Frl1std2frlred Gender1m2f Error</td>
<td>206978.010</td>
<td>405.839</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gr5math Hypo Error</td>
<td>206978.010</td>
<td>1556.657</td>
<td>.212</td>
<td>.646</td>
<td></td>
</tr>
<tr>
<td>Frl1std2frlred Gender1m2f Error</td>
<td>3113.315</td>
<td>405.839</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gr5math Hypo Error</td>
<td>206978.010</td>
<td>405.839</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender1m2f Grd5math</td>
<td>206978.010</td>
<td>405.839</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The hypothesis was not rejected because there was not a significance difference across the data for all three years when the variables of free/reduced lunch, gender, and 5th grade achievement were entered into the equation.

**Summary of Results**

- Hypothesis one was rejected. The study found a significant difference in student achievement for all three combined cohort years of the study between single-gender and mixed-gender students when controlling for 5th grade achievement.
• Hypothesis two was rejected. The study found a significant difference in each individual cohort year of the study in student achievement for single-gender and mixed-gender students when controlling for 5\textsuperscript{th} grade achievement.

• Hypothesis three was not rejected. A significant difference was not found in the achievement of the students for single-gender and mixed gender classes when controlling for FRL, gender, and 5\textsuperscript{th} grade achievement.
Chapter 5
Discussion of Findings

Introduction

In this era of No Child Left Behind (NCLB, 2002), educators are under pressure by federal, state and local agencies. Tensions arise among teachers, students, parents, and policymakers because NCLB assessments are used to rank students and districts on local, state, and nation levels (Sloane & Kelly, 2003). Educators no longer have the luxury of sitting back and assuming that student learning will just work out. Educators cannot assume that yesterday’s classroom meets the needs of today’s children. School reformers have discussed change in the terms of leverage points, especially in relation to the value they bring to the educational enterprise (Dufour, Dufour, Eaker, & Karhanek, 2004; Fullan, 2003; Senge, 2005). Leverage points are policies and practices on which educators have the most direct impact. Prominent leverage points are curricula, instruction, professional development, and the use of assessment data. Challenging our own assumptions about who is being served by our schools drives us to achieve deeper, transformational initiatives. As educators, we are challenged to leave no child behind and ensure that all students attain equal success at the same rate. Educators who examine their own
assumptions about education, students, and related topics are in turn better prepared to affect change and transform the system.

In a relative small, Midwestern middle school, four teachers decided that they needed to challenge their assumptions about students and the educational system. They spent much of their time engaging in discussions about how they could address the trends they saw in their classrooms. The four teachers agreed that it is a fact of life that boys and girls become more aware of each other as they get older, but one teacher explained that “we would really like for them to be more aware of what we are doing in class”. These feelings and assumptions led them to begin educating themselves about gender differences in the classroom.

Many educators know instinctively that boys and girls do not learn the same way or at the same rate. “Males and females are equal in their common membership of the same species, humankind, but to maintain that they are the same in aptitude, skill or behavior is to build a society based on a biological and scientific lie” (Moir, 1993, p. 22). “Boys and girls are different. They just come out of the womb that way,” explained a parent of four. During an interview for Gurian a teacher reflected that “I’ve learned that while boys and girls are the same in a lot of ways, they are definitely different. Every year I change the way I teach to accommodate that one fact” (Gurian, 2001,
Many educators will tell that they can see and sense differences between boys and girls from the moment the students walk in the door on the first day of school. One teacher described that boys and girls “express emotion differently. They speak differently. They interact with the world differently. Boys tend to be more aggressive and girls more passive”.

Throughout our careers, educators have witnessed a gamut of changing theories in and about education and child development (e.g., Bandura, Bowlby, DuFour, Senge, Skinner). One of the primary focuses in recent years is the area of brain research and how the brain processes knowledge. Teachers are engaging in continuing education coursework to study the development of the brain and to explore developmental differences between boys and girls. This development is in stark contrast to Gurian’s (2001) finding that in a sample of 200 teachers, none received formal training in this arena while in college.

Gurian (2001), author of *Boys and Girls Learn Differently*, suggests that the differences between boys and girls can significantly impact on how educators choose to set up and deliver instruction in their classrooms. Gurian studied brain research and synthesized ideas on the numerous ways that girls’ and boys’ brains function and learn differently. One difference he noted was in maturity: “In most cases and in most aspects of developmental chronology, girl’s brains mature
earlier than boys” (p. 19). This maturity tends to allow girls to acquire complex verbal skills earlier than boys. Gurian’s work supports the findings of researchers, Hanlon, Thatcher and Cline from Virginia Tech (Hanlon, 1999) who found that the areas of the brain involving language and fine-motor skills matured about four years earlier for girls than for boys. The areas in the brain involving geometry and spatial relations mature four years earlier for boys than for girls. Other noted gender differences are that girls take in more sensory data and tend to have better verbal abilities, whereas boys tend to rely heavily on nonverbal communication and spatial abilities. Gurian summarized that “theses noted differences in gender brains can have immense ramifications in our culture, which relies heavily on talk and conversation” (p. 27).

Differences in girls’ and boys’ brains are visible in Magnetic Resonance Imaging and Positron Emission Tomography scans, which show how certain areas of the brain, are structured differently and how blood and neurotransmissions vary by gender (Gurian, 2001). Sax (2005) expressed the importance of linking these findings to educational practice:

With this research on how brains develop in different order and at different times in girls compared to boys, there may be a risk in having a curriculum that teaches the same subjects in the
same sequence to both boys and girls. Girls and boys behave differently because their brains are wired differently. (p. 74)

Sax also noted that because gender plays a role in the way the brain functions, it is important for parents and teachers to know and understand these differences. Sax illuminated his argument with examples of the ways boys and girls assess risk. That is, boys tend to overestimate their abilities and girls tend to underestimate their abilities; also, boys tend to be more aggressive and girls tend to be more passive. These differences in aggression are also noted in how boys and girls fight. Boys can be mean, but their aggression is usually on the surface and is generally short-lived, whereas tension between girls can simmer and build for weeks or months, undermining friendships until relationships fall apart.

The differences between girls and boys and the roles those differences play in school have garnered the attention from a variety of scholars. Publication of the book *In a Different Voice: Psychological Theory and Women's Development* (Gilligan, 1993 triggered an academic revolution. Gilligan theorized that girls think, interact, display leadership and make decisions in psychologically and developmentally unique ways. As such, Gilligan argued that the male-based model for learning simply did not fit the way girls learn (1993).
Gilligan's work (1982, 1993), coupled with a growing professional awareness of educational disparities between girls and boys, led to a closer examination of what actually occurs in co-educational classrooms. In a 1992 report entitled *Shortchanging Girls, Shortchanging America*, the American Association of University Women (AAUW) found that girls routinely were called upon less often in class than boys. Sadker and Sadker (1995) echoed those findings in *Failing at Fairness: How Schools Shortchange Girls*, a compendium of 10 years of their research at American University. They found that girls did not receive their fair share of attention in the classroom because despite their best intentions, teachers respond to boys and teach them more actively than girls. Sadker and Sadker also found that boys called out eight times more often in class than girls, a practice teachers frequently rewarded with praise. When girls answered questions in class, teachers normally nodded or said “okay”, yet when boys responded, teachers offered them more attention through praise, corrections, assistance, or criticism. Sadker and Sadker also noted that, in a mixed-gender classroom, inconsistent treatment of boys and girls had the potential to create climate issues.

Sommers (2000) asserted that after reviewing studies on gender differences in the classroom, it is clear that “boys not girls are on the weak side of the educational gender gap.” On average, boys are a year
and a half behind girls in reading and writing; also, they are less likely to go to college. This discrepancy was described by the president of AAUW in an interview with *Women* magazine: “Both girls and boys are being shortchanged in education” (Woods, 2002).

Gender differences in the classroom and related assumptions, along with the call to improve student performance, led to the following research question: If boys and girls learn and interact differently, what effect will gender-based classes have on mathematics student achievement?

This final chapter provides an overview of the study design followed by a listing of the research questions that framed the study. Subsequent sections of this chapter include a discussion of the findings from Chapter 4, as well as conclusions and recommendations based upon the findings of the study.

*Statement of Hypotheses*

The purpose of this study was to examine single-gender groupings for sixth grade mathematics classes as a strategy to improve student achievement. To accomplish the purpose, the following research questions were developed:

1. Are there differences in achievement over the course of the three years of data for students randomly assigned to single-gender sixth grade mathematics classes and students randomly
assigned to mixed-gender sixth grade mathematics classes, when controlling for 5th grade achievement?

2. Are there differences in achievement for each cohort year of students randomly assigned to single-gender sixth grade mathematics classes and students randomly assigned to mixed-gender sixth grade mathematics classes, when controlling for 5th grade MAP mathematics scores?

3. Are there differences in achievement for single-gender and mixed-gender classes when controlling for 5th grade MAP mathematics scores, FRL and gender?

In order to test these research questions three hypotheses were used:

1. There are no significant differences in achievement for all students, experimental and control groups, over the course of the three years of data for students when controlling for fifth grade achievement.

2. There are no differences in achievement for each cohort year of students randomly assigned to single-gender sixth grade mathematics classes and students randomly assigned to mixed-gender sixth grade mathematics classes, when controlling for 5th grade MAP mathematics scores?
3. There are no significant differences in achievement for students randomly assigned to single-gender sixth grade mathematics classes and students randomly assigned to mixed-gender sixth grade mathematics classes when controlling for, prior year achievement, Free and Reduced Lunch (FRL) status and gender.

**Summary Descriptive Data**

This study of single-gender and mixed-gender classroom achievement included three cohorts of students from the same school with the same teachers during academic years 2006-2007, 2007-2008, and 2008-2009. Data were gathered based on control and experimental groups, gender, Free and Reduced Lunch (FRL) status, fifth grade mathematics Missouri Assessment Program (MAP) test achievement, and sixth grade mathematics MAP test achievement.

The control group included students who were randomly selected and placed in the mixed-gender classes. The experimental group included students who were randomly selected and placed in the single-gender classes.

The total number of students enrolled in single-gender classes was 254 and the total number of students enrolled in mixed-gender classes was 272. The numbers were close to consistent each year for both of the groupings. Males enrolled in single-gender mathematics classes during each of the three years numbered 42, 42, and 41.
respectively, for a total of 125. The number of males enrolled in mixed-gender classes during the same period numbered 44, 50, and 48 for a total of 132.

The number of females enrolled in single-gender classes during each of the three years numbered 41, 45, and 43 respectively, for a total of 129. The number of females enrolled in mixed-gender classes during the same period numbered 42, 42, and 56 for a total of 140.

Free and Reduced Lunch (FRL) data provided information about students’ economic standings. Of the 526 students, 109 students participated in FRL, 51 of whom were in single-gender classes and 58 of whom were in mixed-gender classes. The remaining 417 students did not receive FRL, 203 of whom were in the single-gender classes and 214 of whom were in the mixed-gender classes.

All 526 of the students included in this study took the MAP mathematics test during their fifth grade years. The overall MAP mean index score for all students was 667.74. As sixth graders, the same students were randomly placed into single-gender or mixed-gender classes. The fifth grade students who were later placed in the single-gender classes had a mean MAP index score of 670.28, which is 4.90 points higher than the students who were placed in the mixed-gender classes, whose mean MAP index score was 665.38. The MAP mathematics test data also showed that for the students’ sixth grade
years when sorted by single-gender and mixed-gender classes, those single-gender classes had a mean MAP index score of 683.17. While students in the mixed-gender classes had a mean MAP mathematics index score of 675.15. The single-gender classroom students’ mean index score was 8.02 points higher than their mixed-gender classroom peers. By further looking at the data it revealed that 254 students who were in single-gender classes during the sixth grade years realized an average increase of 12.90 between their fifth and sixth grade MAP mathematics mean scores. The 272 students who were in the mixed-gender classes during the sixth grade years realized an average increase of 9.78 between their fifth and sixth grade mean MAP mathematics test scores. When considering the overall mean and difference of all 526 students, there was an average increase of 11.28 between their fifth and sixth grade MAP mathematics mean test scores. Students in the single-gender classes outperformed the overall average increase of all students and the mixed-gender students by 1.62 index points and 3.12 index points respectfully.

The 417 students, who did not participate in the FRL program, 203 were in the single-gender classes and 214 were in the mixed-gender classes. For those 109 students in the FRL program, 51 students were in the mixed-gender classes and 58 students were in the single-gender classes. The students who were in the single-gender
classrooms and did participate in the FRL program outperformed their peers in the mixed-gender classrooms with mean MAP mathematics index scores of 686.10 and 680.43 respectively, which is a difference of 5.67 points. Students who participated in the FRL program also showed a difference in performance. FRL students enrolled in single-gender classes had a mean score of 671.51, whereas FRL students enrolled in mixed-gender classes had a mean score of 655.67, which is a difference of 15.84.

The 526 students in the study, 257 were male and 269 were female. Average score for males in the single-gender classes was 684.47, and the average score for males in the mixed-gender classes was 676.86. For females in the single-gender classes the average score was 681.91 compared to an average score for females in the mixed-gender classes of 673.54. There was an overall trend of positive increases in MAP mathematics index scores for students in the single-gender classes when compared to students in the mixed-gender classes.

The data for the cohort years and grouping showed that for the 254 single-gender students their means scores ranged from a high of 689.65 in school year 2006-2007 to a low of 676.02 in school year 2008-2009. While the 272 mixed-gender students had mean
scores that ranged from 676.09 in 2006-07 to 674.65 in cohort year 2008-09.

The data were sorted into the categories of gender and grouping. The 42 male single-gender classroom students had a 19.88 increase in the means of their fifth and sixth grade MAP mathematics test scores. The second group of 42 male single-gender classroom students had a 5.83 increase in the means of their fifth and sixth grade MAP mathematics test scores. The third year group had 41 male single-gender classroom students and a 3.49 increase between the means of their fifth and sixth grade MAP mathematics test scores. The same data on gender and MAP mathematics mean scores for females showed 41 female first-year single-gender classroom students had a 21.59 increase in the means of their fifth and sixth grade MAP mathematics test scores. The 45 female second-year single-gender classroom students had a 12.02 increase in the means of their fifth and sixth grade MAP mathematics test scores. The 43 female third-year single-gender classroom students had a 13.63 increase in the means of their fifth and sixth grade MAP mathematics test scores. There was a positive difference in the gains in MAP mathematics index scores.

The study included data for mixed-gender students. During the first year of the study 44 male students were enrolled in the mixed
gender classes. They had a 14.18 increase in the means of their fifth and sixth grade MAP mathematics test scores. In the second year of the study, 50 male students were enrolled in the mixed-gender classes, and they had a 15.95 increase in the means of their fifth and sixth grade MAP mathematics test scores. In the third year of the study, 38 male students were enrolled in the mixed-gender classes, and they had a 1.84 increase in the means of their fifth and sixth grade MAP mathematics test scores.

The first year of the study, the 42 females enrolled in the mixed-gender classes had a 15.95 increase in the means of their fifth and sixth grade MAP mathematics test scores. In the second year 42 females enrolled in the mixed gender-classes had a 6.86 increase in the means of their fifth and sixth grade MAP mathematics test scores. In the third year 56 girls enrolled in the mixed-gender classes had an 8.57 increase in the means of their fifth and sixth grade MAP mathematics scores.

There was an overall trend of positive differences in the descriptive data for MAP mathematics index scores for those students in the single-gender classes when compared to students who were in the mixed-gender classes. However, it should be noted that the experimental group (single-gender classes) were highest in the first year of the experiment and the achievement gains from grade five to
grade six dissipated with each subsequent year. Simultaneously, the achievement gains for the control group (mixed-gender) classes were much more consistent across the three years of the study. This pattern of declining effectiveness in the experimental group raises the probability that there was an initial “halo” effect with the first cohort for the single-gender classes and that the effect moderated with each subsequent year as the “newness” of the change dissipated.

Summary of Hypothesis Testing

The first hypothesis tested in this study was: There are no significant differences in achievement for all students, experimental and control groups, over the course of the three years of data for students when controlling for fifth grade achievement. The hypothesis was rejected because for the compiled data from the three years of the study there was a significant difference in single-gender and mixed-gender classes for how these students performed on their 6th grade MAP mathematics tests when controlling for prior achievement using their 5th grade MAP mathematics scores.

The second hypothesis tested in this study was: There are no significant differences in achievement for each cohort year of students randomly assigned to single-gender sixth grade mathematics classes and students randomly assigned to mixed-gender sixth grade mathematics classes when controlling for 5th grade MAP mathematics
scores. The hypothesis was rejected. The sixth grade achievement for each of the three individual cohort groups in single-gender and mixed-gender classes were significantly different when controlling for the 5th grade MAP mathematics scores.

The third hypothesis tested in this study was: There are no significant differences in achievement for students randomly assigned to single-gender sixth grade mathematics classes and students randomly assigned to mixed-gender sixth grade mathematics classes when controlling for prior year achievement, Free and Reduced Lunch (FRL) status and gender.

The hypothesis was not rejected because there was not a significant difference in the achievement of the students who were in the single-gender and the mixed-gender classes when controlling for their prior achievement, FRL status and gender.

We acknowledge that several years have passed from the time that this study was started to the present. During that time some schools have started implementation of single-gender classes, while others have continued to do research and analyze the impact of single-gender classes. More current research and articles can be found in places such as the National Association for Single Sex Public Education’s website pertaining to new schools that are implementing
single-gender education and research being done on the subject in places like Dallas, Texas and Columbus, Ohio.

We must also point out that the span of early adolescent years is an ever changing period of life. Adolescent’s developmental stages were not a factor that controlled for in this study; however it may have an effect on the findings. Other factors not controlled for that might have influenced the results of this study were the competencies and attitudes of the teachers. Clearly teachers are a critical variable in the learning experience.

*Implications for Theory and Future Research*

The current study was conducted to understand the elements of the use of single-gender classrooms as a strategy to improve student achievement. The descriptive findings of this study were generally consistent with the research and theories of Gurian, Sax and the Virginia Tech Study. The descriptive data and two of the three hypotheses tested support and viability of single-gender classes as a strategy to improve student achievement. However, when the data analyses included free and reduced lunch data and student gender data, the level of significance was not affirmed. This mixed finding raises an important caution in the interpretation of these data. The findings do not confirm a mathematical difference when poverty and gender are considered along with prior achievement. Therefore, the
value of single-gender classes may well not be as worthwhile as is commonly claimed in the literature. The mixed findings from this study preclude a definitive answer to the question based upon the data for the participants in this study.

Recommendations for future research

The following are specific recommendations for future research based upon the findings of this study.

- Develop a comparative design for assessing single-gender and mixed-gender classes using student outcome variables beyond student achievement including, but not limited to: student participation in school activities, student participation in non-school activities, student self-concept, student self-esteem, global self-esteem, academic self-efficacy, student self-standards, individual student behavior, school-wide student behavior, parent-student interactions, and student homework.

- Examine the impact of single-gender classes on student engagement/participation during class learning time.

- Examine the long-term impact on student achievement in later grade levels, persistence to graduation, and attendance.

- Develop a comparative design with a larger student population by placing students in quartiles by selected variables such as the ones used and/or recommended in this study, thus gaining
specific insight about the potential impact of single gender classes on the quartile groups.

- Examine the relationship between single-gender classes and factors of adolescent development.
- Examine the relationships between single-gender classes and teacher competencies and attitudes.

Closing Comments

From this study, a firm conclusion about the value of single-gender classes is problematic. The mixed findings, particularly the finding that the differences are not significant when a proxy measure for poverty (free and reduced lunch) and gender are both added to the statistical formulae along with prior achievement. On the surface, it appears that the argument for the value of single-gender classes has merit. But when analyzed more carefully, that is not necessarily the case based on the data from this study. Of particular interest from this study is the waning effect of the difference over the three years of the study. The differences for the first-year were noticeably higher than were the differences for the second year cohort; and likewise, the differences for the third year cohort were still less. Further research is clearly needed to bring more adequate statistical light to the value of single-gender classes in today’s middle school. Hopefully, this study
will play some small role in advancing and shaping the use and implementation of single-gender classrooms as a practice in schools.
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Comment Number: 243706 (10-20-2009)
Message sent on Oct 20, 2009:
To: ValentineJ@missouri.edu, dgvtf3@mizzou.edu
BCC: greeningjm@missouri.edu
Subject: Campus IRB: Project #1144437

Hello,

The Campus IRB conducted an internal audit on this file and determined the activities do not meet the definition of "human subjects research". This project no longer requires IRB oversight and will be withdrawn. If you have any questions, please contact me at greeningjm@missouri.edu. Thank you.

Janelle Greening
Quality Assurance Associate, Campus IRB

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Vita

Douglas Gerald Van Zyl was born on November 22, 1968, in Montevideo, Minnesota. He was raised in Montevideo, where he graduated from high school in 1987. He received his Bachelor of Arts in Elementary Education from the Northwestern College in Orange City, Iowa in 1991, a Master of Education in Educational Administration from Sam Houston State University in 2002, and a Doctorate of Educational Administration from the University of Missouri-Columbia in 2011. He taught for two years as a 3rd grade teacher in Aldine, Texas, two years as a 4th grade teacher in Conroe, Texas. He also served as an administrator for 2 years in Texas, prior to becoming an elementary principal in Independence, Missouri for seven years. He later served as the assistant superintendent and then superintendent for the Harrisonville Schools for five years. He currently works as the superintendent of schools for the Fort Dodge Community School District in Fort Dodge, Iowa. He is married to the former Danielle Smith of Waterloo, Iowa. They have one son, Parker and two daughters, Lani and Elizabeth.