1998

An examination of the nature of a single-sex mathematics class

Amy Burns
San Jose State University

Follow this and additional works at: https://scholarworks.sjsu.edu/etd_theses

Recommended Citation

Burns, Amy, "An examination of the nature of a single-sex mathematics class" (1998). *Master's Theses*. 1735.

DOI: <https://doi.org/10.31979/etd.eat7-jped>
https://scholarworks.sjsu.edu/etd_theses/1735

This Thesis is brought to you for free and open access by the Master's Theses and Graduate Research at SJSU ScholarWorks. It has been accepted for inclusion in Master's Theses by an authorized administrator of SJSU ScholarWorks. For more information, please contact scholarworks@sjsu.edu.

INFORMATION TO USERS

This manuscript has been reproduced from the microfilm master. UMI films the text directly from the original or copy submitted. Thus, some thesis and dissertation copies are in typewriter face, while others may be from any type of computer printer.

The quality of this reproduction is dependent upon the quality of the copy submitted. Broken or indistinct print, colored or poor quality illustrations and photographs, print bleedthrough, substandard margins, and improper alignment can adversely affect reproduction.

In the unlikely event that the author did not send UMI a complete manuscript and there are missing pages, these will be noted. Also, if unauthorized copyright material had to be removed, a note will indicate the deletion.

Oversize materials (e.g., maps, drawings, charts) are reproduced by sectioning the original, beginning at the upper left-hand corner and continuing from left to right in equal sections with small overlaps. Each original is also photographed in one exposure and is included in reduced form at the back of the book.

Photographs included in the original manuscript have been reproduced xerographically in this copy. Higher quality 6" x 9" black and white photographic prints are available for any photographs or illustrations appearing in this copy for an additional charge. Contact UMI directly to order.

UMI

A Bell & Howell Information Company
300 North Zeeb Road, Ann Arbor MI 48106-1346 USA
313/761-4700 800/521-0600

AN EXAMINATION OF THE NATURE
OF A SINGLE-SEX MATHEMATICS CLASS

A Thesis
Presented to
The Faculty of the Department of Mathematics
San Jose State University

In Partial Fulfillment
of the Requirements for the Degree
Master of Arts

by
Amy Burns
December 1998

UMI Number: 1392800

**Copyright 1998 by
Burns, Amy Lynn**

All rights reserved.

**UMI Microform 1392800
Copyright 1999, by UMI Company. All rights reserved.**

**This microform edition is protected against unauthorized
copying under Title 17, United States Code.**

UMI
**300 North Zeeb Road
Ann Arbor, MI 48103**

© 1998
Amy Burns
ALL RIGHTS RESERVED

APPROVED FOR THE DEPARTMENT OF MATHEMATICS

Dr. Joanne Rossi Becker

Dr. Jane Day

Dr. Barbara Pence

APPROVED FOR THE UNIVERSITY

ABSTRACT

AN EXAMINATION OF THE NATURE OF A SINGLE-SEX MATHEMATICS CLASS

by Amy Burns

This study presents a detailed description of the nature of one single-gender mathematics class. Two surveys administered to an all-female algebra class of 20 ninth-grade students explored the students' attitudes and opinions about mathematics and the single-gender setting. Nine students with differing ability levels and attitudes were selected for in-depth interviews. In addition, classroom observations recorded the nature of the student-teacher interactions, student behaviors, and modes of instruction.

The results indicated that the classroom climate differed from typical coeducational mathematics classrooms. The students demonstrated cooperative learning behaviors and identified closely with their peer group. They behaved assertively and were eager to participate in class. The student-teacher interactions revealed that the students regularly shared the teacher's attention. The single-gender setting appeared to affect the students' behavior in the classroom, but did not reveal a significant effect on their attitudes towards mathematics.

ACKNOWLEDGEMENTS

I would like to give special thanks to Dr. Joanne Rossi Becker, who made this project possible through her guidance and support. Thanks also to my husband Stephen Ellis, for his never-ending patience, support, and encouragement.

TABLE OF CONTENTS

Chapter 1:	Introduction	1
Chapter 2:	Review of the Literature	4
Chapter 3:	Methodology	27
Chapter 4:	Results	39
Chapter 5:	Conclusions	104
Appendix A:	First Survey	118
Appendix B:	Second Survey	119
Appendix C:	Interaction Tables	120
References		132

CHAPTER 1

Introduction

The ideas for this study began to form during my first teaching assignment at an all-girls parochial school. The school catered to students from disadvantaged backgrounds and was situated in an urban environment. Eighty percent of the students lived below the poverty line and attended the school tuition-free, and many of the students chose to attend because it was a safer local alternative to the neighborhood public school. The students came from a variety of ethnic and cultural backgrounds, but most of the students did not enter high school with education as their highest priority. They had after-school jobs, family duties, and other concerns that seemed to be more important than an education.

However, many of these students underwent a dramatic transformation during their time at the all-girls school. Students who had previously failed classes began to succeed academically. Students who had been uninvolved in their coeducational middle schools began to join activities, volunteer their time, and become a part of the community. The students behaved as a cohesive group, identifying with one another and the school. This behavior occurred in the classroom as well as outside of the academic realm. There appeared to be a unique quality to the mathematics classes I taught: the students created a supportive atmosphere of camaraderie that I had never before witnessed in a mathematics class. I thought perhaps these trends were due to the fact that the students belonged to a small private school, where every member of the community knew everybody else.

The school eventually closed for budgetary reasons and I continued my career at a small, independent coeducational school. This school was situated in a suburban environment and catered to several different segments of the population. Like the members of the all-girls school, these students also came from a variety of ethnic and cultural backgrounds. This school also focused on fostering a positive atmosphere in the

classroom and on the campus: students and teachers alike worked hard to create a sense of community. However, the nature of the students as a community and their behavior in the classroom differed greatly from that seen in the all-girls school. Particularly in the mathematics classroom, the general atmosphere appeared to be different. The students were not as supportive of one another in general, and it became increasingly difficult to distribute attention equally to all students in the classroom. I noticed many female students who appeared to be mathematically capable but lacked confidence in their abilities and did not behave assertively. It was only then that I realized this behavior had been noticeably absent from the students at the all-girls school.

As I became more interested in equitable treatment in the mathematics classroom, I often recalled that my experiences in the all-girls school did not match what I had learned about the typical mathematics classroom. I then began to search for articles about single-gender schools and their potential benefits to girls. It appeared that girls in the single-gender setting potentially reap many rewards: they experience improved attitudes towards mathematics, higher participation rates in the classroom, and improved levels of confidence and self-esteem. However, the majority of these studies examined private all-girls schools, and suggested that many of the potential benefits to girls might be as much a result of the nature of the school itself as the fact that it was a single-gender setting.

The literature about single-gender settings focused mainly on the benefits to girls, but did not often explain why those benefits occurred. What was it about the all-girls setting that proved beneficial to girls? I tried to think about the qualities of the all-girls mathematics classes that I had taught, and realized that they differed in many ways from coeducational classes. I began to develop more questions about the quality of an all-girls mathematics class. Is an all-girls class truly different from a coeducational class? If so, in what ways? How do the girls behave when they are in a single-gender setting? Most

importantly, what qualities unique to an all-girls setting might result in academic or affective benefits to girls in mathematics?

When a local public school created single-gender academies within the school, this seemed to be an ideal opportunity for a study. The students were not attending a small, friendly private school but rather a large, semi-urban public school. Many of the advantages open to students in small independent schools would not exist for these students. The major difference would be the single-gender setting. Would the benefits that girls experience in single-gender schools still occur with these students? Would the single-gender mathematics class differ in any way from coeducational classes? This setting would provide a unique opportunity to answer several of these questions and gain insight into the nature of an all-girls mathematics class.

CHAPTER 2

Review of the Literature

Why Gender and Mathematics?

Educators often refer to mathematics as a critical filter (Fuller, 1997). Success in mathematics can lead to high level careers, salaries, and economic independence. Without mathematics skills, young men and women may be barred from entering the top levels of academics and business. However, girls do not appear to excel mathematically at the same level as boys (Sadker & Sadker, 1994). Girls participate in mathematics at lower rates than boys, and their achievement levels as measured by standardized tests are lower than those for boys (AAUW, 1992; Leder, 1992). These differences emerge in adolescence and by the time students reach college, the deck is already stacked against girls (AAUW, 1992). As a result, women are underrepresented in mathematics-related careers, which may be a factor contributing to the disparity between men and women in economic power.

Traditionally, gender differences in mathematics have been seen as a "girl problem." Taking the male experience as the universal standard, research focused on the characteristics females lacked that resulted in lower levels of participation and achievement in mathematics (Campbell, 1995). Within this context, researchers explored ways to help girls gain what they were missing. Educators suggested interventions such as: extra encouragement to boost attitudes in mathematics, additional opportunities to become more assertive, additional experience with technology, manipulatives, or other mathematical tools, and exposure to more female role models in mathematics. However, these strategies may not fully address the real issue. Critics claim that any positive effects resulting from these interventions may eventually disappear when girls are returned to a more traditional atmosphere. Rather than focusing on ways to change girls, researchers are now searching for ways to change mathematics education (Campbell, 1995). Advocates for gender equity

are now beginning to promote curricular reform measures that will present mathematics in a manner more palatable to females. Many of the gender equity concerns remain, but strategies for addressing these concerns appear to be changing.

Gender Differences In Mathematics

Introduction

Gender equity in mathematics has been an issue of interest in the mathematics education research community for several decades. This concern has given rise to a large body of research on equity issues in the classroom. It is important to realize that gender differences in participation, attitudes, and achievement in mathematics are small and declining. Recent meta-analyses have found only very small differences in male and female performances in mathematics. In addition, a comparison of recent research to earlier studies reveals a significant decline in gender differences (AAUW, 1992; Campbell, 1995; Fennema, 1995; Friedman, 1996; Leder, 1992; Oakes, 1990; Wilson & Hart, in press). Also, differences in performance between boys and girls tend to be much smaller than within-group differences (Bornholt, 1988; Leder, 1992; Wilson & Hart, in press). While it is reasonable to question the significance of such small differences, we must recall that these small differences are consistent across a large body of research and thus cannot be ignored.

Significant gender differences in mathematics achievement, participation, and attitudes only begin to appear in adolescence. Girls and boys enter school roughly equal in mathematics ability; no gender differences have been found in the problem-solving ability of elementary- and middle-school girls and boys. By the time students reach junior-high school, small differences favoring males emerge. These differences grow as students reach high school. Large research studies have found no gender differences in mathematics performance at age nine, minimal differences at age thirteen, and larger differences at age

seventeen (AAUW, 1992; Gwizdala & Steinback, 1990; Sadker & Sadker, 1994). While boys and girls enter school performing equally well in mathematics, girls graduate from high school trailing behind boys.

In addition to differences in achievement and participation, differences in attitudes towards mathematics also appear in middle school and high school. Eccles (1989) reported that there were no major sex differences in confidence prior to seventh grade. Differences began to emerge in junior high school, at which point females had lower estimates of their mathematical ability than did males. The size of this sex difference grew as students moved into high school. Oakes (1990) pointed out that sex differences in mathematics confidence appeared in junior high school just before participation and achievement differences began to appear.

Achievement

What evidence exists for gender differences in mathematics performance? Statistical evidence suggests that by the beginning of high school, boys frequently outperform girls on standardized tests of mathematics (Leder, 1992). According to Wilson and Hart (in press), both national and international studies report boys scoring higher on standardized achievement tests and performing better on higher-level mathematics tasks. Males are disproportionately represented among students with the top 10% scores on standardized mathematics tests (Wilson & Hart, in press). Males also consistently outscore females on the mathematics Standardized Achievement Test (SAT) (AAUW, 1992; Sadker & Sadker, 1994). The average mathematics score on the SAT reasoning test has been higher for males every year from 1972 to 1996. These differences varied from 35 points to 46 points (Friedman, 1996). The size of gender differences found in mathematics performance appears to depend on the content of the test, the age level of students taking

the test, and whether classroom grades or standardized tests of achievement are considered (Leder, 1992).

Participation Rates

Gender differences in mathematics participation when courses are no longer compulsory are also well documented. Differences in mathematics course participation are small, occur mainly in higher-level courses, and appear to be stable (AAUW, 1992; Leder, 1992; Sadker & Sadker, 1994; Wilson & Hart, in press). The National Science Board of the National Science Foundation (1990) reported that from 1982 to 1987, the average number of mathematics credits that a male high-school student received increased from 2.61 to 3.04. During that same time period, the average number of mathematics credits that a female student received increased from 2.46 to 2.93. In 1982 males received .15 more mathematics credits than females, and in 1987 males received .11 more credits. In general, college-bound high school females take about one-half year less of mathematics than their male peers, despite the fact that females in general receive better grades in mathematics than males (Eccles, 1989). The highest differences in participation occur in the higher-level courses (Leder, 1992). On average 8.5% of males but only 4.5% of females take mathematics at the highest levels in high school, even though approximately equal percentages of females and males could do moderately complex procedures and reasoning (AAUW, 1992). Differences in exposure to formal mathematics courses are linked to gender differences on standardized tests, so these discrepancies in participation may affect females' achievement levels in mathematics (Leder, 1992).

Gender Differences And Affective Variables

Attitudes towards mathematics play an important role in the successful learning of mathematics (Steinback & Gwizdala, 1995). Kloosterman (1991) found that students' beliefs about mathematics are related to achievement levels. Analyses of both national data

and small-scale studies have found that males express more positive attitudes towards mathematics than females do (Oakes, 1990; Steinback & Gwizdala, 1995). Thus it is important to examine the differences in attitudes among boys and girls and their possible connections to participation and performance. Research about gender differences in attitudes generally focuses on confidence, usefulness, and sex-role congruency.

Confidence

Gender differences in confidence are strongly correlated with continuation in mathematics classes and with performance levels. Mathematics confidence has been found to be more highly correlated with performance than any other affective variable (AAUW, 1992; Kloosterman, 1991; Leder, 1992). Females more than males have been found to doubt their confidence in mathematics (AAUW, 1992; Bornholt, 1988; Leder, 1995; Oakes, 1990; Wilson & Hart, in press). Oakes (1990) found that girls are less confident in their mathematics ability even when compared to equally able boys. Males are more likely than females to attribute their success in mathematics to ability, while females are more apt to attribute their failure to lack of ability (Fennema, 1995). The Educational Testing Service (Dossey, Mullis, Lindquist, & Chambers, 1988) reports that gender differences in perceptions of being good at mathematics increase with age. Third graders reported about equal levels of confidence (64% of females thought they were good at mathematics versus 66% males), seventh graders showed a slight difference (57% versus 64%), and the differences were stronger for eleventh graders (48% versus 60%). Many studies reveal that a drop in confidence levels for females precedes a drop in performance and participation (AAUW, 1992). Since confidence in one's ability to learn mathematics is so strongly correlated with achievement and participation, it is one of the most important affective variables.

Usefulness

Males are more likely than females to envision themselves using mathematics as adults, and tend to see mathematics as more useful in general (AAUW, 1992; Fennema, 1995; Wilson & Hart, in press). Eccles (1989) reported that females show a linear decrease over age in their assessment of the value of mathematics. These gender differences in perceived usefulness are meaningful because perceptions of usefulness have been linked to gender differences in achievement in the middle and senior high school levels (Oakes, 1990). Perceptions of usefulness have also been shown to be related to students' decisions to enroll in elective mathematics courses at the high school level (Meyer & Koehler, 1990).

Sex-Role Congruency

A meta-analysis of affective variables associated with participation levels in elective mathematics courses indicates that gender differences are not large, with the exception of sex-role congruency (AAUW, 1992). Boys and girls both see mathematics as something that men do (Campbell, 1995; Leder, 1992; Stallings, 1979). For females, a view of mathematics as a masculine pursuit is negatively correlated with achievement and participation (AAUW, 1992; Campbell, 1995, Oakes, 1990). Girls with less sex-stereotyped views tend to do better in mathematics; girls in advanced mathematics courses are more likely to not see mathematics as a male subject. As Gwizdala and Steinback (1990) note, "the traditional view of mathematics as a male domain has contributed to the decline in performance, attitude, and ultimately participation of females in high school mathematics classes" (p. 215).

As we have seen, females not only exhibit lower performance and participation rates in mathematics, but also demonstrate lower levels of confidence, usefulness, and sex-role congruency. These affective variables can affect a girl's experiences with mathematics

and her educational experience in general. While there are certainly many factors outside the classroom contributing to gender differences in mathematics, it is important to question whether the current coeducational environment negatively impacts female students' attitudes towards mathematics.

Lack of Evidence for Biological Explanations of Gender Differences

A large body of evidence supports the contention that these differences in achievement, participation, and attitudes are not merely biological in nature. Leder (1992) noted the lack of evidence for any biological explanations of gender differences in mathematics learning. She later mentioned that "collectively, the data illustrate that gender differences in mathematics learning are often a reflection of prevailing circumstances rather than an indication of absolute and unchangeable differences between males and females" (Leder, 1995, p. 209). These differences are also not consistent across different groups, and interventions have been shown to reduce them. Fennema (1995) reported that gender differences in mathematics vary by socio-economic status and ethnicity, by school, and by teacher. In particular, a large-scale study found that girls and boys gained equally from instruction in spatial-visualization skills, despite initial gender differences before the intervention (AAUW, 1992). Carey, Fennema, Carpenter, and Frank (1995) note that gender equity can be accomplished when equity concerns are blended with knowledge-derived mainstream mathematics education research about learning.

Classroom Interaction Issues

The nature of the coeducational classroom is one possible source for these gender differences in mathematics participation and performance. Lockheed and Klein (1985) state that "A sex-equitable classroom environment is one in which both the overt and the hidden curriculum treat boys and girls equitably, so that they receive equal benefits from the instruction" (p. 209). A large body of evidence shows that this is not the case in today's

classrooms. Differential treatment occurs between teachers and students and among students in the mathematics classroom.

Teacher Interaction Patterns

Numerous studies show that males receive more attention from teachers and generally dominate classroom discussions and activities. Lee, Marks & Byrd (1994) found that in 54% of the coeducational classes they observed, instances of sexism occurred, with two thirds of the events initiated by the teachers. Stallings (1979) reported that differential treatment of males and females may be a factor in females' low enrollment in mathematics courses. In the mathematics classroom, teachers interact more with boys than with girls. Teachers praise and scold boys more than girls, call on boys more than girls, and encourage and criticize boys more often than girls (Campbell, 1995; Fennema, 1995; Leder, 1995; Lee, Marks, & Byrd, 1994; Oakes, 1990; Sadker & Sadker, 1994; Stallings, 1979; Wilson & Hart, in press). Girls are less likely than boys to receive advice, counseling, and encouragement to take advanced mathematics courses (Lee, Marks, & Byrd, 1994). Becker (1981) found that teachers gave males more response opportunities, praise and criticism, encouragement, and individual help. Stallings (1979) found that teachers asked males more questions than females. She also found that even when girls volunteered as often as boys, they were called on less often than boys.

In addition to different amounts of attention given to boys and girls, studies have also shown that the nature of interactions differs as well. Leder (1995) noted that teachers provide longer wait times when interacting with males than with females. Becker (1981) found that the cognitive level of questions provided by teachers differed depending on whether teachers addressed boys or girls. For example, teachers were more likely to ask direct knowledge level questions of girls, such as "what happens when we divide both sides by x ?" and more likely to ask higher-cognitive level questions of boys, such as "can you prove that these two figures are congruent?" Teachers may also use different criteria

for assessing the progress of male and female students (Stallings, 1979). Oakes (1990) noted that girls for whom teachers had high expectations were subjected to more public criticism, while their male counterparts received more public affirmation.

In addition to differential treatment in the classroom, research shows that teachers' expectations for their male and female students may not be the same. Studies have shown that teachers attribute boys' success more to ability and girls' success more to effort (Fennema, 1995). Fennema also found that during stimulated recall interviews, teachers reported that they thought more about boys than about girls during instruction. Teachers may have higher educational expectations for boys than girls; for example, teachers are more likely to encourage boys to pursue higher-level courses and educational experiences than girls. Teachers are also more likely to believe that boys are better at mathematics than girls (Oakes, 1990; Sadker & Sadker, 1994). Given the different level of expectations teachers place on the mathematics ability of boys and girls, it is not surprising that students themselves reflect these differing expectations.

Student Interaction Patterns

In addition to differential treatment from teachers, students' behaviors in the classroom may pose educational disadvantages for girls. Males are more likely than females to monopolize student-teacher interactions (Eccles, 1989). Becker (1981) found that female students were quieter in the classroom and less active than males. They called out less often and initiated informal contacts less often. The same interaction patterns appear in small-group situations. Researchers report that boys in small groups usually receive help from girls when they ask for it, but boys often ignore girls' requests for assistance. Although these mixed-sex groups may provide leadership opportunities for boys, girls are often viewed as merely followers (Bailey, 1993). Whether it be in large-

group or small-group instruction, boys take on active leadership roles and girls become silent observers.

The Struggle For Equitable Treatment In The Coeducational Classroom

Differential treatment patterns on the part of mathematics teachers are probably not the result of overt or even conscious sexism. Female teachers are as likely as male teachers to exhibit differential interaction patterns (Fennema, 1995). Campbell (1995) states that teachers are often not aware of the differences in the way they treat girls and boys. Fennema (1995) did not find major examples of overall sexist behaviors on the part of teachers, but rather small differences in behavior, which, when combined with the organization of instruction, made up a pattern of classroom organization that generally favored males.

Even teachers who are aware of equity issues and concerned about their behavior may find it difficult to transfer these concerns to the classroom environment. Teachers react to pressures from students, and they get more pressure from boys (Fennema, 1995). Males and females display different behaviors, with males demanding more attention and more leadership opportunities by being more assertive and by having more out-of-school experiences with mathematics. Since females typically do not protest the differential treatment that results, even well-intentioned teachers may fail to see the inequity of their own classroom behaviors (Eccles, 1989; Gould, 1995). Whyte (1984) found that teachers who consciously tried to give girls equal amounts of attention have actually felt they were being unfair to boys. In general, it is clear that teachers seldom deliberately treat boys and girls differently, but their behavior is unconscious and often unexamined. The difficulty with achieving equitable treatment in the coeducational classroom points towards a single-sex environment as one possible avenue for advancing females' opportunities in mathematics.

Gender Differences In Learning Styles

Mathematics education researchers have conducted numerous studies involving gender differences in learning styles. In general, it appears that girls may not prefer the same learning situations that boys prefer. Conventional teaching strategies may benefit boys more than girls (Fennema, 1995).

Cooperative Learning

Eccles (1989) reported that classrooms in which female students were most likely to take higher mathematics courses had five things in common: there were more cooperative learning strategies or individualized learning strategies and less public drill; there was a lack of competitive motivational strategies; there were more hands-on learning and more problems with practical implications and opportunities for creative solutions; there were more active, open-ended learning situations; and the teachers stressed the importance and usefulness of mathematics. Boys and girls engage in different mental activities during problem solving, and the impact of working in groups on their learning may be different for boys and girls; competitive activities encourage boys' learning and has a negative impact on girls' learning, while the opposite is true for cooperative activities (Fennema, 1995). Oakes (1990) reported that girls may have a greater interest in people than in things, and may respond more positively to ideas in context rather than in isolation. However, evidence shows that traditional mathematics instructors usually teach concepts in isolation.

Competitive Versus Cooperative Environments

In addition to gender differences in learning styles, evidence also shows that the traditional methods of teaching mathematics, while benefiting boys, may actually result in lower interest and performance levels for girls. Bailey (1993) found that participation in competitive mathematics activities facilitated the achievement of boys, but those teaching

strategies did not help and may, in fact, have hindered girls' achievement. In contrast, girls' mathematics achievement on both lower- and higher-level tasks was positively related to participation in cooperative mathematics activities, whereas boys' engagement in such activities was negatively related to their mathematics achievement. Different teaching strategies may also affect more than achievement. Eccles (1989) reported that females had more favorable attitudes than males towards mathematics in classrooms in which there were low levels of competition, high levels of personal contact with the teacher, and low levels of public drill and practice. Oakes (1990) found similar results: girls in competitive classrooms with frequent public criticism have more negative attitudes in mathematics than boys. In general, it is clear that competitive classroom activities appear to contribute to boys' mathematics achievement but are detrimental to girls'.

Since competitive activities are so much more prevalent than cooperative learning, conventional classrooms are more favorable to boys' learning than girls' learning (Fennema, 1995). The implication is that conventional teaching strategies lead to early gender differences in attitudes and performance, which then lead to differences in performance. Since boys and girls generally benefit from different teaching strategies, the single-sex classroom could provide an opportunity to focus on instructional strategies that will better facilitate female learning in mathematics.

The Single-Sex Setting

Reports about inequities in the coeducational classroom have sparked a rekindling of interest in single-sex schooling for girls. Single-sex education can mean single-sex schools or single-sex classes within coeducational schools. Public schools have begun to create single-sex classes for girls, often in mathematics (Campbell & Wahl, n.d.). These classes are seen as one way to address girls' lower levels of participation and achievement in mathematics.

Single-Sex Classes in Coeducational Public Schools

The potential effects that a single-sex setting might provide for females in mathematics have led some researchers and educators to suggest the implementation of single-sex classes in coeducational schools. In particular, all-girls' mathematics classes are seen by some as one possible way to promote success for females in mathematics. Numerous studies have been conducted in Australia on the single-sex classroom within a public coeducational school. The majority of girls who enrolled in single-sex mathematics classes reported increased self-confidence and more positive attitudes about mathematics. Students and teachers both reported that the classroom atmosphere changed for the better. Students had more opportunities to participate in the classroom and received more attention from teachers (Hildebrand, 1996). However, the results on achievement levels have not been strongly conclusive. The effects of a single-sex setting within a coeducational school are still not clear.

In the United States, single-sex classes within public coeducational schools are generally considered violations of Title IX. However, several public secondary schools across the nation are beginning to experiment with single-sex settings. Formal research in the United States on the specific topic of single-sex classes within coeducational schools has been limited due to lack of participating institutions. As the single-gender class phenomenon grows more popular, considerably more research will be needed in this area.

Limitations of the Current Body of Research

While there is a large body of research on the effects of single-sex education, it defies most generalizations. Results from studies conducted over the past twenty years are not strongly conclusive as to whether single-sex schools are more effective than coeducational schools in promoting mathematics achievement for girls. Lee (1998) identified the "file drawer problem" for research on single-sex schooling: studies showing

differences for single-sex education are typically the ones that are published. Journal editors are less likely to accept studies for publication that do not reveal significant effects. As a result, any literature review on the effects of single-sex education may be biased.

Another concern with characterizing the effects of single-sex education involves the difficulty in controlling for influences not directly related to the single-sex environment. The academic and developmental consequences of attending a single-sex versus a coeducational school might vary for different groups of students. The consequences of attending single-sex schools appear to be negligible for middle-class or otherwise advantaged students, while they are more significant for at-risk students, ethnic and religious minorities, females, and students from low socio-economic backgrounds (Riordan, 1998).

In addition, the majority of studies on single-sex education have been conducted with private schools. Lee and Byrk (1986) found consistent effects for Catholic schools, but Lee failed to replicate those effects in later studies involving non-Catholic independent schools. Many researchers question whether the effects found in Catholic or other private schools can be transferred to the public school setting. Some studies, such as the one conducted by Rowe (1988), do suggest that the results originally seen in the Lee and Byrk study can also occur in the public-school setting. However, researchers are far from reaching any consensus on this point. Many hypothesize that the reasons why single-sex schools reveal effects on achievement and affective variables have more to do with the schools themselves than the fact that they are single sex.

Despite the lack of conclusive evidence about the effects of single-sex schooling, there do exist many significant studies that reveal important information about the single-sex environment, and thus merit discussion. Most studies investigate whether the single-sex setting results in benefits in participation and achievement, or in affective issues such as self-esteem, confidence, and attitudes towards mathematics.

Achievement and the Single-Sex Setting

Numerous studies have found increases in achievement for females in the single-sex setting. Jimenez and Lockheed (1989) found that randomly chosen females in Thailand achieved more in the single-sex classroom than their counterparts in the coeducational setting. Lee and Byrk (1986) examined single-sex and coeducational Catholic schools in Chicago. They found that girls achieved at significantly higher levels in reading and science in the single-sex schools. Riordan (1990), examining the High School and Beyond data, found that females' achievement levels were positively affected in single-sex schools. These results remained even after adjusting for initial ability and home background.

Researchers have also found significant results in mathematics achievement. Lee, Marks, and Byrd (1994) examined single-sex and coeducational schools in Nigeria. They found that girls in single-sex schools surpassed their coeducational counterparts in mathematics achievement. The Jimenez and Lockheed (1989) study found that a Thai eighth-grade girl chosen randomly would improve her mathematics achievement by approximately 40% by attending a single-sex school. The results were particularly compelling because Jimenez and Lockheed controlled for personal background, socio-economic status, and past achievement levels. Marsh (1989) examined the transition of one Australian school from a single-sex to a coeducational environment. The teachers' perceptions were that girls' academic achievement levels in mathematics and science were higher in the single-sex setting. However, Marsh found no significant differences in achievement levels over a five year period. Another study of an Australian school found that randomly assigned girls who relocated from coeducational to single-sex classes in a public high school experienced significant gains in mathematics achievement scores (Rowe, 1988). Smith (1986) examined segregated and mixed classes over a five-year period in Britain. He found that segregated girls did significantly better on numeracy tests. However, he found no significant results for mathematics problem-solving skills.

It is clear that the results for mathematics achievement for girls in single-sex classes are mixed. Conflicting results arise from the different nature of the studies. Researchers examine different populations of students in different settings. However, the fact that numerous studies have revealed significant increases in mathematics achievement for females in the single-sex setting merits further investigation into this matter.

Mathematics Participation and the Single-Sex Setting

Researchers hypothesize that the single-sex environment may encourage girls to participate more in mathematics. Leder and Forgasz (1994) examined single-sex mathematics classes in a coeducational public high school in the United States. Students were randomly selected to attend either single-sex or coeducational classes. They found that females in the single-sex classes enrolled in mathematics courses for the following year at a rate equal to males. Their counterparts in coeducational classes enrolled at lower rates. Lee and Byrk (1986) also found that the single-sex setting yielded significant results in mathematics participation. Girls in the single-sex Catholic schools took more mathematics than those in the coeducational Catholic schools, and experienced higher educational aspirations.

Affective Issues and the Single-Sex Setting

The evidence for the effect of a single-sex setting on achievement levels for girls is conflicted and not strongly conclusive. However, the evidence for effects on affective issues is stronger. Studies of affective issues examine changes in self-esteem, confidence, sex-type stereotypes, and attitudes towards mathematics.

Self-esteem. Girls in single-sex schools typically experience higher levels of self-esteem (Sadker & Sadker, 1994). In Marsh's study of single-sex classes in an Australian coeducational high school, teachers reported that their female students in the

single-sex classes were more likely to exert themselves and exhibit strong desires to succeed. The teachers' perceptions were that girls in the single-sex setting exhibited higher levels of self-esteem in general (Marsh, 1988). Riordan (1990) found that girls in single-sex schools generally scored higher on variables such as self-concept, locus of control, and attitudes towards working women than girls in coeducational schools. However, the results are not universal. In one study of British secondary schools, no differences were found for the self-esteem levels of females in single-sex versus coeducational schools (Foon, 1988).

Confidence. Research has suggested that the single-sex setting may provide positive benefits to confidence levels for girls. Considering the significant link between confidence and achievement in mathematics, the single-sex setting's potential benefits for confidence may have far-reaching effects. Rowe (1988), in his study of single-sex classes in an Australian public school, found significant differences in confidence levels for girls in single-sex mathematics classes versus those in coeducational classes. The students were randomly assigned to single-sex classes. Rowe also found that for students in the single-sex mathematics classes, confidence was a significant predictor of achievement. Cairns (1990) found similar results in Ireland: pupils at single-sex schools experienced an increased sense of cognitive competence. One study in England reported that females in single-sex schools were more likely to rate their achievement in mathematics higher than their coeducational counterparts (Foon, 1988).

Sex-Type Stereotypes. Girls who view mathematics as an appropriate pursuit for females may be more likely to take more mathematics and achieve at higher rates (AAUW, 1992). Researchers believe that girls who attend single-sex schools may be less likely to consider science and mathematics a male domain. Shmurak (1995) examined research from Great Britain, Australia, and Canada. The studies examined indicated that

girls in single-sex schools are less likely to view mathematics and science as masculine and are more likely to enroll in these courses than girls in coeducational schools. Colley, Comber, and Hargreaves (1994) found that in younger ages, girls from single-sex schools showed stronger preferences for mathematics than girls from coeducational schools. They also found that for elementary and junior-high school students, there was less gender stereotyping of subjects in single-sex than in coeducational schools. Lee and Byrk (1986) reported that girls' school students were considerably less likely to evidence stereotyped sex role attitudes than were comparable girls in coeducational schools. Lee, Marks and Byrd (1994) found similar results in Nigeria. They reported that girls in Nigerian single-sex schools held less stereotypical views towards mathematics than girls in coeducational schools. The same trend appeared in England as well. Foon (1988) examined private schools in Britain and found that those attending single-sex schools were less rigidly attached to traditional views about the appropriateness of subject areas by sex.

Attitudes towards Mathematics. Many researchers report that girls in single-sex schools are more interested in mathematics than their coeducational counterparts (Sadker & Sadker, 1994). Gwizdala and Steinback (1990) found that female students in single-sex independent schools had a more positive attitude about mathematics and their ability in mathematics than their counterparts in mixed-sex schools. Single-sex independent schools in Britain revealed similar results: females in single-sex schools were more likely to prefer science and mathematics than their coeducational counterparts (Foon, 1988). The same pattern appears to hold for Catholic schools as well. Girls' Catholic schools evidence consistent and positive effects on student attitudes towards academics in general and mathematics in particular (Lee & Byrk, 1986).

The Nature of the Single-Sex Mathematics Class

While the general body of research on the results of single-sex education yields conflicting results, there do exist a significant number of studies showing positive effects for females in the single-sex environment. Fewer studies have been conducted examining why these results occur. Researchers are now beginning to explore aspects of the single-sex environment that may lead to positive effects for females in mathematics. Fuller (1997) observed dozens of single-sex and coeducational mathematics classrooms in four Catholic schools. She found that "In all the single-sex classes, a sort of camaraderie and high degree of comfort characterized a particular tone that was never evident in the coeducational classes I observed" (p. 244).

Single-sex classrooms may provide a different learning atmosphere from coeducational classes, one that favors female learning styles. Teachers who teach all-female classes can cater their instructional strategies to favor girls. Girls may have more chances to participate in an all-female mathematics class, and may feel more comfortable doing so. While the single-sex setting is not a panacea for eliminating stereotypes, it does provide an opportunity for teachers and students to focus on gender equity.

Benefits of a Single-Sex Mathematics Classroom

The sub-standard education girls receive in coeducational mathematics classrooms is well documented. Girls receive less attention and have fewer opportunities to participate in classrooms in which they must share the spotlight with boys. In a single-sex environment, however, girls may feel more comfortable about participating in the classroom. Many studies have shown that females in single-sex mathematics classes feel more comfortable and thus ask more questions in class than they would in a coeducational classroom (Gwizdala & Steinback, 1990; Sadker & Sadker, 1994; Streitmatter, Blair, & Morasco; n.d.). Leder and Forgasz (1994) found that girls in single-sex classes reported

feeling more free to ask questions without the fear of teasing from boys. Students also reported receiving more attention from their teacher than they received in mixed classes.

Streitmatter, Blair, and Morasco (n.d.) examined an all-girls algebra class in a public high school. Girls in the class reported feeling more confident and being able to participate more often. The teacher reported that her students were more willing to take risks and more willing to be responsible for their learning than girls in her coeducational classes. Other studies have revealed similar testimonials from students and teachers. Rowe (1988) interviewed students and teachers who participated in a single-sex program in an Australian public high school. Teachers of the single-sex classes reported that the single-sex setting provided an improved working atmosphere. Students stated that they identified more closely with their peer group in the single-sex setting. Students also reported having an easier time speaking out in class without the presence of boys. Sangster (1988) interviewed students in single-sex classes in a public high school that converted from coeducational to single sex. Female students reported improved concentration and fewer distractions in the single-sex setting. They also stated that they felt more comfortable and less intimidated in segregated mathematics classes.

Learning Environments That Encourage Females

Single-sex mathematics classes allow female students to work together in a cooperative environment. The majority of high-school girls report a strong preference for same-sex work partners and groups (Bailey, 1993; Leder & Forgasz, 1994). There also exists evidence that same-sex work groups might benefit girls. Webb (1984) examined cooperative groups of different sex ratios. She found that females were usually responsive to all other group members, regardless of sex, but males responded to other males far more often than females. The combination of tendencies for females to seek help from males and of males to ignore those requests for help often resulted in females being less successful.

Such disadvantages disappeared for females in single-sex work groups. Fuller (1997) reported that when girls were alone together, they tended to support each other. They helped one another on problems, and took the time to ensure that all group members understood before proceeding. She did not observe that level of supportive behavior in the coeducational classes.

The single-sex setting can also allow teachers to focus on instructional strategies that cater specifically to female learning styles. Gilbert (1992) writes that girls' schools offer the opportunity for girls to learn in their ways, because they can be taught with curricula and strategies that work best for girls. Rowe (1988) reported similar results. He found that teachers teaching in single-sex mathematics classes had an easier time matching curriculum content and teaching styles to specific gender-related student interests. In one study of single-sex classes in a public school, teachers reported that they worked differently with the all-girls' group than with the coeducational classes: they employed more cooperative learning procedures, emphasized the usefulness of mathematics, and provided more open-ended problems.

Perhaps most importantly, single-sex mathematics classes provide an opportunity for teachers and students to focus on equitable treatment of women. Lee, Marks, and Byrd (1992) found that fair treatment of both genders was most likely to occur in girls' schools: teachers presented content material in an unbiased manner regarding both males and females. The frequency of equitable treatment found in coeducational classes was slightly less than half of that found in girls' classes. However, it is important to realize that single-sex classes or schools may not necessarily be a panacea for eliminating stereotypes. In the same study, Lee, Marks and Byrd found incidents of sexism in 45% of the all-girls' classes, mainly initiated by the teacher. Types of sexism found in all-female mathematics classes mainly involve talking down to girls in an attempt to make mathematics more palatable. Teachers of all-girls' classes may stereotype girls by shying away from

aggressive teaching and strong academic demands, or by over-anticipating academic problems and offering help before it is requested. These types of behavior are rarely found in boys' or in coeducational schools (Lee, 1992). Fuller (1997) found evidence of all-girls' schools creating environments in which highly stereotyped behaviors appeared at rates higher than in coeducational schools.

The Need for Additional Research

Research has shown that gender differences exist in mathematics achievement, participation levels, and affective variables. Some of the causes of inequity in the mathematics classroom may exist as a result of boys and girls behaving differently and being treated differently when they are in the same classroom. The single-sex setting is one way to address this specific issue. Research has also shown that the single-sex classroom may provide benefits to females in mathematics. However, these findings are incomplete at best. While they reveal compelling evidence that the single-sex setting may benefit some females in mathematics, little is known in general about what specific benefits occur, which students benefit the most, and which settings provide the most effective atmospheres. More importantly, very little research has been conducted investigating the specific nature of the single-sex classroom. Few researchers have examined what specific elements of a single-sex mathematics classroom result in benefits to females. The AAUW Report (1992) states that:

Research studies indicate that girls often learn and perform better in same-sex work groups than they do in mixed-sex groupings. Additional research is needed, however, to better understand the specific dynamics of these interactions, particularly the circumstances under which the single-sex groupings are most beneficial. (p. 74).

The question remains, why do these benefits occur? What is it about the single-sex classroom that affects how females view mathematics? How does the all-girls' setting differ from a coeducational classroom, if at all? What sorts of interactions occur in the

classroom among the students, and between the students and the teacher? Studies that attempt to answer these questions will provide further insight into the nature of the all-girls' mathematics learning environment and may shed light on reasons behind the benefits to females in the single-sex classroom.

CHAPTER 3

Methodology

This study presents an in-depth description of the nature of one single-gender mathematics class. The study began with several questions in mind: Did the single-gender class differ from a typical coeducational mathematics class? How did the teacher and the students behave in the classroom? What was the nature of the interactions in the class? What type of mathematics learning environment existed in the classroom? How did this environment affect the students' achievement levels and attitudes towards mathematics and learning? What was the overall culture of the single-sex classroom? The researcher created a case study of one class, examining the experiences and attitudes of the students and the teacher.

The study consisted of several major components. The first was a series of classroom observations in an all-female algebra class. The classroom observations were designed to capture the nature and the frequency of interactions between the teacher and the students, and among the students. The second component was a set of two surveys administered to the female algebra students at the beginning and the end of a three-month period. The surveys gathered data on the students' attitudes towards mathematics and the single-gender setting. The third component of the study was a set of in-depth interviews with the teacher and with a subset of students from the algebra class. The purpose of the student interviews was to examine their attitudes towards mathematics and their experiences in the single-gender mathematics setting. Lastly, the researcher gathered information about the learning environment of the classroom and its effects on the students by examining the curriculum, instructional methods and materials, and achievement rates.

The study took place at a high school near a large urban area in northern California. The high school created a program consisting of two single gender academies: one for males and one for females. The program was open to all ninth grade students, but specifically targeted students who showed high academic potential while displaying difficulties in achieving academic success. Students joined the single gender academy on a voluntary basis. The program began on January 21, 1998, the first day of the second semester of the academic school year.

The female academy consisted of 21 ninth grade students. Eight students were Hispanic American, five were African American, three were East-Indian American, three were Asian American, and two were European American. With one exception, these students attended every class together as one group: mathematics, computer applications, Spanish, English, science, and physical education. The sole exception was for the mathematics class: 20 students attended the algebra class, while one student studied geometry independently.

Classroom Observations

Although the all-female algebra class began on January 21, the classroom observations did not begin until March 10. Students experienced an instructor change during the semester. The first teacher instructed the students from January 21 until March 8. The second instructor began teaching on March 9. Due to the change of instructor, the class experienced a new beginning on March 9. The methods of instruction changed as well as the classroom rules and grading procedures.

Initially, the nature of the study was discussed with the classroom teacher and the administrators in charge of the program. On the second day of observation, the researcher explained the purpose of the study to the students. The observation portion of the study consisted of thirty-three classroom observations that spanned a period of twelve weeks.

The majority of the observations occurred in blocks of three days: Tuesday, Wednesday, and Thursday of each week. The observations continued until the last day of instruction, which occurred on June 5, 1998.

The data from the first seven days of observation consisted of detailed notes about the curriculum, instructional strategies, and conversations that occurred in the classroom. The researcher recorded in writing conversations that occurred among the students and between the students and the teacher. The data from the remaining twenty-six days of observation consisted of these notes in conjunction with student-teacher interaction codes. The interaction codes recorded the nature and the frequency of interactions that occurred between the students and the teacher. The first five codes are adapted from Stallings, Needels, and Sparks (1987). This instrument was chosen due to its reputation as an excellent vehicle for recording classroom interactions (Wilson & Hart, in press). It allows the researcher to study the quality of classroom discourse and determine which students participate most often in the class discussion, which students say little or nothing, which students are most likely to be called on by the teacher, and which students seek out or avoid interactions with the teacher. This instrument allows the observer to record the number and type of interactions the teacher has with the entire class as well as with individual students. The remaining six codes were created after the first two days of coding interactions, to better capture the nature of interactions that occurred in this particular classroom. The eleven codes are defined as follows:

<u>Code</u>	<u>Meaning</u>
?	Knowledge-level question (direct question): Requires students to recall facts. <i>Example:</i> What is the result when we divide each side by $2x$?
√	Check for understanding: Requires students to show they understand the content or procedures of the lesson. <i>Example:</i> What is wrong with this procedure?

- H** **Higher cognitive questions:** Requires students to think, apply, interpret, analyze, create, or evaluate.
Example: What reasoning did you use to solve that problem?
- **Reprimand:** Teacher reprimands behavior.
Example: Janice and Sophia, please stop talking!
- +** **Praise or acknowledgment:** Teacher praises or acknowledges students' academic responses, actions, or behaviors.
Example: That is correct. Great job!
- *** **Student-initiated comment:** Student initiates a comment to the teacher.
Example: These problems are fun, I hope we do more tomorrow!
- a** **Student answer:** Student answers a teacher-generated question.
Example: The answer is 46.
- a+** **Answer and feedback:** Student answers a teacher-generated question and receives praise or acknowledgment.
Example: Student: The answer is 46. Teacher: That is correct!
- aC** **Answer and correction:** Student answers a teacher-generated question incorrectly, and the teacher corrects the answer.
Example: Student: The answer is 46. Teacher: That is not quite right; remember that we must still divide by 2.
- *A** **Student-initiated question and answer:** Student initiates a question and the teacher provides an answer.
Example: Student: Why did you invert the fraction? Teacher: Because the exponent is negative.
- *I** **Student-initiated question and no response:** Student initiates a question and the teacher ignores the student.
Example: Student: Why did you invert the fraction? (Teacher ignores).

The observer used these eleven codes to record each interaction that occurred in the classroom. Each day, the codes were recorded in a seating chart to keep track of the students' participation levels. The seating chart was designed so that the teacher's comments to the entire class were differentiated from comments to individual students. A typical seating chart is shown in Figure 1:

Figure 1

Typical Seating Chart

<u>Whole Class</u> -----? - ??? - ????? + ?? √ ?? - ???					
<u>Mindy</u> a a a aC a	<u>Adelle</u> a ? a a --	<u>Ming</u> ---	<u>Peg</u>	<u>Marcy</u> a a a ? ?	<u>Tamara</u> -- *A *I aC
<u>Rayanne</u> - *A *A a *I		<u>Sally</u> *A a+ a a+ a+ a+ a a a	<u>Nadine</u>	<u>Estrella</u> --	
<u>Betty</u> -	<u>Ana</u> *A *A *A *I *A a a ? a		<u>Jamie</u> --- a *A -	<u>Stacy</u> --	<u>Ariana</u> *A *A a a aC
<u>Jennifer</u> a a+ a	<u>Marbella</u>	<i>Note: Brigitte, Luisa, and Rosa absent</i>			

The results from each day's interactions were then compiled into a table. Since interaction codes were recorded on twenty-six days, twenty-six individual interaction tables were compiled. However, the first four tables were not as accurate as the last twenty-two tables due to the fact that the researcher had not learned every student's name. Therefore, only the last twenty-two tables were used for data analysis (Appendix C). Each table followed the format shown in Table 1:

Table 1

Sample Interaction Table

	a	a+	aC	*	*A	*I	?	-	+	√	H	Total
Whole Class												
Adelle												
Ana												
Ariana												
Betty												
Brigitte												
Estrella												
Jamie												
Jennifer												
Luisa												
Marbella												
Marcy												
Mindy												
Ming												
Nadine												
Peg												
Rosa												
Rayanne												
Stacy												
Sally												
Tamara												
Total												

Student Surveys

The students were recruited for both surveys in their algebra class. The researcher explained the nature of the surveys during the class period, and the students then participated in the survey on a volunteer basis. Each of the students and one of their parents read and signed a consent form before participating in the study. The researcher administered both surveys during the first ten minutes of the class period.

The first survey was administered on March 19, 1998 (Appendix A). Nineteen of the twenty algebra students responded to the survey. The survey was designed to identify students' reasons for participating in the single-gender academy, their attitudes and experiences surrounding the Algebra class, and their attitudes towards mathematics in

general. The questions on the first survey were repeated in the student interviews and on the second survey to test their reliability. After the students completed the first survey, the results from the survey were compiled and broken into categories. Students were placed into different categories based on their responses to questions about their attitudes towards mathematics. These categories were later used to select students for follow-up interviews.

The second survey was administered on June 5, 1998 (Appendix B). Fifteen students responded to this survey. The survey was designed to follow up on the students' experiences surrounding the single-gender mathematics class. In addition, the second survey repeated some of the questions asked on the initial survey regarding students' attitudes towards mathematics. These questions were repeated to identify any changes that might have occurred throughout the semester.

Interviews

Student Interviews

A subset of the students who responded to the initial survey was chosen for the interview process. The interview subjects were chosen based on their responses to the initial survey, their behavior during the classroom observations, and their academic performance in the mathematics class. The researcher chose nine students for the interviews. Two students received high grades in the mathematics class, responded with positive remarks about mathematics on the initial survey, and participated often in the classroom. Three students responded with neutral to positive remarks about mathematics on the initial survey, participated rarely in the classroom, and received average to poor grades in the mathematics class. One student responded with neutral remarks on the initial survey, participated often in the classroom, and struggled academically. Three students responded with negative remarks about mathematics on the initial survey, rarely participated in the classroom, and struggled academically. These students were chosen to

represent a broad cross-section of attitudes towards mathematics, behavior in the classroom, and academic achievement. Four students were Hispanic American, two students were Asian American, two students were African American, and one student was European American.

Each of the students was asked the same questions in the interview. The goal of the interview was to explore the students' experiences surrounding the single-gender mathematics setting, and to determine the nature of their attitudes towards mathematics in general. The questions were drawn from primarily two sources. Gwizdala and Steinback (1990) surveyed students from an all-female high school and an all-male high school. They explored the students' attitudes towards mathematics and the single-gender setting. Ehlers (1997) interviewed high-school females to determine students' experiences in mathematics and their attitudes towards mathematics. The concepts from both of these sources were incorporated into the present interview. The questions were reorganized for the purposes of this study and to respond to this particular environment. Additional questions were asked that pertained particularly to the single-gender academy and the nature of this particular mathematics class. The researcher used the script below for the interview:

1. What do you like about this math class?
2. What would you change about this class if you could?
3. Is this class any different from your previous math classes? How is it different?
4. Do you enjoy learning math in an all-girls' class?

Prompt: What is it about the all-girls' setting that you like or dislike?

5. Describe yourself as a student.

Prompts:

- Do you like working alone or with your peers?
- Do you prefer to listen to the teacher explain things or do you like to try it on your own?
- What would you do if you were given a math problem and you didn't know how to do it?

6. Do you feel like you are good at math? Why?
7. When you do a math problem, how sure are you that it is correct?
8. Do you think you will do well in your next math class?
9. How confident are you about your abilities in math?
10. Do you enjoy math? Why or why not? When did you start enjoying it?
11. Have you ever noticed differences between boys and girls in your math classes?
12. Do you think math is a subject for girls?
13. Do you think math is a worthwhile subject? Is it worth learning?
14. Do you plan to take more math after Geometry? Why or why not?
15. Describe how a person might use math in a normal workday.
16. Do you think you will use math in your own career? How?
17. Describe a typical day in your current math class.

- Prompts:*
- What does the teacher do?
 - What do the students do?
 - How much time is spent with the teacher lecturing?
 - How much time do you spend doing activities?
 - What kinds of activities do you do in class?

18. Why did you decide to join the single-gender academy?

The interviews were conducted during the last few minutes of the algebra class, or directly after the algebra class during the students' lunch period. Each interview was recorded on audio tape and labeled with the student's pseudonym. After each interview was completed, it was transcribed. The researcher then summarized each of the interviews by sorting the experiences and attitudes described by the students.

Teacher Interview

The teacher participated in an interview on the last day of the semester. The purpose of the interview was to explore the teacher's experiences with the single-gender

mathematics classes, and to determine his attitudes about teaching, his students, and the single-sex setting. The teacher taught both the female algebra class and the male algebra class. The questions for the teacher's interviews are original. The following script was used for the interview:

1. How many years have you been teaching?
2. How long have you been teaching at this particular high school?
3. How long have you been teaching Algebra?
4. What is your age?
5. What is your educational background?
6. Why did you agree to teach in the single-gender academy? What interested you about it?
7. What were your expectations for how the class would go? Have they been fulfilled?
8. How do you feel the class went? What were your successes, and what were your challenges?
9. Is there anything you would do differently if you had to do it all over again?
10. Will you teach in the single-gender academy again? Why or why not?
11. Describe your teaching techniques used in the female class.
12. Describe your teaching techniques used in the male class.
13. Describe the curriculum you covered in the female class and in the male class.
14. Describe your assessment techniques used in the female class and the male class.
15. Do you think there were any differences in the ways the girls behaved versus the boys?
16. Were there any differences in the classroom atmosphere of the two classes?
17. Did you attend the gender equity workshops?
 - What were the key ideas?
 - Have you had any other exposure to equity issues through reading, news, staff meetings, etc.?
 - Has this affected your teaching? If so, how?

18. Do you think the single-sex setting had any effect on the students' behavior or attitudes?
19. Did the fact that you were teaching single-sex classes affect your own attitudes or pedagogy in any way?
20. As a result of this experience, what is your opinion on the single-sex setting? Do you think it makes a difference in the educational experience?
21. Identify the two or three strongest students in the class, and the two or three weakest.

The teacher's interview was recorded on audio tape and then transcribed. The responses to the interview questions were then compared to the classroom observation data.

Artifacts Collected

In order to better examine all aspects of the students' learning experience, the researcher collected several artifacts throughout the observation period. First, all assessment instruments were collected. The instructor assessed the students' comprehension and performance primarily through chapter quizzes and tests. The researcher collected every quiz and test, as well as the final exam. The instructor also provided students with worksheets for practicing newly learned skills. All worksheets were collected, and student work was reviewed on several worksheets periodically throughout the observation period. Finally, the instructor allowed the students to practice their skills on an algebra program designed for IBM-compatible systems running DOS 3.0. The program, called "Beginning Algebra Computer Lab," provided students with practice problems in basic algebra. The researcher collected student work from the computer program and explored the different levels of the program.

Data Analysis

After the end of the semester, the researcher analyzed the data in several different stages. The observation data for each day were compiled into individual tables at the end of

each class period (see Appendix C). At the end of the semester, the twenty-two observation tables were compiled into one total table. The researcher did not combine the individual tables until after the observations were completed, in order to avoid bias during data collection. Total interactions and the relationships between different types of interactions were examined over the entire semester. Data analysis also included an exploration of the interaction patterns over time for each individual student.

The results from each of the two surveys were compiled and compared to one another to detect similarities and differences between the first and second survey. When available, the results from the surveys were also compared to the interview responses for individual students. The researcher also gathered the interview data from each of the nine students and compared the different responses question by question, in order to determine overall trends and attitudes among the students interviewed. These responses were also compared to the teacher's interview responses.

The last stage of the data analysis involved an examination of the data as a whole for each individual student. The researcher gathered the notes from classroom observations, the interaction data, the survey responses and the interview responses for each student. The students were then grouped together according to survey responses, and the other data sources were examined to detect possible similarities in classroom behavior and interactions patterns.

CHAPTER 4

Results

This chapter is organized in such a manner that the reader may gain insight into the nature of the mathematics class, the students, and the teacher. What follows is a detailed description of the classroom atmosphere and the students. The data are arranged in four different categories: the nature of the classroom, the surveys, differences between the single-sex setting and a typical coeducational setting, and the effect of the single-sex setting on different types of students.

The nature of the classroom describes the students and the teacher, the physical setting, reasons for joining the single-gender academy, the curriculum, and the instructional and assessment methods, as well as providing a general overview of the interaction patterns that occurred during the observation period. The surveys show the overall results from the first and second surveys. The description of how the single-sex class differed from many coeducational classrooms discusses the cooperative nature of the class, the social atmosphere among the students, and the interaction patterns between the students and the teacher. The description of the different types of students provides sample student profiles, as well as examining how different groups were affected by the nature of the single-sex setting.

The Nature of the Classroom

The Students and the Teacher

The mathematics class met daily from 11:26 to 12:22. The school occasionally operated on an alternate schedule to accommodate extra-curricular activities, and during the 33-day observation period, two observation days occurred during an alternate schedule. The mathematics class consisted of twenty female students. These twenty students

remained constant throughout the semester; there were no additions to the class and no students left the class. Eight students were Hispanic American, five were African American, three were Asian American, two were East-Indian American, and two were European American. The instructor was a twenty-five year old Asian-American male. The year the study took place constituted his first year as a full-time teacher. During the previous year, he taught algebra on a part-time basis. Before the implementation of the single-gender academies, the school hosted two workshops on gender equity. Attendance was voluntary, and the teacher did not attend the workshops. He had not experienced any exposure to or education regarding issues about single-sex education.

A variety of students attended the single-gender academy. Because the academy was directed towards students with high academic potential who had difficulty succeeding academically, many students in the class did not identify themselves as high achievers. However, the mathematics class did consist of a wide range of abilities and experiences. Several students had already taken algebra in junior-high school and were repeating the course. Some students excelled mathematically and earned high grades in the class. Others had not passed the first semester of algebra and struggled with the content during the second semester.

The teacher entered the program with pre-conceived notions about the nature of the students. He made the following comments about his expectations of the students during the interview:

Well, I had got information about what I was getting, so I kind of knew what to expect. Very low level in the math portion. Discipline problems. Problems outside of the classroom, at home. So I -- much of what I expected was pretty true.

Before the instructor began teaching in the program, the students already possessed a reputation among the teachers in the mathematics department. They were characterized as students with academic and discipline problems. While these assumptions were true for many students in the classroom, they did not apply to all students.

The Physical Setting

The female students attended every class together as one group: mathematics, computers, Spanish, English, science, and physical education. The girls were assigned to a portable classroom and attended mathematics, computers, Spanish, and English in this one room. During the mathematics class, students sat in individual desks and did not sit according to a seating chart. Students chose different seats on different days. There were 22 individual student desks in the classroom and one teacher's desk. The student desks faced the teacher's desk and the white board at the front of the room.

The room also contained 13 Macintosh computers and one printer. The computers were lined up against two walls of the rectangular room. The nature of the room's decorations changed throughout the semester. While it was rather barren and empty during the first few weeks of the semester, it became more welcoming and vibrant as the weeks passed. Student work appeared on the walls, as well as additional posters and decorations. The majority of the posters and student work came from the English and Spanish classes. However, two posters about mathematics, created by the students, did appear on the walls before the end of the semester.

Many of the students stated in the surveys and the interviews that they did not like remaining in one room all day, and they did not like having every class with the same group of students. The students and the teacher alike viewed that aspect of the program as a significant disadvantage. Ming (not her real name) stated in the initial survey that being with the same group all day was "boring and a waste of time. Being in the same class with the same girls really gets on your nerves." One student discussed her feelings about being in the same classroom during the interview by stating that "I'm tired of being in the same class." When asked about staying in the same classroom, she explained further:

You see the same people the whole day, so like -- I don't know, sometimes we get

on each other's nerves and...There used to be, like, in the beginning there used to be a lot of fights or whatever. With the girls and stuff.

The instructor expressed similar views about the students staying together all day in one classroom:

Well, part of it is, I think, having them stay together is really rough on them ... Having them come to the same classroom is very difficult. They tend to get really territorial about their equipment, their materials, their classroom. And I just think seeing each other all day is just not healthy for most of them. They need a change of scenery I think.

Reasons for Joining the Single-Gender Academy

Attendance in the single-gender academy was voluntary. The first survey asked students to state their reasons for joining the single-gender academy. The majority of the students joined because they were forced to join by their parents. However, these students also stated other reasons for joining, such as the desire to get better grades, learn more, or be with their friends. Table 2 summarizes the students' reasons for joining the program:

Table 2

Reasons For Joining the Single-Gender Academy

<u>Reason for Joining</u>	<u>Students citing this reason</u>
My parents forced me to join.	7
I want to get better grades.	7
I think I will learn more in the single-gender academy.	4
I desire a new learning experience.	4
I want to be with my friends.	2
I want a better schedule.	2
I want access to better classes.	1
I didn't like my old teachers.	1
I want to be with only girls.	1

Several students provided more than one reason for joining the academy, and thus the total adds up to 29 instead of 19. Only one student mentioned the all-girls nature of the program as her specific reason for joining. The table also shows that many students expected that they would receive a better education in the single-gender academy. Students expected their grades to improve, they expected to learn more mathematics, and they expected to receive more attention from the teacher. The program was advertised to students and parents as one that would provide extra academic support and guidance. The single-gender academies enjoyed funds that allowed the purchase of new computers and other equipment. The students in the single-gender academies also attended field trips that the rest of the school did not attend. As a result, the academy was attractive to many students for several reasons beyond the all-girls nature of the program.

The teacher's participation in the academy was also voluntary. He took over the position from another mathematics teacher five weeks into the program. The previous teacher did not interact well with the students, and neither the students nor the teacher enjoyed the experience. The students decided to lobby for a new mathematics teacher, and after five weeks with the initial teacher, the administration agreed to provide the students with a new teacher. The program coordinators attempted to make the single-gender position more attractive to potential teachers by providing them with only four classes instead of the standard five. During the teacher interview, the teacher gave the following reasons for joining the academy:

A part of the reason was they needed someone, needed someone to fill in. No real reason, I don't think. Just maybe something new. Only four classes had a little bit to do with it. Had the extra resources, it was kind of nice. But, just almost an experiment. Curious.

While the teacher characterized his time in the single-gender academy as a learning experience, he does not plan to continue in the program after the end of the school year. The teacher feels that his expectations were not met regarding the positive nature of the

single-gender academy. He found the schedule difficult, and did not enjoy the fact that the students remained in the same classroom all day.

Curriculum

The instructor used the text *Merrill's Algebra I: Applications and Connections* (Foster, Winters, Gell, Rath, & Gordon, 1995). He also used review and practice worksheets from the same text. In addition, he occasionally assigned worksheets from *Algebra with Pizzazz!* (Marcy & Marcy, 1984). All other assignments, tests, and quizzes were of the teacher's own creation.

The instructor presented the following topics during the thirty-three days of observation:

<u>Date</u>	<u>Topic</u>
3 / 10	Graphing linear equations
3 / 11	Solving systems of equations by graphing
3 / 12	Solving systems of equations by graphing
3 / 17	Solving systems of equations by substitution
3 / 18	Solving systems of equations by addition and subtraction
3 / 19	Review of solving systems of equations
3 / 23	Solving systems of equations by multiplication and division
3 / 24	Solving systems of equations by multiplication and division
3 / 30	Laws of exponents
3 / 31	Simplifying polynomials using laws of exponents
4 / 1	Simplifying polynomials using negative exponents
4 / 2	Scientific notation
4 / 6	Degree of a polynomial
4 / 7	Degree of a polynomial

4 / 8	Simplifying polynomials
4 / 22	Adding and subtracting polynomials
4 / 23	Multiplying a monomial by a polynomial
4 / 27	Multiplying polynomials
4 / 29	Review of adding, subtracting, and multiplying polynomials
5 / 5	Raising a polynomial to a power
5 / 6	Exam (no new material)
5 / 7	Exam (no new material)
5 / 8	Prime factorization
5 / 12	Factoring binomials
5 / 13	Factoring binomials
5 / 21	Factoring perfect squares and differences of squares
5 / 26	Factoring trinomials
5 / 27	Solving equations by factoring
5 / 28	Review of factoring techniques
6 / 1	Exam (no new material)
6 / 3	Review of laws of exponents and simplifying polynomials
6 / 4	Review of factoring techniques
6 / 5	Review of factoring techniques

The instructor had planned to present more topics than the above, but claimed that he did not have enough time during the semester to finish the assigned curriculum. During the interview he discussed the time limitations:

I didn't cover everything we were supposed to cover. Coming in, the class was already way, real far behind. So I had to pick up, and actually go back a little bit further. We covered maybe a little more than half of what we were supposed to, maybe two-thirds, maybe not even that much. They were supposed to get solving systems of equations, which we covered. Also laws of exponents, multiplying polynomials, and then solving equations by factoring. What we didn't get to was

square roots, rational expressions, and the quadratic formula. So we only covered maybe two-thirds of what we were supposed to.

Assessment

The instructor assessed students primarily through chapter quizzes and tests. He assigned either a chapter quiz or a test every Friday. The teacher also collected homework, which he assigned on a daily basis, every Friday. Every day, during the first few minutes of class, he would check the students' homework individually and stamp it if the homework looked completed. He would then collect the week's worth of homework assignments on Friday and grade them for accuracy.

During 32 of the 33 observation days, the only methods of assessment observed were tests, quizzes, and homework. During one day, the students did attend a computer lab and practice simplifying polynomials on the computer. The instructor recorded a grade at the end of the class based on whether the students had finished the program. Otherwise, the teacher did not check student work during the class period and he did not assign any projects. All student work that he collected and graded was individual work. When asked to describe his assessment techniques, the teacher stated that he used a variety of methods: "Chapter tests, chapter quizzes, I'm going to have a final exam, we had small projects, class work, computer lab one day, homework. Also their notebook will get graded. Activities in class." When asked about the activities and small projects, the teacher stated that he had assigned projects during the first semester (before the single-gender academy began), but did not have time to do so with the all-girls' class.

Instructional Methods

Throughout the 30 observation days during which the students were not taking exams, the teacher instructed the students to work individually or in groups for three days. On those three days the students worked on their homework assignment, which was either

a collection of problems from the text or a practice worksheet. For one day, students worked in the computer lab doing drill problems. During the remaining 26 days, the teacher presented a new lesson at the board in a large-group lecture format. Every time the students were introduced to a new topic, it was through the whole-group lecture format.

The typical class began with the teacher checking students' homework at their seats and stamping it. He would then ask the students if they had questions from the previous night's homework. If so, he would illustrate a few examples on the board from the homework problems for the entire class. The teacher would then introduce a new topic at the board. He required the students to take notes during his lecture. The teacher's typical lecture style involved asking a series of short, knowledge-level questions to the entire class. He did not call on students individually or require students to raise their hands to answer questions. The teacher typically finished his lecture 10 minutes before the end of the period. He would then allow the students to work individually or together on their homework problems. However, the majority of the students preferred to use this time for social activities.

As seen in the interview, the teacher entered the class with very low expectations for his students. He did not expect the students to possess high-level mathematics skills or abilities, and his instructional strategies appear to have been affected by this expectation. The level of problems introduced in class and assigned to the students were always the lowest available in the textbook, even though several students completed the problems with ease and appeared to crave more challenging work. The students did not have access to graphing calculators or computer-related technology. New concepts were introduced in an abstract, algorithmic manner, without multiple representations or higher-level extensions. When presenting new concepts, the teacher provided abstract rules for the students, often stating the rules and definitions in formal terms before doing specific examples. He did not employ any discovery teaching methods or focus on allowing the students to create their

own rules. The teacher focused on abstract mathematics and avoided discussing practical applications, rather than presenting new concepts in the form of real-world problems.

Interaction patterns

The number of students who answered questions, asked questions, and received praise and criticism from the teacher was recorded for 26 days. Because the students did not have a seating chart, the first few days contained data that were not as reliable as the days after which the observer learned every student's name. As a result, only the last 22 observation days were used for the final analysis. Table 3 shows the interaction totals over the entire semester (names shown are not students' real names). The codes "a", "a+", and "aC" refer to student responses to the teacher's questions. Codes "*", "*A", and "*I" refer to student-initiated interactions, and "?", "-", "+", "√", and "H" are teacher-initiated interactions, either academic or disciplinary. See page 29 for a more complete description of the codes.

Table 3

Interaction Totals for 22 Days

	a	a+	aC	*	*A	*I	?	-	+	√	H	Total
Whole Class	0	0	0	0	0	0	728	238	6	6	0	978
Adelle	59	8	6	0	31	0	3	2	0	0	0	109
Ana	163	29	11	1	21	9	3	8	2	0	0	247
Ariana	50	5	15	0	48	4	8	23	0	0	0	153
Betty	3	0	0	0	3	1	0	25	0	0	0	32
Brigitte	2	0	0	0	1	0	0	1	0	0	0	4
Estrella	4	0	2	0	5	2	1	19	0	0	0	33
Jamie	49	11	6	0	20	5	2	19	0	0	0	112
Jennifer	34	7	10	3	30	7	4	53	0	0	0	148
Luisa	88	5	4	0	9	0	0	1	0	0	0	107
Marbella	0	0	0	0	0	0	0	9	0	0	0	9
Marcy	29	6	0	0	2	1	0	1	0	0	0	39
Mindy	66	6	6	0	0	0	2	2	1	0	0	83
Ming	30	4	3	2	18	2	8	10	0	0	0	77
Nadine	17	1	1	0	16	3	0	13	0	0	0	51
Peg	1	1	0	0	0	0	0	0	0	0	0	2
Rosa	2	0	0	0	2	0	0	1	0	0	0	5
Rayanne	23	0	1	0	3	0	1	0	0	0	0	28
Stacy	5	0	1	1	11	0	1	7	1	0	0	27
Sally	9	2	1	1	20	7	6	17	2	0	0	65
Tamara	12	0	1	0	3	0	1	15	0	0	0	32
Total	646	85	68	8	243	41	768	464	12	6	0	2341

The teacher's practice of asking a large number of knowledge-level questions (?) is clear from the table above. While he asked 768 knowledge-level during the 22 observation days, he asked only 6 checking-for-understanding questions and he did not ask a single higher-cognitive level question. Also, the table shows that the teacher did not use praise or positive reinforcement as a common teaching technique. While he made 464 negative or disciplinary comments during the observation period, he only made 12 positive comments.

The students were highly active during the observation period. They asked a total of 243 questions and answered 646 questions. These interactions reveal only the dialogue

between the students and the teacher. They do not include the dialogue that occurred among the students, which was abundant every day.

Figure 2 provides a visual representation of the teacher-student interaction totals for the 22 observation days by student:

Figure 2

Teacher-Student Interaction Totals

As the chart shows, there was a wide variety of participation levels among the students. However, one does not see a pattern in which only one or two students dominate the conversation at the expense of the rest of the class. Half of the students interacted more than 50 times during the observation period, an average of more than twice a day. The dramatic differences in participation rates are mainly due to the fact that all participation in

the class was voluntary. The teacher did not call on specific students. Instead, he asked general questions to the entire class, and any student who wanted to answer did so without raising her hand. Every voluntary student answer was coded, even if more than one student answered the same question. Most of the questions the teacher asked received responses by several students at one time.

Some students attended class more often than others, and thus the interaction totals are slightly skewed due to attendance differences. (See Appendix C for attendance records). A few students were absent from class fairly often, and this pattern of absenteeism grew throughout the semester. More students missed class more regularly during the last few weeks of the term than earlier in the semester. Figure 3 adjusts for the number of days a student was present and shows the number of average daily interactions. The differences are slight and the general overall pattern is the same.

Figure 3

Average Daily Interactions

Not surprisingly, students who received positive interactions from the teacher appear to be more likely to voluntarily participate in class, as seen below. Ana received the highest number of positive comments, and also participated the most often in class. Other students who receive a high number of positive comments, such as Adelle, Jamie, Jennifer, and Mindy, among others, also participated often in class. Figure 4 shows positive interactions versus student participation:

Figure 4

Positive Interactions and Student Participation

However, the converse is not true. Students who received negative interactions from the teacher were not necessarily the same students who did not voluntarily participate in class. The figure below shows negative interactions. Jennifer received the highest number of negative comments from the teacher, but she was also one of the top six students who initiated interactions with the teacher. Ariana received the third highest number of negative comments, but initiated more interactions than any other student except Ana. The amount of attention received from the teacher appears to be the most important factor determining how often a student interacted in class, regardless of whether the attention from the teacher was positive or negative.

Figure 5

Negative Interactions and Student Participation

First Survey

The first segment of this study consisted of the administration of the first survey on March 19, 1998. Nineteen students responded to the survey (Appendix A). The results are shown in Table 4. Below each underlined question, the left column shows student responses and the right column shows the number of students citing each particular response.

Only four students stated that they liked or loved mathematics, and many did not think that the all-girls class would be any different from other classes. However, a

majority of respondents (ten students out of fifteen who answered the question) stated that they enjoyed learning mathematics in an all-girls setting. Surprisingly, fifteen out of the sixteen students thought mathematics was a subject for females (or both females and males). The students appeared to be self-aware and have some knowledge of gender-related issues in mathematics. One student stated that "it was tested that boys tend to do better in math, but I know a lot of girls better than boys in math."

Two-thirds of the responding students considered mathematics useful in their everyday lives. The most common examples of how one would use mathematics involved issues with money, shopping, taxes, and accounting. Self-rated measures of ability and confidence revealed mean scores slightly higher than average. While these results are interesting, they are not conclusive due to the small sample size.

Table 4

Initial Survey Results

How do you think this class will be different from your other math classes?

I don't think there will be any difference.	7
I will get more attention from the teacher.	7
I think I will learn more.	2
This class will be easier to understand.	2
I will be more comfortable due to the lack of boys.	2
The material will be easier.	1

Do you enjoy doing math?

I dislike math.	8
I hate math.	4
I like math.	3
I sort-of like math.	3
I love math.	1

Do you like learning math in the all-girls class?

Yes	10
No	5
It Doesn't matter	3

Are there any things you do not like about the all-girls math class?

It is boring being with the same people all day.	6
There is nothing I don't like.	5
I am learning things I already know.	1
I don't like my classmates.	1
I don't like the competition.	1
I miss having boys around.	1

Is math is a subject for boys or for girls?

For both	13
For girls	2
For boys	1

Do you think math is useful?

Yes	10
No	5

Students were asked to rate their ability in mathematics on a scale of 1 to 5.

Mean:	3.05
Standard Deviation:	1.25

Students were asked to rate their confidence in mathematics on a scale of 1 to 10:

Mean:	5.61
Standard Deviation:	2.79

Second Survey

Fifteen students responded to the second survey, conducted on June 5, 1998, the last day of instruction (Appendix B). Every student who completed the second survey also completed the first, so a total of fifteen students responded to both surveys. The results are shown in Table 5. While only 33% of the students in the initial survey thought that the all-girls class would be no different from previous mathematics classes, 50% of those responding to the second survey thought that the class had been no different from others. Thirty-three percent of the exit survey respondents listed the major difference as a better teacher, while those in the initial survey listed the major difference as more attention from the teacher. Forty-two percent of the students on the initial survey expressed a dislike for mathematics, and that percentage grew slightly to 53% on the exit survey. However, the smaller number of students responding to the exit survey may account for this slight difference. While 56% of the students initially stated that they liked the all-girls math class, only 43% of the students still stated positive remarks about the all-girls class on the exit survey.

Students still overwhelmingly stated that mathematics was for girls (or for both genders) on the second survey. Most still stated that mathematics was useful and 13 out of the 14 respondents planned on taking more mathematics in the future. The self-rated ability mean increased slightly from 3.00 to 3.05. The confidence mean increased from 5.61 to 6.93. However, these changes cannot be deemed significant due to the small number of respondents both times, and the lower number of respondents in the second survey.

Table 5

Final Survey Results

How is this class different from your previous math classes?

There is no difference.	6
The teacher was better.	4
The teacher had no disciplinary control.	1
I could understand math this time.	1

Do you enjoy doing math?

No	8
Sort-of	4
Yes	3

Reasons for liking or disliking mathematics:

I don't understand math.	4
I find math easy.	2
I'm not good at math.	1
I think math is boring.	1
Math is a waste of time.	1

What did you like about learning math in an all-girls class?

Nothing / I didn't like it.	8
You get more help and attention.	3
There were no distractions.	2
It didn't make a difference.	1

What would you have changed about this class?

The classroom atmosphere (poor discipline).	4
I would have changed nothing.	4
Better explanations and teaching techniques.	2
I would have changed everything.	1

What would you have changed about this class (continued)?

I would like more worksheets.	1
I would like less homework.	1
I would have preferred different people.	1

Is math is a subject for boys or for girls?

Both	9
Neither	1
Boys	1

What subject did you enjoy most?

Science	7
English	3
Math	2
Spanish	2
P.E.	1
None	1

Do you plan on taking more math in the future?

Yes	13
No	1

Reasons for taking more mathematics:

To get into college.	5
I need it to graduate.	4
For my career.	1
To get ahead in school.	1
Because I understand it.	1

What do you see yourself doing for a living when you are 30?

Doctor	4	Math teacher	1
Don't know	1	Interior Decorator	1
Model	1	Psychiatrist	1
Accountant	1	Own a restaurant	1
Lawyer	1		

Students were asked to rate their ability in mathematics on a scale of 1 to 5:

Mean: 3.00
Standard Deviation: 1.51

Students were asked to rate their confidence in mathematics on a scale of 1 to 10:

Mean: 6.93
Standard Deviation: 3.26

How Did the Single-Sex Setting Differ from a Coeducational Classroom?

The first significant goal of this study was to provide an in-depth description of the nature of the all-female mathematics class. The observations were conducted with several questions in mind: Did the students behave any differently than girls usually behave in a coeducational classroom? Were there any differences in the way the students worked together? Was the energy level or assertiveness level of the students noticeably different from what one would see in a coeducational class? How did the students behave towards one another socially and academically? How did the teacher behave towards the class as a whole and towards the individual students?

The classroom observations, student surveys, student interviews, teacher interview, and interaction data combined to provide insight into the above questions. Taken together, the different groups of data reveal noticeable trends in the behavior of the students and the class as a whole. Several patterns were discernible in the data. The

classroom atmosphere was cooperative in nature rather than competitive. The social atmosphere among the students also revealed some interesting features: students were eager and willing to help one another academically, they felt free to ask questions and admit their confusion to the class without fear of ridicule, and they demonstrated an attitude of patience and caring with their peers' struggles with the content. Whenever possible, the researcher used data from different sources to support these same conclusions.

The Cooperative Nature of the Classroom

The cooperative nature of the students became clear largely through the observation data. Students also made comments on the surveys that supported the results seen in the observation data, and the teacher's comments in his interview supported these results as well. The students demonstrated cooperative behavior in several ways. They showed evidence of sharing, supporting autonomy, cooperative work habits, positive reinforcement towards one another, a group identity, and non-competitive behavior regarding grades. Many of the examples from the data shown below could support several different categories; several descriptions, for example, reveal students behaving cooperatively while supporting one another's autonomy and providing positive reinforcement. The selected descriptions and quotes shown below are just a few representative samples of the data available.

Sharing. Examples of students sharing with one another appeared in the observation data. Below are instances in which the students demonstrated sharing behavior, and the dates during which these examples occurred in the classroom. These examples are quoted as they appeared in the observation data:

3 / 12 The teacher broke students into groups and assigned one group to work on the computers while the remaining groups were supposed to work on algebra homework. The groups took turns working on the computers. Students who worked on the algebra homework provided assistance to one another, helping each other with problems. There was no evidence of a rush to finish before the

other group members. Students who were on the computers were happy to relinquish their time to the other groups when their turn was up.

- 6 / 1 Students worked on the computer and shared the computer time equally. There were no instances of one student doing all of the work while another looked on. Students who worked on handwritten projects shared the work equally -- all students in the group were actively engaged. I did not see any instances of participant versus observer -- all students participated. Nobody dominated.

The classroom observations revealed many instances in which students yielded time, materials, resources, and technology to one another. There were no instances of one student dominating resources while others looked on during the thirty-three days of observation. While the students did not appear to be possessive of their materials or space with one other, they did demonstrate possessive behavior as an entire group against outsiders. For example, on April 1 and May 13, the students did not want to allow the boys to enter "their" classroom and use "their" computers. The teacher noticed this behavior as well, and commented that "they tend to get really territorial about their equipment, their materials, their classroom."

Supporting Autonomy. Students were willing to support the autonomy of others in the learning process, while still providing help and encouragement. The following examples reveal instances in which students supported one another's autonomy:

- 3 / 19 The teacher asked for two volunteers to do problems on the board. One student chose to volunteer because she did not know how to do the problems, so she wanted the class to help her on the board. There was no fighting over who got to go to the board. The two students did the problems as the rest of the class called out helpful suggestions when the students became stuck. The class was supportive of the students on the board and patiently waited for them to figure out the problems, rather than shouting out the answers or telling them how to do it.
- 3 / 30 The teacher asked for a volunteer at the board. Ana volunteered but the teacher wanted to pick somebody who participated less often. Ana accepted this. Sally went up to the board and tried to do the problem. She had some difficulty and looked to her classmates to help. They helped her, but only gave hints. They did not give her the answer or try to do it for her. They did not make fun of her for having difficulty. She eventually got the problem correct.

The classroom observations revealed a pattern in which students provided support and help to a class member when needed, but did not try to do the problems for one another or remove the learning opportunity for the other students.

One student, Jamie, mentioned that the all-girls aspect of the classroom made this process more natural. On the first survey, she commented that "there's no guys to run against you to call out the right answers before you've figured it out."

Cooperative Work Habits. During the observation period, students appeared to prefer cooperative work habits to competitive work habits. Whenever they were allowed, students attempted to work together on problems. They appeared to prefer working cooperatively in non-structured situations, and were quick to provide or ask for assistance when needed. The following examples from the classroom observations reveal situations in which students demonstrated spontaneous cooperative work habits:

- 3 / 12 Students moved around, 5 on the computers doing research, and the rest doing algebra homework. The students were in self-formed groups. Among the individual groups, students help one another, as expected. Interestingly, students also helped other groups -- group 2 is now helping group 3 finish the homework.
- 5 / 5 The teacher allowed the students to work on worksheets during class. Throughout the entire period, the students talked and helped one another. There was a complete lack of teasing or any comparison of abilities. The students were supportive of one another.
- 5 / 6 During a district-wide standardized test, the students did not want to work alone. They did not care about their grades or doing well on the test, but they tried to work together, even though the teacher would not allow it.

On the second survey, Rosa stated that the cooperative aspect of the all-girls class was what she liked most about doing mathematics. She stated that she enjoyed herself "when we do group projects and stuff like that." Even though the teacher did not assign any group projects, students like Rosa preferred to work with others when possible.

Positive Reinforcement. Students often supplied positive reinforcement towards one another's efforts. As a result, the students demonstrated a willingness to

attempt problems publicly, work on the board, and ask questions that is rarely seen in females in coeducational classes (Eccles, 1989). The students did not express a fear of ridicule when the teacher asked for volunteers to present problems on the board. The teacher also noticed that the students' positive attitudes towards one another allowed them to take risks in front of their peers: "They had a little less anxiety working on problems on the board, working in front of their peers." Many students viewed time on the board as an opportunity to gain a better understanding of concepts that provided difficulty, as seen in the example above from March 19. The instances below describe situations in which students provided positive reinforcement for their peers.

- 4/2 A student answered a difficult question and Ariana commented "You guys are so smart!"
- 4 / 7 Star volunteered to do a problem on the board. She did it correctly and then explained how she did it to the rest of the class. The classmates politely listened to her and then, when she finished, spontaneously applauded her explanation.
- 4/29 Jennifer complimented Jamie on getting a difficult problem correct.

Group Identity. An interesting verbal pattern appeared throughout the observation period. Students began to speak in terms of "we" instead of "I". When one student experienced difficulty with a concept, other students identified with her and shared her experience with the teacher. The students helped one another communicate with the instructor as a group, rather than as a gathering of individuals.

- 3 / 19 The teacher introduced problems involving solving simultaneous systems of equations. The equations contain fractions and the students become easily frustrated. Ming lost her patience and called out "I don't like these, it's too hard!" Other students were succeeding, but when she said this, they supported her and agreed. They all began discussing their difficulties with the teacher, as if the entire class shared the same difficulties.
- 4 / 1 The teacher explained how to do a problem with negative exponents, and Jennifer exclaimed "I'm too young for this." The teacher responded "complaining is not going to help." Betty replied (as if he had spoken to her and not Jennifer) "nobody is complaining but we don't get it." Other students joined in and made remarks like "we don't understand why you added there instead of multiplied" and "we like to use the shortcuts, why do we have to do it the long way?"

5 / 26 On this day, many students were confused and they seemed to spontaneously chose a spokesperson to talk to the teacher. Stacy told him "We don't understand and we don't want to learn it, which is why we talk. It's hard and it's useless." Nobody made fun of the students who were confused. Ana was bored, since she already knew the material, but she patiently waited, along with others, while the teacher tried once again to explain the concepts to the students who were confused.

Every student who discussed the classroom in the interview talked about what happens in the class in terms of "we" rather than "I". For example, Ariana, when asked to describe what the mathematics class was like for her, stated that "He goes over stuff. And we don't listen to him. We do other homework." When asked why she didn't listen to him, she said "Because he goes over it too many times and then we already know it, and we try to tell him that we know it, and then he gets, like, really cold." Ming also described her experiences in terms of "we" instead of "I":

And, we're loud in class. In the beginning no one pays attention but, like, by the end of the day, we -- some of us learn something new and like, get down like jot down all the stuff we learned. And we get through our lessons, like, in the beginning it's noisy but at the end it's okay, it's calm.

Non-Competitive Behavior. The students did not demonstrate competitive behavior regarding grades. They did not compare abilities or discuss which students were better than others. This lack of competitive behavior was noticeable throughout the observation period. As a result, it took several weeks before it became clear which students achieved at a higher rate than others in the mathematics class. The following examples are representative of the type of non-competitive behavior exhibited by the students:

3 / 23 The teacher passed back a test. Some students shared their scores, but not many. There was little comparison of who did better. Star looked at her test and then complained that she didn't understand and won't bother to do test corrections. Her friend, who had a higher grade, didn't make fun of her or mention her grade but instead encouraged her to do the corrections. She said "Just do it so that you can get an A!"

4 / 6 Three boys entered the room and worked quietly on the computers while the teacher passed back quizzes to the girls. The boys immediately asked the teacher if the girls did better than the boys on the quiz, and started talking about who was better. The

girls, although they had been previously interacting with the boys, showed no interest in grade comparisons. They did not care which class had done better, and ignored the boys' comments about the quiz.

- 5 / 6 The teacher told students to prepare for a district-wide exam. The students were not enthusiastic about participating in the exam. The teacher tried to motivate the students by introducing a competitive element: he said "Let's see if you can be more cooperative than the boys were today." The students did not respond to this challenge and were not motivated by the remark.

However, one student, Marbella, did not perceive the non-competitive nature of the class noticed by the researcher. She had joined to avoid competitive situations and when asked in the first survey what she did not like about the all-girls class, she stated that "Sometimes there's competition."

The Social Atmosphere Among the Students

In addition to academically-related work habits of a cooperative nature, the students behaved socially in ways not often seen in coeducational classrooms (Bailey, 1993; Oakes, 1990). Students were eager to provide academic assistance to one another and they also readily provided other forms of assistance such as sharing materials, translating requests to the teacher, and helping one another with technical matters. Students stated that they did not fear ridicule from one another, and the observation data supports that: they did not exhibit shyness or reticence in asking for assistance and admitting mistakes. The students created a safe social environment within the classroom, and demonstrated patience and caring for one another's academic struggles.

Some students also mentioned the improved learning atmosphere of an all-girls classroom. Sally commented on the first survey that "I like learning math in the all-girls class because I can concentrate more." Jennifer agreed, stating that "I like it better because there are less distractions." On the second survey, Rosa stated similar views, writing that she liked learning math in the all-girls class because "You don't have boys in the classroom distracting you." Many students thought that the single-gender academy would help them

learn better, and several students expressed a curiosity about being with all girls. As Jamie stated on the initial survey, "I wanted better opportunities...I thought it would be interesting to be in a class with just my gender. It's easier to learn with girls than it is to learn with boys."

Willingness to Provide Assistance. As described in chapter two, in coeducational classes male students often ignore females' requests for assistance, while girls are more likely to provide help to boys (Bailey, 1993). The students demonstrated this tendency to provide help again and again in the all-girls' classroom. Students readily and willingly provided academic assistance to one another. There were no examples during the entire observation period of a student ignoring or refusing a request for help from another student.

Instances of students providing help for one another came in many forms. Students aided one another with algorithmic techniques for solving problems. They gave hints to one another during the problem-solving process. Some students asked others to check their work for errors. There were several examples of the teacher ignoring students' requests for assistance, and of other students nearby answering those requests instead. Students explained directions to one another and provided assistance with using calculators and computers.

Examples of students providing help for one another occurred on all thirty-three days of observation. There are more than sixty recorded instances of students helping one another. Many of the examples followed the same format as the following descriptions:

- 4 / 6 Jennifer had a question but the teacher ignored her. However, the other students answered her question for her.
- 4 / 8 There were many examples of students helping one another during this day. Students worked on a drill program on the computers. Jennifer was confused about how to simplify a polynomial in fractional form, and Mindy helped her solve the problem. Ariana helped Sally proceed from level I of the drill program to level II. The faster students did not try to rush to finish first, but instead used

their extra time to help their neighbors.

4 / 23 Nadine asked the teacher to do a problem from the homework. The teacher refused to do it, so Adelle volunteered to do the problem for her instead. She did it correctly at Nadine's desk, even though the teacher did not approve of Adelle moving from her seat to help Nadine.

5/6 Sally was confused about the directions to the test, so Tamara explained them for her.

One of the students who enjoyed mathematics and frequently understood the content with ease stated that she enjoyed helping others. During the interview, Mindy explained that she liked both working alone and with her peers: "When working with other people, I can help the other people so they know how to do the problem."

Perhaps most revealing is what was not observed. During the twenty-two observations days during which interaction data were collected, students asked questions and were ignored by the teacher 41 times. However, during that same period, when students asked questions to another student, their requests were ignored zero times.

Willingness to Ask Questions and Admit Confusion. The observation data revealed a multitude of examples during which the female students behaved assertively in the classroom. They did not exhibit shyness or embarrassment when asking questions. They freely asked for help from one another and from the teacher. During the class lectures, the students used assertive language to clearly state their confusion, as shown below:

3 / 10 Rather than exhibiting fear or shyness, Ariana, Jennifer, and Sally called out questions to the teacher during the middle of the lecture. They did not wait for the teacher to ask for questions, and they did not raise their hands. Instead they interrupted him the minute he wrote something down that did not make sense to them. Later in the period other students demonstrated similar behavior.

3 / 17 The teacher asked for questions on the homework from the night before. Almost half of the students called out questions loudly to the teacher. No student laughed at any of the others for having questions or needing to see further examples.

4 / 1 The teacher introduced negative exponents and the majority of the students did not understand how to eliminate a negative exponent. Ming called out that she did not

see how an exponent changed from negative to positive when the base was moved from the numerator to the denominator of the fraction. Several other students agreed with her and supported her question. One student who did understand, Ana, did not make fun of Ming's question. Instead she turned around and tried to explain the concept to Ming.

The students themselves noticed the difference in the numbers of questions asked in the classroom. Many commented on their lack of fear in exposing themselves to the rest of the class. Rosa mentioned on the first survey that "There aren't any boys in our class, so it's more comfortable to answer the wrong answer to a question." Rayanne stated that "You are not just pressured, like if I say something, the boys will say that's a stupid question. In here, I just ask away." Marie supported that sentiment and mentioned that "It's cool because if you want help you could raise your hand without having a guy tease you" on the first survey. Many students commented on their increased comfort levels due to the lack of boys in the classroom. During his interview, the teacher mentioned that he had also noticed an increased level of participation among the girls: "I think they were a little more outspoken in the classroom than they would be in a mixed classroom."

The interaction data supported this willingness to participate in the classroom. Students asked a total of 243 questions during the 22 observation days. Seventeen out of the 20 students asked at least one question during the lecture format, in front of the entire class. The bulk of the questions were not asked by just one or two students; 9 out of the 20 students asked at least ten questions during the observation period. The pattern of student questions is shown in Figure 6. The graph combines three categories: "*", "*A", and "*I". "*" refers to instances in which students initiated a comment to the teacher. "*A" refers to instances in which students asked the teacher a question and received an answer, while "*I" refers to instances in which students asked questions and were ignored by the teacher.

Figure 6

Student Questions

An Environment of Safety. The students demonstrated a unique level of patience with their peers' struggles with the content. Their behavior towards one another demonstrated elements of caring and compassion towards each other academically. Students complimented one another on their abilities, tried to force the teacher to help other students, and did not allow the lessons to continue until every student understood. The following examples from the observation data describe these elements of caring behavior:

- 3 / 24 Estrella did not understand the material. The teacher saw her frustration and said "Why don't you just ask?". Estrella didn't want to speak to the teacher, so Jennifer helped her out by explaining "Because she's frustrated and just wants to give up." Jennifer then talked about how it's understandable to be frustrated, and she feels that way too. Several other students agreed.
- 3 / 31 Jennifer was confused about the phrase "raise to a power". She thought that if you raised x to the power y , it meant you should substitute y for x . At this comment the teacher actually laughed at her, but the students did not. Instead of laughing at her, they tried to explain it to her. They did not mind stopping the lesson to make sure that she understood.

- 3 / 30 Nadine became frustrated when trying to understand the teacher's explanations of simplifying monomials with exponents. She wanted to give up but Sally encouraged her, telling her it would be okay and she could figure it out. Nadine then volunteered to do the next problem.
- 4 / 1 Ariana did not understand how to simplify negative exponents. The teacher did an example but she did not understand it. She became frustrated and wanted to just give up. The other girls around Ariana, instead of allowing the class to move on, tried to rephrase Ariana's questions for the teacher so that he could understand her confusion.
- 4 / 8 Students worked individually and together on a computer drill program. One student had difficulty while another had an easier time. The student who struggled became discouraged. Her neighbor said "You're not stupid. You're smart. You can do this."
- 5 / 11 Ming gave an incorrect answer in response to the teacher's question about a divisibility test. The teacher found the answer amusing and laughed at her, but the students did not laugh. Some of the students glared at the teacher for laughing at Ming.

Although the students readily supported one another academically, this positive behavior did not translate into the social realm. There were a few isolated examples of students calling names to one another or insulting one another. On May 7, for example, Adelle publicly insulted Mindy and several students laughed, finding the comment funny. However, these insults did not remain once the students were mathematically engaged. A few days later, Adelle helped Mindy with a mathematics problem.

The students' comments on the surveys and interviews reflected a feeling of safety within the all-girls environment. Jamie stated on the first survey that "it's easier to learn with girls than it is to learn with boys." Ming echoed a similar sentiment in the interview:

I like it because I can talk to anyone in that class because I know everyone. It's easy to be me, you know, just be yourself, you don't have to act different towards anyone...You could act stupid if you want and they wouldn't care.

The teacher also noticed the differences in the all-girls classroom:

I think it provides them a more safer environment. They feel less threatened, I think, when boys aren't around. Especially in math. They can feel more confident around just the girls. Just the intimidation factor, I think, is a big thing.

One counterexample exists to the positive atmosphere created by the students. On May 11, a student asked the teacher to slow down. Ana protested that and Ariana agreed, by saying "No, she's just slow."

The interaction data reveal another interesting aspect about the positive manner in which the students behaved towards one another. During the observation period, the teacher made only a total of 12 positive comments, such as complimenting a student on her successful completion of a problem or praising her ability to work quickly. In contrast, he made 464 negative comments, such as disciplining students publicly, or berating a student for not trying hard enough. The supportive, safe atmosphere among the students was clearly not fostered by the teacher. In fact, in spite of the teacher's behavior, the students themselves made positive, supportive comments towards one another on a regular basis.

Differences in Interaction Patterns from the Typical Coeducational Classroom

In response to the survey question regarding how the students thought the all-girls class would be different from previous mathematics classes, the most commonly cited answer was that students would get more attention and help from the teacher. These female students had probably experienced in previous classes the typical interaction patterns seen in mixed classrooms; they may have received less attention, less praise, less constructive criticism and less help from their teachers than the boys (Becker, 1981; Campbell, 1995; Fennema, 1995; Leder, 1995; Lee, Marks, & Byrd, 1994; Sadker & Sadker, 1994). Rayanne, Marbella, Jaime, Nadine, Luisa, and Ana were among some of the students who thought they would receive more attention in the all-girls class. As Ana stated, "I think I will learn more because the teacher takes time to help with the students who have difficulties."

The interviews were conducted half-way through the course, while students had gained more experience in the all-girls setting. Several students again mentioned that they received more personal attention from the teacher than they had in previous classes. Jennifer stated that one advantage of the single-gender academy was that "Your teachers get to spend more individual time with you." Ana agreed, by stating that "If you have a question, then he'll come see you, like personally and he'll explain it, if you don't get it."

By the end of the course, fewer students spontaneously mentioned having received more individual attention from the teacher. Only three students mentioned that they received more individual attention. However, at least two of the students who had focused on that aspect of the all-girls class on the first survey were absent for the second survey. As Marcy stated, the all girls aspect of the class made a difference because "You get more help if you need it."

As seen in Figure 7, different students shared the interaction spotlight on different days. For three arbitrarily selected observation days of April 1, April 29, and May 28, three different students interacted most heavily with the teacher: Ana, Jamie, and Mindy. The figure also shows that some students did not interact at all on one or more of the selected days.

Figure 7

Separate Day Interactions

Rather than the typical coeducational pattern of one or a few students dominating interactions (Eccles, 1989), fully half of the students had at least one day in which they interacted most often with the teacher:

<u>Days in which students interacted most often:</u>				
Ana: 7	Jamie: 2	Adelle: 2	Estrella: 1	Ariana: 3
Mindy: 2	Sally: 2	Luisa: 2	Jennifer: 1	Ming: 1

During several of the observation days, there was not any pattern of one student interacting many more times than the other students. Usually several students interacted roughly the same amount with the teacher, and the group of students who interacted most often changed from day to day (see Appendix C for individual interaction tables).

While Ana had the highest number of days of most interactions and by far the highest number of total interactions, this is misleading. Ana did not dominate the discussion. Most of her interactions with the teacher (163 out of 247) consisted of her answering questions and receiving no feedback from the teacher. The teacher asked dozens of short, open-ended questions to the entire class on a daily basis, and several students usually called out answers. Ana did this often. However, she did not ask the highest number of questions herself, and she did not receive the most attention from the teacher. Two other students, Jennifer and Ariana, received more attention from the teacher than did Ana, as shown in Figure 8:

Figure 8

Attention From Teacher

Were Different Types of Students Affected Differently?

The second significant goal of the study was to determine if the single-gender setting affected different types of students in different ways. Was any one type of student more likely to respond positively to the single-gender classroom than another? Several students were chosen for interviews who represented a range of confidence levels, abilities, motivation levels, and enjoyment of mathematics. These students were followed closely throughout the semester. Profiles of the interviewed students reveal some similarities among several groups within the class.

Student Profiles

Students who responded to the interviews fell naturally into three groups with similar characteristics. Those who reported that they enjoyed mathematics and found it useful also reported high confidence levels. These students also earned high grades in the mathematics class. Students who reported that they disliked mathematics and did not find it useful also tended to report low confidence levels, and did not receive high grades in the mathematics class. The following student profiles consider students from three groups: those who reported high confidence and enjoyment of mathematics; those who reported low confidence and a dislike for mathematics; and those students who did not strongly like or dislike mathematics. The profiles shown below describe students' responses to the surveys, comments on the interviews, behavior in the classroom, and interaction patterns throughout the semester.

Group A: High Confidence, Enjoys Mathematics. Ana, Mindy, and Ariana all reported that they liked mathematics, found it useful, and planned to take more. All three students reported high levels of confidence in mathematics, and rated their own abilities as high. The students all enjoy trying new things on their own, rather than being told how to do a problem. Students were mixed on whether they liked to work alone or

with others; most students liked both, depending on the situation. In general, Ana, Mindy and Ariana reported positive attitudes about mathematics on the surveys and during the interviews.

Ana:

Ana is an Asian-American student who enjoys mathematics more than any other subject. She reported high confidence and ability on both surveys: she scored her ability level as 4 out of 5 both times, and her confidence as 10 out of 10 and 9 out of 10, respectively. Ana reported liking mathematics on both surveys. On the first survey, she stated that she loved mathematics: "It is my favorite subject because I do very well with numbers." She also stated that this class would offer her more than other classes due to the teacher and the fact that he takes time to help students who have difficulties. She does not think the all-girls aspect has any effect on the class: "To me it doesn't matter...I think it's how hard you try and how great the teacher explains." Ana thinks mathematics is a subject for girls, and plans to use mathematics in her career. She wants to be an accountant.

During the interview, Ana reported liking math because she finds it fun and easy. She also likes the teacher and feels that she learns well in this class: "Because he explains himself and like he takes the time to like....if you have a question, then he'll come see you, like personally and he'll explain it, if you don't get it or whatever." She does not like the all-girls aspect of the class, and describes herself as a person who gets along better with boys than with girls. Ana describes herself as a lazy student who sometimes likes to work alone and sometimes likes to work with others, and who prefers to try things on her own.

I'm lazy, but, like, if I know that I'm not doing good in school then I'll get my job done. But, if I don't think it then I kinda slack, yeah, I kind of like get a little lazy and then I don't want to do my work. I think I'm good because I think I'm a fast learner. Like, I catch on pretty quickly.

The teacher identified Ana as the strongest student in the class. She had the highest number of interactions with the teacher at 247 interactions. She answered more questions

than any other student and received more praise than any other student. Ana's interactions decreased throughout the semester, as seen in Figure 9. Ana often reported feeling bored in the class and she behaved as if she craved a more challenging atmosphere. The teacher did not provide challenging questions or material for the students, and this setting did not appeal to Ana. While discrete data points most accurately represent the interaction levels for each day, the following graph best shows the overall trend over the semester.

Figure 9

Ana's Interactions Over Time

Ana's behavior was mentioned specifically in the observation notes on the following days:

- 3 / 30 Ana volunteered to do a problem on the board but the teacher picked another.
- 3/31 The teacher called on Ana to do a problem on the board. Later that day Ana answered a question correctly and the teacher turned it into a mathematical rule: subtract exponents when dividing variables.

- 4/22 Ana did two problems on the board.
- 4/23 The teacher asked for questions and Ana asked him to do a problem, which he did.
- 5/11 Ming asked the teacher to slow down but Ana and Ariana protested that.
- 5/26 Ana asked the teacher to do problems from the homework, and he did them.
During the new lecture she was bored because she already knew the material.
- 5/27 Ana asked the teacher to do a problem from the homework, and he did it.

Mindy:

Mindy is a European-American student who had already been exposed to algebra in eighth grade. Mindy reported an ability level of 5 out of 5 and a confidence level of 10 out of 10 on both surveys, and reported strongly liking mathematics on the first survey. Mindy was less sure on the second survey. On the first survey she stated that she liked mathematics because she finds it easy. On the second survey, she still thought mathematics was easy but wrote "I don't enjoy it, but it's a part of life." She thought she would like the all-girls class because "Boys usually throw things or talk during a lesson, and you can't understand the teacher." She does, however, miss the humor boys provide. By the end of the semester she did not think the all-girls aspect of the class made any difference. Mindy does plan to take more mathematics and plans to use it in her future career as a doctor.

During the interview Mindy stated that this class is the same as any other class. She described herself as a student who has ability but is not motivated:

I know how to do the stuff, but...it's like...you know, they make it so it's like you don't want to do it. You have the ability, it's like, they make it so it's not fun. They give you, like, a bunch of stuff that you already knew and they try to teach it to you over again. And then they yell at you if you don't do it their way.

She likes both working alone and with others, and she likes to try new things on her own. Mindy described herself as good at mathematics in the interview. She reported high confidence in the interview and reported an enjoyment of mathematics. When asked about the differences between boys and girls in mathematics classes, she stated that "The boys

tend to not get it as much and they tend to make a lot of noise and be very rude." She thinks girls are as good at mathematics as boys. She also thinks mathematics is worthwhile and plans to take more mathematics in the future.

Mindy had the seventh highest number of interactions at a total of 83. However, she had the 3rd highest number of questions answered, second only to Ana and Luisa. Mindy's interactions increased through the semester, as shown in Figure 10:

Figure 10

Mindy's Interactions Over Time

Mindy's behavior was mentioned specifically in the observation notes on the following days:

- 3/30 Mindy did a problem on the board and made a small error, which the class corrected for her.
- 4/8 Mindy helped Jennifer.
- 4/22 Mindy did a problem on the board.
- 4/23 Mindy helped Estrella on the computer.

- 5/7 Mindy received an insult in front of the entire class from Adelle. The class laughed at her, and the teacher defended her.
- 5/11 Ariana volunteered an answer but the teacher picked on Mindy instead.
- 5/12 Mindy called out an answer.
- 5/28 Rayanne asked Mindy to check her work and she did.
- 6/4 Mindy surreptitiously helped Rayanne on a test, and they both were caught and reprimanded.

Ariana:

Ariana is an African-American student who had already taken an algebra class in the eighth grade. Although she passed algebra the first time, her parents and teachers thought she should take it again in high school. Ariana reported an ability level of 4 out of 5 and a confidence level of 8 out of 10 on both surveys. She reported liking mathematics on both surveys, but more strongly on the second survey. On the first survey, Ariana stated that "Sometimes it's fun when you are learning new stuff, but when you go over stuff you already know it's boring." Even during the time of the first survey, she did not think the all-girls characteristic of the class would make any difference. Ariana thinks mathematics is for "Both boys and girls, because everyone is equal." She thinks mathematics is useful in everyday life, and plans on taking more mathematics because she feels that she does not have a choice in the matter.

During the interview Ariana stated that algebra is easy because she has had it before; she dislikes this class because she finds it boring. She does not think this class is any different from other mathematics classes she has taken in the past. Ariana likes both working alone and with others, and prefers to try things on her own. She thinks she is good at mathematics and reported high confidence in the interview:

It depends on how I'm feeling that day. Like when they give you like, those big old long problems and they don't explain it well, then, that's when I don't like it. But I'm good at it: I don't know why. I just am.

Ariana thinks basic mathematics is worthwhile but algebra is useless:

Because you're not going to need that in your job. You're not going to need to know how to do A to the third plus B to the second times...duh duh duh...you're not going to need all of that.

She does plan on taking more mathematics and plans on using it in her career.

Ariana had the second highest number of interactions at 153. Approximately a third of those were answering questions and a third were questions she generated. She also received a significant number of negative interactions. Her interaction patterns did not appear to increase or decrease dramatically throughout the semester:

Figure 11

Ariana's Interactions Over Time

Ariana's behavior was mentioned specifically in the observation notes on the following days:

3/23 Ariana told the teacher that she doesn't care if she passes the class or fails.

3/24 Ariana participated often today.

- 3/30 Ariana did a problem on the board correctly.
- 3/31 The teacher called on Ariana to do a problem on the board. Later that day the teacher praised Ariana for making a discovery when she said "Why can't we just subtract exponents instead of writing it out?"
- 4/1 Ariana did not understand the material and became frustrated. The other girls tried to explain her questions to the teacher for her. At the end of the class she received personal help from the teacher.
- 4/2 Ariana was called to do a problem on the board.
- 4/8 Ariana helped Sally .
- 5/6 Sally asked a question about a test that the teacher didn't answer. Immediately after, Ariana asked a similar question and the teacher answered it.
- 5/7 Ariana let Sally copy off of her mathematics test when the teacher was turned away.
- 5/11 Ariana volunteered an answer but the teacher picked on Mindy instead. Ming asked the teacher to slow down but Ana and Ariana protested that. Today the teacher called on Ariana more than anybody else just to keep her in line, at the expense of the other students. Ariana dominated the class today.
- 5/12 Ming made an error on the board and Ariana found it for her. After the teacher did an example which Ariana ignored, she decided she wanted to understand so she made the teacher do it again, even though the rest of the class understood already.
- 5/27 Ariana was highly disruptive today.
- 5/28 Ariana left because she decided she didn't want to stick around and learn math today.
- 6/1 Sally praised Ariana's work.

Group B: Low Confidence, Dislikes Mathematics. Marbella, Betty, and Tamara all reported that they disliked mathematics on both surveys. They also reported low confidence and ability levels on the surveys. Marbella and Betty do not plan to take more mathematics, while Tamara does. These students discussed their discomfort with the class and the subject material in the interview, and did not enjoy any aspect of the learning process.

Marbella:

Marbella is a Hispanic-American student. Marbella reported disliking mathematics on both surveys: "I don't enjoy it but if I got to do it, I will." She reported ability levels of 1 out of 5 and 2 out of 5, and confidence levels of 3 and 2 out of 10, respectively. She thought the single-gender mathematics class would provide more help and be more interesting and easy to understand. She also reported on the first survey that she looked forward to being in a single-gender class because "If you want help you could raise your hand without having a guy tease you." Marbella thinks both males and females can do mathematics, but does not think it is useful. At the end of the class, on the exit survey, she did not think it had been any different from her other classes. She plans to take only enough mathematics to graduate and does not see herself using it in the future.

During the interview Marbella described herself as being bad at mathematics. She stated that she has already given up, because she thinks it is too late to succeed:

And when we learned it, and then, like, it confuses me because they always tell us "Well, if you don't know math from a long time ago - like, from the beginning of the semester, you don't know it now", and it's too late.

She does not like the teacher. When asked what she would change about the class, she stated that "I would change the way he teaches it. I don't understand the explanations and it's boring. Writing it down on the notes doesn't help. It doesn't help me do the problems." Marbella does not think the all-girls aspect of the class has made any difference. She dislikes mathematics and does not plan to take any mathematics classes that she does not have to take.

Marbella had extremely few interactions with a total of only 9. All nine were negative comments from the teacher. She did not answer any questions or ask any questions. Due to the small number of interactions, it was not possible to detect a trend throughout the semester. The teacher identified Marbella as one of the weakest students in the class.

Marbella's behavior was mentioned specifically in the observation notes on only two days:

- 5/7 Marbella refused to take a chapter test and turned it in blank. The teacher allowed this, although later when Brigitte tried to turn in the same test with some answers blank, he tried to make her finish it.
- 5/26 Even though Marbella was being quiet and others were being loud, the teacher told her to move away from her friends or leave the class. She chose to leave.

Betty:

Betty is a Hispanic-American student who only completed the first survey. She reported an ability level of 3 out of 5 and a confidence level of 4 out of 10. Betty stated that she disliked mathematics and that "It's very boring." She only joined the single-gender academy because she was forced to do so. She did not think the all-girls characteristic of the class made any difference, and dislikes this particular class because "Math I have no interest in."

During the interview, Betty stated that she had never been good at mathematics. She easily becomes frustrated in class: "I'll try, but I get frustrated. It's easier not to try." When asked what she would change about the class, she stated that she would like to change her skills. She stated that she has always been bad at mathematics for as long as she can remember. Betty wishes that she had stronger abilities in mathematics. When asked to describe herself as a student, Betty said that she was loud. "I don't participate. I'm loud. I have a bad attitude. That's the way I've always been." She thinks that mathematics is useless, and there is no point to learning mathematics because calculators have made the subject obsolete.

Betty had only 32 interactions, 25 of which were negative comments from the teacher. She did not receive a single positive comment from the teacher during the observation period. Betty only answered three questions and only asked three questions

during the observation period. The pattern of Betty's interactions was fairly consistent over time, and did not sharply increase or decrease as seen in Figure 12:

Figure 12

Betty's Interactions Over Time

Betty's behavior was mentioned specifically in the observation notes on the following days:

- 3/18 Betty moved her seat to be near her friends. The teacher allowed this.
- 3/24 Betty asked when she'll ever use this knowledge (solving systems of equations). The teacher ignored this comment.
- 3/30 Betty saw the pattern that leads to the rule of multiplying exponents. She later asked an obvious question and Ariana said "Duh", and the teacher told her "We don't need any of that", to which Ariana said "It was a joke!". Betty didn't seem to care and was just excited that she understood. But it did seem to affect her -- later she almost volunteered on the board, but changed her mind.
- 3/31 The teacher called on Betty to do a problem at the board.
- 4/1 The teacher helped Betty individually for 7 minutes.

- 4/2 The teacher told Betty to sit outside for disciplinary reasons. She left the classroom. She returned after a few minutes.
- 4/7 Betty smiled today for the first time since the beginning of the semester.
- 4/27 The class behavior was really poor today, and the teacher said that he knows some students are giving up on him. He asked those students to just refrain from bothering others (he no longer cared if they paid attention or not). So Betty left the lecture and went to work on the computers.
- 4/29 The teacher told Betty to leave the room if she didn't want to pay attention. She chose to leave.
- 5/6 Betty refused to take the district-wide mathematics test.
- 5/7 Today was a chapter test and Betty decided not to take it. The teacher allowed her to give up and accept a zero. He asked her and Marbella to leave the class so they did not disturb others.
- 5/26 Betty was among several students talking. The teacher reprimanded her publicly, but did not reprimand anybody else. He told her to move to another desk or to leave the class. She chose to leave.
- 5/28 Betty and Ariana decided they did not want to be in class, so they left the room.

Tamara:

Tamara is an African-American student. Tamara reported disliking mathematics on both surveys, and she also reported low ability and average to high confidence both times. On the first survey, Tamara reported an ability of 1 out of 5, and a confidence level of 9 out of 10. On the second survey, she reported an ability level of 2 out of 5 and a confidence level of 5 out of 10. Tamara stated that she did not think the all-girls class would be any different from other mathematics classes. She thinks the all-girls aspect of the class makes it boring. She thinks mathematics is a subject for girls, because "Everybody needs math." However, she does not know if it is useful.

During the interview Tamara did not have any strong opinions about the class or the teacher, good or bad. She misses the boys. As a student she thinks she tries hard and is a decent student: "I try my hardest. I try my best you know and if I don't understand I'll ask for help. I think I'm good." She likes working with others and prefers to listen to

somebody explain it to her rather than try things on her own. Tamara stated that she dislikes mathematics and does not think she is very good at it:

I don't like math that much. Because, ever since I was in sixth grade there was just like this weird feeling that I hate math, you know, and that I'm not good or nothing...that's why I had to go to summer school.

Tamara also reported low confidence in the interview. She thinks she will need math in the future, but would not learn it if she had a choice: "Well, because my mom keeps telling me about it and she's all 'You have to learn it for the future and you have to learn it for when older'." She joined the single-gender academy to please her parents, who wanted her to achieve higher grades. However, she does not think that joining the single-gender academy has enabled her to earn higher grades than she would have otherwise.

Tamara only had 32 interactions, half of which were negative. Tamara was absent from class so often that it was difficult to chart her interactions throughout the semester. Tamara missed class more and more often as the semester progressed:

Figure 13

Tamara's Interactions Over Time

Tamara's behavior was mentioned specifically in the observation notes on only two days:

- 4/6 Tamara spent the day sitting on the floor working on a poster for Spanish. Despite this, the teacher ignored her and instead focused on Jennifer and asked if *she* was taking notes (even though Tamara clearly was not).
- 5/6 Tamara helped Sally with a question.

Group C: Average Confidence and Ability. Ming, Nadine, and Jennifer are students who did not respond strongly one way or another with regards to their feelings about mathematics. Some students stated that they liked mathematics and other students stated that they disliked it. These three particular students provide strong examples because they all participated in at least one survey and the interview, and discussed their feelings at length.

Ming:

Ming is an Asian-American student. On the first survey Ming identified herself as having average ability and confidence levels: 3 out of 5 and 6 out of 10. On the second survey, Ming rated her ability level as a 1 out of 5, and confidence as 10 out of 10. Ming does not think the all-girls class will be any different from the others: "It's the same teacher I had last semester -- still teaches the same boring stuff that does not make any sense to me." Ming strongly dislikes the instructor. She thinks the class is boring and a waste of time, and dislikes being with all girls. She thinks mathematics is a subject for girls, and thinks she might use some mathematics in her future career as a psychiatrist. It is important for Ming to get into college, and so she has resigned herself to taking more mathematics to achieve that goal.

By the time of the interview Ming had changed her mind about the class. She said that she liked the class, because she knows everybody in there and it is easy to pay attention, but she dislikes the teacher:

That class -- I hate the teacher. But I like it because I can talk to anyone in that class because I know everyone. It's easy to be me, you know, just be yourself, you don't have to act different towards anyone. I like it. You could act stupid if you want and they wouldn't care. Because they would already know you.

Ming wishes she had a female teacher because she thinks she could relate better to a female teacher. She does not think the all-girls class is any different from her previous mathematics classes. Ming describes herself as a rude student, but one who is good at mathematics. She prefers to have things explained to her. She expressed high confidence in the interview in her mathematics abilities. She did not express any strong preference for or dislike of math. Ming thinks mathematics is worthwhile and plans to take more: "You need it later in life. I want to become a psychiatrist. So I think I'm going to have to be doing some math stuff for like medications and stuff."

Ming was in the top half of the class for total interactions. She had 77 interactions. Most of her interactions came in the form of answering questions and asking the teacher questions. Ming only received 10 disciplinary comments. The number of interactions did not fluctuate throughout the semester:

Figure 14

Ming's Interactions Over Time

Ming's behavior was mentioned specifically in the observation notes on the following days:

- 4/23 Ming volunteered to explain how she did a problem in class (multiplying a monomial with a binomial).
- 4/27 Ming asked to do a problem on the board. The teacher let her, and she did it correctly. (Simplifying polynomials). She asked for an extra example after the teacher was done explaining the new topic. He did one for her.
- 5/11 Ming was concerned about her grade (she was worried about passing the class). The teacher assured her that she could bring it up by the end of the year. Ming participated a lot today and when the teacher asked a new question, he asked for somebody else to answer besides Ming, even though Ana and Ariana had answered more times than Ming. Later Ming gave an incorrect answer that was amusing. The teacher laughed at her but the students did not. Later, Ming asked the teacher to slow down with his explanation. Ana and Ariana said "No, don't. Ming's just slow."
- 5/12 The teacher asked Ming to do an example on the board. She did and made a small error, which Ariana found. Then she called the teacher a name and insulted him because he would not give her a coupon. He ignored her behavior and she continued to insult him until he relented and gave her one.

5/13 The teacher asked for questions. Ming asked him to do #21 and Jamie asked him to do #28 -- he did #28.

5/21 Ming asked the teacher to do a problem on the board and he did it.

6/1 Ming worked with Peg on a computer project.

Nadine:

Nadine is a soft-spoken Hispanic-American student. On the first survey Nadine identified herself as average in ability and confidence. She rated herself as a 3 out of 5 for ability and 5.5 out of 10 for confidence. Nadine thinks the all-girls class will allow her more personal attention. She does not enjoy mathematics, and states "What is there to enjoy?" Nadine does not like the all-girls setting, and especially dislikes the fact that the students must take every class together. She thinks mathematics is for girls, and also thinks mathematics is useful. She described how she uses mathematics in her everyday life: "When you're at lunch and buy something and you got a five and what you buy is one dollar...then therefore you need math to calculate change..." Nadine did not fill out an exit survey.

During the interview Nadine talked about disliking the class because she considers it boring. However, she does like the instructor. She thinks he is a good teacher, and appreciates it when he takes the time to explain concepts to her. Nadine says that she pays attention more in this class than the other mathematics classes, but that is only due to the teacher. She does not think the all-girls characteristic of the class makes any difference: "It's the same difference. It doesn't really matter to me." However, she misses boys, and states that she enjoys being in a class with boys more than an all-girls class: "It's more fun to talk to boys." Nadine likes working alone and likes to have things explained to her sometimes, and other times she prefers to try problems on her own. She thinks she is fairly good at mathematics, but only reports average confidence. Nadine is not sure if she will do well in her next mathematics class. Nadine thinks mathematics is worthwhile and

that she will use it in the future, possibly as an engineer. "We need it in the future. You know, to have a career or a job." She plans to take more mathematics after algebra.

Nadine had a fairly average number of interactions at 51. She was the 11th student out of 20 for interaction totals. Most of her interactions were based on answering and asking questions. She received 13 negative comments from the teacher. Nadine was absent so often that it was difficult to determine if her interactions changed over the semester, and thus no pattern is apparent.

Figure 15

Nadine's Interactions Over Time

Nadine's behavior was mentioned specifically in the observation notes on the following days:

- 3/30 Nadine was frustrated with the material, and Sally encouraged her, telling her it will be okay. A few minutes later Nadine volunteered to do the next math problem.
- 4/22 Nadine asked the teacher to slow down and he agreed to do so.

- 4/23 The teacher assigned warm-up problems and Nadine asked for help. The teacher said "just try it first and then later we'll all go over it together".
- 5/5 Nadine asked Betty and other students to help her with her math. They helped her.
- 5/28 Jennifer was at the board getting individual help from the teacher. Nadine joined her at the board. They worked together with the teacher.

Jennifer:

Jennifer is an enthusiastic, outspoken Hispanic-American student. Jennifer reported very low ability and confidence levels on her survey, giving herself the lowest scores possible. On the first survey she stated that she dislikes mathematics "Because I don't understand it." Jennifer chose to join the single-gender academy because she thought it would give her the motivation to do her work and improve her grades. She thinks that the all-girls class provides an advantage to her, because there are fewer distractions. She likes the all-girls aspect of the class. Jennifer thinks that mathematics is for girls, and thinks that it is useful. However, she stated that "I don't think I will ever use algebra again." Jennifer did not complete an exit survey.

By the time Jennifer participated in the interview, she no longer thought the all-girls aspect of the class made a difference.

I don't think it really makes a difference. It -- like the other teacher he used to, like, sit there, and however long it took for me to learn he'll sit there with me. But [the teacher] has to attend to everybody else, you know. But, like -- I don't know. It's different kind-of. Just -- I don't know. The girls, we're just with the same girls every day. It gets tiring after a while.

Jennifer does not consider herself a good mathematics student: "Math is my worst subject. It used to be my best but now it's my worst. It's hard." When asked why mathematics is her worst subject, she responded,

Because they started adding letters into it. I don't know why they did that, but they started adding letters, and a lot of y's and stuff like that. Before this we had things like adding and stuff with numbers and I was good at that. I can do it on the board, and sometimes I can do it on my homework but when the test comes, it's like, everything goes blank. I don't understand why that happens. Like, I'll look at it and I, like, I know I know it but it's just -- I lose it, for some reason I just lose it.

When asked if she liked mathematics, Jennifer responded "Yes, I do actually. Because I use it a lot." She has always liked mathematics, and referred to her mother as a role model who often uses mathematics in her everyday life. Jennifer states that she has always enjoyed talking to boys more than girls, and she misses having boys in the classroom. She does think mathematics is a subject for girls. Jennifer also thinks that mathematics is a worthwhile subject, but she does not plan to take any more mathematics than is necessary.

Jennifer had the third highest number of interactions at 148, a third of which were negative comments from the teacher. The rest were answers to questions or questions she initiated to the teacher. Jennifer's pattern of interactions appears to be fairly consistent across the semester:

Figure 16

Jennifer's Interactions Over Time

Jennifer's behavior was mentioned specifically in the observation notes on the following dates:

- 3/23 Jennifer stated that she cared about passing the class because her father cares. Later she opened the door and stayed outside for a while, ignoring the lesson.
- 3/24 Jennifer stated that she thinks these problems (solving systems of equations) are impossible because there is too much to remember. The teacher agreed that it is tough. Later the students asked about the importance of this and Jennifer said "All you really need to know is arithmetic". The teacher responded, "We don't need to discuss this now. You're here, you might as well do it. We all have to do things we don't want to do."
- 3/31 Jennifer asked why they had to have letters in algebra. The teacher said "To make it more difficult". Later he explained that variables stand for numbers that "vary". Jennifer was confused today. She thought that "raise to a power" meant substitute y for x . The teacher laughed at her but the class did not.
- 4/1 Jennifer asked the teacher to re-explain a problem because she was not paying attention the first time. He agreed to do it. He later helped her individually for several minutes.
- 4/2 Jennifer asked about the point of learning scientific notation. The teacher delayed the question and later discussed how very large numbers cannot be put into calculators.
- 4/6 Jennifer had an academic question but the teacher ignored her. Another student helped her instead. Later she sat quietly at her desk (while others were talking and were sprawled out on the floor). For some reason the teacher focused on her and asked her if she was taking notes.
- 4/7 Jennifer was upset today about another class. The teacher took her outside and talked to her individually for a while. Later he personally helped her while other students worked at the board.
- 4/8 Students worked on old computers today and Mindy helped Jennifer with the problems. There were three levels of mathematics problems, and Jennifer did not want to move on to level 2 because "there are too many letters".
- 4/29 Jennifer complimented Jamie on getting a problem correct.
- 5/6 Students had to take a district-wide test today. Jennifer wondered what flipping coins had to do with mathematics. She eventually refused to take the test without help.
- 5/13 Jennifer was confused today and the teacher did not answer many of her questions. She asked "How come you don't teach me, Mr. F?".
- 6/4 Students were supposed to take another district-wide test today. Jennifer got easily upset when she did a factoring problem incorrectly. She dominated the teacher's time for about 20 minutes, trying to get him to help her understand. He did so reluctantly and half-heartedly.

Student Summaries

The data from the three general groups of students were gathered in one table (see Table 6), showing patterns among attitudes towards mathematics, future aspirations, achievement levels, and interactions levels. The two numbers in the "Ability" and the "Confidence" columns refer to students' self-rating of their ability and confidence levels on the first and second surveys. "Explain vs. Try" refers to whether students would prefer to have a new concept explained to them versus trying it on their own. "Int." And "Academic Int." refers to the total number of interactions each student experienced, and the total number of academic interactions with the teacher for each student. The trend refers to whether or not each student's interactions increased or decreased throughout the semester. The teacher identified Ana, Peg, and Luisa as the three strongest students in the class, and he identified Marbella, Nadine, and Betty as the three weakest students.

The grades in the class varied widely among the students, but the teacher assigned an unusually high number of failing grades. Eight students failed the course. The average grade-point for the mathematics class was 1.75 out of 4.00, the lowest out of all of the courses. In contrast, the average grade-point for all of the courses in the single-gender academy was 2.58 out of 4.00. Due to the unusually high number of low grades, the students who received B's or even C's were still regarded by their peers as students who did well in the course.

The following students appear in the table because they constitute a representative sample of the different types of attitudes and behaviors found in the entire class of twenty students. All students interviewed appear in the table, as well as a few additional students who provided complete answers in the surveys.

Table 6

Student Summaries

	Likes math	Ability	Confidence	Math Useful	Take more
Ara	Yes, Yes	4, 4	10, 9	Yes	Yes
Mindy	Yes, Sort-of	5, 5	10, 10	Yes	Yes
Rayanne	Yes, Sometimes	4, 4	9, 9	Yes	Yes
Ariana	Sometimes, Yes	4, 4	8, 8.5	Yes (but not Alg.)	Yes
Peg	Yes	4, na	6, na	Yes	Yes
Luisa	No	3, na	6, na		
Marbella	No, No	1, 2	3, 2	No	No
Estrella	No, No	1, 1	1, 1	No	
Jamie	No, No	3, 2	5, 5	No	Yes
Tamara	No, No	2, 1	5, 9	Doesn't know	Yes
Ming	No, No	3, 1	6, 10	Yes	Yes
Nadine	No	3, na	5.5, na	Yes	Yes
Betty	No	3, na	4, na	No	No
Jennifer	Yes	low	low	Yes	No
	Explain vs. Try	Int.	Academic Int.	Grade	Trend
Ara	Try	247	66	A	Decrease
Mindy	Try	83	15	A	Increase
Rayanne		28	5	B	Slight Increase
Ariana	Try	153	76	C	Neither
Peg		2	1	A	n/a
Luisa		107	18	A	Increase
Marbella		9	0	F	n/a
Estrella		33	8	F	Neither
Jamie		112	39	F	Decrease
Tamara	Explain	32	5	F	Neither
Ming	Explain	77	33	D	Neither
Nadine	Depends	51	18	F	Neither
Betty		32	3	F	Neither
Jennifer	Explain	143	51	F	Neither

High-Achieving Students

Students identified as high achievers mathematically by the teacher were Ana, Peg, and Luisa. Other students who succeeded academically in the class were Mindy, Rayanne, Rosa, Marcy, and Adelle. These students fell into the "high-achieving" group because they

received strong grades on tests and homework and demonstrated that they understood the mathematics concepts introduced in the course. Throughout the study, several questions involved the possible similarities among the high-achieving students. Were these students affected more positively by the single-sex setting than other students? Were there any patterns in how they behaved or were treated in the classroom?

A majority of the students reported that they enjoyed mathematics. Most of the above students also reported ability and confidence levels that were either above average or high. These students all stated that they thought mathematics was useful and planned to take more in the future.

This is where the similarities end among the high-achieving students. Some students, like Ana and Luisa, had a high number of interactions. However, Peg had only two interactions, and Rayanne had only 28. While Mindy, Rayanne, and Luisa experienced an increase in interactions throughout the semester, Ana's interactions decreased. This is consistent with the fact that she was less enthusiastic about mathematics by the end of the course. Some of the high-achieving students were active participators in the classroom, while others were quiet and withdrawn. The teacher did not behave in a similar manner towards all students in this group.

Low-Achieving Students

The teacher identified Marbella, Nadine, and Betty as low achievers. These students, along with Estrella, Jamie, Tamara, and Nancy appear in the low-achieving category because they received poor grades on tests and homework, demonstrated low levels of motivation and interest in the classroom, and did not demonstrate an understanding of the mathematical concepts introduced. Did these students experience treatment or behavior in the classroom different from the other groups of students? How

did these students, who entered the semester with poor attitudes about mathematics, react as a group to the single-gender setting?

All of the students in this group reported that they disliked mathematics. They all reported either low or average confidence and ability levels. All of the students except Nadine reported that they did not think mathematics was useful, but about half of the students did plan to take more mathematics in the future. All of the students in this category experienced either no difference in the number of interactions throughout the semester, or a decrease in interactions.

All of the students in this category also experienced low numbers of interactions except Jaime. Jaime's interactions were, for the most part, initiated by her and not the teacher. There are two examples, on April 23 and April 27, of the teacher actively ignoring Jamie's request for help and attention. Jamie was a student who demanded the teacher's attention but did not always succeed as well as others in obtaining it.

High versus Low Participation Rates

Since one of the major questions about a single-gender class compared to a traditional coeducational class is the pattern of interactions and participation, it was natural to question whether the students who participated often in class gained significantly more than the students who did not participate often. Did the students who experienced a high number of interactions thrive in the classroom? Did they appear to enjoy the content, demonstrate higher motivation levels, and succeed academically at a higher rate than other students?

Six students experienced over 100 interactions: Adelle, Ana, Ariana, Jamie, Jennifer, and Luisa. Ana and Luisa were two of the three students identified as high achievers, and Ariana and Jennifer reported that they liked mathematics. Jamie was the only student of these six who reported disliking mathematics. These students as a group

did appear to enjoy the content, with the exception of Jamie. They were active and appeared to be highly motivated in the classroom. Adelle and Luisa, in particular, grew in their appreciation of mathematics and the class throughout the semester. Their interaction patterns markedly increased throughout the observation period:

Figure 17

Interactions Over Time

Six students experienced less than thirty interactions: Brigitte, Marbella, Peg, Rosa, Rayanne, and Stacy. While Marbella was one of the students identified as a low-achiever by the teacher, the other students did not fall into that category. Peg and Rayanne did enjoy mathematics and experienced success in the class. While Brigitte reported a small drop in confidence from the initial survey to the exit survey, Rosa reported an increase in confidence. There do not appear to be any similarities among these students.

In general, it appears that the students who interacted most often in the classroom and received the most attention from the teacher were also likely to appreciate the class most strongly, report an enjoyment of mathematics, and be the most salient in the classroom discussions. While a large number of interactions with the teacher reveals this pattern, the converse does not appear to be true. Students who receive a small number of interactions do not appear to be more likely to like or dislike mathematics, or to succeed or fail in the classroom.

Increasing Interactions versus Decreasing Interactions

Six students experienced an increase of interactions over the observation period: Adelle, Luisa, Rayanne, Mindy, Stacy, and Sally. The first four students fell into the high-achieving category and reported an enjoyment of mathematics. While Sally commented that she disliked mathematics on the initial survey, she reported that she liked it on the exit survey. Very little data are available from Stacy as she chose not to complete the surveys.

Ana, Marcy, and Jamie experienced a decrease in interactions throughout the semester. There do not appear to be many similarities among these students. Ana enjoyed mathematics and succeeded in the classroom, while Jamie did not enjoy mathematics and often experienced frustration in the classroom. Marcy experienced a total of only 39 interactions, so her slight decrease is not conclusive.

Students Who Benefited

Students who experienced a high number of non-negative interactions were the same students who experienced a high number of total interactions. The six students who received over 90 non-negative interactions were the same six students who experienced over 100 total interactions. While not every student in this group thrived in the all-girls setting, most of the six students reported an enjoyment of mathematics and appeared to be engaged and motivated in the classroom. In particular, of the students whose interactions

increased throughout the semester, five of the six students appeared to thrive in the all-girls setting. In general, it appears that students who receive non-negative academic attention from the teacher are the same students who are more likely to improve in the class.

However, the data do not support the converse. Although some students who experienced very few interactions struggled in the classroom, others succeeded and reported an enjoyment of the class and the content material.

CHAPTER 5

Conclusions

Through extensive observations in the classroom and interaction with the class members throughout the semester, several questions developed during the study. First, did this particular single-sex setting differ in any way from a typical coeducational mathematics classroom? Secondly, did the students receive any benefit from the fact that they were in a single-sex class, and if so, what benefits? Finally, what type of student might be most likely to thrive in this particular mathematics class? The results gleaned from the observational data, the surveys, and the interviews reveal several interesting trends. There are two major sets of conclusions one can derive from the data. The first involves the nature of the single-sex setting: the data reveal how the students behaved in the class as individuals and as a group. Secondly, the data provide several interesting results about which types of students benefited most from this particular single-sex mathematics classroom.

Defining Characteristics of the Single-Sex Classroom

As seen in Chapter 4, the data reveal patterns in the behavior of the students that differ from typical behaviors of female students in coeducational mathematics classes. The students not only exhibited distinctive behaviors as individuals, but as a group demonstrated a level of camaraderie and a high degree of comfort similar to what Fuller (1997) observed in single-sex mathematics classes. Even the pattern of interactions between the teacher and the students involves characteristics that appear to be markedly different from a coeducational setting.

Individual Student Behaviors

The students' readiness to participate often in class, ask questions of the teacher and their peers, and contribute to the class discussion parallels results from similar studies of student behavior in single-sex mathematics classes (Leder & Forgasz, 1994; Lee & Byrk, 1986). As several students and the teacher remarked, the students felt more comfortable participating in the all-girls class. They did not have to fear disparaging remarks from their classmates. As the semester progressed, several students who were shy and timid became more outspoken and assertive in the classroom. In particular, Adelle, Luisa, Marcy, and Rayanne all became more bold throughout the semester. Perhaps the lack of dominant, aggressive behavior often demonstrated by boys (Eccles, 1989) allowed the girls to overcome their fear of speaking in class.

Students' willingness to provide assistance to one another was also noticeably different from typical behaviors in a coeducational classroom. As Bailey (1993) observed, boys usually receive help from girls when they ask for it, but often ignore girls' requests for assistance. In this classroom, the girls did not experience any denial of requests for assistance, unless that request was directed towards the teacher. When the students asked one another for help, it was readily provided. As mentioned in Chapter 4, a request for help from one student to another was never denied during the entire observation period. In addition, the students readily shared their time, resources, and materials with one another. This friendly, helpful attitude displayed by the students might be one factor that allowed several members of the class to feel comfortable enough to begin asking more questions as the term progressed.

The fact that the students happily provided assistance to one another on a regular basis is just one facet of the overall caring behavior that the students demonstrated in the classroom. Students tended to behave supportively towards one another in a manner similar to that described in Fuller's (1997) study of all-girls' classrooms. The students

often praised one another, encouraged one another's efforts, and did not laugh at each other, even when they observed the teacher mocking a student. The number of times one student provided spontaneous positive reinforcement to another student was unusually high. This overall demonstration of caring behavior may be one reason why girls in single-sex schools typically experience higher levels of self-esteem, higher confidence levels, and more positive attitudes towards mathematics than their coeducational counterparts (Gwizdala & Steinback, 1990; Lee & Byrk, 1986; Rowe, 1988; Sadker & Sadker, 1994).

One of the most interesting features of the all-girls class was the fact that the students demonstrated the above behaviors without explicit encouragement from the teacher. In fact, in several cases the teacher demonstrated behaviors that may have discouraged some students from asking questions or taking risks in class. The teacher occasionally laughed at a student who made a mistake, but the students did not laugh at one another. The teacher also ignored the students' requests for assistance 41 times, an average of about twice per day, but the students did not repeat this behavior. The single-gender setting may have reinforced these positive behaviors demonstrated by the students, but the instructor did not seem to contribute to the positive atmosphere.

Student Attitudes and Affective Issues

Overall, the students reported attitudes towards mathematics that were not noticeably different from typical female attitudes in coeducational mathematics classes. This is not surprising for several reasons. First, the students were in the single-gender class for only four months. Mathematics attitudes are formed over years and are not likely to change overnight. Secondly, many students reported a dissatisfaction with the instructional methods and the content. While these same students might have enjoyed the all-girls nature of the class, they did not enjoy the actual mathematics, the teacher, or the manner in which they were forced to learn.

One affective issue, sex-role congruency, appeared to be noticeably different from that seen in typical female students. Almost every student thought that mathematics was a subject for girls. Students clearly stated this on both surveys and during the interviews. However, this difference cannot be considered conclusive. Other studies that investigated sex-role congruence typically used widely-accepted Likert scales, such as the Fennema-Sherman Mathematics Attitudes Scales (Fennema & Sherman, 1976). This study did not use such a scale and instead asked students point-blank: "Do you think mathematics is a subject for boys, or for girls, or both?" Students are probably more likely to respond that mathematics is a subject for girls to such an obvious question than they are to more subtle indicators.

Group Behaviors

Not only did the students demonstrate unique behaviors as individuals, but the entire tone of the group characterized a level of safety, comfort, and cooperation not often observed in coeducational mathematics classes. The students demonstrated a preference for a cooperative work environment, which is not surprising given the multitude of studies showing that female students prefer and are more likely to succeed in a cooperative learning atmosphere (Bailey, 1993; Eccles, 1989; Fennema, 1995; Oakes, 1990). While the teacher did not encourage cooperative work habits, the students naturally gravitated towards cooperative groups whenever they were allowed to work on their own. Once the students were in groups or working together, they shared resources equally, helped one another among and between groups, and respected other students' autonomy in the learning process. Because female students are more likely to thrive in a cooperative environment, these behaviors may have reinforced themselves and helped to create a more positive learning atmosphere. This may be one reason why some studies have detected higher

mathematics achievement and participation levels for females in single-sex schools (Jimenez & Lockheed, 1989; Lee & Byrk, 1986; Marsh, 1989).

The students' lack of appreciation for competitive instructional strategies was instantly noticeable. The instructor attempted to motivate students through competitive measures on several occasions, but the students never responded positively. The teacher taught an all-boys' mathematics class as well as the all-girls' class, and stated that he used the same instructional strategies for both classes: "I think I taught them relatively the same -- I kept them on the same pace, I did the same thing for both classes, so I didn't change much for either one." The competitive instructional strategies that may have worked well in the boys' class did not succeed in the girls' class. The students demonstrated no interest in comparing grades with one another, and never attempted to determine which students were the strongest. When the students worked in groups, they did not rush to see who finished first, or attempt to "beat" one another. When students called out the answers to questions, they did not try to answer first or loudest. Again, perhaps because this behavior occurred in a setting without the traditional competitive behaviors displayed by boys, it became more noticeable throughout the semester.

Rowe (1988) interviewed students who participated in a single-sex program in an Australian public school and found that the female students identified more closely with their peer group in the single-sex setting. The same effect occurred in this program as well. In fact, the students developed an unusually strong group identity, and often communicated to the teacher as an entire group rather than a set of individuals. As the examples displayed in Chapter 4 show, the students even communicated in terms of "we" rather than "I". The level of group cohesiveness seen in this classroom was unusually high.

Interaction Patterns

Numerous studies have shown that boys receive more attention from teachers and generally dominate the classroom discussion (Becker, 1981; Campbell, 1995; Fennema, 1995; Leder, 1995; Lee, Marks, & Byrd, 1994; Oakes, 1990; Sadker & Sadker, 1994). Studies that have investigated interaction patterns in the classroom reveal a trend of unequal attention throughout the class. In the typical coeducational mathematics class, the bulk of the teacher's attention usually falls on a small handful of students, usually male, who dominate the classroom throughout the entire year (Bailey, 1993; Campbell, 1995; Eccles, 1989).

This pattern of one or two students dominating the class discussion every day throughout the semester did not occur in the all-girls' class. Ten out of the 20 students experienced at least one day in which they interacted most often with the teacher. This is from only 22 days of observation. It is likely that over the entire span of the semester, even more students might have experienced at least one day in which they dominated the classroom discussion. In addition, during any class discussion, there were usually several students who interacted in roughly similar amounts with the teacher. The group of students who interacted most often changed from day to day, as if the students were taking turns.

This unusual interaction pattern was not facilitated by the teacher in any way. The teacher did not call on individual students, and thus did not make any noticeable attempt to distribute his attention around the classroom. Instead, the teacher followed the students' lead. When a student responded to his questions, he often followed up with that particular student. The majority of the teacher's attention towards any given student occurred in response to an initiation from that student. As a result, the students and not the teacher determined the pattern of interactions for any given day. The students' general behavior of sharing with one another thus translated into sharing the teacher's attention as well.

Who Benefited From This Single-Sex Setting?

The second major question of the study involved the students and the potential effects of the single-sex setting on the students' attitudes towards mathematics, participation levels, and achievement rates. In addition to trying to determine whether any students benefited from the single-sex environment, it was also natural to question whether the all-girls' class affected some students more than others. What types of students were most likely to benefit from the all-girls' environment?

This was not a clear-cut question, as "benefit" may mean different things for different students. Due to the fact that the quality of instruction was ineffective for most of the students, it was difficult to accurately measure achievement rates. However, some students did appear to gain a meaningful understanding of the content and enjoy the mathematics class more than others. Through an examination of the students who appeared to benefit from the class, one can detect a few similarities in the ways in which these students were treated in the classroom.

Students Who Thrived in the All-Girls' Mathematics Class

Students who thrived in the class were those who left the semester with positive attitudes about mathematics and the class, who enjoyed the experience in the all-girls' setting, who experienced high confidence levels or an increase in confidence, and who demonstrated an understanding of the concepts introduced in the course. Rosa, Rayanne, Peg, Mindy, and Ana all achieved at high levels in the class and reported positive attitudes about mathematics on the exit survey. Other students also achieved high grades in the class or reported a positive experience, such as Marcy, Luisa, Adelle, and Ariana.

There are few similarities among the interaction patterns of these. The most striking similarity is that none of the five students who reported both high grades and positive attitudes towards mathematics received a large number of negative interactions from the

teacher (see Table 3, page 49). Ana received 8 negative comments from the teacher, the highest among these five students, but she also received the highest total number of interactions. Ana's negative comments from the teacher only comprised 3% of her total interactions. Other students in the class received as many as 53 negative interactions, and for one student, 100% of her interactions with the teacher were composed of negative comments. On average, negative comments from the teacher comprised 17% of a student's daily interactions. For this group of five students, negative comments from the teacher comprised only 3% of their total interactions. In addition to positive comments from the teacher, these students are also the ones who received a large number of helpful, positive comments from their peers. These students were encouraged and praised throughout the semester by other members of the class.

However, there are few other similarities for the thriving students. Some students interacted often with the teacher and others did not. Some students behaved enthusiastically in class and others were more quiet. However, every student appeared to be actively engaged in learning mathematics on a daily basis. Rosa was the only student in this group who experienced an increase in confidence throughout the term, and Mindy and Rayanne were the only students who experienced an increase in interactions. Some students enjoyed the all-girls aspect of the class, and other students reported that they missed being in a classroom with boys. These students form a diverse group, with different experiences and learning preferences.

It is interesting to note that the most salient student in the class was Ana, the student with whom the teacher had the most interactions and also the student he identified as the strongest mathematically. In general, the students who experienced a high degree of non-negative attention from the teacher were the same students who participated often in class and appeared to be engaged and motivated in the classroom. Non-negative academic

attention from the teacher appeared to be related to improved performance and attitudes on the part of the students.

Students Who Did Not Benefit from the All-Girls' Mathematics Class

Other students did not enjoy their experience in the all-girls' mathematics class. In particular, Marbella, Estrella, Jamie, Tamara, Betty, and Nancy reported low attitudes towards mathematics at the end of the class, did not behave enthusiastically in the classroom, and received failing grades. These students all reported a dislike for mathematics. The students did not appear to have many positive experiences in the classroom, and they were not often actively engaged in learning mathematics.

Jaime is the only student in this group who experienced a high number of interactions, and they were largely initiated by her. The other students did not experience any significant amount of positive or academic attention from the teacher. For this group of students, negative comments from the teacher comprised 37% of their daily interactions on average, as opposed to 3% for the group of thriving students. These students did not receive large amounts of positive or academic attention from the instructor; instead, the bulk of attention from the teacher came in the form of negative comments. In addition, these students did not receive as many positive comments from their peers as others in the class. They were less engaged in general, and thus did not seek out or receive encouragement. It is not surprising that these students did not thrive in the classroom. If they had received more positive attention from the teacher or their peers, they might have improved academically or enjoyed a more positive experience in the classroom.

The Student Most Likely to Benefit

There appear to be several trends that point to the fact that positive attention from the teacher and from fellow students is linked to higher participation rates, achievement rates, and positive attitudes towards the class. However, the data do not support the

conclusion that this positive attention from the teacher actually causes these results. The students who entered the class with a positive attitude, who liked mathematics and who had previously excelled in mathematics were the most likely to participate often in the class discussions. These students were the same ones who often provided correct answers to the teacher's questions, who helped others, and who were motivated in the classroom. The teacher probably noticed these behaviors and reinforced them through his positive attention.

However, the classroom atmosphere and the behavior of the students and the teacher did create a learning environment that would be more beneficial to some students than to others. Students who prefer a cooperative work environment, who identify closely with their peers, and who are content with supporting one another's learning would be most likely to appreciate this all-girls' setting. Students who prefer a competitive environment would probably not thrive in this particular setting. This single-sex mathematics class provided a particularly unique opportunity for students who might have been unsure of their abilities or wary of speaking up in class. This class provided a safe, caring environment in which these students could begin to take risks in the classroom. For this type of student, the all-girls' setting provided benefits that are unlikely to occur in a coeducational classroom.

Summary

One of the most interesting characteristics of this all-girls' mathematics class is the set of behaviors that was not observed. There were few or no instances of name calling, grade comparisons, comments about which students were the best, reluctance to admit confusion or ask questions, or racing to see who could finish first. Students did not actively dominate the teacher's attention, dominate a group activity, refuse to share resources, refuse to help one another, or make fun of others for not understanding. The students created and maintained an atmosphere of patience and positive support towards

one another that is rarely observed in coeducational mathematics classes. Even the pattern of interactions revealed a slightly more equitable treatment of the group as a whole, with students sharing the spotlight from day to day. These results of an improved learning atmosphere and more outgoing students reflect what we have seen from previous research (Fuller, 1997; Rowe, 1988; Sangster, 1988).

It is also worth noting that the behaviors demonstrated in the class were probably highlighted and reinforced solely by the fact that the class was composed of only girls. The instructor did not reinforce these behaviors. He did not teach according to what educators know about how girls learn best, but instead employed the same traditional teaching methods that he used for the all-boys' mathematics class. The students appeared to naturally gravitate towards cooperative behaviors, but the instructor did not focus on cooperative work. The students appeared to be willing to share the instructor's time and attention, but he did not make any attempt to distribute his attention equally among the students. The classroom atmosphere provided an ideal setting in which the teacher could have focused on female learning styles and equitable treatment of all students. The fact that he did not do so was a missed opportunity. However, it is encouraging to note that even in the absence of the instructor facilitating positive behavior, the students still created a unique classroom atmosphere. The absence of the instructor's facilitation of these behaviors supports the hypothesis that it was the all-girls' setting that resulted in an improved learning environment.

Limitations of the Research

This study was intended to explore the experiences of a heterogeneous group of public-school students in a single-sex setting. The fact that these students belong to a public school provided a unique opportunity, because many of the previous studies explored the single-gender environment in private or parochial settings. However,

participation in the program was voluntary and thus may have resulted in a selection bias. The program was specifically geared towards students with high academic potential who were not succeeding in school. While there were a few exceptions, the group was mainly composed of students who struggled academically. While the students came from a diverse array of ethnic and cultural backgrounds, economic status and English ability were not considered in this study. The AAUW report (1992) found that socioeconomic status is the best predictor of achievement. This and other factors, such as family background, may have affected the students' attitudes and behaviors in the classroom.

The atmosphere of the entire single-gender program may have affected the students' attitudes and behaviors in ways that cannot be attributed solely to the all-girls' characteristic of the mathematics class. The parents who chose to send their students to the academy displayed an interest in their daughters' education that one might not see in a more general public-school setting. The single-gender program maintained close contact with the parents, and provided extra academic help not available to the general school population. The students in the single-gender program had access to technology, materials, and experiences that they would not have enjoyed otherwise. Finally, the students spent the entire day together as one group. This extended contact with one another probably affected the students' formation of a group identity and may have helped to foster the supportive atmosphere seen in the mathematics class.

Because this observation study focused on only one classroom, one cannot make broad conclusions based on the experiences seen in a single class. This class consisted of a unique group of students in an unusual situation. The students experienced a change of instructor five weeks into the program, which disrupted the learning environment. The study only extended through twelve weeks, and thus did not allow enough time to observe any possible attitudinal changes. Due to the quality of instruction, the students did not

achieve at levels they might have in a setting more conducive to learning mathematics. As a result, it was impossible to accurately examine achievement issues.

Questions for Future Research

Generally, the results of this study provided several insights into the all-girls' mathematics environment. The behavior of the students as a cohesive group in the single-sex classroom may provide some of the reasons for the benefits girls appear to receive in the single-sex setting. This study also showed how the all-girls' setting differed from a typical coeducational classroom. However, little is still known about the specific benefits that might occur as a result of this setting, and which students are most likely to benefit.

The data were not strongly conclusive regarding links between the way students were treated in the classroom and how strongly they benefited from the experience. Since behavior patterns among the students and between the students and the teacher are clearly different in a single-sex environment, it would be interesting to explore more thoroughly the relationship between student-teacher interactions and student attitudes or mathematics achievement over an extensive time period. In addition, it would be beneficial to see a more thorough examination of what type of student is most likely to benefit from the single-sex setting. Perhaps there is a link between personality traits, academic achievement levels, or affective variables and whether or not a female student would benefit from the single-sex environment.

Riordan (1990) reported that the consequences of attending a single-sex school were most significant for at-risk students, ethnic and religious minorities, and students from low socio-economic backgrounds. The single-gender academy targeted at-risk students, specifically recruiting those whose chances of succeeding in high school appeared to be low. These students did reap noticeable benefits from the single-gender setting. Would advantaged students reap the same benefits from the single-sex setting? Perhaps an

exploration of a single-gender program open to all students would help determine whether or not some groups of students are more likely to benefit from the single-sex setting than others.

It would also be interesting to conduct a comparison study of male and female single-sex classes. A great deal of research has been conducted into the nature of the all-girls' atmosphere, but fewer studies have investigated the all-boys' setting. Would the classroom atmosphere in an all-boys' classroom differ from a coeducational classroom? How would it compare to the all-girls' environment? Would the nature of interactions between the boys and the teacher differ from the interactions between the girls and the teacher?

Finally, most of the research conducted in the United States surrounding single-sex education has been conducted in independent single-sex schools. The growing popularity of single-sex classes within public schools provides a unique opportunity to examine the potential benefits of a single-sex classroom without the interference of other factors such as school type or family background. It would be beneficial to investigate single-sex classroom issues within a public school setting, especially in an environment in which the students were not clustered together for the entire day. Some public schools are experimenting with creating single-sex mathematics classes, but allowing students to attend coeducational classes for other subjects. Without the influence of a complete single-sex school day, would students still experience benefits from attending just one single-sex class?

APPENDIX A

Initial Survey

This information will be kept completely confidential. If you do not feel comfortable answering a question, please leave it blank.

ID: _____

1. Why did you choose to participate in the single-gender academy?
2. How do you think this class will be different from your other math classes?
3. Do you enjoy doing mathematics? Why or why not? What do you enjoy about it?
4. Do you think you are good at mathematics? If 1 indicates low ability and 5 indicates high ability in math, circle the number that shows how good you think you are at math.

1 2 3 4 5
5. How confident do you feel in mathematics? If 1 indicates low confidence and 10 indicates high confidence, circle the number that shows how confident you are doing mathematics in general.

1 2 3 4 5 6 7 8 9 10
6. Do you enjoy learning math in the all-girls classroom? If so, what do you like about it?
7. Are there any things you do not like about the all-girls math class?
8. Do you think math is a subject more for boys or for girls, or both? Please explain.
9. Do you think math is useful in your everyday life? Describe how you would use math in the real world.

APPENDIX B

Exit Survey

This information will be kept completely confidential. If you do not feel comfortable answering a question, please leave it blank.

ID: _____

1. Do you think you are good at mathematics? If 1 indicates low ability and 5 indicates high ability in math, circle the number that shows how good you think you are at math.

1 2 3 4 5

2. How confident do you feel in mathematics? If 1 indicates low confidence and 10 indicates high confidence, circle the number that shows how confident you are doing mathematics in general.

1 2 3 4 5 6 7 8 9 10

3. Do you enjoy doing mathematics? Why or why not? What do you enjoy about it?

4. How was this class different from other math classes you've had in the past?

5. What did you like about learning math in an all-girls class?

6. What would you have changed about this class if you could?

7. Do you think math is a subject for boys or for girls, or both? Please explain.

8. Which subject did you enjoy most this year?

9. Do you plan on taking more math classes in the future? If so, why?

10. What do you see yourself doing for a living when you are 30 years old? Will you be using math in your career? If so, how?

APPENDIX C

Individual Interaction Tables

<u>Code</u>	<u>Meaning</u>
?	Knowledge-level question (direct question): Requires students to recall facts. <i>Example:</i> What is the result when we divide each side by $2x$?
✓	Check for understanding: Requires students to show they understand the content or procedures of the lesson. <i>Example:</i> What is wrong with this procedure?
H	Higher cognitive questions: Requires students to think, apply, interpret, analyze, create, or evaluate. <i>Example:</i> What reasoning did you use to solve that problem?
-	Reprimand: Teacher reprimands behavior. <i>Example:</i> Janice and Sophia, please stop talking!
+	Praise or acknowledgment: Teacher praises or acknowledges students' academic responses, actions, or behaviors. <i>Example:</i> That is correct. Great job!
*	Student-initiated comment: Student initiates a comment to the teacher. <i>Example:</i> These problems are fun, I hope we do more tomorrow!
a	Student answer: Student answers a teacher-generated question. <i>Example:</i> The answer is 46.
a+	Answer and feedback: Student answers a teacher-generated question and receives praise or acknowledgment. <i>Example:</i> Student: The answer is 46. Teacher: That is correct!
aC	Answer and correction: Student answers a teacher-generated question incorrectly, and the teacher corrects the answer. <i>Example:</i> Student: The answer is 46. Teacher: That is not quite right; remember that we must still divide by 2.
*A	Student-initiated question and answer: Student initiates a question and the teacher provides an answer. <i>Example:</i> Student: Why did you invert the fraction? Teacher: Because the exponent is negative.
*I	Student-initiated question and no response: Student initiates a question and the teacher ignores the student. <i>Example:</i> Student: Why did you invert the fraction? (Teacher ignores).
AB	Student was absent from the mathematics class.

4/1/98	a	a+	aC	*	*A	*I	?	-	+	√	H	Total
Class	0	0	0	0	0	0	34	19	1	0	0	54
Adelle	0	0	0	0	0	0	0	0	0	0	0	0
Ana	15	4	2	0	6	4	0	1	0	0	0	32
Ariana	2	1	0	0	7	2	0	0	0	0	0	12
Betty	0	0	0	0	0	0	0	0	0	0	0	0
Brigitte	0	0	0	0	0	0	0	0	0	0	0	0
Estrella	0	0	0	0	0	0	0	0	0	0	0	0
Jamie	1	0	0	0	0	0	0	1	0	0	0	2
Jennifer	7	0	0	0	4	3	0	5	0	0	0	19
Luisa	0	0	0	0	0	0	0	0	0	0	0	0
Marbella	0	0	0	0	0	0	0	0	0	0	0	0
Marcy	1	0	0	0	0	0	0	0	0	0	0	1
Mindy	0	0	0	0	0	0	0	0	0	0	0	0
Ming	1	0	0	0	0	0	1	0	0	0	0	2
Nadine	0	0	0	0	0	0	0	0	0	0	0	0
Peg	0	0	0	0	0	0	0	0	0	0	0	0
Rosa	1	0	0	0	0	0	0	0	0	0	0	1
Rayanne	0	0	0	0	0	0	0	0	0	0	0	0
Stacy	0	0	0	0	0	0	0	0	0	0	0	0
Sally	0	0	0	0	0	0	0	0	0	0	0	0
Tamara	0	0	0	0	0	0	0	0	0	0	0	0
Total	28	5	2	0	17	9	35	26	1	0	0	123

4/2/98	a	a+	aC	*	*A	*I	?	-	+	√	H	Total
Class	0	0	0	0	0	0	35	13	1	2	0	51
Adelle	0	0	0	0	0	0	0	0	0	0	0	0
Ana	18	0	0	0	1	0	0	0	0	0	0	19
Ariana	3	0	1	0	0	0	1	0	0	0	0	5
Betty	0	0	0	0	0	1	0	1	0	0	0	2
Brigitte	0	0	0	0	0	0	0	0	0	0	0	0
Estrella	0	0	0	0	1	0	0	0	0	0	0	1
Jamie	0	0	0	0	0	0	0	1	0	0	0	1
Jennifer	1	0	0	0	2	1	0	3	0	0	0	7
Luisa	0	0	0	0	0	0	0	0	0	0	0	0
Marbella	0	0	0	0	0	0	0	0	0	0	0	0
Marcy	0	0	0	0	1	0	0	0	0	0	0	1
Mindy	0	0	0	0	0	0	0	0	0	0	0	0
Ming	0	0	0	0	1	0	0	1	0	0	0	2
Nadine	1	0	0	0	1	0	0	1	0	0	0	3
Peg	0	0	0	0	0	0	0	0	0	0	0	0
Rosa	0	0	0	0	0	0	0	0	0	0	0	0
Rayanne	0	0	0	0	0	0	0	0	0	0	0	0
Stacy	0	0	0	0	0	0	0	0	0	0	0	0
Sally	0	0	0	1	0	0	0	0	0	0	0	1
Tamara	0	0	0	0	0	0	0	0	0	0	0	0
Total	23	0	1	1	7	2	36	20	1	2	0	93

4/6/98	a	a+	aC	*	*A	*I	?	-	+	√	H	Total
Class	0	0	0	0	0	0	35	13	1	2	0	51
Adelle	0	0	0	0	0	0	0	0	0	0	0	0
Ana	18	0	0	0	1	0	0	0	0	0	0	19
Ariana	3	0	1	0	0	0	1	0	0	0	0	5
Betty	0	0	0	0	0	1	0	1	0	0	0	2
Brigitte	0	0	0	0	0	0	0	0	0	0	0	0
Estrella	0	0	0	0	1	0	0	0	0	0	0	1
Jamie	0	0	0	0	0	0	0	1	0	0	0	1
Jennifer	1	0	0	0	2	1	0	3	0	0	0	7
Luisa	0	0	0	0	0	0	0	0	0	0	0	0
Marbella	0	0	0	0	0	0	0	0	0	0	0	0
Marcy	0	0	0	0	1	0	0	0	0	0	0	1
Mindy	0	0	0	0	0	0	0	0	0	0	0	0
Ming	0	0	0	0	1	0	0	1	0	0	0	2
Nadine	1	0	0	0	1	0	0	1	0	0	0	3
Peg	0	0	0	0	0	0	0	0	0	0	0	0
Rosa	0	0	0	0	0	0	0	0	0	0	0	0
Rayanne	0	0	0	0	0	0	0	0	0	0	0	0
Stacy	0	0	0	0	0	0	0	0	0	0	0	0
Sally	0	0	0	1	0	0	0	0	0	0	0	1
Tamara	0	0	0	0	0	0	0	0	0	0	0	0
Total	23	0	1	1	7	2	36	20	1	2	0	93

4/7/98	a	a+	aC	*	*A	*I	?	-	+	√	H	Total
Class	0	0	0	0	0	0	7	8	0	0	0	15
Adelle	0	0	0	0	0	0	0	0	0	0	0	0
Ana	0	0	0	0	0	0	0	0	0	0	0	0
Ariana	0	0	0	0	0	0	0	0	0	0	0	0
Betty	0	0	0	0	0	0	0	1	0	0	0	1
Brigitte	0	0	0	0	0	0	0	0	0	0	0	0
Estrella												AB
Jamie	1	0	0	0	1	0	0	3	0	0	0	5
Jennifer												AB
Luisa	0	0	0	0	0	0	0	0	0	0	0	0
Marbella	0	0	0	0	0	0	0	0	0	0	0	0
Marcy	0	0	0	0	0	0	0	0	0	0	0	0
Mindy	0	0	0	0	0	0	0	0	0	0	0	0
Ming	0	0	0	0	0	0	0	0	0	0	0	0
Nadine												AB
Peg	0	0	0	0	0	0	0	0	0	0	0	0
Rosa	0	0	0	0	0	0	0	0	0	0	0	0
Rayanne	0	0	0	0	0	0	0	0	0	0	0	0
Stacy												AB
Sally	1	0	0	0	1	0	0	0	0	0	0	2
Tamara	0	0	0	0	0	0	0	1	0	0	0	1
Total	2	0	0	0	2	0	7	13	0	0	0	24

4 / 22 / 98	a	a+	aC	*	*A	*I	?	-	+	√	H	Total
Class	0	0	0	0	0	0	56	11	1	0	0	68
Adelle	3	0	0	0	0	0	0	0	0	0	0	3
Ana	20	5	0	0	0	0	0	0	2	0	0	27
Ariana	4	2	0	0	5	0	1	0	0	0	0	12
Betty	0	0	0	0	0	0	0	0	0	0	0	0
Brigitte	0	0	0	0	0	0	0	0	0	0	0	0
Estrella	0	0	1	0	0	0	1	0	0	0	0	2
Jamie	3	0	1	0	2	0	2	1	0	0	0	9
Jennifer	4	0	0	0	1	0	1	4	0	0	0	10
Luisa	0	0	0	0	0	0	0	0	0	0	0	0
Marbella	0	0	0	0	0	0	0	1	0	0	0	1
Marcy	4	0	0	0	0	0	0	0	0	0	0	4
Mindy	3	0	0	0	0	0	0	0	0	0	0	3
Ming												AB
Nadine	6	0	0	0	4	0	0	0	0	0	0	10
Peg	0	0	0	0	0	0	0	0	0	0	0	0
Rosa	0	0	0	0	0	0	0	0	0	0	0	0
Rayanne	0	0	0	0	0	0	0	0	0	0	0	0
Stacy	0	0	0	0	0	0	0	0	0	0	0	0
Sally	0	0	0	0	0	0	1	0	1	0	0	2
Tamara	0	0	0	0	0	0	0	0	0	0	0	0
Total	47	7	2	0	12	0	62	17	4	0	0	151

4 / 23 / 98	a	a+	aC	*	*A	*I	?	-	+	√	H	Total
Class	0	0	0	0	0	0	58	17	0	0	0	75
Adelle	0	1	0	0	1	0	0	0	0	0	0	2
Ana	30	8	1	0	1	2	0	2	0	0	0	44
Ariana	1	1	1	0	1	1	0	0	0	0	0	5
Betty	0	0	0	0	0	0	0	4	0	0	0	4
Brigitte	0	0	0	0	0	0	0	0	0	0	0	0
Estrella	0	0	0	0	0	0	0	2	0	0	0	2
Jamie	5	6	0	0	4	1	0	0	0	0	0	16
Jennifer	5	1	1	0	2	1	0	7	0	0	0	17
Luisa	0	0	0	0	0	0	0	0	0	0	0	0
Marbella												AB
Marcy	3	0	0	0	0	0	0	0	0	0	0	3
Mindy	1	0	0	0	0	0	0	0	0	0	0	1
Ming	4	0	0	2	1	1	0	0	0	0	0	8
Nadine	0	1	0	0	2	1	0	1	0	0	0	5
Peg	0	1	0	0	0	0	0	0	0	0	0	1
Rosa	0	0	0	0	0	0	0	0	0	0	0	0
Rayanne	0	0	0	0	1	0	0	0	0	0	0	1
Stacy	2	0	0	1	0	0	0	0	1	0	0	4
Sally	0	0	0	0	0	0	0	0	0	0	0	0
Tamara	0	0	0	0	0	0	0	0	0	0	0	0
Total	51	19	3	3	13	7	58	33	1	0	0	188

4/27/98	a	a+	aC	*	*A	*I	?	-	+	√	H	Total
Class	0	0	0	0	0	0	57	19	0	0	0	76
Adelle	4	1	0	0	0	0	0	0	0	0	0	5
Ana	28	2	0	0	0	0	0	0	0	0	0	30
Ariana	0	0	0	0	1	0	0	2	0	0	0	3
Betty	0	0	0	0	0	0	0	1	0	0	0	1
Brigitte	0	0	0	0	0	0	0	0	0	0	0	0
Estrella	1	0	0	0	0	0	0	0	0	0	0	1
Jamie	6	0	0	0	4	2	0	0	0	0	0	12
Jennifer	1	0	1	0	2	0	0	6	0	0	0	10
Luisa	0	0	1	0	0	0	0	0	0	0	0	1
Marbella	0	0	0	0	0	0	0	2	0	0	0	2
Marcy	8	0	0	0	0	0	0	0	0	0	0	8
Mindy	1	0	0	0	0	0	0	0	0	0	0	1
Ming	9	1	0	0	1	0	2	0	0	0	0	13
Nadine	0	0	0	0	0	0	0	2	0	0	0	2
Peg	0	0	0	0	0	0	0	0	0	0	0	0
Rosa	0	0	0	0	0	0	0	0	0	0	0	0
Rayanne	4	0	0	0	0	0	0	0	0	0	0	4
Stacy	0	0	0	0	0	0	0	0	0	0	0	0
Sally	0	0	0	0	0	1	0	1	0	0	0	2
Tamara	0	0	0	0	0	0	0	3	0	0	0	3
Total	62	4	2	0	8	3	59	36	0	0	0	174

4/29/98	a	a+	aC	*	*A	*I	?	-	+	√	H	Total
Class	0	0	0	0	0	0	57	13	1	0	0	71
Adelle	0	0	0	0	0	0	0	0	0	0	0	0
Ana	7	0	1	0	0	0	0	0	0	0	0	8
Ariana	4	1	1	0	1	0	0	0	0	0	0	7
Betty	0	0	0	0	0	0	0	2	0	0	0	2
Brigitte	0	0	0	0	0	0	0	0	0	0	0	0
Estrella	0	0	0	0	0	0	0	2	0	0	0	2
Jamie	27	2	3	0	2	0	0	0	0	0	0	34
Jennifer	2	0	0	1	0	0	0	1	0	0	0	4
Luisa	0	0	0	0	0	0	0	0	0	0	0	0
Marbella	0	0	0	0	0	0	0	0	0	0	0	0
Marcy	2	0	0	0	0	0	0	0	0	0	0	2
Mindy	1	0	0	0	0	0	0	0	0	0	0	1
Ming	3	0	0	0	0	0	0	0	0	0	0	3
Nadine	4	0	0	0	0	0	0	1	0	0	0	5
Peg	0	0	0	0	0	0	0	0	0	0	0	0
Rosa	0	0	0	0	0	0	0	0	0	0	0	0
Rayanne	0	0	0	0	0	0	0	0	0	0	0	0
Stacy	0	0	0	0	0	0	0	0	0	0	0	0
Sally	0	0	0	0	0	0	0	1	0	0	0	1
Tamara	0	0	0	0	0	0	0	0	0	0	0	0
Total	50	3	5	1	3	0	57	20	1	0	0	140

5/5/98	a	a+	aC	*	*A	*I	?	-	+	√	H	Total
Class	0	0	0	0	0	0	14	2	0	0	0	16
Adelle	6	0	1	0	1	0	0	0	0	0	0	8
Ana	0	0	0	0	1	0	0	0	0	0	0	1
Ariana	0	0	0	0	0	0	0	1	0	0	0	1
Betty	0	0	0	0	0	0	0	1	0	0	0	1
Brigitte	0	0	0	0	0	0	0	0	0	0	0	0
Estrella	0	0	0	0	0	0	0	0	0	0	0	0
Jamie	0	0	0	0	0	0	0	0	0	0	0	0
Jennifer	0	0	0	0	0	0	0	0	0	0	0	0
Luisa	0	0	0	0	0	0	0	0	0	0	0	0
Marbella	0	0	0	0	0	0	0	0	0	0	0	0
Marcy	0	0	0	0	0	0	0	0	0	0	0	0
Mindy	0	0	0	0	0	0	0	0	0	0	0	0
Ming	0	0	0	0	2	0	0	0	0	0	0	2
Nadine	1	0	0	0	1	0	0	2	0	0	0	4
Peg	0	0	0	0	0	0	0	0	0	0	0	0
Rosa	0	0	0	0	0	0	0	0	0	0	0	0
Rayanne	0	0	0	0	0	0	0	0	0	0	0	0
Stacy	0	0	0	0	1	0	0	0	0	0	0	1
Sally	0	0	0	0	0	0	0	0	0	0	0	0
Tamara												AB
Total	7	0	1	0	6	0	14	6	0	0	0	34

5/6/98	a	a+	aC	*	*A	*I	?	-	+	√	H	Total
Class	0	0	0	0	0	0	0	8	0	0	0	8
Adelle	0	0	0	0	2	0	0	0	0	0	0	2
Ana	0	0	0	0	3	0	0	0	0	0	0	3
Ariana	0	0	0	0	3	0	0	2	0	0	0	5
Betty	0	0	0	0	2	0	0	0	0	0	0	2
Brigitte	0	0	0	0	0	0	0	0	0	0	0	0
Estrella	0	0	0	0	0	1	0	5	0	0	0	6
Jamie	0	0	0	0	0	0	0	2	0	0	0	2
Jennifer	0	0	0	0	2	1	0	1	0	0	0	4
Luisa	0	0	0	0	0	0	0	0	0	0	0	0
Marbella	0	0	0	0	0	0	0	2	0	0	0	2
Marcy	0	0	0	0	0	0	0	0	0	0	0	0
Mindy	0	0	0	0	0	0	0	0	0	0	0	0
Ming												AB
Nadine												AB
Peg	0	0	0	0	0	0	0	0	0	0	0	0
Rosa	0	0	0	0	1	0	0	0	0	0	0	1
Rayanne	0	0	0	0	0	0	0	0	0	0	0	0
Stacy	0	0	0	0	0	0	0	2	0	0	0	2
Sally	0	0	0	0	2	1	0	1	0	0	0	4
Tamara	0	0	0	0	0	0	0	2	0	0	0	2
Total	0	0	0	0	15	3	0	25	0	0	0	43

5/7/98	a	a+	aC	*	*A	*I	?	-	+	√	H	Total
Class	0	0	0	0	0	0	0	8	0	0	0	8
Adelle	0	0	0	0	2	0	0	1	0	0	0	3
Ana	0	0	0	0	1	0	0	0	0	0	0	1
Ariana	0	0	0	0	2	0	0	3	0	0	0	5
Betty	0	0	0	0	0	0	0	1	0	0	0	1
Brigitte	0	0	0	0	0	0	0	0	0	0	0	0
Estrella	0	0	0	0	0	0	0	0	0	0	0	0
Jamie	0	0	0	0	0	0	0	0	0	0	0	0
Jennifer												AB
Luisa	0	0	0	0	0	0	0	0	0	0	0	0
Marbella	0	0	0	0	0	0	0	0	0	0	0	0
Marcy	0	0	0	0	0	0	0	0	0	0	0	0
Mindy	0	0	0	0	0	0	0	1	0	0	0	1
Ming	0	0	0	0	0	0	0	0	0	0	0	0
Nadine	0	0	0	0	0	0	0	0	0	0	0	0
Peg	0	0	0	0	0	0	0	0	0	0	0	0
Rosa	0	0	0	0	0	0	0	0	0	0	0	0
Rayanne	0	0	0	0	0	0	0	0	0	0	0	0
Stacy	0	0	0	0	0	0	0	0	0	0	0	0
Sally	0	0	0	0	1	1	0	1	0	0	0	3
Tamara	0	0	0	0	1	0	0	2	0	0	0	3
Total	0	0	0	0	7	1	0	17	0	0	0	25

5/11/98	a	a+	aC	*	*A	*I	?	-	+	√	H	Total
Class	0	0	0	0	0	0	36	4	0	1	0	41
Adelle	0	0	0	0	3	0	0	1	0	0	0	4
Ana	17	1	2	0	0	0	0	0	0	0	0	20
Ariana	9	0	4	0	8	0	2	2	0	0	0	25
Betty	1	0	0	0	1	0	0	3	0	0	0	5
Brigitte	1	0	0	0	0	0	0	0	0	0	0	1
Estrella	0	0	0	0	0	0	0	0	0	0	0	0
Jamie	0	0	0	0	0	0	0	0	0	0	0	0
Jennifer												AB
Luisa	3	2	1	0	0	0	0	0	0	0	0	6
Marbella	0	0	0	0	0	0	0	0	0	0	0	0
Marcy	0	0	0	0	0	0	0	0	0	0	0	0
Mindy	3	2	3	0	0	0	1	0	0	0	0	9
Ming	3	2	2	0	1	0	0	1	0	0	0	9
Nadine												AB
Peg	0	0	0	0	0	0	0	0	0	0	0	0
Rosa												AB
Rayanne	1	0	0	0	0	0	1	0	0	0	0	2
Stacy												AB
Sally												AB
Tamara	0	0	0	0	0	0	0	3	0	0	0	3
Total	38	7	12	0	13	0	40	14	0	1	0	125

5/12/98	a	a+	aC	*	*A	*I	?	-	+	√	H	Total
Class	0	0	0	0	0	0	30	1	0	0	0	31
Adelle	2	1	0	0	3	0	0	0	0	0	0	6
Ana												AB
Ariana	8	0	4	0	8	1	4	0	0	0	0	25
Betty	2	0	0	0	0	0	0	0	0	0	0	2
Brigitte	0	0	0	0	0	0	0	0	0	0	0	0
Estrella	1	0	1	0	0	0	0	2	0	0	0	4
Jamie	0	0	0	0	2	0	0	0	0	0	0	2
Jennifer												AB
Luisa	19	1	0	0	0	0	0	0	0	0	0	20
Marbella	0	0	0	0	0	0	0	1	0	0	0	1
Marcy	3	0	0	0	0	0	0	0	0	0	0	3
Mindy	1	0	0	0	0	0	0	0	0	0	0	1
Ming	0	0	1	0	0	0	2	0	0	0	0	3
Nadine												AB
Peg	0	0	0	0	0	0	0	0	0	0	0	0
Rosa	0	0	0	0	0	0	0	0	0	0	0	0
Rayanne	0	0	0	0	0	0	0	0	0	0	0	0
Stacy	0	0	0	0	1	0	0	1	0	0	0	2
Sally	0	0	0	0	1	0	0	1	0	0	0	2
Tamara	3	0	0	0	1	0	0	1	0	0	0	5
Total	39	2	6	0	16	1	36	7	0	0	0	107

5/13/98	a	a+	aC	*	*A	*I	?	-	+	√	H	Total
Class	0	0	0	0	0	0	35	4	0	0	0	39
Adelle	0	0	0	0	0	0	0	0	0	0	0	0
Ana	6	0	0	0	1	0	0	0	0	0	0	7
Ariana	0	0	0	0	0	0	0	2	0	0	0	2
Betty	0	0	0	0	0	0	0	1	0	0	0	1
Brigitte	0	0	0	0	0	0	0	0	0	0	0	0
Estrella	0	0	0	0	0	0	0	0	0	0	0	0
Jamie	1	0	0	0	0	0	0	0	0	0	0	1
Jennifer	5	0	4	0	2	0	0	3	0	0	0	14
Luisa	0	0	0	0	0	0	0	0	0	0	0	0
Marbella	0	0	0	0	0	0	0	0	0	0	0	0
Marcy	0	0	0	0	0	0	0	0	0	0	0	0
Mindy	13	0	1	0	0	0	1	0	1	0	0	16
Ming	4	0	0	0	1	0	1	0	0	0	0	6
Nadine	0	0	0	0	0	0	0	0	0	0	0	0
Peg	0	0	0	0	0	0	0	0	0	0	0	0
Rosa	0	0	0	0	1	0	0	0	0	0	0	1
Rayanne	0	0	0	0	0	0	0	0	0	0	0	0
Stacy	0	0	0	0	1	0	0	0	0	0	0	1
Sally	4	0	1	0	4	2	4	0	1	0	0	16
Tamara	9	0	1	0	0	0	1	2	0	0	0	13
Total	42	0	7	0	10	2	42	12	2	0	0	117

5/21/98	a	a+	aC	*	*A	*I	?	-	+	√	H	Total
Class	0	0	0	0	0	0	39	18	0	1	0	58
Adelle	9	1	0	0	2	0	0	0	0	0	0	12
Ana	0	0	0	0	0	0	0	0	0	0	0	0
Ariana	4	0	0	0	2	0	0	3	0	0	0	9
Betty	0	0	0	0	0	0	0	0	0	0	0	0
Brigitte	0	0	0	0	0	0	0	0	0	0	0	0
Estrella	0	0	0	0	0	0	0	4	0	0	0	4
Jamie	2	0	1	0	1	0	0	2	0	0	0	6
Jennifer	0	0	0	0	1	0	0	1	0	0	0	2
Luisa	16	0	0	0	1	0	0	1	0	0	0	18
Marbella	0	0	0	0	0	0	0	1	0	0	0	1
Marcy	0	0	0	0	0	0	0	0	0	0	0	0
Mindy	13	0	0	0	0	0	0	0	0	0	0	13
Ming	2	0	0	0	3	0	0	1	0	0	0	6
Nadine	2	0	0	0	0	0	0	0	0	0	0	2
Peg	0	0	0	0	0	0	0	0	0	0	0	0
Rosa	0	0	0	0	0	0	0	0	0	0	0	0
Rayanne	0	0	0	0	0	0	0	0	0	0	0	0
Stacy	0	0	0	0	0	0	0	1	0	0	0	1
Sally	0	0	0	0	0	0	0	4	0	0	0	4
Tamara												AB
Total	48	1	1	0	10	0	39	36	0	1	0	135

5/26/98	a	a+	aC	*	*A	*I	?	-	+	√	H	Total
Class	0	0	0	0	0	0	39	14	0	0	0	53
Adelle	5	0	0	0	0	0	1	0	0	0	0	6
Ana	14	0	3	0	2	1	1	3	0	0	0	24
Ariana	4	0	2	0	2	0	0	5	0	0	0	13
Betty	0	0	0	0	0	0	0	1	0	0	0	1
Brigitte	0	0	0	0	0	0	0	1	0	0	0	1
Estrella	0	0	0	0	0	0	0	3	0	0	0	3
Jamie	0	0	0	0	0	0	0	1	0	0	0	1
Jennifer	0	0	0	0	4	1	0	2	0	0	0	7
Luisa	3	0	0	0	0	0	0	0	0	0	0	3
Marbella	0	0	0	0	0	0	0	1	0	0	0	1
Marcy	0	0	0	0	0	0	0	0	0	0	0	0
Mindy	2	0	1	0	0	0	0	0	0	0	0	3
Ming	4	1	0	0	2	1	2	1	0	0	0	11
Nadine	3	0	1	0	8	2	0	3	0	0	0	17
Peg	1	0	0	0	0	0	0	0	0	0	0	1
Rosa	1	0	0	0	0	0	0	1	0	0	0	2
Rayanne	2	0	0	0	0	0	0	0	0	0	0	2
Stacy	2	0	0	0	1	0	1	1	0	0	0	5
Sally												AB
Tamara												AB
Total	41	1	7	0	19	5	44	37	0	0	0	154

5/27/98	a	a+	aC	*	*A	*I	?	-	+	√	H	Total
Class	0	0	0	0	0	0	87	20	0	2	0	109
Adelle	16	0	1	0	4	0	0	0	0	0	0	21
Ana	1	0	0	0	0	0	0	0	0	0	0	1
Ariana	0	0	0	0	0	0	0	0	0	0	0	0
Betty	0	0	0	0	0	0	0	0	0	0	0	0
Brigitte	1	0	0	0	0	0	0	0	0	0	0	1
Estrella	0	0	0	0	0	0	0	0	0	0	0	0
Jamie	0	0	0	0	0	0	0	1	0	0	0	1
Jennifer	7	2	3	0	1	0	2	6	0	0	0	21
Luisa	12	1	1	0	2	0	0	0	0	0	0	16
Marbella	0	0	0	0	0	0	0	0	0	0	0	0
Marcy	6	0	0	0	0	0	0	0	0	0	0	6
Mindy	26	2	1	0	0	0	0	0	0	0	0	29
Ming	0	0	0	0	0	0	0	0	0	0	0	0
Nadine												AB
Peg	0	0	0	0	0	0	0	0	0	0	0	0
Rosa	0	0	0	0	0	0	0	0	0	0	0	0
Rayanne	7	0	0	0	0	0	0	0	0	0	0	7
Stacy	0	0	1	0	0	0	0	0	0	0	0	1
Sally	0	0	0	0	3	1	0	0	0	0	0	4
Tamara												AB
Total	76	5	7	0	10	1	89	27	0	2	0	217

5/28/98	a	a+	aC	*	*A	*I	?	-	+	√	H	Total
Class	0	0	0	0	0	0	38	5	0	0	0	43
Adelle	8	2	2	0	3	0	1	0	0	0	0	16
Ana	4	0	0	0	0	0	2	0	0	0	0	6
Ariana	0	0	0	0	0	0	0	1	0	0	0	1
Betty	0	0	0	0	0	0	0	1	0	0	0	1
Brigitte	0	0	0	0	0	0	0	0	0	0	0	0
Estrella												AB
Jamie	0	0	0	0	0	0	0	1	0	0	0	1
Jennifer	2	3	0	0	2	0	1	6	0	0	0	14
Luisa	9	0	0	0	1	0	0	0	0	0	0	10
Marbella	0	0	0	0	0	0	0	0	0	0	0	0
Marcy	0	0	0	0	0	0	0	0	0	0	0	0
Mindy	1	0	0	0	0	0	0	0	0	0	0	1
Ming	0	0	0	0	1	0	0	0	0	0	0	1
Nadine	0	0	0	0	0	0	0	0	0	0	0	0
Peg	0	0	0	0	0	0	0	0	0	0	0	0
Rosa	0	0	0	0	0	0	0	0	0	0	0	0
Rayanne	5	0	1	0	0	0	0	0	0	0	0	6
Stacy												AB
Sally	3	2	0	0	2	0	1	1	0	0	0	9
Tamara												AB
Total	32	7	3	0	9	0	43	15	0	0	0	109

6 / 1 / 98	a	a+	aC	*	*A	*I	?	-	+	√	H	Total
Class	0	0	0	0	0	0	0	3	0	0	0	3
Adelle	0	0	0	0	1	0	0	0	0	0	0	1
Ana	0	0	0	0	1	0	0	0	0	0	0	1
Ariana	0	0	0	0	0	0	0	0	0	0	0	0
Betty	0	0	0	0	0	0	0	1	0	0	0	1
Brigitte	0	0	0	0	0	0	0	0	0	0	0	0
Estrella												AB
Jamie	0	0	0	0	0	0	0	0	0	0	0	0
Jennifer	0	0	0	0	1	0	0	0	0	0	0	1
Luisa	0	0	0	0	0	0	0	0	0	0	0	0
Marbella												AB
Marcy	0	0	0	0	0	0	0	0	0	0	0	0
Mindy	0	0	0	0	0	0	0	0	0	0	0	0
Ming	0	0	0	0	1	0	0	0	0	0	0	1
Nadine	0	0	0	0	0	0	0	0	0	0	0	0
Peg	0	0	0	0	0	0	0	0	0	0	0	0
Rosa												AB
Rayanne	0	0	0	0	1	0	0	0	0	0	0	1
Stacy												AB
Sally	0	0	0	0	0	1	0	1	0	0	0	2
Tamara												AB
Total	0	0	0	0	5	1	0	5	0	0	0	11

6 / 3 / 98	a	a+	aC	*	*A	*I	?	-	+	√	H	Total
Class	0	0	0	0	0	0	54	6	0	0	0	60
Adelle	6	2	2	0	6	0	1	0	0	0	0	17
Ana	0	0	0	0	0	0	0	0	0	0	0	0
Ariana	11	0	2	0	8	0	0	1	0	0	0	22
Betty	0	0	0	0	0	0	0	2	0	0	0	2
Brigitte	0	0	0	0	0	0	0	0	0	0	0	0
Estrella	0	0	0	0	0	0	0	1	0	0	0	1
Jamie	1	0	0	0	0	0	0	1	0	0	0	2
Jennifer	0	0	0	0	0	0	0	0	0	0	0	0
Luisa	26	1	1	0	3	0	0	0	0	0	0	31
Marbella	0	0	0	0	0	0	0	0	0	0	0	0
Marcy	0	0	0	0	0	0	0	0	0	0	0	0
Mindy	0	0	0	0	0	0	0	0	0	0	0	0
Ming	0	0	0	0	0	0	0	0	0	0	0	0
Nadine	0	0	0	0	0	0	0	0	0	0	0	0
Peg	0	0	0	0	0	0	0	0	0	0	0	0
Rosa												AB
Rayanne	4	0	0	0	1	0	0	0	0	0	0	5
Stacy	1	0	0	0	2	0	0	1	0	0	0	4
Sally	1	0	0	0	4	0	0	2	0	0	0	7
Tamara	0	0	0	0	0	0	0	0	0	0	0	0
Total	50	3	5	0	24	0	55	14	0	0	0	151

6 / 4 / 98	a	a+	aC	*	*A	*I	?	-	+	√	H	Total
Class	0	0	0	0	0	0	0	16	0	0	0	16
Adelle	0	0	0	0	3	0	0	0	0	0	0	3
Ana	0	0	0	0	4	1	0	1	0	0	0	6
Ariana												AB
Betty	0	0	0	0	0	0	0	3	0	0	0	3
Brigitte	0	0	0	0	1	0	0	0	0	0	0	1
Estrella	0	0	0	0	1	0	0	0	0	0	0	1
Jamie	0	0	0	0	2	0	0	3	0	0	0	5
Jennifer	0	0	0	0	6	0	0	1	0	0	0	7
Luisa	0	0	0	0	0	0	0	0	0	0	0	0
Marbella	0	0	0	0	0	0	0	1	0	0	0	1
Marcy	0	0	0	0	0	0	0	1	0	0	0	1
Mindy	0	0	0	0	0	0	0	1	0	0	0	1
Ming	0	0	0	0	3	0	0	3	0	0	0	6
Nadine												AB
Peg	0	0	0	0	0	0	0	0	0	0	0	0
Rosa	0	0	0	0	0	0	0	0	0	0	0	0
Rayanne	0	0	0	0	0	0	0	0	0	0	0	0
Stacy	0	0	0	0	4	0	0	0	0	0	0	4
Sally	0	0	0	0	2	0	0	4	0	0	0	6
Tamara	0	0	0	0	1	0	0	0	0	0	0	1
Total	0	0	0	0	27	1	0	34	0	0	0	62

6 / 5 / 98	a	a+	aC	*	*A	*I	?	-	+	√	H	Total
Class	0	0	0	0	0	0	0	6	0	0	0	6
Adelle	0	0	0	0	0	0	0	0	0	0	0	0
Ana	0	0	0	0	0	0	0	0	0	0	0	0
Ariana	0	0	0	0	0	0	0	1	0	0	0	1
Betty	0	0	0	0	0	0	0	0	0	0	0	0
Brigitte	0	0	0	0	0	0	0	0	0	0	0	0
Estrella	0	0	0	0	0	0	0	0	0	0	0	0
Jamie	0	0	0	0	0	0	0	2	0	0	0	2
Jennifer												AB
Luisa	0	0	0	0	2	0	0	0	0	0	0	2
Marbella	0	0	0	0	0	0	0	0	0	0	0	0
Marcy	0	0	0	0	0	0	0	0	0	0	0	0
Mindy	0	0	0	0	0	0	0	0	0	0	0	0
Ming	0	0	0	0	1	0	0	2	0	0	0	3
Nadine												AB
Peg												AB
Rosa	0	0	0	0	0	0	0	0	0	0	0	0
Rayanne	0	0	0	0	0	0	0	0	0	0	0	0
Stacy	0	0	0	0	1	0	0	0	0	0	0	1
Sally	0	0	0	0	0	0	0	0	0	0	0	0
Tamara	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	4	0	0	11	0	0	0	15

REFERENCES

- American Association of University Women. (1998). *Separated by sex: A critical look at single-sex education for girls*. Washington, DC: AAUW.
- American Association of University Women. (1992). *How schools shortchange girls: A study of major findings on girls and education*. Washington, DC: AAUW.
- Bailey, S.M. (1993). The current status of gender equity research in American schools. *Educational Psychologist*, 28(4), 321-339.
- Becker, J.R.. (1981). Differential treatment of females and males in mathematics classes. *Journal for Research in Mathematics Education*, 12(1), 40-53.
- Bornholt, L. J. (1988). *Perceptions of achievement: The effects of gender, school type, and grade*. (Report No. PS-018806). Australia (New South Wales). ERIC Document Reproduction Service No. ED 305989.
- Cairns, E. (1990). The relationship between adolescent perceived self-competence and attendance at single-sex secondary schools. *British Journal of Educational Psychology* 60, 207-211.
- Campbell, P.B. (1995). Redefining the 'girl problem' in mathematics. In W.G. Secada, E. Fennema, & L.B. Adajian (Eds.), *New directions for equity in mathematics education* (pp. 225-241). New York: Cambridge University Press.
- Campbell, P.B. & Wahl, E. (n.d.). *Of two minds: Single-sex education, coeducation, and the search for gender equity in k-12 public schooling*. Unpublished manuscript.
- Carey, D.A, Fennema, E., Carpenter, T. & Frank, M. (1995). Equity and mathematics education. In W.G. Secada, E. Fennema, & L.B. Adajian (Eds.), *New directions for equity in mathematics education*. (pp. 93-125). New York: Cambridge University Press.
- Colley, A., Comber, C., & Hargreaves, D.J. (1994). School subject preferences of pupils in single sex and co-educational secondary schools. *Educational Studies*, 20(3), 378-85.
- Dossey, J.A., Mullis, I.V., Lindquist, M.M., & Chambers, D.L. (1988). *The mathematics report card: Are we measuring up?* Princeton, NJ: Educational Testing Service.
- Eccles, J.S. (1989). Bringing young women to math and science. In M. Crawford & M. Gentry (Eds.), *Gender and thought: Psychological perspectives* (pp. 36-58). New York: Springer-Verlag Inc.
- Ehlers, G.A. (1997). *Attitudes and experiences of Mexican-American females in mathematics*. Unpublished masters thesis, San José State University.

- Fennema, E. (1995). Mathematics, gender and research. In B. Greuholm & G. Hanna (Eds.), *Gender and mathematics education: An ICMI study*. (pp. 21 - 38). Sweden: Lund University Press.
- Fennema, E., & Sherman, J.A. (1976). Fennema-Sherman mathematics attitude scales. *JSAS: Catalog of Selected Documents in Psychology*, 6 (1), 21. (Ms. no. 1225).
- Foon, A. (1988) The relationship between school type and adolescent self esteem, attribution styles, and affiliation needs: Implications for educational outcome. *British Journal of Educational Psychology* 58 (part 1), 44-54.
- Foster A., Winters, L., Gell J., Rath, J., & Gordon, B. (1995). *Merrill algebra 1: Applications and connections*. Lake Forest, IL: Glencoe Publishing.
- Friedman, L. (1996). Meta-analysis and quantitative gender differences: Reconciliation. *Focus on Learning Problems in Mathematics*, 18(1, 2, & 3), 128-138.
- Fuller, K.C.A. (1997). With boys or without them: An exploratory study of mathematics education for girls in single-sex and coeducational high schools (Doctoral dissertation, Stanford University, 1997). *Dissertation Abstracts International*, 58, 07A.
- Gilbert, E. (1992). Girls' schools: Laboratories in progress. In D. Hollinger & R. Adamson (Eds.), *Single-sex schooling: Proponents speak*. (pp. 5). Washington, DC: U.S. Department of Education.
- Gould, C.J. (1995). High ability girls and the all-girls mathematics setting: Do teacher interaction patterns change? *Achieving gender equity in the classroom and on the campus: The next steps*. (pp. 104). AAUW Pre-Convention Symposium.
- Gwizdala, J. & Steinback, M. (1990). High school females' mathematics attitudes: An interim report. *School Science and Mathematics*, 90(3), 215-222.
- Hildebrand, G. (1996, April). *Together or apart? Organization, policy and practice in co-educational and single-sex education*. Paper presented at the annual meeting of the American Educational Research Association, New York, NY.
- Jimenez, E. & Lockheed, M. (1989). Enhancing girls' learning through single-sex education: Evidence and a policy conundrum. *Educational Evaluation and Policy Analysis*, 11(2), 117-142.
- Kloosterman, P. (1991). Beliefs and achievement in seventh-grade mathematics. *Focus on Learning Problems in Mathematics*, 13(3), 3-15.
- Leder, G.C. (1992). Mathematics and gender: Changing perspectives. In D.A. Grouws (Ed.), *Handbook of research on mathematics teaching and learning*, (pp. 597-623). New York: Macmillan Publishing Company.
- Leder, G.C. (1995). Equity inside the mathematics classroom: Fact or artifact? In W.G. Secada, E. Fennema, & L.B. Adajian (Eds.), *New directions for equity in mathematics education*, (pp. 209-224). Cambridge: Cambridge University Press.

- Leder, G.C. & Forgasz, H.J. (1994). *Single-sex mathematics classes in a co-educational setting: A case study*. (Report No. SE-054-399). Paper presented at the annual meeting of the American Educational Research Association, Orlando, FL. ERIC Document Reproduction Service No. ED 372946.
- Lee, V. (1992). Single-sex schooling: What is the issue? In D. Hollinger & E. Adamson (Eds.), *Single-sex schooling: Proponents speak* (pp. 39). Washington, D.C.: U.S. Department of Education.
- Lee, V. (1998). Is single-sex secondary schooling a solution to the problem of gender inequity? *Separated by sex: A critical look at single-sex education for girls*, (pp. 41-52). Washington, D.C.: AAUW.
- Lee, V.E. & Byrk, A.S. (1986). Effects of single-sex secondary schools on student achievement and attitudes. *Journal of Educational Psychology*, 78(5), 381-395.
- Lee, V., & Marks, H. (1992). Who goes where? Choice of single-sex and coeducational independent secondary schools. *Sociology of Education*, 65(July), 226-253.
- Lee, V., Marks, H. & Byrd, T. (1994). Sexism in single-sex and coeducational independent secondary school classrooms. *Sociology of Education*, 67(April), 92-120.
- Lockheed, M.E. & Klein, S.S. (1985). Sex equity in classroom organization and climate. In S.S. Klein (Ed.), *Handbook for achieving sex equity through education*, (pp. 189 - 217). Baltimore, MD: Johns Hopkins University Press.
- Marcy, S., & Marcy, J. (1984). *Algebra with pizzazz: Practice exercises for first year algebra*. Palo Alto, CA: Creative Publications, Inc.
- Marsh, H. (1989). Effects of attending single-sex and coeducational high schools on achievement, attitudes, behaviors, and sex differences. *Journal of Educational Psychology*, 81(1), 70-85.
- Marsh, H., Owens, L., Marsh, M. & Smith, I. (1988). *The transition from single-sex to coeducational high schools: Teacher perceptions, academic achievement, and self-concept*. (Report No. C6-021215). Australia. ERIC Document Reproduction Service No. ED 300720.
- Meyer, M.R., and Koehler, M.S. (1990). Internal influences on gender differences in mathematics. In E. Fennema & G.C. Leder (Eds.), *Mathematics and gender*, (pp. 60-95). New York: Teachers College Press.
- National Science Board. (1990). *Science & engineering indicators - 1989*. Washington, DC: U.S. Government Printing Office.
- Oakes, J. (1990). *Lost talent: The underparticipation of women, minorities, and disabled persons in science*. Santa Monica, CA: Rand Corporation.
- Riordan, C. (1990). *Girls and boys in school: Together or separate?* New York: Teachers College Press.

- Riordan, C. (1998). The future of single-sex schools. *Separated by sex: A critical look at single-sex education for girls*, (pp. 53-62). Washington, D.C.: AAUW.
- Rowe, K.J. (1988). Single-sex and mixed-sex classes: The effects of class type on student achievement, confidence and participation in mathematics. *Australian Journal of Education*, 32(2), 180-202.
- Sadker, M. & Sadker, D. (1994). *Failing at fairness: How our schools cheat girls*. New York, NY: Simon and Schuster.
- Sangster, S. (1988). *Effects of sex-segregated mathematics classes on student attitudes, achievement and enrollment in mathematics: A.Y. Jackson secondary school; Year III*. (Report No. SE-051-251). North York Board of Education, Willowdale. ERIC Document Reproduction Service No. ED 316420.
- Shmurak, C.B. (1995, April). *Attitudes and aspirations of female adolescents; A longitudinal study-in-progress*. (Report No. C6-026562). Paper presented at the Annual Meeting of the American Educational Research Association, San Francisco, CA. ERIC Document Reproduction Service No. ED 386678.
- Smith, S. (1986). *Separate tables? An investigation into single-sex settings in mathematics*. London: Her Majesty's Stationary Office.
- Stallings, J.A. (1979). *Comparison of men's and women's behaviors in high school math classes*. Menlo Park, CA: SRI International.
- Stallings, J.A., Needels, M., & Sparks, G.M. (1987). Observation for the improvement of classroom learning. In D.C. Berliner & B.V. Rosenshine (Eds.), *Talks to teachers* (pp. 129 - 158). New York: Random House.
- Steinback, M. & Gwizdala, J. (1995). Gender differences in mathematics attitudes of secondary students. *School Science and Mathematics*, 95(1), 36-41.
- Streitmatter, J., Blair, H. & Marasco, J. (n.d.). *Girls-only classes in public schools; Ambivalence and support*. Unpublished manuscript.
- Webb, N.M.. (1984). Sex differences in interaction and achievement in cooperative small groups. *Journal of Educational Psychology*, 76(1), 33-44.
- Wilson, K.L. & Boldizer, J.P. (1990). Gender segregation in higher education: Effects of aspirations, mathematics achievement, and income. *Sociology of Education*, 63(January), 62-74.
- Wilson, P. and Hart, L. (in press). Teachers as researchers: Understanding gender issues in mathematics education. In J. Jacobs, J.R. Becker, & G. Gilmer (Eds.), *Changing the faces of mathematics: Perspectives on gender*. Reston, VA: NCTM.
- Whyte, J. (1984). Observing sex stereotypes and interactions in the school lab and workshop. *Educational Review*, 36(1), 75-86.

San José State
UNIVERSITY

**Office of the Academic
Vice President**

**Associate Vice President
Graduate Studies and Research**

One Washington Square
San Jose, CA 95192-0025
Voice: 408-924-2480
Fax: 408-924-2477
E-mail: gstudres@wanos.sjsu.edu
http://www.sjsu.edu

TO: Amy Burns
Hoskins 3A, Escondido Village
Stanford, CA 94305

FROM: Serena W. Stanford *Serena W. Stanford*
AVP, Graduate Studies & Research

DATE: March 2, 1998

The Human Subjects-Institutional Review Board has approved
your request to use human subjects in the study entitled:

"An Investigation into the Mathematical Experience
and Attitudes of Females in the Single-Gender
Setting"

This approval is contingent upon the subjects participating in
your research project being appropriately protected from risk.
This includes the protection of the anonymity of the subjects'
identity when they participate in your research project, and
with regard to any and all data that may be collected from the
subjects. The Board's approval includes continued monitoring
of your research by the Board to assure that the subjects are
being adequately and properly protected from such risks. If at
any time a subject becomes injured or complains of injury, you
must notify Serena Stanford, Ph.D., immediately. Injury
includes but is not limited to bodily harm, psychological
trauma and release of potentially damaging personal
information.

Please also be advised that all subjects need to be fully
informed and aware that their participation in your research
project is voluntary, and that he or she may withdraw from the
project at any time. Further, a subject's participation, refusal to
participate, or withdrawal will not affect any services the
subject is receiving or will receive at the institution in which
the research is being conducted.

If you have any questions, please contact me at
(408) 924-2480.

The California State University:
Chancellor's Office
Bakersfield, Chico, Dominguez Hills
Fresno, Fullerton, Hayward, Humboldt
Long Beach, Los Angeles, Maritime Academy,
Monterey Bay, Northridge, Pomona
Sacramento, San Bernardino, San Diego,
San Francisco, San Jose, San Luis Obispo,
San Marcos, Sonoma, Stanislaus

IMAGE EVALUATION TEST TARGET (QA-3)

APPLIED IMAGE, Inc
1653 East Main Street
Rochester, NY 14609 USA
Phone: 716/482-0300
Fax: 716/288-5989

© 1993, Applied Image, Inc., All Rights Reserved