

AN INVESTIGATION INTO THE GENDER BIAS ISSUE

THESIS

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Chapter I

Introduction

Everyday newspapers, popular magazines, and professional journals report that gender bias is rampant in our nations' schools. This issue is blamed for the disproportionate representation of women in the fields of mathematics and science. In general, women tend not to pursue scientific careers. It is shocking to read that fewer women are studying mathematics due to the following issues: lack of parental support, teacher bias in the classroom, peer influences, socioeconomic status, and historical points of view that women do not study the sciences.

Considerable attention has been given to attracting more women into mathematic and scientific fields. Indeed, observing a substantial difference between women's and men's participation in mathematics, researchers began to work on "the problem of women and mathematics." However, they did not ask what women were doing or how they had made their various choices. (Noddings, 1992)

Such information caused this investigation to become very interested in the status of high school mathematics classes. It is believed that some of the most important career decisions are made at the high school level, so that is where the study focused. Some of the questions to be answered seemed to be: Are fewer women studying higher level mathematics?, Why or Why not?, How do women feel about

mathematics?, Is it important to them?, Do they intend to pursue mathematics after high school?, and What are their career goals?

In choosing a large suburban school district of Rochester, New York this investigation hoped to answer some of these questions. The school district chosen had a culturally diverse student body and three high schools which produced an appropriate sample of students to be used in the study. The study focused on students enrolled in higher level mathematics classes only. Therefore those students enrolled in courses like Course III, Calculus, Pre-Calculus, and Advanced Topics were invited to participate.

Limitations of the Study

One important limitation to this study is that the percentage computed for male and females enrolled in courses and enrolled by grade level did not account for those students who may have transferred to other schools. It also did not account for students who may have dropped the course or dropped out of school.

Percentages were calculated for those students in grade ten who could possibly be in Course III or higher. The actual percentage of those students who are in both grade ten and Course III is not known and could possibly have an effect on the conclusion of this study.

In addition, accelerated students who would be taking higher level mathematics while in grades nine or below were not accounted for when

calculating levels of significance between those enrolled in higher level courses and those enrolled in grades ten through twelve.

Lastly, peer influences may have affected the responses on the survey as well. Such peer influences include the following: Students making suggestions to others regarding how they should answer questions, students not taking the survey seriously, thus writing down false information about themselves, or students asking someone else what they think he/she should write down. All of these limitations could lead us to believe that the data may not fully represent particular students.

Chapter II

Review of Literature

Today, most female and male students attend the same schools, sit in the same classrooms, and read the same books; but the legacy of inequity continues beneath the veneer of equal access. Although the school door is finally open and girls are inside the building, they remain second class citizens, according to Myra and David Sadker (1993). During the past few years there have been many stories in the press and on television about the gender bias that is allegedly widespread in the nation's schools, "destroying the self-esteem of girls and affecting their futures." (Ravitch, 1993, editorial page)

The American Association of University Women Educational Foundation (AAUW) (1992) reports that the educational system is not meeting the needs of girls. Girls and boys enter school roughly equal in measured ability. Twelve years later, girls have fallen behind their male classmates in key areas such as higher level mathematics and measures of self-esteem. "The gender bias persists that young women are not able to think logically or to understand scientific principles to the same extent or at the same level as their male counterparts." (Burke, 1993; p. 2) There are many factors involved in the discussion of the gender bias issue. Those factors that seem to be discussed more often are classroom

environment, children's literature, home environment, brain research, and statistical research.

Classroom Environment

"A large body of research indicates that teachers give more classroom attention and more esteem-building encouragement to boys," (The AAUW Report, 1992, p. 2). Observational classroom studies suggest that teachers, unconsciously, tend to expect more risk-taking and independence from boys, who are assumed to be tougher than girls. This type of gender stereotyping exists as early as kindergarten, as teachers subtly express gender bias through their expectations, encouragement, praise, and criticism of students. (Shepardson, 1991)

During the pre-school years boys and girls develop behavioral differences. Boys are encouraged to be active and assertive while girls are directed toward quiet play and passivity. Girls develop cooperative, turn-taking play and communication styles; boys, aggressive, competitive play and communication styles. (Chambers and Flynn, 1994)

Girls are said to "require less attention from teachers because they're more often on task and manageable. Boys are more demanding of attention and less compliant." (Chambers and Flynn, 1994, p. 59) Boys who are better students often gain attention by calling out answers or misbehaving, resulting in less teacher attention given to the girls who display good behavior. (Chambers and Flynn, 1994) Myra and David

Sadker (1994) agree that boys demand attention by calling out . They claim that when boys call out they get "real feedback," but when girls call out they get " reprimanded" or get "the brush-off with a response like 'OK'." (p. 23) Even when boys do not volunteer, teachers are more likely to encourage them to give an answer or an opinion than they are to encourage girls. (The AAUW Report, 1992)

Gender segregation is another issue. Most boys and girls at younger ages prefer to play and work in same-sex-groups and have same-sex-friends. Teachers also accept gender segregation in the cafeteria, on the playground and in the classroom. (Chambers and Flynn, 1994) Lynn Benore (1989) states that "half of America's classrooms are informally segregated, in seating, work groups, and informal interactions." (p. 2) Gender segregation deprives boys and girls of opportunities to gain mutual understanding and break down gender stereotypes. It also contributes to "boys' development of a greater sense of importance and even male dominance over girls." (Chambers and Flynn, 1994)

What Can Teachers Do?

With gender inequality being a prevalent part of our society, teachers have a special role to play if they are to help their students identify where it exists in the classroom and school environment. (Masland, 1993) "While educators need to demonstrate greater concern for inequities in student outcomes by gender, they must also pay greater

attention to the unequal way educational services are delivered to males and females." (Benore, 1989, p. 2) In addition, teachers must become aware of the subtle, subconscious, gender biases in their own teaching styles. (Shepardson, 1991)

Children's Literature

Literature is only part of the cultural media available to our children. Because they learn to read in close relationships with adults, we teachers, parents, and writers have a wonderful chance to discuss their world with them through what they read. If necessary, teachers should allow students the possibility to rage at the values and question the situations present. (Fox, 1993) In traditional rhymes and stories children hear messages about their roles and behaviors in society. "Many say girls are sweet, conforming, dependent; boys are strong adventurous, and independent." (Masland, 1993, p. 104) In the twenty or so children's literature books Temple (1993) could locate out of the last forty years' children's book winners, the majority of them show females as caretakers, mothers, princesses, helpers in the kitchen, teachers, and nurses. The males act in the larger sphere, as fighters, explorers, and adventurers of various sports. Fox (1993), a college professor, asked her undergraduate students "to write the beginning of a children's book and read it to the class." Most of the main characters were male! When she asked if their character could be female instead, without ruining the aim of the story,

they were puzzled to realize that this was absolutely possible. They wondered why they hadn't thought of it. On the other hand, a librarian discovered that there is a need for more strong male-centered adventure stories, in order to keep the interest of boys, especially those at a young age.

Even in the schools, curriculum content favors males. "Females are less likely to be studied in history and read about in literature. Math and science problems are more likely to be presented in a framework of male stereotypes." (Benore, 1989, p.1). According to Myra and David Sadker (1994), brand new history textbooks devote only 2% of their space to women.

Home Environment

Ravitch (1993) feels that gender bias begins in the home. Children see it in the movies and on television. They are less likely to see it in schools, he claims; where students are accustomed to seeing women in positions of authority. Of those women who rise to leadership positions, McGrath (1992) says that these women usually come from rural areas and small towns that have allowed them to build power bases and overcome stereotypes. She also says that they are often first born or only children.

The AAUW (1992) reports that "girls from low-income families face particularly severe obstacles." These obstacles can include poor schools in dangerous neighborhoods, low teacher expectations, and inadequate

health care and nutrition. Test scores of low-socioeconomic-status girls are somewhat better than for boys from the same background in the lower grades, but by high school these differences disappear. Among high-socioeconomic-status students, boys generally outperform girls regardless of race/ethnicity.

Brain Research

In the last decade neurobiologists have reported structural differences in at least two regions of the human brain. One is the corpus callosum, the mind's big telephone cable, the other is the hypothalamus, the master controller for the integration of many basic behavioral patterns. Studies suggest that men and women may process the same information differently and yet come to the same or similar conclusions. (Phillips, 1990) On the average men have better spatial function than women. This refers to the ability to mentally visualize and maneuver objects within three-dimensional space. Females generally speak earlier, learn foreign languages more easily, and outperform males in tests of verbal fluency. Additionally, studies among mathematically gifted students reveal that males outnumber females among the superior achievers, which may be related to greater male ability in spatial tasks. (Restak, 1984) It is said that the male brains are more lateralized than those of females, thus allowing for more right-brain performance or visuospatial skills. Because females have increased bilateralization, they excel at verbal skills since there is

more cross-communication and it then causes a decreased focus on the right hemisphere: (Phillips, 1990)

How Are Girls Doing In Math?

The AAUW (1992) reports that differences between girls and boys in math achievement are small and declining. Yet in high school, girls are still less likely than boys to take the most advanced courses and be in the top-scoring math groups. Even girls who are highly competent in math are much less likely to pursue scientific or technological careers than are their male classmates. Girls who see math as "something men do" do less well in math than girls who do not hold this view. (p. 4) Myra and David Sadker (1994) say that in the early grades, girls are equal to or ahead of boys on almost every standardized test but by high school girls score lower on the SAT and ACT exams and that the gender gap is greatest in math and science. "The impact on girls is that they lose self-esteem as they go through school. Girls and boys who like math and science have higher self-esteem and greater career aspirations." (Mincer, 1994, p. 27)

Ravitch (1993) claims that the difference in test scores has not deterred women's progress a bit. Twenty years ago, more boys went on to college than girls; today the reverse is true: Sixty-seven percent of female high school graduates go to colleges, compared with 58 percent of male high school graduates. She says that "the gender bias in our culture will ultimately be vanquished by the legions of young women who are now

graduating from our colleges and universities and are entering the worlds of business, medicine, law, education, government and journalism. So, instead of asking why women lag behind men in mathematics, we might ask why men lag behind women in elementary school teaching, early childhood education, nursing, full-time parenting and like activities.

(Noddings, 1992)

The growing consensus is that we owe it to children to teach them to argue with what they hear and see as well as read. (Temple, 1993)

Women and men need to be made aware of the obligation for and the opportunities of an education that is free of gender bias. In an era of increasing emphasis on excellence and accountability, we cannot afford to squander any of our talent. (Burke, 1993)

Chapter III

RESEARCH DESIGN

The goal of this research on gender bias in mathematics is to understand why girls, who are in upper level mathematics classes, have chosen to continue their studies in higher level mathematics. This researcher wanted to get an idea of how they feel as learners, how much self-esteem they have when they approach mathematics, and who or what situations have influenced them.

Three public high schools located in a large suburb of Rochester New York were chosen for this research. The investigator's interest was only in those students enrolled in upper level math courses, Course III, Pre-Calculus, Calculus, Advanced Topics in Mathematics, and Discrete Mathematics.

The research process was divided into three sections: Enrollment Data Collection, Surveys, and Interviews.

Enrollment Data

To answer the first question regarding whether or not there are fewer women studying higher level mathematics, the enrollment data was studied. From the master schedules for each individual high school this investigator was able to determine the number of males and females in all

courses being offered to students. Unfortunately only the 1992-93 and 1993-94 school year master schedules were available.

The main interest was in the higher level courses as previously stated. Using the master schedules this investigator wanted to get the percentage of males and females in higher level courses. Looking at each higher level course the percentage of males and females per class for each of the three high schools was calculated. Then for each class, a percentage based on all three high schools for males and females was calculated. Finally a grand percentage involving all three high schools and all five course listings was calculated, giving percentage of males and females taking higher level math courses for the combination of all three high schools.

In order to determine if there happened to be a significant difference in the percentages between genders, the investigator needed an estimate of the number of males and females per grade level at each high school. With the help of each high school's counselors, the number of males and females for grades ten through twelve in the 1993-94 school year was obtained. The data for 1992-93 was no longer available. Since the average youngest student to enroll in Course III is a tenth grade student, it was only necessary to get data from grades ten through twelve. These were also converted to percentages.

Surveys

The next step in the study was to design a questionnaire that would help better understand why females were taking higher level math courses, how they felt about themselves as mathematicians and who or what their influences may have been.

The investigator contacted each mathematics department chair for each high school asking if their school would be interested in participating in the research. When possible, individual teachers were spoken with about the research, giving them a better idea of what was being looked for. Along with a cover letter, ample numbers of surveys were sent to each qualifying mathematics teacher at each of the three high schools. Any teacher teaching one of the higher level math courses received a detailed cover letter explaining the purpose for the research as well as introducing the researcher, making the teacher feel more comfortable about administering the survey. From the participating classes, 285 male surveys and 343 female surveys were received from the following courses; Course III, Pre-Calculus, Advanced Topics in Mathematics, and Calculus.

Design of the Survey

The survey consisted of four parts. The top section gathered information regarding their current mathematics course, whether or not it served as an elective, and their age and gender. Part I was designed to

determine if a student was accelerated or not and also to get an idea of what previous courses the student had taken. Part II was an attitudinal survey based on general feelings and reactions toward mathematics. Finally, Part III consisted of open-ended questions. The purpose of this section was to get an idea of what and who has influenced the student as well as if there is a possibility that the student will pursue studies in Mathematics. The survey is included as appendix A. The survey is one page in length and at most takes a student five minutes to complete.

Interviews

After studying the surveys the researcher conducted teacher interviews. The goal was to obtain the teachers' view on why females were and were not continuing their studies with higher level mathematics as well as other questions surrounding the gender bias issue. Appendix C contains the format of teacher interview questions. Teachers were chosen based primarily on availability. Four of which were female and two of which were male. The questions remained the same for all teachers and the interview took approximately fifteen minutes each. The interviews were taped for the purposes of researcher facilitation. It should be noted that, unfortunately, one of the three high schools did not have a teacher representative for the interview. However, the researcher was able to ask a few questions of them on an informal basis.

In addition to teacher interviews, one male counselor was interviewed, also based on availability. The procedures by which students get placed in mathematics courses and how much they can or will influence a student's decision to drop a mathematics course was discussed.

The researcher also attempted to contact the parents of five students who had dropped Pre-Calculus, but unfortunately was unsuccessful due to end-of-the-year schedules. One graduate of one of the high schools was interviewed informally regarding her influences and insights on the issue of gender bias, providing a student's point of view.

Chapter IV

Data Analysis

The first question to be investigated was, Are fewer women studying higher level mathematics? If so, Why? As you can see, the answer to this question was no. From here the investigator chose to determine why there was equity in the district. Interest was focused on how many of these students went through the accelerated program, what female attitudes were, who and what influenced them and what their career goals were. Three hundred and forty three females and two hundred and eighty five males who were enrolled in Course III, Pre-Calculus, Calculus, or Advanced Topics for the 1993-94 school year participated in the study and completed the survey. In addition four female mathematics teachers and two male mathematics teachers, one male counselor, and one female student participated in interviews. All subjects were of the same suburban school district, but from different high schools.

Enrollment Data Percentages

In order to determine whether or not fewer women were studying higher level mathematics in the district, Percentages were calculated from enrollment data for the 1992-93 and 1993-94 school years. Percentages

were then calculated for the number of females and males in grades ten through twelve for the 1993-94 school year.

From the enrollment data, percentages were calculated by course and by school, as shown in Table A. After getting totals for males and females for each course the overall percentage was 47% male and 53% female who were enrolled in the upper level courses. Interestingly, both the 1992-93 and the 1993-94 school years had the same overall percentages.

Table A
Enrollment Data

1992-1993 Percentages

school	Course III		Pre-Calc		Calculus		Discrete		Adv. Topics	
	m	f	m	f	m	f	m	f	m	f
Arcadia	53	47	44	56	22	71	65	35	61	39
Olympia	54	46	48	52	50	50	X	X	X	X
Athena	47	53	52	48	59	41	33	67	25	75
Total	51	49	48	52	44	56	49	51	43	57

Overall: 47% male
53% female

1993-1994 Percentages

school	Course III		Pre-Calc		Calculus		Discrete		Adv. Topics	
	m	f	m	f	m	f	m	f	m	f
Arcadia	47	53	53	47	25	75	42	58	44	56
Olympia	48	52	53	47	49	51	50	50	47	53
Athena	46	54	45	55	55	45	50	50	47	53
Total	47	53	50	50	43	57	47	53	46	54

Overall: 47% male
 53% female

Since it would not have been accurate to draw conclusions from the above results without knowledge of the actual percentage of males and females at those grade levels, it was necessary to determine approximately the percentage of males and females in grades ten through twelve. There was no need to look at grade levels below tenth since under normal circumstances the youngest student in Course III would be in tenth grade.

Percentages were calculated for each grade level and from those arrived at an overall percentage of 48% male and 52% females in grades ten through twelve for the 1993-94 school year. (See Table B)

Table B
1993-1994 School Year Enrollments
By Grade Level

School	10		11		12		% total	
	m	f	m	f	m	f	m	f
Arcadia	131	134	129	144	153	145	49	51
Olympia	141	136	142	142	130	121	51	49
Athena	107	184	153	162	134	153	44	56
% Total	45%	55%	49%	51%	50%	50%		

Overall: 48% male
 52% female

A Chi Square Goodness of Fit was calculated to determine if there was a significant difference between the percentage of 47% male vs. 53% female for course enrollment and the percentage of 48% male vs. 52% female for enrollment in grade levels ten through twelve. With a Chi Square of .04 and a critical value of 3.84, the null hypothesis was not rejected. Therefore, there is no significant difference between the percentages enrolled in higher level mathematics courses and the percentages enrolled in grades ten through twelve.

Acceleration

On Part I of the survey, students were asked to circle their course of study or fill in the blank if none applied. The purpose of this section was to determine how many students went through the accelerated program. If all circles appeared in column one then the student went through a complete accelerated program up until 1994. It indicates that in eighth grade the student took Course I. As shown on Table C, an overall of 41% of the females surveyed went through the accelerated mathematics studies and an overall of 41% of the males surveyed went through the accelerated mathematics studies as well. Percentages by course are also available from the table, as well as actual response numbers per male and female by course.

Table C
Male/Female Response to Acceleration
Of Those Surveyed

	Accelerated		Not Accelerated		No Response	
	f	m	f	m	f	m
Calculus	34	30	0	0	0	0
Prè-Calc	39	39	36	32	1	1
Adv. Topics	2	5	14	10	0	0
Course III	67	43	149	121	1	4

Overall Female Percentages in Actual Courses Who Went Through

The Accelerated Program:	Course III	31%
	Pre-Calc	51%
	Adv.Topics	12%
	Calculus	100%

Overall Male Percentages in Actual Courses Who Went Through

The Accelerated Program:	Course III	26%
	Pre-Calc	54%
	Adv. Topics	33%
	Calculus	100%

Female Attitudes Towards Mathematics

From Part II of the survey percentages for attitudes to five statements on the survey were determined. For each statement a student was asked to strongly agree (SA), agree (A), disagree (D) or strongly disagree (SD). It was determined that overall 94% of the females surveyed agreed or strongly agreed that mathematics is important in order to get a good job. 83% agreed or strongly agreed that they are good at doing mathematics problems. 76% of the females surveyed have a good feeling towards mathematics, 70% have a strong desire to learn mathematics, and of the females surveyed 52% agree or strongly agree that doing mathematics is fun. (See Table D)

Table D
Female Attitude Responses From Survey

A = Agree/Strongly Agree

A.T. = Adv. Topics

D = Disagree/Strongly Disagree

P.C. = Pre Çalışus

NA= No Answer

Calc= Çalışus

CIII = Course III

Course	A	D	NA	A	D	NA	
A.T. #1	16	0	0	#2	12	4	0
P.C.	71	5	0		67	9	0
Calc	31	3	0		30	4	0
CIII	200	17	1		178	44	0

A.T. #3	10	6	0	#4	9	7	0
P.C.	65	11	0		57	19	0
Calc	29	5	0		31	3	0
CIII	152	65	1		127	89	1

A.T. #5	5	11	0	% total for Agree/Strongly Agree:			
P.C.	46	30	0	#1	94%	#2	83%
Calc	26	8	0	#3	76%	#4	70%
CIII	88	127	2	#5	52%		

Female Influences For Studying Higher Level Mathematics

From Part III of the survey, it was asked that the student respond to who and what has been most influential in their decision to study higher level mathematics. After charting the data on responses, it was found that 155 females felt their parents were most influential, 55 credited themselves, and 54 credited their teachers. Of the 155 parental responses, 64 responded as "parents", 38 responses were "mom", and 53 responses were "father". Of the 54 teacher responses, 20 responded as "teacher", 27 specifically responded "female teacher", and 7 responded specifically "male teacher". It was also found that 123 males felt their parents were most influential, 78 credited themselves, and 42 credited their teachers. Of the 123 parental responses, 48 responded as "parents", 32 responses were "mom", and 43 responses were "father". Of the 42 teacher responses, 19 responded as "teacher", 12 responded as "male teacher", and 11 responded "female teacher".

See table E for remaining female responses. It should be noted some students responded two or three times and all responses were accounted for.

Table E
Who Influenced Females Most?

<u>#Responses</u>	<u>Response</u>
64	parents
55	self
53	father
38	mom
27	female teacher
20	teacher
12	no-one
10	brother
8	sister
8	male counselor
7	male teacher
7	counselor
5	female counselor
2	male friend
1	grandmother
1	grandfather
1	female cousin
1	boyfriend
29	no response

The "what" influenced their decision was very interesting. After charting the data on responses, it was found that 91 of the females surveyed responded that college has influence them to study higher level mathematics, careers and jobs influenced 43 of them, and 30 of them stated that they like mathematics. As with the "who" influences, some students responded two or three times and all responses were accounted for. (See Table F)

Table F
What Influenced Females Most?

<u>#Responses</u>	<u>Response</u>	<u>Single responses</u>
91	college	natural to them
43	career	instilled at early age
30	"like it"	fun
28	Regents	good understanding
21	"good at it"	no calc. in college
17	"challenge"	like the teacher
6	future	acceleration
5	"easy"	assumed
2	desire to learn more	experience
2	for science courses	pressured to take better opportunity

27

no response

more adv. society

live up to brothers'

standards

Female Career Goals

Question three in Part III asked if they intended to pursue mathematics in college. Overall 64% of the females surveyed will continue their studies, 11% will not continue their studies in mathematics, and 25% responded possibly. (See Table G)

Table G

Pursue Studies in Mathematics

	Yes	No	Possibly
<u>Course III</u>	55%	10%	35%
<u>Pre-Calc</u>	72%	4%	24%
<u>Adv. Topics</u>	69%	12%	19%
<u>Calculus</u>	59%	18%	23%
<u>Overall:</u>	64%	11%	25%

An extremely large variety of career goals was found after charting responses from question four in part III. Since many of the females who

were surveyed gave several responses, all responses were accounted for. The top three career goals, in general form, are teacher, with 62 responses, medical field, consisting of doctors, dentists, nurses, veterinarians, etc. with 56 responses, and 37 responses for science field, consisting of marine biology, biochemistry, and other forms of science. (See Table H)

Table H
Female Career Goals

<u>#Responses</u>	<u>Response</u>	<u>Single Responses</u>
62	Teacher	Secretary
56	Medicine	College degree
37	Science	Legal secretary
19	Accounting	Gerontology
19	Engineer	Publisher
18	Psychology	Airline
17	Business	Culinary arts
17	Law	Anthropology
14	Fine Arts	Speech pathology
9	Journalism	Real Estate
6	Architect	Work with kids
6	Computers	Astro-Physicist
6	Criminal Justice	Fire Protection

6	Mathematics	Pilot
5	Communications	Liberal Arts
4	Sports Medicine	Book Editor
3	Health	Environmental
3	Social Work	Conservationist
3	International Business	
2	Counselor	
2	Fashion Design	
2	Foreign Language	
39	undecided	

Interview Analysis

Although only six teachers were interviewed, all seemed to agree on most questions (See Appendix C for interview questions). Five teachers agreed that females are becoming more independent in their learning. One teacher did not notice a difference in her twenty years of teaching. "Most females, twenty two years ago, took mathematics in order to get into college, now they are actually using it in a profession," commented a teacher.

Since a decrease in female interest does not appear in some of these classes, it was asked what could have caused less interest in

mathematics years ago. Many felt that male dominance played a part and some females at that time were told that they could only become a teacher, mother, secretary, or a nurse.

Not everyone agreed on the third question, Are teachers biased? One teacher said that she is biased. She calls on the boys because they do not do their homework. Another teacher calls on anyone whose attention she does not have, boy or girl. Interestingly, more girls do better on exams than boys. Most teachers agreed that girls work much harder and take greater pride in work well done. They feel that boys study higher level mathematics because they think they have to, where girls go on because they like it. From a parental point of view, one teacher feels that certain teachers are indeed biased towards females and others biased towards different races.

The teachers were hesitant to say whether or not socioeconomic status plays a part in females' lack of interest in mathematics, however they strongly feel that if the family values education then the student will value education. One teacher commented that if socioeconomic status does play a part, it would be the male who could not continue.

When asked why their district has equity, most felt that it is because there are so many strong women teachers in the mathematics department and they have been there for about twenty years. Others also felt that more parents are pushing education and "the work ethic is there." When I spoke with a female graduate of the district, she felt strongly that her continued studies in mathematics should be credited to her mathematics

department from high school. She had all extremely talented female teachers, as well as very supportive parents.

While speaking with one of the counselors I learned that counselors strongly encourage all students to stick with the Regents courses. In fact one teacher mentioned that she wanted a student to drop to Non-Regents, but a counselor talked the student into staying in Regents courses. The counselors do not see a pattern of gender differences. They have noticed that girls are willing to talk about what they want to do. If they do not know where to begin, they take a career interest survey. This particular counselor's name appeared on one of the student's surveys as one who has been influential in that student's decision to continue studies in higher level mathematics.

Chapter V

Implications of The Research

Discussion and Conclusions

Discovering that this district had a gender equity among students who were studying higher level mathematics was a surprise. After the publicity that gender bias influences females' attitudes towards mathematics and related fields, it was interesting to find that this district was different. After this finding, the research focused on what made these females different. Why do they study higher level mathematics?

Taking a look at the results of acceleration, 51% of the females surveyed went through accelerated courses. This means that 49%, who did not go through acceleration, continued to have an interest in mathematics, regardless of their abilities.

The attitudinal section of the survey revealed that females believe mathematics is important in order to get a good job, and a good percentage of them are confident enough to say that they are good at mathematics. Most seem to like mathematics and have a desire to learn it. This actually corresponds nicely with those who plan to continue their studies. 64% responding yes and 25% responding possibly is promising.

It is obvious that they have their futures in mind. Studying mathematics is their key to college and career and most are enjoying it. It

is also extremely obvious that the people in their lives play important roles. The support of both parents and teachers has proven to be part of the decisions these young women are making today. They have also revealed to us that they take pride in work they have done, they have even credited themselves as being one of the primary influences in their lives. The teacher's voices also compliment this. They are aware that females are working very hard and take pride in work well done.

Although the top career choice was in the field of teaching and may require less mathematics, the next four top career goals, medicine, science, accounting, and engineering, reveals that they not only feel mathematics is important, and that their primary influences are college and career, but also that they intend to use in their future. As you browse through the list in the summary survey (See Appendix B) you will notice that our females are not planning to become housewives, and there is not an overwhelming number of nurses or secretaries. Females have the mathematical ability and are taking the steps to use it in their futures.

Recommendations for Further Study

One recommendation to teachers who want to further investigate the gender bias issue in the classroom would be to complete a four or five year longitudinal study beginning in the eighth grade. It would be interesting to look at the number of accelerated students who drop out along the way and study their reasons for doing so. This investigation is

sure that there will be other issues than gender bias but this would for sure be an interesting study.

Using the surveys, if time had permitted the researcher would have compared the male results to the female results. There is a possibility that males will respond differently and there may be some interesting comparisons of percentages. The comparison of career goals as well as the desire to continue with mathematics in college may prove to be quite different among males and females.

Another interesting study would be to locate those students who had dropped out of higher level mathematics and interview them to get ideas on their thoughts and feelings towards mathematics. It would also be advisable to interview or survey their parents as well.

A more difficult study would be to observe teachers in the classroom to determine a level of bias. Finding teachers who are willing to cooperate and be judged could be difficult. A simple tally method would be sufficient to determine a bias level, however.

Most importantly, comparing this district to surrounding districts would be fascinating. What does this district do that others' are not and possibly should be doing for their students? Do their students share the same attitudes and career goals? Maybe other districts will have better results! If so, What are they doing different?

It is intriguing that the public tells us that our teachers are biased towards females in the classroom, that it is deterring them from the field of mathematics and the sciences, and something needs to be done. This

investigation is convinced that in this particular district, with the support of its teachers, counselors, and of course, the parents, are females are not getting lost. It cannot be concluded that gender bias does not exist in the classroom, but from the results in this district, the females are taking the higher level mathematics courses, planning careers that will utilize those skills, and enjoying it.

Appendices

Appendix A

Math Survey

Current math course _____

Is this course an elective or part of a sequence required for graduation?

Your age _____

Your Gender: Male, Female

I. Circle the course you took in the following grades. If none apply, please fill in.

Grade _____ Other (give title) _____

11	pre-calc	Course III
10	Course III	Course II
9	Course II	Course I
8	Course I	8th grade math

II. Respond to the following statements. (Circle one :SA= strongly agree, A= agree, D=disagree, SD=strongly disagree)

I am good at doing mathematics problems.	SD	D	A	SA
I have a good feeling toward mathematics.	SD	D	A	SA
I have a strong desire to learn mathematics.	SD	D	A	SA
Doing mathematics problems is fun!	SD	D	A	SA

III. 1. What influenced you to study higher level mathematics?

2. Who has been most influential in your decision to further your study in mathematics? Indicate relationship to you and the person's gender. (male teacher, mom, female counselor, etc.)

**3. Do you intend to pursue mathematics in college (circle one)?
Y, N, or Possibly**

4. What are your career goals?

Thank you for your cooperation

Appendix B

Summary Survey

Current Math Course_____385 Course III, 148 Pre-Calc, 64 Calculus, 31 Adv. Topics

Is this course an elective or part of a sequence required for graduation?(disregard)

Your age_____ (disregard)

Your Gender: Male, Female 285 males, 343 females

I. Circle the course you took in the following grades. If none apply, please fill in.
Grade _____ **Other (give title)** _____

11	pre-calc	Course III
10	Course III	Course II
9	Course II	Course I
8	Course I	8th grade math

_____ accelerated not-accel. no response

	m	f	m	f	m	f
Calc	34	30	0	0	0	0
precalc	39	39	36	32	1	1
advtop	2	5	14	10	0	0
CIII	67	43	149	121	1	4

Overall female in
accelerated:
 CIII: 31%
 PreCalc: 51%
 Calculus: 100%
 Adv.Topics: 12%

II. Respond to the following statements. (Circle one :SA= strongly agree, A= agree, D=disagree, SD=strongly disagree)

Mathematics is important in order to get a good job.
 I am good at doing mathematics problems.
 I have a good feeling toward mathematics.
 I have a strong desire to learn mathematics.
 Doing mathematics problems is fun!

SA	A	D	SD
SA	A	D	SD
SA	A	D	SD
SA	A	D	SD
SA	A	D	SD

	#1			#2			#3		
	A	D	NA	A	D	NA	A	D	NA
A.T.	16	0	0	12	4	0	10	6	0
P.C.	71	5	0	67	9	0	65	11	0
Calc	31	3	0	30	4	0	29	5	0
CIII	200	17	1	178	44	0	152	65	1

	#4			#5		
	A	D	NA	A	D	NA
A.T.	9	7	0	5	11	0
P.C.	57	19	0	46	30	0
Calc	31	3	0	26	8	0
CIII	127	89	1	88	127	2

A.T.= Advanced Topics
P.C.= Pre-Calculus
Calc=Calculus
CIII = Course III

III. 1. What Influenced you to study higher level mathematics?

91-college, 43-career, 30-like it, 28-regents, 21-good at it, 17-challenge, 6-future, 5-easy, 2-for science courses, 2-learn more, 27-no response, single responses-natural, instilled at an early age, fun, understand, no calculus in college, like the teacher, acceleration, assumed, experience, pressured, better opportunities, more advanced society, live up to brothers' standards.

2. Who has been most influential in your decision to further your study in mathematics? Indicate relationship to you and the person's gender. (male teacher, mom, female counselor, etc.)

64-parents, 55-self, 53-father, 38-mom, 27-female teacher, 20-teacher, 12-no-one, 10-brother, 8-sister, 8-male counselor, 7-male teacher, 7-counselor, 5-female counselor, 2-male friend, single responses: grandmother, grandfather, female cousin, boyfriend.

3. Do you intend to pursue mathematics in college (circle one)? Y, N, or Possibly

	Yes	No	Possibly
Course III	55%	10%	35%
Pre-Calc	72%	4%	24%
Adv. Topics	69%	12%	19%
Calculus	59%	18%	23%
Overall:	64%	11%	25%

4. What are your career goals?

62 teacher, 56 medicine, 37 science, 19 accounting, 19 engineer, 18 psychology, 17 business, 17 law, 14 fine arts, 14 physical therapy, 9 journalism, 6 architect, 6 computer, 6 criminal justice, 6 mathematics, 5 communication, 4 sports medicine, 3 health, 3 international business, 3 social work, 2 counselor, 2 fashion design, 2 foreign language, 2 politician, 2 pre-school, 2 to be successful, single responses: secretary, College degree, legal secretary, gerontology, publisher, airline, culinary arts, anthropology, speech pathology, real estate, work with kids, astro-physicist, fire protection, pilot, liberal arts, environmental conservationist, book editor, 39 undecided.

Thank you for your cooperation

Appendix C

Teacher Interview Questions

1. Are females becoming more independent in their learning?
2. What leads to decrease in female interest?
3. Are teachers bias?
4. Does socioeconomic status play a part?
5. Why do you think your district has equity?
6. Are there any females in mind that you felt could have moved on but did not?

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