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The Correlation Between the Geographical Region of a High School and the Enrollment Ratio of Males to Females in Accelerated College-Preparatory Level Mathematics Courses

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and the Enrollment Ratio of Males to Females in Accelerated

College-Preparatory Level Mathematics Courses

by

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Abstract

Females, in this modern age of feminism, have excelled in all fields of study and graduate from college in larger numbers than males. However, few women go into the STEM fields (Hill, Corbett, & St. Rose, 2010). To close this gap in mathematics-related fields, it is paramount that high schools produce female students who are advanced in Mathematics. The problem was the underrepresentation of females in mathematical fields of study, with a more pressing issue of underrepresentation of females in college-preparatory mathematics classes at the high school level. The purpose of this study was to determine if the geographical region of a high school contributed to the resulting ratio of males to females enrolled in college level mathematics courses. In this mixed methods study, 21 urban, 14 suburban, and 30 rural public school districts in Missouri, were selected and the ratio of males to females enrolled in Calculus for each district was obtained. The researcher's rationale for this comparison was that the culture of each geographical region created bias affecting females' choice in their fields of study.

The research question was: Does the ratio of males to females differ between urban, rural, and suburban high schools in advanced mathematics courses? Two types of analyses were applied in this study and obtained the following results. The data analyzed in the study did not support a difference in ratios when comparing urban, rural, and suburban schools, nor did it support a difference in male to female ratios enrolled in advanced placement coursework. The data did not support a relationship between the ratio of Calculus students and the district budget, but did yield a mild positive correlation when comparing the ratios of male to female students in Calculus and male to female mathematics teachers.

Historically, lower enrollment of women in the STEM fields than males is a trend supportable by the findings of this study. In rural and suburban areas there were fewer females than males enrolled in advanced mathematics. However, in the urban areas a slight difference yielded more females than males enrolled in similar coursework.

Table of Contents

List of Tables

List of Figures

Chapter One: Introduction

Common statements heard by women pursuing a career in mathematics and science fields are "Women are not mathematical thinkers," (aerospace engineer, anonymous, personal communication, February 2009) "Women are incapable of performing mathematics-related jobs because their brains just don't think that way," (Quality Control Chemist, anonymous, personal communication, February 2009) or "The only mathematics job a woman can handle is teaching" (Quality Control Statistician, anonymous, personal communication, February 2009). These stereotypes may prevent women from entering fields of mathematics. As revealed in interviews of young women who hold prominent positions in several well-known Midwestern engineering and chemical companies, the women heard comments like these repetitively through their schooling and as adult professionals. These women already made it through an undergraduate degree in the field of Mathematics, and some have master degrees. They know that women are just as capable of getting a 4.0 grade point average in a mathematics course of study as men and are not bothered by the negativism. They do not believe in maintaining the status quo.

However, younger females, just thinking of entering a field in mathematics, may not be as willing to overlook degrading comments. Young women can face such comments as, "What a wonderful career choice!", "Being a woman you will go far, because there aren't many women in that field" (Mathematics Professor, personal communication, anonymous, February 2009), but then they are belittled with, "Wouldn't you rather get a sensible degree, find a husband, settle down, and have some kids?" (Mathematics Professor, personal communication, anonymous, February 2009). In teenesteem courses offered at high schools, adolescents are told that one degrading comment will have a longer lasting effect on an individual than twenty good comments (Emery, 2006). This is also true about the choices teenagers make. If the choice is met with a negative reaction, they are less likely to pursue that path. The women who heard these types of comments were girls labeled ‘gifted’ or ‘tracked’ into the ‘high’ mathematics level. Some of these women were not labeled as ‘smarter than the rest’ and defied the odds, made choices to track themselves and became someone they knew they could be, even though they were more socially challenged than their male counterparts.

Background of the Study

With negative publicity toward women when they announce their career choices, it is no wonder that universities like Missouri University of Science and Technology (2006) boast about reaching a three to one male to female ratio. It is also no wonder there have been numerous studies in the new millennium on why there are so few females holding positions in the fields of mathematics, computer science, engineering, and science, especially since women’s rights and society have advanced so far in the last 100 years (Hill, Corbett, & St. Rose, 2010). Women went from not being allowed to vote, to running for President, from fighting to be heard and have control over their own bodies and property to being some of the wealthiest people in the world. Women are considered equal in almost every area of employment, but their numbers are low when obtaining positions in the mathematics career fields; only 13.5% of the architecture and engineering occupations are held by women (Censuses Bureau, 2008). Studies conducted at various Mathematics, Science, and Technology Universities, like those reviewed by American Association of University Women (AAUW) in 2010, asked whether women’s aversion to choosing a mathematics degree is biological or social, and what the AAUW can do about the problem in their universities. These researchers fail to step back into the classrooms of incoming freshmen to find real answers about female's lack of mathematics choices. The studies also have not checked to see if this problem exists in the high schools across the United States or if it is isolated in certain areas of the United States. Some researchers have tried to pinpoint the reason for the gender gap that becomes visible in the middle school years (Sanders and Peterson, 1999). These researchers neglect to look to the future and ask about career and university choices high school students plan to make. An understanding of what area of study students plan to focus on for the next six to ten years of their lives could also be helpful. During course selection in high school, juniors are encouraged to take a fourth year of mathematics if they plan to attend college.

In interviews, mathematics teachers (anonymous, personal communication, April 2009) say they are often frustrated because their students do not know what they want to be when they grow up; therefore, the teachers cannot assign the appropriate course. Statistics for business majors, mathematics analysis for those not going into a bachelor of science field, Calculus for those who want to be doctors or engineers; these are choices that the students need to make before their junior year of high school in order to set up the prerequisites for college (high school guidance counselors, anonymous, personal communication, January 2009). Other teachers say students dumbfound them when they say they want to be a doctor or get a medical degree of some kind, but these students are currently attempting to pass Algebra I, a freshmen level class, as a junior. The students have no intention of taking any more mathematics, because they are not aware that they need Calculus for their degree.

Generally speaking, students who take Calculus at the high school level are usually in several other college-preparatory classes (high school guidance counselors, anonymous, personal communication, January 2009). These are the students who will graduate high school with college credit and will have taken at least one college mathematics course. The students in Calculus courses are put through some of the toughest mathematics training the public school systems have to offer. Every student enrolled in a public school has the opportunity to take Calculus during his or her senior year; however, according to the National Commission on Excellence in Education (NCES, 1983) 94% choose not to do so. This means that six percent of the nation's senior population takes Calculus in high school. Statistically speaking, three percent of the senior population should be females taking Calculus; however, the data does not show that female students arriving as university freshmen are ready to major in a mathematical field (NCES). Approximately half of the human population is female; therefore, approximately half the population of a freshmen Calculus class at any university should be female. Likewise, approximately half the population of a senior Calculus class at a high school should be female. These statistics are not representative of the local high schools, nor are they representative of the universities searching for females to enter their mathematics programs (Missouri University of Science & Technology, 2006).

Statement of Problem

The problems facing America, in both high schools and colleges, are the underrepresentation of females in mathematics classes and the underrepresentation of females in mathematical fields of study. In order to gain insight into these problems, an understanding of the student's educational past is required. Juniors and seniors in high school need to make the choice whether or not they are going into a field requiring mathematics, and not delay this decision until they are freshmen in college. These high school seniors are the ones making the decisions that affect the universities' enrollment; therefore, the new problem, and more pressing issue, is the underrepresentation of females in college-preparatory mathematics classes at the high school level.

Purpose of Study

At the time of this writing, for the past several years, university researchers have tried to find out why there are fewer females in their mathematics, science, and engineering programs than males (Hill, Corbett, & St. Rose, 2010). This study will examine if this problem stems from the cultural differences due to different geographical locations of schools or if it is a part of the American culture as a whole. There were several variables contributing to the culture in which a female student was raised, such as geographical region, political party, religious affiliation, parents, gender of teachers, and socioeconomic status (Guiso, Monte, Sapienza, & Zingales, 2008). All of these factors existed on various levels in rural, urban, and suburban schools. This study will determine if there is a statistical difference in these three regions in terms of the enrollment of males and females in advanced placement mathematics courses at the public high school level. If a significant difference is found, parents may start migrating to different regions of the state in order to ensure their child has all of the advantages a school can offer. However, if no statistical difference is found, then lower enrollment of females in mathematics related courses of study may be contributed to the American culture as a whole, rather than to characteristics of individual regions.

The purpose of this study was to determine if the geographical region of a high school contributed to the resulting ratio of males to females enrolled in college level mathematics courses. This study will also compare the proportion of females in Calculus classes in rural schools to the proportion of females in Calculus classes located in urban and suburban schools. The researcher's theory is that there is a difference in the three geographical locations due to the culture and background of the regions. This study will also consider descriptively the ratios of freshmen males to females enrolled in Pre-Algebra and Geometry courses to determine if differences in gender distributions existed when comparing those students enrolled in a mathematics course a year later than traditional enrollment to those enrolled a year earlier.

Research Questions and Hypotheses

The following questions were addressed:

1. Does the ratio of males to females enrolled in college-preparatory level mathematics courses, such as Calculus, differ among urban, rural, and suburban high schools? If so, how?
2. Does the ratio of male to female mathematics teachers correlate with the ratio of male to female mathematics students enrolled in Calculus? If so, how?
3. Does the ratio of males to females in advanced placed mathematics classes change as the students progress through their four years of high school? If so, how?
4. Does the school budget have any effect on the ratio of males to females enrolled in advanced placed mathematics courses, or the ratio of students taking Calculus? If so, how?

Null Hypothesis # 1: There will be no difference in the ratios of males to females enrolled in Calculus when comparing urban, rural, and suburban schools.

Null hypothesis # 2: There will be no relationship between the ratio of male to female students in Calculus and the ratio of male to female mathematics teachers.

Null Hypothesis # 3: There will be no difference between the ratios of males to females enrolled in advanced placement mathematics classes as the students progress through the four years of high school.

Null hypothesis # 4: There will be no relationship between the ratio of males to females enrolled in Calculus and the district funding.

Alternative Hypothesis # 1: There will be a difference in the ratios of males to females enrolled in Calculus when comparing urban, rural, and suburban schools.

Alternative Hypothesis # 2: There will be a relationship between the ratio of male to female students in Calculus and the ratio of male to female mathematics teachers.

Alternative Hypothesis # 3: There will be a difference between the ratios of males to females enrolled in advanced placement mathematics classes as the students progress through their four years of high school.

Alternative Hypothesis # 4: There will be a relationship between the ratio of males to females enrolled in Calculus and the district funding.

Definition of Terms

For the purpose of this study the researcher created the following definitions:

Urban – A geographical region with a population of 2,500 people or more per square mile.

Suburban – A geographical region with a population between 1,000 and 2,500 people per square mile.

Rural – A geographical region with a population less than 1,000 people per square mile.

Advanced placed mathematics students – Students who are enrolled in a grade-level course and are in the grade previous to that courses grade. For example, Geometry is a 10^{th} grade course, according to the Missouri Department of Elementary and Secondary Education, and this study looks at the enrollment data of 9^{th} graders in Geometry.

District Funding – Current expenditure per average daily attendance, which is the amount spent daily by the school district.

In the 1990's and before, the United States Census Bureau defined urban areas as regions with a population of 2,500 people per square mile, or more, and rural as regions with a population of 2,500 people per square mile, or less. In the current millennium the definitions of these areas grew more complicated and the definition of suburban was added. For the purpose of this study, the urban definition was kept the same, the suburban definition was created, and the rural definition was lowered to better represent the population density of the Midwest.

Limitations

The primary limitation to this study is the effect on data by the lack of ability to offer particular levels of courses at smaller public schools. If a school was too small, it would not have enough student enrollment or faculty to offer courses like Calculus. Therefore, many of the smaller school districts that reside in rural settings may not be eligible for this study. In contrast, the larger suburban districts have multiple high schools and the data for each of the high schools was compiled as a sum for the district. Consequently, the suburban sample had fewer than 15 districts even though the population included more than 30 high schools. The limitation created by selecting public schools as the population, was that some students from educationally-driven families may have been enrolled in private schools or may have been home schooled, thus eliminating their data from the sample pool. Another limitation was not all schools reported their enrollment data to the Missouri Department of Elementary and Secondary Education (MODESE), because they did not need state funding. These schools were not included in this study. Also, the data used in this study was obtained from the MODESE and was only as accurate as the data reported by the individual school districts.

An additional limitation for this study lies in the definition of advanced mathematics class. The study did not calculate the ratio of male to female students enrolled in each type of mathematics class; Algebra I, Geometry, Algebra II, Pre-Calculus, and Calculus. The researcher defined advanced mathematics class to be a situation in which the student was enrolled in the course at least one year before it would traditionally have been assigned. Therefore, a narrower was been taken in examining the male to female ratios. The study analyzed the ratio of male to female students in an accelerated track as opposed to the male to female ratio enrolled in each individual type of mathematics class.

Summary

The research information gained from this project may allow society to determine whether rural, urban, or suburban culture had an effect on female’s desire to participate in college level mathematics courses. If it is determined that culture affects female achievement, then parents may look more closely at the school districts in which they buy their homes and what environmental, or cultural, attributes affect the raising of their children. Possible indirect benefits to society from data collected and analyzed within this study would be to provide statistical evidence that the gender gap in the fields of mathematics and science may begin well before majors are chosen in college.

Chapter Two: Review of the Literature

The review is presented in five categories: psychology of female students, female anxiety as related to the mathematics fields, the psychology of the female's ability to relate to male teachers, expectations of females, and culture of a geographical region. The author does not pretend to have exhausted all of the literature pertaining to each of these five categories. The author does not pretend to be a psychologist or psychiatrist; however, she is relating her observations of females attending schools in these geographical regions with a thorough attempt to acquaint the reader with the research that has been conducted in these areas.

Psychology of the Female Student

Since the topic of females in college-preparatory mathematics classes has not been covered at the high school level, it was necessary to delve into the psychological aspect of females. Several of the following researchers suggested that gender, age, and behavioral differences were important to females as they relate to mathematics. Brown, Teufe, Birch, and Kancherla (2006) stated that girls reported more worries than boys. According to Orton (1982), girls worried more about family, personal adequacy, personal health, and ornamental issue" and reported no gender differences when it came to "social adequacy, economic, or academic worries (e.g., employment and clothing)." Silverman, La Greca, and Wasserstein (1995) said "Girls seem to worry more about school, classmates, future events, and appearance." Brown et al. (2006) found that girls had more issues with social acceptance and their appearance.

As gifted females go through adolescence, depression becomes more prevalent than in their male counterparts (Sands & Howard-Hamilton, 1995). At this point in a girl's life, she becomes more aware of herself, and begins to pick up on what society expects of her, especially in terms of her femininity, (Sands & Howard-Hamilton). Sands and Howard-Hamilton found that adolescent females with higher educational goals had the attitudes that mirrored their aspirations; most adolescent males, however, still envisioned themselves as the primary bread winner. Their research further indicated "that gifted girls feel more frustrated, worried, and generally tense than gifted boys" (Sands & Howard-Hamilton, p. 192). The researchers concluded that adolescent gifted females, in general, but more specifically those from poor socioeconomic backgrounds and those of color, were pressured by society to meet low expectations and to fulfill their roles as women rather than intelligent people (Sands & Howard-Hamilton). These researchers concluded that these messages contributed to gifted adolescents' depression (Sands & Howard-Hamilton). Gifted students from one of these groups may even be ignored by peers because their peers think the gifted female was trying to relate to a higher class or different race (Sands & Howard-Hamilton). Many gifted adolescents suffered from a feeling of being different from their peers and this created a fear of failure, but sometimes, more importantly, a fear of success (Sands & Howard-Hamilton). Sands and Howard-Hamilton concluded that adolescence was the most important time for being exposed to successful female role models.

There was another side to the gender gap which maintained that mathematics and the hard sciences were masculine oriented subjects and not suited for females (Ziegler, Albert, Hiller, & Kurt, 2000). Ziegler et al. reported that in Germany one-third of mathematics and physics teachers believed females were less capable than males in these subjects (Ziegler et al.). These researchers concluded that this type of thinking contributed to female anxiety and even self-perceived helplessness which could be helped by stressing the importance of gender-specific socialization (Ziegler et al.).

Another stressful situation for girls was how to navigate between power, control, and politeness. The process of establishing and maintaining friendships with other women was critical to female development and during adolescence, female relationships were especially important in terms of providing women with a sense of wellbeing (Crothers, Field, & Kolbert, 2005). The United States is a melting pot of cultures, classes, and races which provide numerous behavioral combinations and makes it difficult for women to classify themselves into a specific identity. Thus, aggression in adolescent girls often erupts, especially in friendships, because the female does not behave according to the category others have placed on her (Crothers et al.). Within each race, social expectations are different between the classes, which is another reason it is hard to place adolescent girls into a specific gender identity (Crothers et al.).

Another major concern was with the psyche of females. Females believed they were successful in mathematics because they get outside help and put forth great effort, and failed because they were not capable; whereas, males were successful on their own and blame external factors on their failures (Lloyd, Walsh, & Yailagh, 2005). According to Lloyd, Walsh, and Yailagh, females showed a self-defeating attribution pattern and males showed a self-enhancing attribution pattern (Lloyd et al.). Females often related success to being lucky rather than to being smart, which often accounts for their feeling of not knowing why they are so smart (Lloyd et al.). Powell (2001) suggested the developmental psychology of adolescent girls brings with it conflict within oneself, as well as identity issues, especially between the ages of thirteen and nineteen. Girls learn to deal with mental and physical changes as adolescents, while they worry about what society expects of them, what they are expected to look like, and their own expectations of themselves (Powell). Santrock (2001) said adolescent females were trying to find out: (1) who they are, separate from their families; (2) what they are about, their interests and personalities, and (3) where they are going, in order to discover their place in adult life (as cited in Powell). All of these questions and concerns that most girls had were added to the gifted girl's problems of fitting in and finding her place in a society that could not classify her. According to Porath (2001), young females had better interpersonal communication skills then males; this trait can help women answer some of these life questions and read the nuances of social groups they may not fit in, but wish to join.

In Cury et al. (1996) research, it was found that adolescent students can be self-motivated if they feel they are capable of achieving the task and are viewed as an equal in the situation. Self-motivation creates determined, confident, interested, and low stressed students (Cury et al.). Cury et al. concluded that adolescent girls will be intrinsically motivated to master an objective when they feel the goal of the objective is mastery rather than social standing.

In the research for a study conducted in 2006, it was found that students spent more time with their peers and less time with parents and teachers; this contributed to another problem with adolescent girls, and their desire to fit in because friendships became increasingly more important, and stronger, throughout high school (Crumb, Farkas, & Muller, 2006). Their research suggested that these groups of peers, or groups of girlfriends, were a negative influence and could cause delinquency and behavior problems; however, the study proved that these groups of girlfriends could also promote higher academic achievement, better behavior, and an otherwise uncharacteristic sense of confidence, which could inspire girls to enroll in advanced mathematics and science courses (Crumb et al.). These findings suggested that if an individual or girl wanted to do better in life, or school, they needed to find a group of same-sex peers who had the same goals, because girls were positively influenced by the group's choices, just like they were positively influenced by involved female role models (Crumb et al.).

When Lenver and his associates were researching for *Influences of Gender on Academic Achievement* (2000) they found that men and women had only two small and specific differences in mathematics and verbal abilities; that of three-dimensional mental rotation, favoring men, and speech production, favoring women. They also found that the gender gap on standardized tests declined over the past few decades preceding their research, though achievement was not the only reason for girls to make career choices (Lenver, Davis-Kean, & Eccles, 2000). These changes in the gender gap could come from the effort shown to bolster scores in mathematics, the teacher's perspective of girls and mathematics, as well as the general rise in society's level of education (Lenver et al.). Lenver and his associates suggested making mathematics and science occupations more appealing to high-achieving adolescent women rather than placing so much emphasis on academic success; they said this intervention needed to begin before junior high when the lack of interest in mathematics appeared to begin (Lenver et al.).

Through a survey conducted by Cole, Jayaratne, Cecchi, Feldbaum, and Petty (2007), it was discovered that people believed gender played a role in a person's ability to nurture; however, gender did not play a role in ability to successfully think mathematically or to be violent. "Men were more likely than women to use genetics to explain perceived gender differences in nurturance, but not in mathematics or violence" (Cole et al., p. 211).

The results of a study conducted by Seon-Young and Alszewski-Kiebilius (2008) supported the belief that academically-gifted students were more morally sensitive, were more advanced in moral reasoning, and possessed greater leadership potential than non-academically-gifted students. Academically-gifted students made academically higher scores as expected, but they were not always advanced in emotional intelligence, as compared to heterogeneous groups of students (Seon-Young & Alszewski-Kiebilius). Academically-gifted male students seemed to have the same level of emotional intelligence as normal male students; however, academically-gifted female students fell behind their normal female counterparts (Seon-Young & Alszewski-Kiebilius). This may indicate that intelligence does not always eliminate all stress levels. In fact, gifted students were found to be more impulsive and less tolerant; they also showed poor stress management skills (Seon-Young & Alszewski-Kiebilius).

Hanna's (2000) research found that, in the sixties, the feminist movement suggested that in order to have gender equality in mathematics and science occupations, "the creation of conditions that would ensure equal representation of males and females in mathematics and science courses in high school, including the advanced courses, as well as in the mathematics and science programs in the universities," was required. Unequal representation perpetuated unequal work patterns (p. 1). Hanna found that through the early seventies biology was used as the reason why females did not go into mathematics and science fields (Hanna). Later, the reason changed to the fact that women were less confident in their mathematics abilities and attributed their correct answers to good luck rather than intelligence (Hanna). After the seventies, the mass research showed there was no intellectual difference between males and females, and the lack of female participation in the fields of mathematics and science was attributed to the way the females were raised (Hanna). The social and cultural factors were not intentional barriers, but they played a role in hindering the female achievement rate in mathematics and science (Hanna).

Reasoning skills versus mathematical self-confidence remained at the root of the stress level and socially inadequate feelings of adolescent girls. Recent meta-analyses indicated that gender differences in mathematics were not found in every grade-level (Casey, 1999). In fact, this analysis pointed out that during the elementary and middles school years, few overall gender differences in mathematics were actually found. It was suggested that males did not actually get an increase of mathematical ability over girls until high school, which could account for female’s feeling inferior and their rate of dropping out of upper level mathematics courses and mathematics-related fields. Most girls just did not seem to want to compete with boys and this was an easy way to avoid competition. In most studies, the subjects of stress and competition were difficult to test, thus getting girls into mathematics-related fields remained a struggle and the psychology of the young woman remained a mystery.

Female Anxiety as Related to Mathematical Fields

In general, girls tended to have much higher stress levels during adolescence and that was why females had more anxiety when it comes to mathematical fields (Watt, 2000). In early research, attitudinal change was measured in mathematics and English over the first year of junior high. Watt found that the transition into junior high negatively affected the student's self-concept and his or her belief in mathematical and English abilities, but previous research had not addressed changes in task evaluations and achievement behaviors. Changes in student attitudes were also related to gender and the level of academic achievement (Watt). Many researchers found that on average, boys had more positive attitudes and self-perceptions than girls in mathematics; thus, accounting for girls' high anxiety levels. It was suggested that gender intensification occurs with age; therefore, girls become more negative about male-stereotyped domains, such as mathematics. In self-evaluations, boys had a higher perception of their mathematical talents and expected to perform higher than girls in this field of study and never failed to share these feelings with the girls; this moved girls' anxiety to still higher levels. "The only gendered achievement behavior occurred among the high achievers in mathematics, with high-achieving girls negligibly outperformed by their male counterparts" (Watt, p. 14). It was thought that this negligible difference might disappear with an attitude differentiation. Girls must get over their anxiety, self-perception that, and belief that boys are better in mathematics-related subjects.

Still another aspect of anxiety entered the mathematical picture with the use of graphic calculators. Ruthven recorded that boys scored better overall than girls in a group using the calculators in a high school setting, but girls' performance was superior to that of boys on items requiring symbolic answers for given graphs (Forster & Mueller, 2002, p. 9). The better performance of girls was attributed to graphical checks, which decrease anxiety. This is particularly relevant to girls because they exhibited less confidence than boys, especially in uncertain conditions. In working with both boys and girls in high school mathematics classes, it was noted that boys were always willing to punch numbers into a calculator and accept whatever answer came out. This method was not as satisfactory to girls; they wanted to be able to prove to themselves that their answer was correct; therefore, pencil and paper worked better for them and relieved their anxiety of uncertainty (Forster & Mueller). The percentage of boys choosing a pure calculator approach to mathematics was always greater than the percentage of girls. This was probably because boys were more successful in using the calculator, which again reverts back to anxiety levels with its use. On the other hand, girls scored higher on function type problems because this method assured them that their answer was correct through checks and balances (Forster & Mueller). Various mathematics classes had marginal differences between genders, but when anxiety could be erased, girls' scores improve (Forster & Mueller). How to go about removing anxiety was the real problem. Girls just seemed to have the need to know they had the right answer and often backed down from competition with boys simply because of uncertainty (Forster & Mueller). It was not certain anyone really knew what girls must do to overcome mathematics anxiety.

Daly (2006) stated that in

> college, boys are more likely to pick the upper-level mathematics and science courses whereas girls are more likely to enroll in English and humanities courses. Due to the fact that females are self-selecting out of these courses in college, careers in mathematics and science are overwhelmingly male". (p. 1)

It is noted, by Daly (2006), that "gender-based achievement gaps exist not only in mathematics and science, but in all facets of education" (p. 2). Most often it seemed these gaps related to anxiety, which affected the student's perceptions of occupational attainment. Daly suggested that schools cheated girls in many ways, foremost by displaying attitudinal differences. For example, a female teaching upper-level mathematics classes would encourage girls to advance in mathematics; whereas, a male teacher may not offer this encouragement. It was not thought to be intentional on the male teacher's part, but it was thought that he may just not have been aware of girls' anxiety issues when it comes to mathematics. Males and females often perceived occupational attainment differently and perhaps females just needed a little push to think outside of the box. Females in college who enrolled in upper-level mathematics courses were still not as likely as boys to choose mathematics-related careers (Daly). Career choice patterns related potential attitudinal differences between males and females when selecting courses. The mere fact that boys were more likely to speak up in class caused girls to fail to voice their opinions (Daly). Teachers viewed girls' unwillingness to speak out as a sign of weakness, or lack of knowledge; whereas, the truth may have been that girls had a need to know they were right before expressing themselves, which circles back to that anxiety level and the main difference between males and females (Daly). Boys did not have to know they were right, and they seemed to not care. If they were wrong, they just go on, while girls get embarrassed (Daly). This may often be what holds them back and keeps them from competing with boys.

Jovanovic and Dreves (1999) stated "until recently, it was believed that male-female differences in mathematics and science were caused by biology. In other words, girls' and boys' brains are different, so they are better suited for different things" (p. 1). Since that time, researchers have tried to focus on finding out if superior spatial abilities really make boys better at mathematical manipulations; whereas girls had better writing and language skills. Evidence showed boys excelled in mathematics, and girls appeared to do better in verbal-related skills (Jovanovic & Dreves). It had not been proven that these differences were a result of biology. At the time of Jovanovic and Dreves studies, researchers had been focusing on social environment. An example of this would be that from early on, boys are given the opportunity to tinker with toys or objects such as building blocks, Legos, or racing cars, thus teaching them principles inherent to mathematics and science. Girls usually lack these experiences; so they enter the mathematics and science classroom feeling insecure and often never shake this anxiety. They begin to believe mathematics was a male domain and were often not willing to be competitive, achievement-oriented, or even social, in a mathematically oriented environment. Unfortunately, parents, teachers, and school counselors who believed in these stereotypes held girls back from achieving what could be a successful mathematics career. “In the classroom, teachers, often unaware of their own biases, call on boys more, praise boys more for correct answers, and are more likely to ask boys for help in science and mathematics demonstrations” (Jovanovic & Dreves, p. 2). These types of actions send the message to girls that they are not as good as boys, so they should stay clear of mathematics and science in their course selection. In order to try to overcome this anxiety, parents should give sons and daughters early mathematics and science experiences, such as visiting science museums or allowing both to play with chemistry sets. Mathematics and science experiences, when young, could avoid anxiety during school years.

Emotional resilience, especially in gifted adolescent females, must also be changed as they often experience a significant social and emotional imbalance during school years. According to Kline and Short (1991), the avant-garde society, such as those who are more modern and open minded, accepted and appreciated the many contributions of women. This was a great stride made over the thinking of the past. Educators and researchers began to believe women and men were psychologically developed equally; however, even though their judgments and values were comparable, they still experienced life differently (Kline & Short). This suggested that women in more recent times may have a different voice, but it is not certain this different voice is strong enough to overcome all of the deficient feelings of the past. Women were often still at risk emotionally, socially, and even medically, since men still often made the rules. Gifted girls often found their giftedness an advantage because it gave them a more positive self-concept. They did well in school because they exhibited obedience and did what was expected. Kline and Short stated, "Callahan points out that the behavior which helped females do well in school may be a detriment to them later in the competitive professional world" (p. 2). This suggested that doing the right thing or what was expected did not serve girls well in the career world; however, these same girls usually changed significantly, both socially and emotionally, as they progressed through school, so hopefully they could make the right thing work to their advantage.

Freeman stated that "boys are more frequently identified as being gifted – almost twice as often as girls" (Fiebig, 2003, p. 166). Because of this statistic, it was imperative that parents, counselors, and educators know what influenced the career decisions of girls. It has been found that the feelings of importance within a family and school may have a larger impact on adolescent girls than peer groups. Girls must feel important and needed if they are to achieve. Fiebig studied college women and found that their career choices were shaped by their assertiveness and independence. Moreover, "women who choose non-traditional careers tend to have high ability, liberal sex role attitudes, and magnetic characteristics" (p. 2). Mother-daughter relationships were also becoming more important to girls' selection of career orientation and aspirations. This was especially true among rural adolescent females. The mother's employment, educational status, and gender role attitude played a big part in female anxiety levels when it came to course and career selection. Mothers did not realize the profound impact they could have on their daughters' lives. Due to the probability that many girls were multitalented, their frustration levels and quick career foreclosures must be minimized. Adults must be aware that their intervention is needed and usually welcomed by girls when it comes to career choices. It is society's obligation not to lose the contribution that girls and women can make if given the opportunity and encouragement (Fiebig).

Differences in mathematical achievement between boys and girls were well documented in the educational and psychological literature. While the differences in general samples were decreasing, boys were well represented in mathematically gifted samples (Manger & Gjestad, 1997). Boys performed better than girls on tasks requiring application of algebraic rules or algorithms, which goes back to Jovanovic and Dreves, (1999) study that stated boys had an advantage because of the toys they were exposed to at young ages. Manipulative mathematics, mathematics involving physical objects that can be manipulated, seemed to be boys forte.

The accepted practice of coeducation in mathematical and science fields was often questioned in the many readings completed for this chapter (Manger & Gjestad, 1997). Arguments were often made for single-sex schools or at least single-sexing some of the classes in a co-educational school. This often happens without mandate because girls did not want to put up with the anxiety of competing with boys and did not sign up for upper-level mathematics classes. It was not unusual to see these classes with as few as one or even no girls. Interpretations of comparisons between single-sex and co-educational schools were often hampered by the fact that single-sex schools were more likely to be selective (Manger & Gjestad). In most countries single-sex schools tended to be private, and thus may have been selective of their students, while the co-educational schools tended to be public. In the United States of America all students were guaranteed a free public education, even if there was a public or private choice. It became evident that controlling the initial attainment and whole environment markedly reduced the difference in achievement between genders, which would relieve much of the anxiety for girls. No matter what the gender, the issue was complicated further by the fact that coeducational schools and classes in comparative studies often included schools or classes with a poor balance of genders (Manger & Gjestad).

Students' choices of classes and career decisions were influenced by their habitat; thus, it was almost impossible to predict courses they may choose without taking into consideration their education and home surroundings (Nagy, Trautwein, Baumert, Koller, & Garrett, 2006). Nagy et al (2006) suggested that "educational systems often differ in the ways they regulate individual's academics and occupational careers" (p. 342). Some students were willing to face stress while working toward career choices, while others were not and took the easy path to a selected career.

Culture can also play a role in how children select subject matter in school and ultimately in their career choices. This can be seen by recognizing the fact that, in most cultures, parents taught their offspring knowledge they gained from their parents and grandparents (Sapienza, Zingales, & Guiso, 2006), and church and schools could also play a part in their selections in academia because, in many areas the values and beliefs taught in either of these played a role in how children tended to believe, which ultimately influenced their class or career selection.

Another real anxiety or stress factor for women was the negative images which lower mathematics test scores. Studies quantify the gender stereotypes impact on women. In one report by Emery (2006), Elizabeth Beer was a straight *A* student and could never figure out why mathematics was her nemesis. She eventually figured out the real difficulty was her mathematics teacher who never gave encouragement but always discouragement instead (Emery). She was one example of what many girls felt. This attitude led to anxiety. The teacher simply did not believe women belonged in mathematics. He felt women were innately mathematics-deficient. In this case, it did not keep Beer from succeeding in the long run, because she had determination. However, it could have accounted for her early struggles. A study published in the journal of *Science* found that telling women that they were worse than men at mathematics was enough to make them stumble on a mathematics test, especially if they thought the underlying reason was genetic (Emery). The study did not determine if there was a real difference between men and women, but showed that just discussing it might make a difference. It is similar to the situation when someone asks you if you do not feel well. You may feel fine, but just the suggestion of someone thinking you might be ill puts the thought in your mind and almost causes you to feel badly. When women stick to the mathematics courses, perhaps leading them to engineering school, people seem to look at them differently. Almost like ’Wow!’ or ’That’s Amazing’. In reality, it is not all that amazing; it really seems to be related to the fact that women just need to be told that they can do it. Still, because this concept cannot easily be put into practice, women seem to shy away from mathematics-related fields. Of students earning undergraduate degrees in engineering in 2001, only about 20 percent were women, according to the National Science Foundation (Emery). These statistics seem to hold steady through time, so it makes one wonder if the whole mathematics problem is being approached wrongly. If anxiety is truly the cause, maybe what is being said should be looked at more closely.

In American high schools, the phrase, “Boys are innately better at mathematics and science, while girls tend to excel in subjects that require verbal skills” is often uttered (Johnston, 2005, para. 1). Nothing has been proven to support this statement according to Stanford scholars (Johnston). There has been no evidence of innate differences in mathematics and science. In fact, the campus study discovered that differences in performance between males and females had shrunk to nearly insignificant levels on most standardized tests (Johnston). The strong belief that boys were better at mathematics was vastly out of proportion to any derived statistics, since girls seemed to make similar gains (Johnston). When boys did better in mathematics, everyone seemed to say it was because boys were more suited to the areas of mathematics and science, but when girls did better, it was attributed to the fact that they studied harder, or luck. Something must be done to change these perceptions. No one ever succeeded only because of luck. If this was true, everyone would sit back, remain stress free, and wait for their luck to manifest.

Another large field of study which evolved in the twenty-first century is that of computer science. The field has been trying to attract women, but the same ideas begin to surface. Girls felt they were not exposed to computers as early as boys. It was thought that, in this very modern up-to-date world we live in, parents still pictured girls in the role of homebodies and felt at early ages they should be playing with dolls, while their male counterparts were being exposed to computers and toys that would prepare them for the scientific world in their future. Tillberg and Cohoon (2005) said in the field of computer science men and women seem to be attracted by similar reasons. Both were influenced by parents; however, boys often more than girls because they received programming instructions from their fathers. Boys and girls alike were encouraged by teachers to enter the computer fields; though, this encouragement was more beneficial to girls, since they needed external encouragement to enter mathematics related areas of study (Tillberg & Cohoon). It seemed that both sexes reported influence toward computer science by work experience and play, though different types. Reverting back to play, boys leaned more toward gaming, which led them to be more likely to choose programming; whereas, girls felt this choice did not enter their minds until after, just by accident, taking a computer class and feeling very successful. Yes, this still showed girls must be given a feeling of success and have the anxiety level removed before feeling comfortable in a mathematics-related field.

A common belief was that the gender-related expectations and beliefs parents hold can become assimilated into their children's own thoughts of self-competence, appropriateness, and the value they place in tasks (Peer Interview, 2008). It demonstrates that one's own sense of self-competence often affects motivation, which then may affect choice, behavior, and effort. If children feel they are able to successfully complete what is required of them in a subject area, they then may become more motivated to try harder and become actively engaged in that area of study. Children were perceived as striving to figure out who they are, what part they play in this world, and what affect they will have on the world in which they live (Peer Interview, 2008). Success plays a huge part in choosing mathematics-related fields, especially for girls.

The associations between general confidence and course performance are different than those between mathematics concerns and course performance. CyberStats appeared to allow a stronger relationship between general confidence and course performance than ActivStats for females, while the opposite was true for males (Alldredge and Brown, 2006). Association between course performance and student beliefs appeared to exist in the software environment. Females continued to have negative feelings toward the statistics field, possibly because there was no association with human beliefs. What emerged from the study described by Alldredge and Brown was, similar to studies summarized earlier in this chapter, persistent skepticism about efficacy of technology as a way of improving learning, was misdirected. The personal touch was found to be imperative, but it must be remembered that what was said or relayed by that personal touch may make or break a situation, especially when dealing with girls (Alldredge & Brown).

Gender differences in motivational and social predictors of mathematics anxiety continued to be cited as one of the key reasons girls in particular do not enter the mathematics-related fields. A research study was conducted at the University of Kentucky suggested findings about mathematics anxiety were important in two ways (Hughes, 1997). First, they were consistent with prior research in agreement that seventh grade females reported higher levels of mathematics anxiety than did males. In addition, they supported earlier findings that students' expectancies and values for mathematics predicted levels of mathematics anxiety. Second, they added to the literature on mathematics anxiety by demonstrating that the pattern of prediction for mathematics anxiety differed for males and females (Hughes). These findings suggested that female and male mathematics anxiety differed and this was an area of study, if the fear wall of mathematics anxiety was going to be able to be removed from females' consideration of mathematics-related fields (Hughes).

Still another wall to be addressed in study was the anxiety of timed versus untimed testing, when used in the field of mathematics. A study was designed by Tsui and Mazzocco (2007), in which a group of sixth grade gifted students was tested under timed conditions demonstrated mathematics anxiety, and thus participants had lowered test scores. The anxiety was apparent when timed conditions preceded untimed conditions. However, it became obvious that students with higher mathematics anxiety or the desire to be perfect had a smaller difference between timed and untimed testing, as compared to students with less mathematics anxiety, or reduced feelings of need to be perfect (Tsui & Mazzocco). Mathematics anxiety in all research, especially among girls, seemed to be the one non-intellectual factor that affected a child's performance in mathematics. Mathematics anxiety has been defined as "the feeling of tension and anxiety that interferes with manipulation of numbers and the solving of mathematical problems in a wide variety of ordinary life and academic situations" (Richardson & Suinn, 1972, p. 551). An anxiety definition has been derived, but how to overcome such anxiety still continued to be a problem in drawing girls into mathematics courses and eventually mathematics-related careers.

Psychology of the Female's Ability to Relate to Male Teachers

Another side of the gender gap became clear when dealing with the subject of the female's ability to relate to male teachers. Often it was the teacher's actions that prevented the female's ability to relate. Warrington and Younger (2000) reported that a male teacher who showed little respect for girls who were able to achieve, and admiration, or even pride, in underachieving boys could tilt the scale to the point that the boys managed to get good grades in the end, even with little effort. Just by supporting the overall view that boys had an innate ability in science class, results could be changed. Girls also needed support and admiration if they were going to do their best (Warrington & Younger). In the described school setting, girls did not develop links, logic, and ability to apply their knowledge in the way that boys did from an intuitive perspective.

Perhaps, too much of the discourse in schools has been placed on the terms of 'boys' and 'girls' as though they were homogeneous groups, despite evidence that factors such as social class, sexuality, and ethnicity, and teacher comments and actions may be more important than gender in determining achievement levels in schools. Many researchers still argued, at the time of this writing, that mathematics and science subjects were still socially constructed as masculine (Warrington & Younger, 2000). If they seemed to back the described teacher's action toward girls, then girls may never learn to relate to male teachers. Warrington and Younger found in some comprehensive schools, girls feel that male physics teachers help, talk to, and directly teach the male students rather than the females in the same class. The authors stated this usually happens because the male teachers felt the boys knew more about the subject and did not ask as many questions, which tended to irritate the teacher. This was obvious in the observation of several schools (Warrington & Younger). This suggested that if all, or most, teaching instruction between teacher and pupil by male teachers took place in a classroom, girls would have a difficult time relating to the male teacher.

Statistics reported in Warrington and Younger's (2000) research that about 34% of girls were aiming toward jobs such as childcare, nursing, work with animals, office work, and hairdressing, and a further 17% were drawn toward work in health care, teaching, or veterinary science. Relatively few girls, 8% in selective schools and 10% in comprehensive, wished to follow a career that may have been traditionally male jobs. Only 3% wanted to become scientists. It seemed strange that articles also showed that male teachers wanted girls in their classes, even though they and the boys gave the impression they devalued them. They needed the girls to provide a support role; almost like in all of life, girls are always there to pick up the pieces, whether at home, in the work place, etc. (Warrington & Younger).

Boys and girls, as well as male versus female teachers, may provide varied settings, but not necessarily better. As a result, a difference in how boys and girls learn and how males and females teach can be expected. Tunnel-vision teaching offered by many teachers, who feel all students learn in the same way, could have been a contributing variable in student deficiency because all students did not learn in the same way, especially males compared to females (Geist & King, 2005). Perhaps a curriculum that is developmentally appropriate individualized, and gender responsive needed to be developed, especially in the field of mathematics. In most high schools there were more male mathematics teachers, since mathematics seemed to be a male subject area of choice, so it would probably have been difficult to break out of the, *we have always done* *it that way and it has always worked* mode. Statistics showed that girls were not getting their mathematics needs met, or at least were not willing to fight hard enough to get their needs met, so it was apparent that something must be done. Ten things teachers, male and female, could do to support mathematics for both boys and girls was listed by Geist and King:

1. Avoid labeling;
2. Get to know the students' learning styles;
3. Get to know the developmental differences of children;
4. Allow children to solve problems in many different ways;
5. Using active and exploratory methods of teaching;
6. Visual spatial versus language based approaches in mathematics;
7. Developing activities based on different levels of boys and girls;
8. Competition versus cooperation;
9. Individual versus group;
10. Inductive versus deductive reasoning. (Geist & King, 2005)

If all of these things, or at least many, were put into use, most any mathematics curriculum could be successful for both boys and girls in the classrooms. Perhaps the most useful of all ten would be to avoid labeling. This may be difficult for male teachers. In a general sense, girls tended to be read-and-write-and auditory learners, whereas boys tended to be visual and kinesthetic learners (Geist & King, 2005). Knowing this could provide an easy application for male and female teachers. "Because of the various developmental levels and learning styles, there may be different ways that children go about solving a problem" (Geist & King, p. 46), thus, a *one way* approach to problem solution is inefficient. Boys were more physically active and like to engage in more exploratory methods than girls. This seemed to be important for teachers, as well as parents, to understand and put into use when possible (Geist & King). Boys were more visual-spatial and girls more verbal processing, so male and female teachers could easily incorporate this into teaching and avoid any problem in relating to the teacher (Geist & King). Attention spans of boys and girls, competition levels, and inductive versus deductive reasoning could also be information used, especially by male teachers who often had the same problems, to draw girls into the fun and games males seemed to find in the mathematics world. Most of all, the individual male teacher-to-boy student, method of teaching needed to change if more girls were expected to be seen on the perceived male career line.

Differential teacher attention to boys and girls from both male and female teachers seemed to no longer work with children at the time of this writing. Beaman, Wheldall, and Kemp (2007) said the concern of sexual inequality was up for debate for more than 30 years. This often caused concern and questions if male and female students sharing the same classroom were getting the same educational opportunities (Beaman et al,). The debate between girls' perception of male teachers giving boys more attention and the boy's/male teachers not seeing this at all had been discussed for years. True or not true, and still under debate, this issue should be addressed and resolved if female anxiety, as related to male teachers, was to be removed. It seems there was a need to establish a significant process in this area. Usually, a series of *if* questions follows these discussions; for example, *if this, if that*. If nothing is ever tried, nothing will ever be changed, and the perceptions of girls on both the side of the teacher and the student will remain the same. If things are always done the same way, the same results will occur. This mind set should be tackled and changed even *if* to only a small degree.

Studies suggested that males and females learn and behave differently. Proponents of single-sex education said that choice allowed teachers to tailor lessons to male or female interests. It also could mean fewer distractions in class, and an environment to help students feel more at ease to raise their hands and participate (Hubbard, 2006). A principal at Macon's Alexander High School was thinking of putting this single-sex education strategy into effect by forming one strictly male class, one female class, and one blended class in the fourth grade for one following school year. She admitted plans were just in the thinking stages, but those in charge were always looking for things to better prepare the students for the world of work. All educators were looking for ways to better prepare their students, but most unfortunately, remained in the thinking stage (Hubbard). Thinking is good, but action is better, especially when it relieves stress and anxiety of students. According to the National Association for Single Sex Public Education, just three public schools across the country offered such programs a decade before his publication, but the number grew to 250 schools (Hubbard). If something was having a positive effect, principals, like the one in Macon, should be encouraged to try it, even if the *it* is segregated classes. One argument against segregated classes was the fact that people did not live in a segregated world. This was true, but was obvious in all literature on education and career choices that end results still remained mostly segregated. Few girls went into male careers. It was getting a little better, which was an improvement. Perhaps, segregating students, as well as teachers, would give girls especially, that thumbs up to go out and succeed in the male world of work.

Grassi (2004) found hidden curriculums that teachers applied in classrooms provided a disservice to female students. This strategy caused a gap in gender-based achievement, thus showing a discrepancy in mathematics which remained a serious problem (Grassi). If teachers have hidden agendas, it potentially contributed to why girls could not overcome their anxieties. The gender gaps in elementary schools were not as great as those seen in middle school and high school. These gaps were especially found in mathematics and mathematics related areas, which caused the female enrollment in upper level mathematics and mathematics related subjects in high school to drop (Grassi). If in high school, more males than females enrolled in upper level mathematics classes. This was likely to continue to the college level. It could be that competition and learning differences between boys and girls seemed minimal in elementary school because most elementary school teachers were women. When the male teaching figures entered the picture, anxiety levels seemed to rise, especially among girls. Most research indicated that mathematics achievement gaps were correlated with age. Perhaps a serious look at male and female teacher ratios was warranted to see if age also correlated with the male teacher entering the picture. The relationship between teachers and students in a mathematics class and the lack of self-confidence that females had in their mathematics abilities contributed to the gender gap in mathematics (Grassi). It then seemed obvious that gender biased instruction techniques in mathematics classrooms could serve to systematically disadvantage female mathematics students. Since there was a visible difference in gender gaps in mathematics, not only researchers and educators, but also law makers have begun to lobby for single-sex education. They felt this would improve self-confidence, thus lessening the gender gap in achievement and enrollment (Grassi).

Generally, the differences in academic beliefs depended on how boys and girls felt academically about a subject which often depended on the domain in question. Males were favored in Mathematics because mathematics was thought to be a male subject; whereas, in language arts females were favored because this was thought to be a female subject area (Pajares & Valienti, 2001). Self-apprehension, self-concept, self-efficacy, and self-regulated learning were all variables to take into consideration when accepting these previously mentioned facts. If girls were given the chance to feel their self-worth in mathematics, they may be more likely to enter the field of mathematics, but if they feel a hidden agenda, language arts may continue to call them. Some readings suggested boys and girls start out with equal innate abilities in all areas of study, thus the anxieties that enter the picture may be the reason for the lack of girls in mathematics-related courses and careers (Parjares & Valienti).

Expectations of Females

Much research has been done on gender successes in school settings. It is usually concluded that boys achieved better in coeducational settings than in gender-segregated settings. For girls, the opposite held, but the difference between mixed- and single-sex schools was not big (Van Houtte, 2004, p. 421). If this was true, then perhaps female expectations should not have been so high in all classroom settings. Van Houtte found within a class, girls' achievement was not really affected by gender because image did not really matter to girls. They were more affected by intimate relationships; whereas, boys felt how groups viewed them as being more important (Van Houtte). These findings seemed contradictory to information that came to the forefront concerning girls. All evidence pointed to the fact that girls left mathematics-related fields because of selfimage. They did not feel they could keep up in the mathematics field. If it could be proven that this was only a self-perception, maybe more girls could be drawn into mathematics-related careers (Van Houtte).

Reay (2001) said, always comparing males to females, or boys to girls, often prevented researchers from seeing many other characteristics. Pigeon holing students as male or female blinds the observer to the diversities within the genders as well as between the sexes (Reay). This suggested that both girls and boys actively involved in the Reading, Writing, and Arithmetic had gender identity problems. Thus, constructing gender processes through a variety and range of social processes may be the answer to many educational problems and may relieve the high expectations placed on females (Reay).

It could be hard to overcome the fact that girls struggled to make meaning of themselves as female constituted, in what is viewed as, a male oriented world. Although girls were generally viewed as hard working, more mature, and more skilled socially, many boys and girls still felt boys were better at most things (Reay, 2001). This caused a clear confusion within the gender working in the classroom. Dominant femininity was clearly thought to be, in matters of everyday life, not within the classroom. It seemed true that women held the everyday world together. Women and mothers were expected to go to work, keep the house clean, cook, wash the clothes, nurture the children, and satisfy their husbands' every need (Reay). They also should have been expected to do well in the world of mathematics. Despite the all-pervading focus on narrow, easily measured learning outcomes in state schooling, learning in the classroom was much wider than test-results suggested. Teaching and learning dealt with the whole person and all, psychological, physical, and educational needs needed to be met if the best possible person was to be sent out into the world of work.

As the 21st century began, the number of women entering colleges had grown larger than the number of men (Education-Portal, 2007). Expectations had greatly changed over the previous three decades. Boys were expected to go to college so they could get high-paying jobs and provide for their wives who were expected to take care of the house and family (Education-Portal, 2007). If women did venture out into the work world, they were only expected to hold menial, low-paying jobs. By the 1980's, things really changed when it was seen that the majority of college freshman were female (Education-Portal). It seemed that the nation's goal was to better educate their women. After this happened, some down-sides were observed: a shortage of eligible men to marry women seeking equally educated partners, the undereducated males became a drain on society, and men were three times more likely to commit suicide than in 1970 (Education-Portal).

Even though more women attended college, the men still tended to enter the higher paying fields, such as engineering and physical sciences, which could have accounted for the wage gap between men and women (Education-Portal, 2007). As women picked up more men's jobs and men headed toward menial labor, there may have been additional problems as many of these jobs were being outsourced (Education-Portal).

At the time of this writing, recently, females were thought to be significantly more skilled in mathematics, and their enrollment in mathematics courses seemed to be rising; however, the number of women completing advanced degrees in mathematics related fields such as science, engineering, and technology was not increasing (Sanders & Peterson, 1999). This was a troubling statistic and educators needed make it a priority to find out where the girls were being lost. Many researchers, in this area, felt this loss of females could be traced back to the middle schools and high schools where girls were subjected to negative attitudes (Sanders & Peterson). Since these lower level filters lea to the decline of females in upper level mathematics classes, fields of science, engineering, and technology may lack female participation. And, since female expectation was always high in all areas of life, something must be done to stop this funnel effect (Sanders & Peterson).

Educators should encourage girls to participate in mathematics related careers by:

1. Continually involving teachers, parents, and students.
2. Encouraging teachers to be gender neutral.
3. Allowing time for mathematics teachers to take part in gender equity training.
4. Making certain counselors encourage girls to enter more mathematics related courses in high school,
5. Encouraging parents to become aware of the mathematics and science related careers for girls.
6. Introducing programs that will increase the awareness of mathematics related career possibilities,
7. Introduce female role models from mathematics, science, technology, and engineering careers. (Sanders and Peterson, 1999, p. 1)

These things seemed extremely important because girls' only mathematics classes did not seem to make sense. No matter how well a girl achieved in a single-sex mathematics class, how stress or anxiety free they became, they must still go out into a male and female world of work in mathematical fields. Since all of these fields were male dominated, they must be able to cope and even more, succeed.

There continued to be sex differences in achievement scores. The only solution would be to design assessments that were fair, meaningful, and valid for girls and boys. Maybe then more level playing field for boys and girls in mathematical fields would exist. This seemed more unlikely than possible because the more researchers delve into the problem, the more differences they found. Examples of areas in which more males than females were known to have problems were areas including dyslexia, mental retardation, alcoholism, and higher rates of violent crime (Leder, 2002). The picture painted for girls was similarly diverse. A group of females also experienced disadvantages, such as a higher incidence of severe eating disorders, depression, and lower levels of income than males with an equivalent educational background (Leder). This painted a dismal picture for students and that was why continued research took place to lift our boys and girls to a higher level, a level which would allow them to cope with the school and world problems that they may face. Leder thought that if unequal educational opportunities, such as those contributed to by the gender social barriers and biases were removed, the path to gender equality would be easily attained. Further research on gender variables, student background, contextual factors, and their interactions may be helpful. Mathematics always seems to be at the forefront of research. It has been confirmed that mathematics-related fields are too simplistic to assume that gender issues alone will dominate contemporary debate about achieving equity in assessment (Leder).

Educators must remember that to determine the similarities or differences between groups, analyses of all demographic variables should be conducted. If a rather closed research is conducted on gifted girls versus general education girls, these additional demographics must also be considered. The result of a study indicated that early-adolescent girls in gifted education, as compared to their general education counterparts, had significantly greater self-perceptions of instrumentality, showed significantly higher levels of achievement motivation; aspired to careers that were significantly more nontraditional for their gender, required significantly more education, were significantly higher in prestige; and had significantly more liberal attitudes toward the rights and roles of women (Mendez, 2001). Mendez's study indicated that gifted girls were least likely to adhere to gender roles, and this was what was usually expected of females at the time. Also, it was necessary to know that the gifted girls were from higher social-economic backgrounds than their general education counterparts, so these educational statistical results cannot be put into neat little columns. There were just very few gender-role stereotypes. Too many outside influences entered the picture (Mendez).

Research on the threats of stereotypes revealed that negatively stereotyping people in general hindered their ability to perform, so telling female mathematics students they were not good at mathematics hindered their ability to do well in mathematics (Keller, 2007). Keller suggested "domain identification and the difficulty level of test items moderate stereotype threat efforts on female students' mathematics performance" (p. 1). In other works, female students seemed to perform better in mathematics if the difficulty level of the test was emulated to stereotypes such as males do better on mathematics tests. "Domain identification and test item difficulty are two important factors that must be considered in an attempt to understand the impact of stereotype's threat on performance" (p. 1).

Early-adolescent years, often defined as ages 11 – 14, represented an important period with regard to initial career development. It was during this time that students began to develop more differentiated views of themselves and their futures, as well as make academic choices that may limit, or broaden, future educational and career-related options (Mendez, 2000). Girls who displayed a competitive spirit, a strong interest in academics, and definitive career goals could defy gender-role stereotypes. Again, to determine the similarity between groups, analyses of all demographic variables was essential (Mendez). This was almost impossible, thus making it seem as if researchers were just spinning their wheels when they tried to make comparisons or find ways to break out of certain situations. By the time they thought they had the answer to improve educational process, they were working with a whole different set of demographics (Mendez). Any good teacher would say what works well with one group of students may not work at all with another group. This was because all classes, and students within those classes, are different. This was true of all students, but most certainly of girls, since very high expectations were placed on them.

As the expectation of females in the work-a-day world, or even just the mathematical world rose, one needed to realize the old adage probably still hold true, 'A nut doesn't fall far from the tree.' This was still true with girls in that their encouragement from home, the educational levels of their parents, and what was expected of them were still elements that affected students, especially girls' courses and career choices more than anything else. If girls have good role-models, especially a mother, grandparent, or older sister, they tended to follow in their footsteps. Education was valuable to girls, but all of the outside influences seemed to affect girls just as much as boys.

Culture of a Geographical Region

Lips (2008) reported on America's educational wellbeing twenty five years after *A Nation at Risk* was published. Lips stated that 17 out of 50 of the nation's largest cities have a graduation rate of below 50% and some cities, like Detroit, are at 25%. In 2008, an average of $9,266 was spent per child and $550 billion on K-12 public schools yet the NAEP exam shows a significant percentage of students falling below basic; in some sub-categories, like free and reduced lunch, as many as 50% fall below basic (Lips, 2008, p. 1). It was felt, by Lips, hat graduation rates continued to be low in many of the nation's larger cities because of ethnic orientation and adult literacy. These inadequacies would impose lower lifetime earnings, thus more welfare and a strain on the tax payers, and even shorter life expectancy, which ultimately threatens our nation's future prosperity and even their security (Lips).

Lips (2008) also stated that high school drop outs have higher health care bills: $35,000 per year compared to $15,000 per year for college graduates. These facts indicated the more adults the nation educates the lower funding will be needed for federal programs such as Medicare (Lips). Table 1 displays the lifetime earnings in millions of dollars for various levels of education, compiled in 2008.

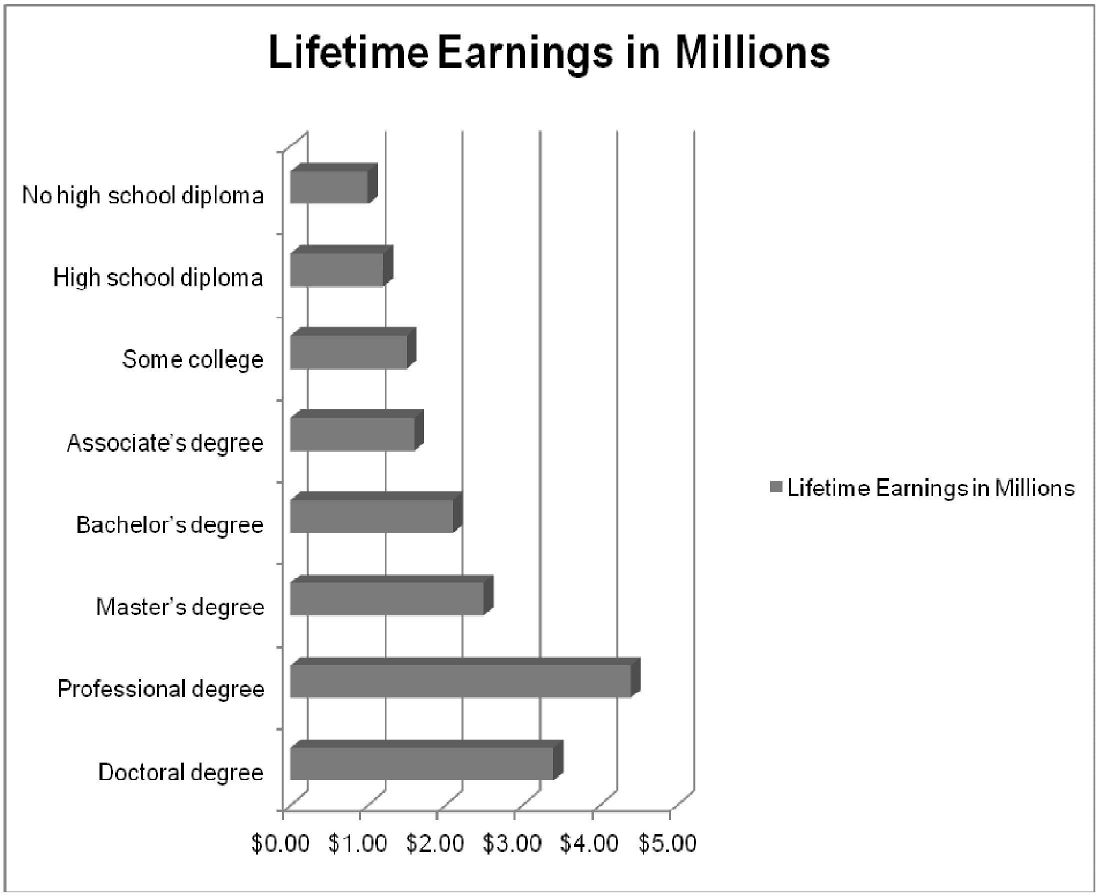

Figure 1. Estimated lifetime earnings: Full-time workers, by educational attainment. Adapted from Lips (2008).

In past research, it has been repeated that socioeconomic status, attitude, and gender differences affected gains in mathematics. A variable simultaneous to this is the culture of any geographic region. A study was conducted by Hativa in 2001using as participants, students of two small elementary schools located in neighboring suburbs – one suburb with a population of low socioeconomic students and the other with medium-to-high socioeconomic students. The two schools were described as *disadvantaged* and *advantaged* schools, respectively. A major finding was the increasing gap between advantaged and disadvantaged students (Hativa, 2001). Most would feel this was an expected result and Hativa thought it probably connected back to educating the parents.

One statistic discovered was that the TV show *Sesame Street* significantly increased the achievement of advantaged children over disadvantaged, and this was probably a result of background. The more knowledge a child brought to a television program, the more he or she would gain out of the program. It was also suggested that the older a child gets, the larger the gap becomes between the social economical classes. Hativa thought this was because the *I don't care* factor entered the picture. If students did not seem to get anywhere, they often stopped trying.

Despite improved assessment strategies designed to identify gifted students independent of race, ethnicity, or socioeconomic status, gifted students as a group often were from higher socioeconomic homes where parents themselves were well educated (Mendez, 2001). These parents often placed greater value on education and career development for their children. Also, being labeled as gifted and participating in a gifted program may be the only thing needed to place a positive impact on the aspiration of girls. This caused them to remain confident, convinced them of their own abilities, and enabled them to maintain career aspirations and content interests, despite negative stereotyping. In 2001, Mendez studied the psychosocial development of gifted children and indicated that both gifted boys and gifted girls tended to be more self-directed and emotionally mature, on average, than their non-gifted counterparts. Gifted girls seemed to show more contemporary attitudes toward the rights and roles of women in society and were more likely to aspire to non-traditional careers than their average ability counterparts (Mendez, 2001). This could be viewed as a problem because many children who were identified as gifted were from families of higher socioeconomic status, so there was a large population overlooked. It connects to the fact that parents of children identified as gifted often were well educated, successful, and invested in their children's education, so it must be determined how to spread the culture of upper level geographic regions to students coming from lower cultural regions. If these higher socioeconomic girls, labeled gifted, felt more independent, assertive, and confident, the perhaps it was in the labeling as well as the background. Findings indicated that girls in gifted education manifested a greater desire than their general education peers to work hard and do a good job, as well as to be intellectually challenged and live up to an internal standard of excellence (Mendez, 2000). Also, gifted girls, at all socioeconomic levels, aspired to less traditional careers than general education students at the same levels (Mendez, 2001).

It was not known if enough was known about girls and mathematics to take action or if extrinsic factors played too much of a role in their mathematical success. Female and male equality or inequality in mathematics had been studied thoroughly, but girls still were not entering mathematics fields. Suggested ways to encourage females to enter mathematics related fields included:

> a) Transform the *nerd* label into a popular status; b) Emphasize career exposure, not career choices; c) Encourage girls to become involved in mathematics and science activities; and d) Create female groups in mathematics and science activities to avoid the feeling of isolation. (Campbell, 1991, p. 4)

Equal opportunity is an open gate and trying to include all needed factors to make a child succeed is almost impossible, even if in the highest of cultures of an upper-class geographic region.

Attitude was often viewed as a result of learning, whether the cause or effect, because self-concept, environment, age, sex, and social status were all influences on a child's attitude (Davies & Brember, 2001). Attitude change was of significant interest to educators. Most teachers felt one could not get beyond an attitude when trying to teach and often associated it with a child's cultural background (Davies & Brember).

When it comes to culture of any geographic region, it would be remiss not to explore some type of an association between gender and racial differences in mathematical performance. Hall, Davis, Bolen, & Chia (1999) studied both fifth and eighth graders and found that when gender was not causing a significant difference in a given subject area, such as mathematics, then racial differences were zeroed in upon, and in many cases these differences were found to be far more pronounced, especially in mathematical concept rather than computation. When multi ethnic-groups of parents were given a questionnaire to fill out, responses indicated that mathematics anxiety was related to what the parents were reporting of themselves, such as their mathematics anxiety, the advanced mathematics classes they had taken, and their educational levels (Hall et al,, 1999). What a parent believes about his or her child's mathematics may play a part in a child's success in the mathematics area, but that success is far more complicated and may vary with race (Hall et al.). Hall et al. found that both gender and racial gaps in mathematics were of major concern in the United States. Since, it has been found that the family influence upon students affects the children's ability and interests in academic areas. Something besides gender and race must be considered as well if more girls were going to be expected to enter the fields related to mathematics (Hall et al.). Anything that could take successes into future generations was considered positive results.

Reineke (2011) looked at the gender and racial gaps in mathematics and education from a different perspective. Reineke determined the gender and ethnic orientation of the students seeking higher mathematics degrees. Consideration was also given to the type of high school students attended. As a result of examining the high school topic more closely, Reineke determined that more students from schools other than public high schools tended to enroll in upper mathematics related studies. The difference between public and private school females entering upper level mathematics classes was also determined and found to be minimal (Reineke).

Reineke (2011) believed the characteristics which need to be focused upon in order to encourage more student participation in upper level mathematics courses were gender, ethnic orientation, type of high school, and family background. As studies of these sub-cultures were done, Reineke determined that more Asian students entered mathematics related studies than Hispanic or African-American students. Highly educated parents also seemed to encourage their children to pursue mathematics fields (Reineke). The NELS: 88 data set supported a significant difference between males who have attended public or private high schools, in their selection of higher mathematics, but no significant difference between girls was found (Reineke).

Mathematics majors, in the sub-cultures studied, showed a drop between the NEL: 88 and the ELS: 2002 (Reineke, 2011). The study; however, also showed that even though the number of mathematics majors were declining, more females seemed to be entering the field. As time passed, the sub-cultures seem to play smaller parts in mathematics major selections; but, ethnic minorities still fell far behind in their selection of mathematics related fields of study (Reineke). In major cities, minority groups tended to cluster into neighborhoods, and Reineke believed that a major factor that could help the field of mathematics was having all educators stress how important a mathematics background was to any career choice. Reineke said teachers could not only teach to the non-ethnic students, as this type of exclusionary teaching leads to the same problems among ethnic students as females had with teachers who only teach to males.

Cultures of geographic regions appeared when looking at how New Jersey tried to fight the gender gap. In North Jersey, Johnston (2005) accepted the challenge of finding a way to entice African-American and Hispanic boys to take rigorous and Advanced Placement Classes. Johnston found a student who breezed through the advanced placement Chemistry, U.S. History, Calculus, and English in four years. The student's success was very simple. He said he set his mind to his task and did not look back. He also reasons that he should work hard in school, like his parents had. This brings the success back to expectations. If a child felt higher levels of success were expected of him or her, the higher levels were usually reached. The culture of geographic regions plays an important part in a child's school successes, especially in mathematics, but it still does not explain why children from what is often referred to as the *other side of the tracks* cannot achieve great things with the proper encouragement and expectations.

In an article by Sapienza (2008), on research by Guiso, Monte, Sapienza, and Zingales (2008), Sapienza argued that gender gaps between men and women in the areas of mathematics and science existed since the beginning of time. However, as far back as 1911, women excelled in these areas, as noted when Marie Curie was awarded the Nobel Prize for her discovery of the elements of radium and polonium. Throughout the 20th century, women made great strides in mathematics and science areas; however, they were continually thought to be not as mentally equipped as men. Sapienza felt that if educational and social programs were put into place in society, the gender gap in mathematics could be greatly narrowed, if not eliminated.

According to the 2007 College Board, of the girls taking the SAT and graduating in 2007, females averaged a grade point of 3.40, while boys averaged 3.24. Even with these differences, boys still scored 533 while girls scored 499 out of a possible 800 in the area of mathematics (Sapienza, 2008). Girls performed better when they had time to double check their work and gain confidence that their answers are correct.

Mathematically precocious mathematics students of either sex seemed to accomplish their goals; however, males tended to become engineers while girls entered fields of law, medicine, biology or English-related fields. According to Hedges and Nowell (1995) of the University of Chicago's study of six comprehensive mental test scores for men and women, they simply concluded that "although average sex differences have been generally small and stable over time, the test scores of males consistently have larger variance" (p. 1). Hedges and Nowell indicated that data supported that more men than women scored higher. Overall global patterns showed boys tended to outperform girls in mathematics; however, in a few countries this was not true. This suggested that the methods of teaching may lead to some interesting discoveries.

Gender gaps in mathematics and reading are illustrated in Figure 2. In reading, no country demonstrated boys out performing girls. An average worldwide indicated girls scoring 6.6 percent higher than boys. This gender gap in reading mirrors the gender gap in mathematics. According to researchers, "social conditioning and gender-biased environments can impact test performance" (Sapienza, 2008, p. 4).

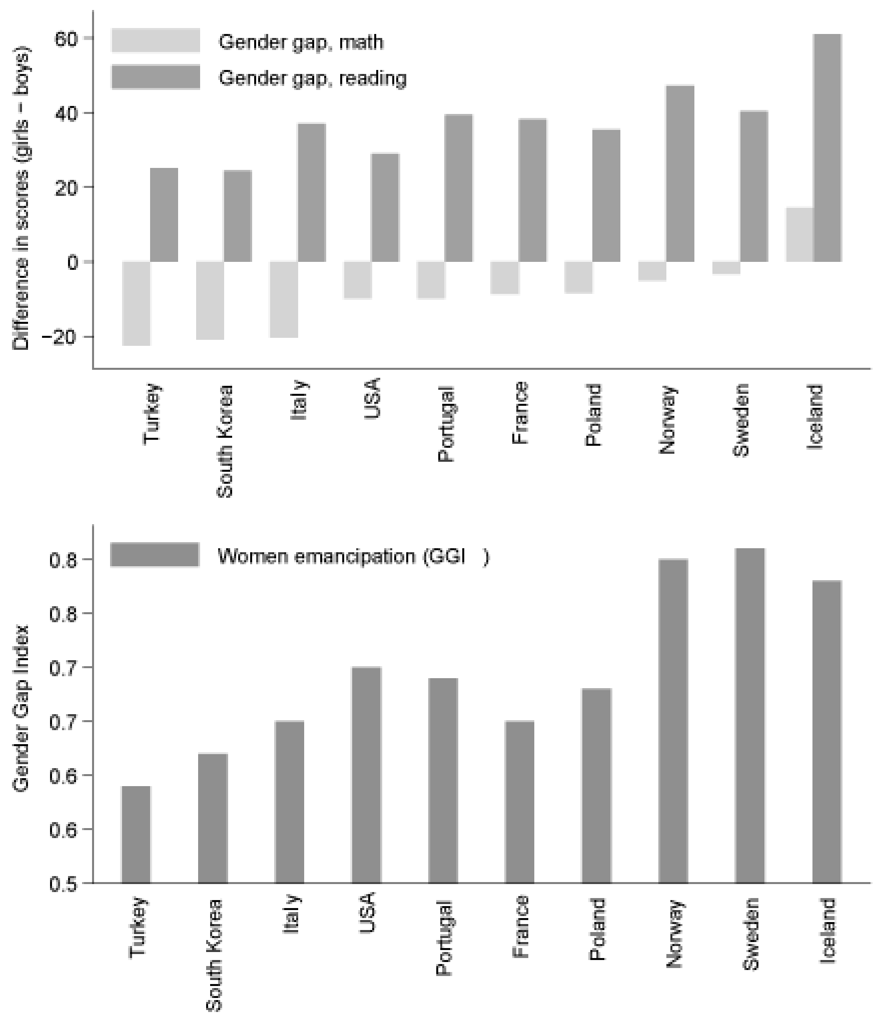

Figure 2. The gender gap in mathematics and reading (Guiso et al, 2008).

"Sapienza and colleagues used four tools to measure how well women are integrated into each society compared with men" (p. 4).

1. The Gender Gap Index (GGI): "Measures resources given to women who want to work, such as maternity leave and child care facilities" (Sapienza, 2008, p. 5). The U.S.A. felt they would be at the top of equality; however, according to the "GGI ranking Sweden 0.81, Norway 0.80, Finland 0.80, and Iceland 0.78 with the U.S. ranking 23rd 0.70" (p. 5).

2. World Values Survey: People around the world were asked questions such as, “If a woman earns more money than her husband, it’s almost certain to cause problems” and “A university education is more important for a boy than a girl.” (p. 5).
3. Sapienza and her colleagues “analyzed the percentage of women aged fifteen or older who are available to work in each country’s labor force” (p. 5).
4. “WEF political empowerment index, which measures the representation of women in government.” (p. 5)

“Guiso et al. found that “improved social conditions for women were related to improved math performance by girls” (Sapienza, 2008, p. 5). Students, both male and female, were able to succeed equally in mathematics and reading in countries, or geographical areas, where females obtained social equality. The best example was Iceland, which had “117 girls for every 100 boys among the top 1 percent of mathematics students” (p. 5). However, no matter in what country or social environment the males lived, boys typically performed better in mathematics than reading, “Boys always score higher in Geometry than arithmetic, while the opposite is observed of girls” (p. 6). Sapienza et al. showed that the reading and arithmetic, or Geometry, differences within the genders were consistent in all environments. This could be a result of biology (Sapienza).

Simply seeing women using the mechanics and the end consequences of mathematics fields may encourage girls to enter mathematics related careers. Women, according to the National Science Foundation (NSF), physicists and scientists were increasing (NSF, 2008). Female science and engineering faculty members were up from

7% in 1973 to 30% in 2006 (NSF). In 2005, 39% of all science and engineering doctorates were earned by women, up from 27% in 1985 (NSF). How one feels about results or consequences is what determines the future.

The words of Madame Curie written over a century ago are still pertinent today, “One never notices what has been done; one can only see what remains to be done”, and much work is still needed in interesting more women in mathematics-related fields (Huie, p. 1).

American politics was increasingly dominated by an urban verses rural dynamic showing that states with a large urban population tended to vote Democratic while states that are mostly rural with small towns tended to vote Republican (University of Montana [RTC], 2005). There were always exceptions to this rule, probably resulting back to the time when Democrats and Republicans came from similar communities (Bishop, 2004).

At the time of this writing, not only did the two parties represent different political philosophies, but they came from varied types of communities, urban Democratic and suburban and rural Republican (Bishop). The split still was not true in every case, but had been widespread and rapidly growing over the past 20 years. A common explanation among political scientists was that Southern communities moved to the Republican Party (Bishop). An example of this trend was Missouri. Missouri was considered a southern state and most of its counties vote Republican, with the two exceptions centered in Kansas City and St. Louis City.

Rural areas were shown to represent 97% of the U.S. land mass while urban areas only represent 3% (RTC, 2005, p. 2). Half of America’s school districts were in rural areas, and according to Applegate’s (2008) study, the main difference between high and low achieving rural schools was the commitment to excellence. This meant the students and teachers had to drive themselves to learn. Especially since, most school districts looked at standardized test scores, student-teacher ratios, and curriculum. If rural areas were moving to conservative and fundamentalist views, then 97% of the American districts would not be accepting of this new way of teaching or a female's liberal viewpoint on her career choices.

Summary

Overall it would seem that achievement levels and attitudes of females in the field of mathematics continued to be a real struggle. Particular concerns were on the psychological levels, their ability to relate to male teachers, expectations of females and, their cultural diversity as related to the mathematical field. Even when teachers were able to verbalize their concerns in the mathematics-related fields, the solutions covered a wide variety of possible solutions that results seemed minimal. Teachers seemed to suffer from mathematics anxiety because they could not get the answers to their many 'why' questions about the insignificant levels of females taking upper-level mathematics courses and entering mathematics-related careers.

It was documented that high mathematics anxiety correlated with low achievement in mathematics, low attitude toward the subject of mathematics, low assessment of one's own ability in mathematics, low confidence in mathematics, and mathematics avoidance in general. It was, however, difficult to determine how to counteract or even eliminate any or, more preferably, all of these problems. Conflicting literatures and educator's beliefs added fuel to the fire. The more possible solutions that seemed to arise, the more questions were asked on t validity. It was established that students' own attitudes toward mathematics affected their own achievement in the subject and it was shown that relationships between attitude and achievement became strong as students progressed through school.

Mathematics anxiety as it relates to low assessment of one's ability in mathematics or low self-confidence in the ability to learn the subject has serious ramifications. Lack of confidence in the study of mathematics was an issue receiving attention in literature, particularly as it related to different sexes. The argument from literature was that females at all ages exhibited less confidence in dealing with mathematics than did their male counterparts. As the years progressed, these differences became more pronounced, accounting for the numbers of women dropping out of upper-level mathematics courses and mathematics-related fields. Parental expectations, praise, and positive reinforcement were critical to the success of girls in mathematics. There was no doubt that there had been differential treatment given to girls in mathematics, especially from male teachers, so this must be remembered.

One last purpose of the research at hand was to determine if geographical regions actually play a part in the placement of girls in mathematics courses and related career fields. Findings were that culture played a part, but even self-concept, parents, home environment, age, sex, socioeconomic status, and children's interest within any designated region could cause differences in entry levels to upper level mathematics classes. Overall, it could be said and backed up by literature that girls and their relation to upper level mathematics class enrollment is a complex situation which may have no one answer to solve the problem.

Chapter Three: Methodology

This mixed methods study was designed to assess the relationship between the ratio of males to females in accelerated college-preparatory level mathematics courses in high school and the geographic region of that high school. The relationship was evidenced through the analysis of state reported district enrollment data, census data, and state collected district demographics. The purpose of the study was to determine if the geographical region of a high school contributed to the resulting ratio of males to females enrolled in college level mathematics courses.

Sample District Information; Rural, Urban, Suburban

Table 1 was compiled by the researcher using data from MODESE (2010). The data from the 65 school districts was categorized by region and each region's average appears in the table.

The ratio of male to female Calculus students was lower in the urban districts, along with the ratio of male to female mathematics teachers. This indicated that there were proportionately more female teachers in the urban districts along with more females than males enrolled in Calculus at the high school level. Also, the urban districts spent more money daily on their students, which correlated with the higher teacher salaries.

The researcher was surprised by the fact that there were more discipline incidences and a higher dropout rate in suburban schools. In the researcher's experience urban schools were stereotyped as having lower incomes, one parent households, and drug and gang violence.

Table 1

Demographic Averages by Geographic Region

	Urban	Suburban	Rural
Population Per Square Mile	6255.63	1714.48	91.36
M/F Calculus	0.8023	1.2385	1.5835
Funding	12163.09	10511.50	8583.93
M/F Mathematics Teachers	0.4929	1.7465	0.8243
Free or Reduced Lunch Count	875.11	37.65	177.86
Students per Class Room Teacher	14.36	15.86	14.80
Avg. Teacher Salary	49632.14	48972.00	38220.10
Teacher Avg. Years' Experience	12.61	12.49	11.86
9-12 Hrs. Absent	91.83	85.94	81.94
Discipline Incidents	110.41	255.79	13.03
Drop Out 9-12 Black	29.95	37.07	0.57
Drop Out 9-12 Hispanic	1.14	4.71	0.23
Drop Out 9-12 White	13.36	30.14	11.73
Drop Out 9-12 Total	44.91	73.50	12.63
Graduates	186.41	626.71	72.73
Enrollment K-12	2863.23	8522.21	1048.77

Note. From MODESE (2010)

Rural schools had higher alcohol problems, possibly because of the lack of entertainment, and in some locations in Missouri high methamphetamine related problems. Even though there were usually two parents, they did not seem to control their children. Then, there was the middle ground, suburbia, where everything was thought to be right, two parents, nice homes and incomes, so discovering the dropout rate was higher there was a surprise to the researcher (MODESE, 2010). The researcher defined suburbia as regions with populations between urban and suburban levels.

Research Questions

The following questions were addressed:

1. Does the ratio of males to females enrolled in college-preparatory level mathematics courses, such as Calculus; differ among urban, rural, and suburban high schools? If so, how?
2. Does the ratio of male to female mathematics teachers correlate with the ratio of male to female mathematics students enrolled in Calculus? If so, how?
3. Does the ratio of males to females in advanced placed mathematics classes change as the students progress through their four years of high school? If so, how?
4. Does the school budget have any effect on the ratio of males to females enrolled in advanced placed mathematics courses, or the ratio of students taking Calculus? If so, how?

Variables

For this study, the independent variable was the location of the high school. The schools were categorized into one of three geographical regions: urban, rural, or suburban. The urban set consisted of 21 districts that turned in enrollment data to the Missouri Department of Elementary and Secondary Education (MODESE) at the end of the 2009/2010 school year, and were located in an area with a population density greater than 2,500 people per square mile. The suburban set consisted of 14 districts that turned in their enrollment data to MODESE at the end of the 2009/2010 school year, and were located in an area with a population density between 1,000 and 2,500 people per square mile. The rural set consisted of 30 districts that were randomly selected from the schools that turned in their enrollment information to MODESE at the end of the 2009/2010 school year, and were located in an area with a population density less than 1,000 people per square mile.

The dependent variables for this study were the ratio of males to females in Calculus classes at the high school level, the ratio of male to female teachers in the school's mathematics department, the districts' funding, and the ratio of males to females who are placed a year ahead of their fellow students in Geometry, Algebra II, Pre-Calculus, and Calculus.

Null Hypothesess

Null Hypothesis # 1: There will be no difference in the ratios of males to females enrolled in Calculus when comparing urban, rural, and suburban schools.

Null hypothesis # 2: There will be no relationship between the ratio of male to female students in Calculus and the ratio of male to female mathematics teachers.

Null Hypothesis # 3: There will be no difference between the ratios of males to females enrolled in advanced placed mathematics classes as the students progress through the four years of high school.

Null hypothesis # 4: There will be no relationship between the ratio of males to females enrolled in Calculus and the district funding.

Defining the Geographical Region

The following definitions where chosen by the researcher, based on the United States Census (2010), for the purpose of this study:

Urban – A geographical region with a population of 2,500 people or more per square mile (U.S. Census, 2010).

Rural – A geographical region with a population less than 1,000 people per square mile (U.S. Census, 2010).

Suburban – A geographical region with a population between 1,000 and 2,500 people per square mile (U.S. Census, 2010).

In the 1990's, and before, the United States Census Bureau (2010) defined urban areas as regions with a population of 2,500 people per square mile, or more, and rural as regions with a population of 2,500 people per square mile, or less. In the new millennium the definitions of these areas grew more complicated and the definition of suburban was added. For the purpose of this study, the urban definition was kept as the original, the suburban definition was created, and the rural definition was lowered to better represent the population density of the Midwest. Even though most studies researched and referenced only used rural and urban, the suburban category was added to this study because it posed a collaboration of both rural and urban cultures. In the year 2010 the majority of the state of Missouri's suburban districts voted Republican, which was unlike the urban Democratic districts. In contrast, the suburban districts had higher populations and more liberal religious views, similar to the urban districts (Election results, 2010). Also, the researcher observed that the suburban districts had higher priced homes occupied by two income, or higher income, families (MODESE, 2010); which led the researcher to believe there may be a difference in the ratio of male and female students in advanced mathematics courses, possibly due to higher educated, employed, or higher paid, women role models.

The Gender Gap

With a Census Bureau report that there has been "an increase in women employed in STEM occupations, but they are still underrepresented in engineering and computer occupations that make up more than 80 percent of STEM employment," (U.S. Census

Bureau, 2013), it is no wonder institutions like Missouri University of Science and Technology (2006) were still trying to rise above their three to one ratio of males to females. College students across America had previously been surveyed to find out why students were choosing their degrees; however, little information is found on high school students and why they are choosing their future institutions of learning. The studies jump from researching the start of the gender gap in middle school to researching where all the females went in college (Brown, Birch, & Kancherla, 2006; Hill, Corbett, & St. Rose, 2010). When students are juniors and seniors in high school, they typically apply for colleges that specialize in their sought after area of study; this is often when the major decisions are made about future careers in engineering versus teaching of mathematics and science. The decision of just how far students want to take their love of mathematics is often based on the prerequisite courses taken in high school (high school guidance counselors, anonymous, personal communication, January 2009). If a student has not reached Calculus or Pre-Calculus by senior year, he or she will be less likely to pass rigorous Science, Technology, Engineering, and Mathematics (STEM) programs at a university; and therefore, may not go into those fields. So then, the focus turns to why these students did not obtained the prerequisites required in high school. According to the Missouri school improvement plan, it is desirable for public high schools to offer three of the following: Algebra II, Geometry, Trigonometry, Mathematics Analysis, or Calculus (MODESE, 2010) and the students have the option their freshmen year to start taking the mathematics courses that will lead them to College Algebra, Pre-Calculus, or Calculus by their senior year. With a higher percentage of females than males graduating high school, college, and masters' degree programs (US Census Bureau, 2008); it was not understood why there was a comparatively low percentage graduating from the science, technology, engineering, and mathematics departments.

Table 2

Gender Ratios at Sample Universities

School	% Male	% Female
Columbia University	47.9	50.3
University of Wisconsin, Madison	47.3	52.7
University of Texas, Austin	49.5	50.5
Purdue University	58.9	41.1
Rice University	43	57
University of Virginia	47	53
Florida Atlantic University	40	60
Kent State University	39	61
University of California, Davis	45	55

Note. Adapted from Leaving Men Behind: Women Go to College in Ever-Greater Numbers, published November 13, 2007.

The problem is the underrepresentation of women in mathematics-related fields. To find a contributing cause of this problem, this study is taking a step back. This study is looking at high schools to see if the problem starts before colleges are picked. Not all high schools offer Calculus and not all students are required to take the pre-requisites needed to advance in mathematics-related majors. In order for students to take Calculus by the senior year of high school, they need to start with Geometry as a ninth grader and, in some districts, double up their tenth grade year with Algebra II and Trigonometry. In order to accomplish this, students must know they are going into a mathematics-related field by the time they enter high school. Therefore, it was determined that this study would look at the ratio of males to females in Calculus at the high school level, rather than the college level after most decisions about future courses of study have been finalized. It was also decided that this study would look at the ratio of males to females in each of the four years of high school to determine if the number of females enrolled in accelerated mathematics courses declined over the four years of high school. Research by Grassi (2004) suggested that the gender gap started in middle school; and following this beginning, females started dropping out of mathematics-related subjects, though he did not know why. Research question three focuses on this problem and pinpointing the year females seem to start to decline in enrollment in these types of courses.

Some people attribute the gender gap to fundamental genetic coding and claim that females are not physiologically capable of being smart. According to some, this approach is supported by the fact that females only score, on average, 499 on the mathematics portion of the SAT and males score 533 (Sapienza, 2008). A study conducted in 2008, by Guiso et al. compared the mathematics scores of males to females in several countries to determine if the gender gap in mathematics was biological or social. The study found that girls on average have higher grade point averages than males, but primarily males out score females in mathematics with few exceptions (Guiso, et al.). In countries like Iceland and Indonesia, where the culture of the nation was more gender neutral, the females outperformed the males. This suggested a social or cultural contribution to the gender gap. A similar study was performed by Pope and Sydnor (2010) comparing the states of America. There was no significant difference found. The American culture between states did not vary as did the culture between countries. However, the U.S. did have pockets of conservative and progressive thinkers. In this study, these areas will be explored to determine where the gender gap in mathematics starts and to find potential contributing factors.

Rural Mindset Versus Urban Mindset

Two of the most widely compared regions in the United States have been rural verses urban. There has been a shift in politics that suggested the party lines could be drawn on a map (RTC, 2005). At the time of this writing, rural voters were consistently voting Republican and urban voters were voting Democratic. This was especially evident when looking at a map representing Missouri's 2008 presidential elections (Figure 3).

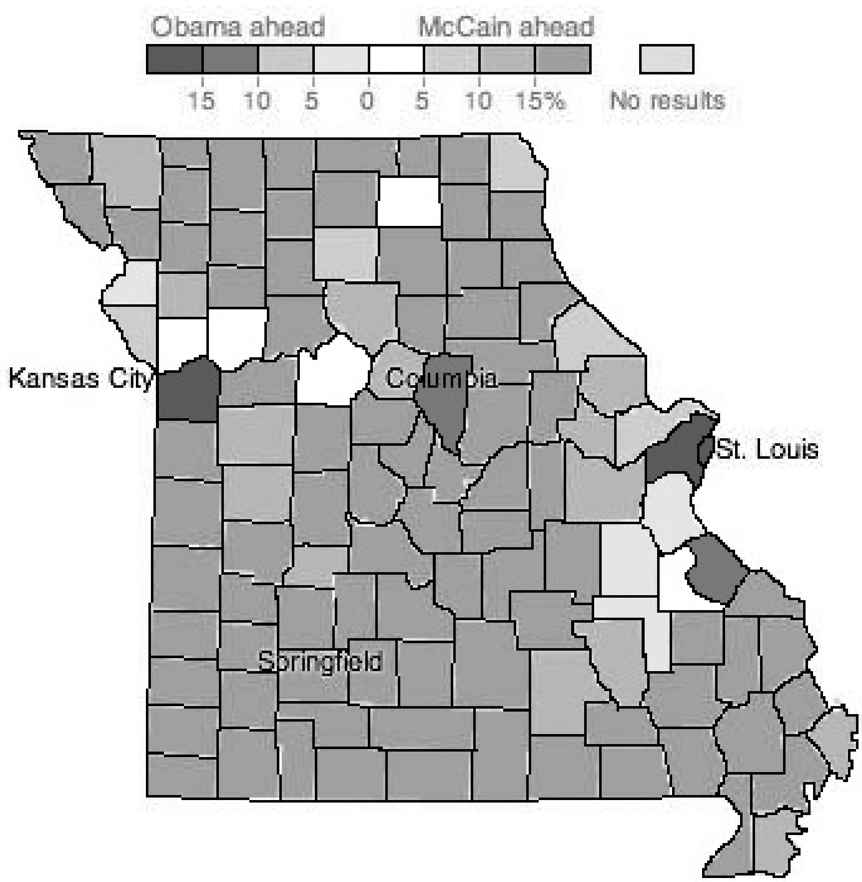

Figure 3. Election results: 2008. Adapted from The New York Times (2008).

The separation in political party distinction may be attributed to a fundamentalist mind set of rural voters. Nelson (1977) talked about the higher rates of fundamentalism in rural communities. Nelson stated that studies, conducted in the 1960's and 1970's, suggested the only difference in religion between rural and urban churches existed in the ideology of the parishioners. He stated that the rural churches were more traditional while the urban churches took liberties with the doctrine. These differences were also explored by Chalfant and Heller (1992) who discovered that similar regions shared a similar religiosity.

Even physical education was looked at in terms of rural versus urban by Reyes (2003), who stated that urban students were taller, but rural students have better grip strength. Likewise the efficiency of schools in urban and rural regions was put to the test by Denaux (2007). Denaux found that the difference in the mean efficiency scores of the rural and urban schools was significant. In the state of Georgia, rural schools were run significantly less efficiently than urban schools (Denaux). Denaux found that the number of county citizens who were classified white or had a bachelor’s degree, or higher, contributed to the inefficiency of the rural schools, along with whether or not the school met Adequate Yearly Progress as set forth by the No Child Left Behind Act.

All of these studies and trends in social behavior suggested a difference in the mindsets of the rural and urban populations. The focus on conservative and fundamental political and religious beliefs may have contributed in rural areas by inspiring a lack of drive for young females to seek career fields outside their community’s gender norms. Missouri was chosen for this study because it had urban, rural, and suburban regions to provide data for comparative study.

Population and Cultural Contributions

In the state of Missouri, there were consistently more males enrolled in schools than females in the 2009-2010 school year (Table 3). This state-wide information contradicted nation-wide information recorded by the U.S. Census Bureau (2008) which stated, as of October 1, 2007, there were more females than males, 153.6 million to 149.4 million, in the United States population. However, according to MODESE (2010) there were more females graduating from four-year high schools than males.

Table 3

Missouri High School Enrollment

Grade	9th	10th	11th	12th	Total
Male	39236	35986	34317	34004	143543
Female	35710	34157	33287	33218	136372
Ratio M/F	1.0987	1.0535	1.0309	1.0237	1.0526

The state of Missouri graduated more female students than male students, even though Missouri had more male students enrolled in high school. This trend was consistent with the national trend. More women than men were graduating all levels of education in America (U.S. Census Bureau, 2010). The sub-culture with the highest graduation rate was White with 84.5% (MODESE, 2010b, n.p.).

As shown in the Table 4, Missouri was not a highly diverse state, since 81% of Missouri's population is White, non-Hispanic, which may lead to inadvertent bias in teaching and cause the higher graduation rate. There is an observable drop in the Missouri graduation rate when comparing the Black graduation rate of 63.9% to the White graduation rate of 84.5% (Table 4).

Table 4

Missouri 2010-2011 Four-Year High School Graduation Rate

Missouri State Rates	Four-Year High School Graduation Rate 2010-2011
All Students	79.8
Asian	85.7
Black	63.9
Hispanic of any race	73.9
American Indian or Alaskan Native	76.8
Multi-Racial	91.8
Native Hawaiian or Other Pacific Islander	81.0
White	84.5
Special Education Students	66.9
English Language Learners (LEP/ELL)	61.2
Free and Reduced Lunch	73.0
Female	83.5
Male	76.4

Note. Adapted from the Missouri Department of Elementary and Secondary Education (2010).

Table 5 compares Missouri's demographics to the demographics of the United States of America. Missouri's data varied slightly from the data of the country, but was close enough to represent the U.S. Some areas to note about Missouri's culture were the higher percentage of women and lower percentage of residents with a bachelor's degree or higher. This lower education level may attribute to the lower median household income and higher poverty level.

Table 5

Missouri Demographics: Background of Study Population

People	Missouri	USA
Population, 2011 estimate	6,010,688	311,591,917
Population, 2010	5,988,927	308,745,538
Population (percent change), 2000 to 2010	7.0%	9.7%
Population, 2000	5,595,211	281,421,906
Persons under 5 years (percent), 2010	6.5%	6.5%
Persons under 18 years (percent), 2010	23.8%	24.0%
Persons 65 years and over (percent), 2010	14.0%	13.0%
Female persons (percent), 2010	51.0%	50.8%
White persons (percent), 2010	82.8%	72.4%
Black persons (percent), 2010	11.6%	12.6%
Asian persons (percent), 2010	1.6%	4.8%
Persons reporting two or more races (percent), 2010	2.1%	2.9%
Persons of Hispanic or Latino origin (percent), 2010	3.5%	16.3%
White persons not Hispanic (percent), 2010	81.0%	63.7%
Living in same house 1 year & over, 2006-2010	83.2%	84.2%
Foreign born persons (percent) 2006-2010	3.7%	12.7%
Language other than English spoken at home, percentage 5+, 2006-2010	5.9%	20.1%
High school graduates, percent of persons age 25+, 2006-2010	86.2%	85.0%
Bachelor's degree or higher, percent of persons age 25+, 2006-2010	25.0%	27.9%
Mean travel time to work (minutes), workers age 16+, 2006-2010	23.2	25.2
Housing units, 2010	2,712,729	131,704,730
Homeownership rate, 2006-2010	70.0%	66.6%
Housing units in multi-unit structures (percent), 2006-2010	19.6%	25.9%
Median value of owner-occupied housing units, 2006-2010	$137,700	$188,400
Households, 2006-2010	2,349,955	114,235,996
Persons per household, 2006-2010	2.45	2.59
Per capita money income in past 12 months (2010 dollars) 2006-2010	$24,724	$27,334
Median household income 2006-2010	$46,262	$51,914
Persons below poverty level (percent), 2006-2010	14.0%	13.8%

Note. Adapted from U.S. Census Bureau (2010).

Missouri, in general, had a lower percentage of businesses owned by members of a minority, but the key point for this study would be the lower percentage of women who owned firms (Table 6). Another quality of Missouri was its rural standing. With only 87.1 people per square mile, Missouri classified as a rural state; though, the U.S. only had 87.4 people per square mile.

Table 6

Missouri Demographics: Business and Geography

Business	Missouri	USA
Private nonfarm establishments, 2009	150,892	7,433,465
Private nonfarm employment, 2009	2,358,706	114,509,626
Private nonfarm employment, percent change 2000-2009	-1.7%	0.4%
Nonemployer establishments, 2009	375,075	21,090,761
Total number of firms, 2007	501,064	27,092,908
Black-owned firms, percent, 2007	4.9%	7.1%
American Indian- and Alaska Native-owned firms, percent, 2007	0.6%	0.9%
Asian-owned firms, percent, 2007	1.9%	5.7%
Native Hawaiian and Other Pacific Islander-owned firms, percent, 2007	0.1%	0.1%
Hispanic-owned firms, percent, 2007	1.2%	8.3%
Women-owned firms, percent, 2007	26.1%	28.8%
Federal spending, 2009	67,372,613	3,175,336,050
Geography	**Missouri**	**USA**
Land area in square miles, 2010	68,741.52	3,531,905.43
Persons per square mile, 2010	87.1	87.4

Note: Adapted from U.S. Census Bureau (2010).

Missouri's population density varied by county and yielded two major urban regions (Figure 4). The major urban counties correlated with the Democratic regions shown in Figure 3. The suburban and rural counties with a population less than 2,500 people per square mile, correlated with the Republican regions found in Figure 3.

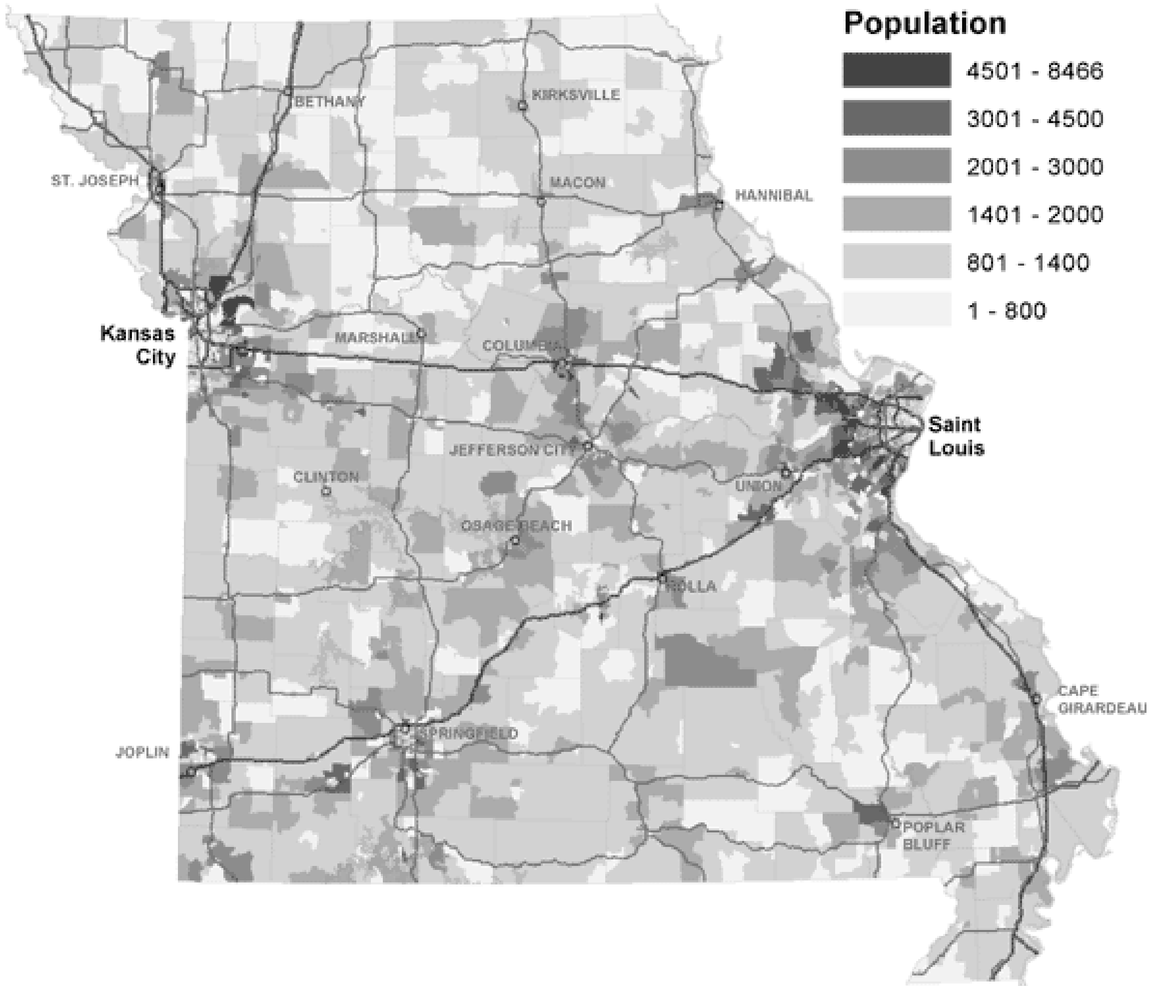

Figure 4. Census 2000 Missouri Population Map. Adapted from Missouri Economic Research and Information Center (2000).

Missouri's higher income families were clustered around the two urban regions, in counties classified, for the purpose of this stud, as suburban (Figure 5). The lowest income level of Missouri was spread all across the top and bottom of the state in rural counties; however, the two major urban areas inside the wealthier suburban areas also fell into the lowest income bracket.

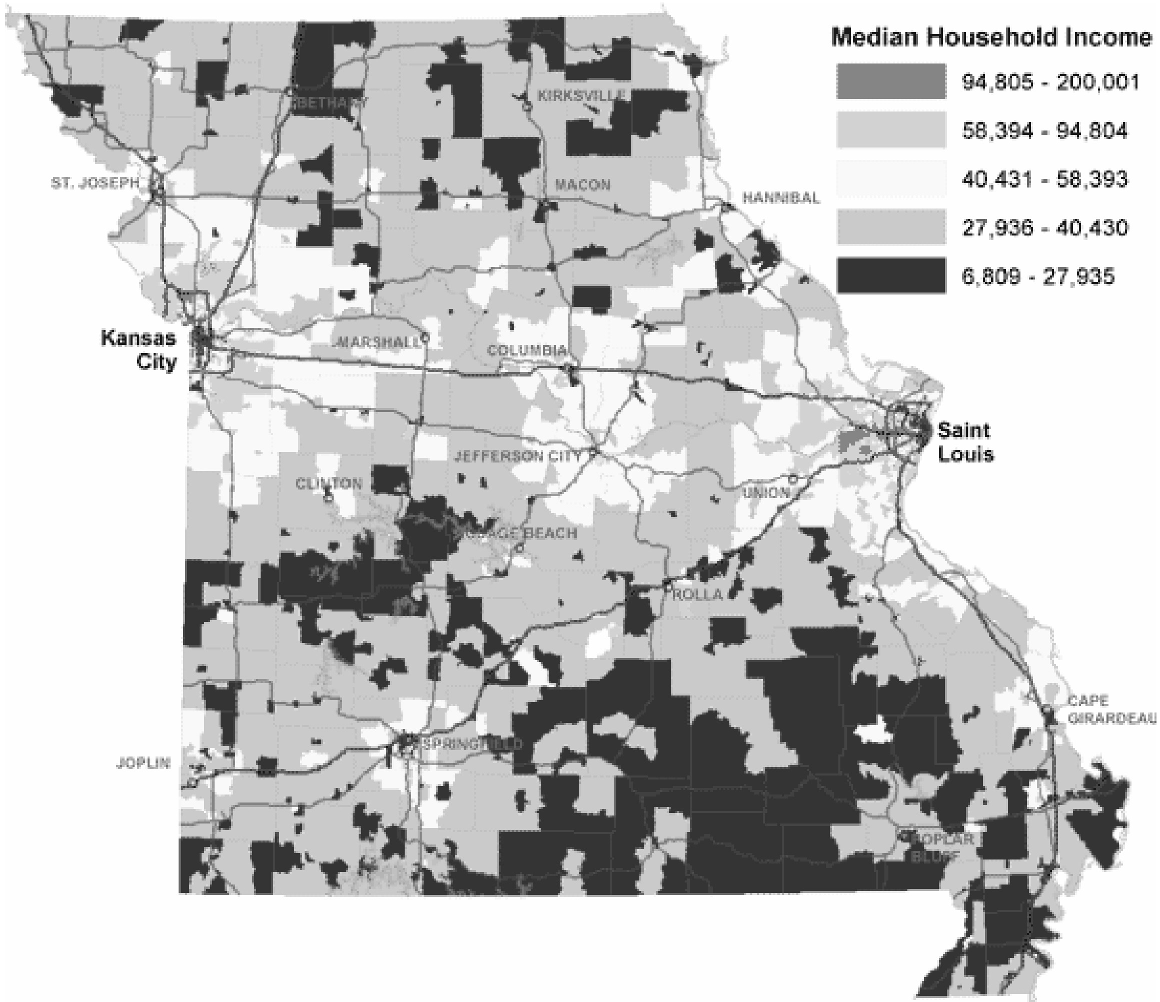

Figure 5. Census 2000 Missouri Median Household Income Map. Adapted from Missouri Economic Research and Information Center (2000).

Sample

MODESE collected data on the total enrollment of a school district and the enrollment of each course offered in the school districts. Only the school districts that gave data to MODESE at the end of the 2010 school year were represented in Table 7. Some school districts may not have reported on all sections offered at their school or may not have offered certain courses considered in this study. Table 7 was adapted by the researcher to show the total number of males and females enrolled in an advanced placement mathematics course at the high school level. For the purpose of this study, advanced placement will represent students who were taking a mathematics course one year before the traditional students. Also shown in Table 7 is Pre-Algebra, which was traditionally an eighth grade course. The students in this class were taking a mathematics course one year later than the traditional students. With males representing 57% of the Pre-Algebra students, females in Missouri did not observably appear to be falling behind in mathematics in their freshman year.

Table 7

Population and Sample Totals and Make-to-/Female Ratios

Category	Total	Male	Female	Ratio: M/F
Population: Missouri	279915	143543	136372	1.0526
Sample: Pre-Algebra: 9th Grade				
(One year behind Traditional)	179488	102756	76732	1.3392
Sample: Geometry: 9th Grade				
(One year ahead of Traditional)	409068	198044	211024	0.9385
Sample: Algebra II: 10th Grade				
(One year ahead of Traditional)	252912	120560	132352	0.9109
Sample: Pre-Calculus: 11th Grade				
(One year ahead of Traditional)	6160	2662	3498	0.7610
Sample: Calculus: 12th Grade				
(One year ahead of Traditional)	161920	80674	81246	0.9910

Note. Adapted from data received by researcher from MODESE

Process for Data Collection

This study focused on the number of males and the number of females with accelerated enrollment in college-preparatory mathematics coursework and Calculus at the public high school level in Missouri. After sending several emailed surveys (Appendix A) in the spring of 2010, to individual public school principals asking for public information about the number of males and females enrolled in mathematics classes, only nine schools responded. The survey was received well because statistics of this nature had never been brought to the forefront of mathematical study; however, the responses were still very slow in returning. It was decided that the necessary information should be obtained through MODESE.

Assessing again at a later time indicated still only nine responses from the 678 public high schools and originally no response from MODESE. The researcher needed another strategy. Murphy, the Chief Aide of a Missouri Senator, showed interest in the topic and offered to approach an official at MODESE to see what data may be available. He was able to provide 16,793 rows of information on this topic. The data included all of the public high school mathematics classes offered to students in the state of Missouri. Two spread sheets were included in the document. One contained the total enrollment for each public high school broken down by grade-level and then by gender, and one held the total enrollment for each mathematics class offered at each public high school broken down by grade-level then by gender. Prior to 2010, this information would not have available from MODESE, since these questions had never been asked of schools in the state before. Questions on gender enrollment for any high school course were not included in end-of-year reports prior to the 2010 class.

Procedure

Data for this study was collected from the MODESE. The data collected included the number of students enrolled in each district, categorized by grade-level and further categorized by gender; and the number of students enrolled in each mathematics course in each district, categorized by district code, course code, grade-level, and finally gender.

The secondary data for this study represented 678 public high schools in the state of Missouri. This number was converted to represent 521 public school districts, because the MODESE collected data, and published data by district. The enrollment data received by MODESE was categorized by district code and gave the number of males and females in each grade-level for each mathematics class offered at the individual district. This information was acquired from the MODESE in the fall of 2010. The 2009-2010 school year was the first year MODESE required districts to report the male and female breakdown of enrollment in classes, and on the date released the data was in raw form. All information for individual schools was a matter of public record, categorized by district code, then further categorized by school code, so individual district names, or individual school names were not used in analysis of data. The numbers used in this study were the numbers reported to MODESE by the individual schools and districts. The enrolment data was used by MODESE to calculate the funding the district would receive from the state. Some school districts did not rely on state funding and therefore may not have turned in their reports. For this reason, a convenience sample of 14 suburban and 21 urban districts where used for this study. More than 30 rural districts reported enrollment data, so 30 numbers were randomly generated to draw 30 rural districts to provide data used in this study.

In addition to the student enrollment data provided by MODESE, school financial information and district census data were secured through the MODESE website in the spring of 2010, which was linked to U.S. Census Bureau data. The individual schools' count of males and females in the mathematics departments of each district was obtained through the individual schools' websites. There were 65 school districts used in this study and 47 had a website with information concerning demographics for the staff.

The raw data received from MODESE was in a lateral excel spread sheet categorized by district code. The information received from the U.S. Census Bureau was in a horizontal excel spread sheet categorized by district code. First, data from these two sources were merged, and then the financial data for 2010, retrieved from MODESE's web site in the winter of 2012, was merged into a new Excel spreadsheet. Before retrieving the data on the mathematics teachers the districts were categorized as urban, rural, or suburban based on the population per square mile, which was found by taking the total population and dividing by the total square miles of the district. The districts' total population and total square miles were obtained from the MODESE web site which linked to the U.S. Census Bureau. It was then discovered that there were only fifteen districts in the state of Missouri that qualified as suburban and one of them did not report enrollment data. Twenty-one urban districts reported data, so all 21 districts were used in this study. There were 423 rural districts, so thirty districts were randomly selected.

Information provided by MODESE was organized into a useable format. The data was sorted by course code, then by district code, and copied and pasted so that each course occupied a single spread sheet. For question one, does the ratio of males to females differ between urban, rural, and suburban schools in college level mathematics courses such as Calculus, the ratio of all students enrolled in Calculus was needed. The Calculus spreadsheet was scanned to make sure all districts had two sets of data, one male and one female. If two sets where not provided, a row was inserted with a 0 entered for the missing gender count. Another column was added for Excel to calculate the number of males divided by the number of females. After this calculation was completed, the 65 districts' data was copied and moved to the combined spreadsheet.

Some of the districts had a ratio of 0 because there were no boys taking Calculus in that district and one was undefined because there were no girls taking Calculus in that district. The lack of either males or females in the calculus class could be due to the fact that the school was a single-gender school, or there may be only one gender enrolled in Calculus. Without knowing the district's name, it could not be determined if the school was single-gender; therefore, the data sets were dropped from analysis.

After narrowing the sample down to 65 districts, question two was addressed. Does the ratio of male to female mathematics teachers correlate with the ratio of male and female mathematics students in Calculus? Each district's web site was visited to gain information on the number of male mathematics teachers and the number of female mathematics teachers at the high schools in each district. Several urban and suburban districts had more than one high school. The schools' data were added together to enter into the spread sheet under the district code. Also, several districts did not have a site, did not offer the names of the teachers, or did not offer the subject area taught by the teachers. All of these school where contacted by phone.

For question three, does the ratio of males to females in advanced enrollment in mathematics classes change as students progress through four years of high school. A definition of advanced enrollment in mathematics class was needed. Since Calculus was a college level class, taken the year before at the high school level, it was decided that advanced enrollment in mathematics class meant a student was taking a course the year before they would traditionally be assigned that course. The ninth graders taking Geometry, a tenth grade course at the time of this study, were separated on the Geometry spreadsheet and all other data on Geometry was removed. Then the data was sorted by male first then female, so that a ratio of the entire states' sampling could be obtained. This process was repeated for tenth graders taking Algebra II or Algebra II/Trigonometry, eleventh graders taking Pre-Calculus, and twelfth graders taking Calculus.

The researcher did not calculate the ratio of male to female students enrolled in each type of mathematics class; Algebra I, Geometry, Algebra II, Pre-Calculus, and Calculus. The researcher defined advanced enrollment in mathematics class to be a situation in which the student was enrolled in the course at least one year before it would traditionally have been assigned. Therefore, a narrower focus was taken in examining the male to female ratios. This study analyzed the ratio of male to female students in an accelerated track as opposed to the male to female ratio enrolled in each individual type of mathematics class.

For the fourth question, does the school budget have any effect on the ratio of males and females in college level courses, another definition was needed. After examining the financial data provided by MODESE the researcher chose the current expenditure per average daily attendance, to represent the school budget. This was the amount of money each district spent on their students per day. It was intriguing to find that at least one large suburban district spent less on students than most rural districts. The 65 bits of data were copied and pasted into the combined Excel spreadsheet.

After necessary data was collected and placed into the Excel spreadsheet, it was determined that using an ANOVA: single factor test on the data would analyze the hypothesis associated with question one, multiple z-tests on data that would analyze the multiple hypotheses associated with research question 3, and a Pearson Product-Moment

Correlation Coefficient (PPMCC) applied to data that would analyze hypotheses associated with questions two and four would be the best course of action. The ANOVA was applied to data representing question one to determine if there was a difference between the three regions' ratios of male to female students enrolled in Calculus, and on question three to determine if there was a difference between the male to female ratios of students enrolled in advanced mathematics courses. The PPMCC test was applied to data for question two to determine if there was a relationship between the male to female ratio of students in Calculus and the male to female ratio of mathematics teachers; and to question four to determine if there was a relationship between the male to female ratio of students in Calculus and the expenditure per average daily attendance.

Summary

Colleges and universities attempted to discover the reason females did not seek mathematics-related degrees, and it was decided that, possibly, the gender gap begins in middle school; however, there was very little research looking at the years between middle school and college.

What caused the gender gap is not known, but studies comparing achievement between countries ruled out biological factors. Those studies suggested a cultural reason. This, coupled with results from studies showing rural communities were moving even farther toward Republican conservatism and religious fundamentalism, along with the fact that urban communities were going toward Democratic and religious liberalism, it was decided that the geographical regions of a state had enough cultural differences that they could be compared in this study. To be more specific, Missouri was chosen because it represented multiple urban and rural districts.

First, this study compared the ratio of male to female Calculus students in each of three geographical regions; urban, rural, and suburban. An ANOVA was used for this test of difference. The desire to know when females started leaving the advanced mathematics courses led to question two, which compared the ratio of male to female students place in an advanced mathematics courses. An ANOVA was used to compare potential differences between all four years of high school.

It was determined that outside factors, previously researched, could be influencing the females' desire to take mathematics. Because females may shy away from male taught classes, the correlation of the ratio of males to females in Calculus and the ratio of male to female mathematics teachers was tested. Other outside factors could be district finances, so the ratio of male to female Calculus students was tested for correlation with the expenditure per average daily attendance.

It was the wish of the researcher to fill the gap in current studies by discovering when females decreased in enrollment in advanced mathematics courses and find some possible contributing factor.

Chapter Four: Results

In order to find some possible contributing factors as to why female enrollment in advanced mathematics courses decreased, and when, the following questions where addressed in this study:

1. Does the ratio of males to females differ between urban, rural, and suburban high schools in college-preparatory level mathematics courses such as Calculus? If so, how?
2. Does the ratio of male and female mathematics teachers correlate with the ratio of male and female mathematics students in Calculus? If so, how?
3. Does the ratio of males to females in advanced mathematics classes change as they progress through their four years of high school? If so, how?
4. Does the school budget have any effect on the ratio of males and females enrolled in Calculus in high school? If so, how?

Null Hypothesis # 1: There will be no difference in the ratios of males to females enrolled in Calculus when comparing urban, rural, and suburban schools.

Null hypothesis # 2: There will be no relationship between the ratio of male to female students in Calculus and the ratio of male to female mathematics teachers.

Null Hypothesis # 3: There will be no difference between the ratios of males to females enrolled in advanced placed mathematics classes as the students progress through the four years of high school.

Null hypothesis # 4: There will be no relationship between the ratio of males to females enrolled in Calculus and the district funding.

Question 1: Comparing Urban, Rural, and Suburban Calculus Ratios

Research Question # 1: Does the ratio of males to females differ between urban, rural, and suburban high schools in college-preparatory level mathematics courses such as Calculus? If so, how?

Null Hypothesis # 1: There will be no difference in the ratios of males to females enrolled in Calculus when comparing urban, rural, and suburban schools.

Independent Variable: the geographical region of the school district.

Dependent Variable: the ratio of male to female students enrolled in Calculus.

In order to answer question one; some definitions had to be established. The Calculus male to female ratio was used to analyze data to answer this question. After researching the mathematics programs in several school districts, it was determined that many schools offered Pre-Calculus and College Algebra interchangeably; therefore, this question only looked at the ratio of male to female students in Calculus. Unlike Pre-Calculus, Calculus was offered in colleges and universities, often as the first class when enrolled in a mathematics program. After determining the specific class to be studied, the Calculus data received by MODESE was sorted by district code and then further sorted by gender. The number of males was divided by the number of females to get a ratio representing urban, rural, and suburban districts.

An ANOVA was applied with an alpha value of 0.05, to determine if there was a difference between the three geographical regions. Table 8 displays the results of the analysis.

Table 8

ANOVA Results: Comparing M/F Ratio of Urban, Rural, and Suburban

Groups	Count	Sum	Average	Variance
Urban	21	18.3116	0.8720	0.8090
Suburban	14	17.3392	1.2385	0.3660
Rural	30	40.6020	1.3534	1.7205

ANOVA

Source of Variation	SS	Df	MS	F	P-value	F crit
Between Groups	2.9393	2	1.4696	1.2864	0.2835	3.1453
Within Groups	70.8335	62	1.1425			
Total	73.7728	64				

With a p-value of 0.284, which is greater than the alpha value of 0.05, the Null Hypothesis was not rejected. There is no difference in the ratios when comparing urban to suburban to rural enrollments. There was an observable 0.4 difference between the urban and suburban averages, so a t-Test: two-sample assuming unequal variances was run comparing the set of urban ratios to the set of suburban ratios (Table 9). The difference was not statistically significant.

Table 9

t-Test: Two-Sample Assuming Unequal Variances: Urban vs. Suburban

	Urban	Suburban
Mean	0.8720	1.2385
Variance	0.8091	0.3660
Observations	21	14
Hypothesized Mean Difference	0	
Df	33	
t Stat	-1.4413	
P(T<=t) two-tail	0.1589	
t Critical two-tail	2.0345	

Based on these tests, it was found that there was no significant difference between the ratios of urban and suburban students. Therefore, the Alternative Hypothesis, there will be a difference in ratio of males verses females enrolled in Calculus when comparing urban, rural, and suburban schools, was not supported.

Question 2: Calculus Enrollment Compared Ratio to Mathematics Teacher Ratio

Research Question # 2: Does the ratio of male and female mathematics teachers correlate with the ratio of male and female mathematics students in Calculus? If so, how?

Null hypothesis # 2: There will be no relationship between the ratio of male to female students in Calculus and the ratio of male to female mathematics teachers.

Independent Variable: the ratio of male to female mathematics teachers at the high school.

Dependent Variable: the ratio of male to female students enrolled in Calculus.

A Pearson Product-Moment Correlation Coefficient, with an alpha of 0.05 was used, to determine if there was a relationship between the ratio of Calculus students and the ratio of mathematics teachers. Also, the coefficient was used to determine if the relationship existed, or was positive or negative. Table 10 indicates the results.

Table 10

Correlation between M/F Calculus Students and M/F Mathematics Teachers

	M/F Calc.	M/F Mathematics Teachers
M/F Calc.	1	
M/F Mathematics Teachers	0.2583	1

It was determined that there is an observable mild, positive correlation of 0.2583 for the relationship between the ratios of male to female mathematics teachers and male to female Calculus students. However, the PPMCC value of 0.2583, compared to the critical value of 0.288 was not significant. The null hypothesis was not rejected and the alternate hypothesis, there will be a relationship between the ratio of male to female students in Calculus and the ratio of male and female teachers, was not supported.

Question 3: Comparing Grade-level Enrollment Ratios

Research Question # 3: Does the ratio of males to females in advanced enrollment in mathematics classes change as they progress through their four years of high school? If so, how?

Null Hypothesis # 3: There will be no difference between the ratios of males to females enrolled in advance placement mathematics classes as the students progress through the four years of high school.

Independent Variable: Grade-level of the students, as assigned to a mathematics class one year prior to the traditional timeline for enrollment.

Dependent Variable: ratio of males and females enrolled in an advanced placement mathematics course.

A z-test for difference in proportions was applied to test Null Hypothesis # 3: There will be no difference between the ratios of males to females enrolled in advanced placement mathematics classes as the students progress through the four years of high school, when comparing each grade-level mathematics class to the next progressing course. Table 11 indicates results of the tests.

Table 11

Z-Test Results: Comparing Grade-Levels

Comparison of Grades	Comparison of Courses	t-Test Value
9^{th} to 10^{th}	Geo./Alg. II	-10.4676
10^{th} to 11^{th}	Alg. II/Pre-Calc.	-55.6254
11^{th} to 12^{th}	Pre-Calc./Calc.	85.1732
9^{th} to 11^{th}	Geo / Alg. II	-10.4676
9^{th} to 12^{th}	Geo/Calc.	20.5420
10^{th} to 12^{th}	Alg./Calc.	30.4062

Note. Critical value is + and - 1.96

Null 1: There will be no difference between the ratios of males to females enrolled in advanced placement mathematics classes as the students progress through their four years of high school when comparing Geometry to Algebra II. The test value of -10.46 compared to the critical value of -1.96 allowed the researcher to reject the Null. There was a significant drop in the ratio, which means the alternate hypothesis that the number of males decreased when compared to the number of females was supported.

Null 2: There will be no difference between the ratios of males to females enrolled in advanced placement mathematics classes as the students progress through their four years of high school when comparing Algebra II to Pre-Calculus. The test value of -55.62 compared to the critical value of -1.96 allowed the researcher to reject the Null. There was a significant drop in the ratio, which means the alternate hypothesis that the number of males decreased when compared to the number of females was supported.

Null 3: There will be no difference between the ratios of males to females enrolled in advanced placement mathematics classes as the students progress through their four years of high school when comparing Pre-Calculus to Calculus. The test value of 85.17 compared to the critical value of 1.96 allowed the researcher to reject the Null.

There was a significant rise in the ratio, which means the alternate hypothesis that the number of males increased when compared to the number of females was supported.

Null 4: There will be no difference between the ratios of males to females enrolled in advanced placement mathematics classes as the students progress through their four years of high school when comparing Geometry to Pre-Calculus. The test value of -10.46 compared to the critical value of -1.96 allowed the researcher to reject the Null. There was a significant drop in the ratio, which means the alternate hypothesis that the number of males decreased when compared to the number of females was supported.

Null 5: There will be no difference between the ratios of males to females enrolled in advanced placement mathematics classes as the students progress through their four years of high school when comparing Geometry to Calculus. The test value of 20.54 compared to the critical value of 1.96 allowed the researcher to reject the Null. There was a significant rise in the ratio, which means the alternate hypothesis that the number of males increased when compared to the number of females was supported.

Null 6: There will no difference between the ratios of males to females enrolled in advanced placement mathematics classes as the students progress through their four years of high school when comparing Algebra II to Calculus. The test value of 30.40 compared to the critical value of 1.96 allowed the researcher to reject the Null. There was a significant rise in the ratio, which means the alternate hypothesis that the number of males increased when compared to the number of females was supported.

Question 4: Calculus Enrollment Compared to School Budget

Research Question # 4: Does the school budget have any effect on the ratio of males and females enrolled in Calculus in high school? If so, how?

Null hypothesis # 4: There will be no relationship between the ratio of males to females enrolled in Calculus and the district funding.

Independent Variable: the average amount of money a district spends on their students each day.

Dependent Variable: the ratio of male and female students enrolled in Calculus.

For this question, the set of ratios comparing male to female Calculus students was again used. After retrieving the financial information for the districts in Missouri from MODESE's website, expenditure per average daily attendance was chosen to represent school funding. This number represented the amount of money a school spent on their students per day. A Pearson Product-Moment Correlation Coefficient (PPMCC) was calculated for male to female ratios and school district funding to determine if there was a relationship. The coefficient determined if the relationship existed or was positive or negative. Table 12 indicates the results.

Table 12

Correlation between M/F Calculus Students and the School's Budget

	M/F Calc.	Funding
M/F Calc.	1	
Funding	-0.2328	1

With an observable negative, mild correlation coefficient of -0.2328 the null hypothesis was not rejected. The PPMCC value of -0.2328, compared to the critical value of -0.288, was not significant, so the researcher did not reject the null hypothesis. The alternate hypothesis, there will be a relationship between the ratio of males to females enrolled calculus and the district funding, was not supported. There is not strong statistical evidence to support the question, but the negative coefficient suggests that there may be an observable relationship between less funding and the ratio of males to females in Calculus.

Summary

For the purposes of this study the researcher assigned the following definitions:

Advanced placement enrollment in mathematics course – a student was assigned to a mathematics class one year prior to the traditional timeline for enrollment.

School Budget - expenditure per average daily attendance.

Urban – population per square mile is greater than 2,500.

Suburban - population per square mile is between 1,000 and 2,500.

Rural - population per square mile is less than 1,000.

Out of the Missouri population of 521 public school districts 21 urban, 14 suburban, and 30 rural districts were used as a sample set.

For question one, an ANOVA was applied and the null hypothesis, there will be no difference in the ratios of males to females enrolled in Calculus when comparing urban, rural, and suburban schools, was not rejected.

To examine question two, a PPMCC was applied and the null hypothesis, there will be no relationship between the ratio of male to female students in Calculus and the ratio of male to female teachers, was not rejected. There was a mild observable positive relationship that was not significant.

Hypothesis three, there will be no difference between the ratios of males to females enrolled in advanced placed mathematics classes as the students progress through the four years of high school, was divided into six null hypotheses that compared the enrollments in each of the four grade-levels. A z-test for difference in proportions was applied for each hypothesis to determine if there was a difference between the two mathematics levels used in each test. All six null hypotheses were rejected. There was a difference in the ratio of males to females, when comparing changes from grade-level to grade-level.

The fourth hypothesis, there will be no relationship between the ratio of males to females enrolled in Calculus and the district funding, was not rejected. A PPMCC was applied to determine if there was a relationship between the ratio of males and females enrolled in Calculus and the expenditure per average daily attendance. No relationship was found.

Chapter Five: Discussion, Implications, and Conclusions

This research explored the question, why are there so few females enrolled in mathematics-related programs, such as engineering and science, in college cannot be answered with one single test. To formulate an answer, this investigation considered factors prior to college enrollment and analyzed data on male versus female enrollment in college-preparatory mathematics courses at the high school level. Several questions were posed in order to provide a complete description of which regions of the state of Missouri supported larger ratios of males to females enrolled in such courses, and the cultural, political, demographic, business, and religious factors of the populations that may have contributed to these ratios.

Implications of Urban, Rural, and Suburban Culture on Calculus Ratios

The first research question, does the ratio of males to females differ between urban, rural, and suburban schools in college-preparatory level mathematics courses, such as Calculus, was asked to determine if the mindset and culture of the region in which a female grows up affects her ability to choose mathematics-related college programs, and high school mathematics classes, without bias. Nelson (1977) discovered that urban and rural churches had a difference in their core beliefs. Urban churches were more liberal with their ideology and rural churches were more fundamental. Urban counties, in the state of Missouri, voted Democratic, more progressive, and rural counties voted Republican, more conservative. Some researchers believed that religious and politically based cultures had different expectations in life of females as compared to males. Reyes found that urban students were taller and rural students had better hand grip strength and Denaux (2007) found a difference in the efficiency scores of urban and rural schools.

These studies on the effects of religion and politics, as well as physical attributes, coupled with the psychological studies indicating that girls need positive role models in mathematical fields of study in order to achieve, led the researcher to believe that females would be more likely to excel in mathematics courses in urban or suburban areas, even though the subject was considered to be naturally male dominated. Urban and suburban areas had more diverse jobs and, therefore, more people with engineering and other mathematics-related degrees, thus more mathematical role models. Urban and suburban areas were also labeled as progressive, possibly providing more female role models for young girls. Progressive thinkers were more open minded to new ideas, such as the acceptance of women pursuing careers in mathematical fields.

The null hypothesis, there will be no difference in the ratio of males to females enrolled in Calculus when comparing urban, rural, and suburban schools, was tested for enrollment in high school Calculus class and not rejected. This means that there was no statistical difference between the ratios of males and females enrolled in high school Calculus, when comparing regions of the state to each other. This is significant to the results of this study because it casts a shadow on the belief that environment, and hence cultural differences, can affect a female’s mindset and chances of success. This information can help parents when deciding where to send their children to school. The acceptance that there were no differences in the gender ratios of students in high school Calculus means that families can live anywhere and their female children will have the same opportunities for educational advancement in mathematics, without bias. Some families will no longer feel like they have to move from a rural community into the suburbs so their female children can develop an open mind and be exposed to more cultural activities and have more educational chances.

What was not investigated by this study was the urban migration problem; often families moved out of the city in order for their children to have more educational chances and not be hindered by the attitudes and behaviors of other students. The data in this study showed an observable, though not statistical, difference in the ratio of males to females enrolled in Calculus in urban high schools. This was the only category that showed, on average, a larger female than male enrollment. The average ratio of males to females enrolled in urban Calculus classes was 0.87; however, the t-test for difference in proportion yielded that the difference between the average urban and suburban ratios was not significant. The observable difference showed that, in the state of Missouri, the urban schools had a larger number of females enrolled in Calculus class one year before they would traditionally enroll, compared to their male counterparts. This difference may be caused by the more liberal, or more accepting, mind set of urban living which leads the researcher to believe that more families should migrate back to urban areas if they are concerned about pressures and bias upon their female children's choices of mathematics study in high school, and subsequently in college.

Also, contrary to the original belief of the researcher, suburban and rural schools shared similar statistics. This may be due to their shared political mind set or relationship to the original U.S. Census (1990) definition that stated rural areas had a population under 25,000 people per square mile. Ultimately, suburban areas can continue to be categorized as rural, as they were in the studies by Nelson (1997), Reyes (2001), and Denaux (2007), because they shared the same statistical and demographical qualities.

Recommendations. When comparing the urban, suburban, and rural school districts, all but one suburban district gave data on Calculus enrollment to MODESE, so data gathered from all suburban schools were used in this study. Sixty-one urban schools were missing data in the state database and the number for missing data representing rural schools was greater. The missing data could mean one of two things; either the district did not need state funding and did not report data or the district did not offer Calculus to their students, which is a more likely situation. If the district did not offer Calculus, the zeroes representing enrollment for a portion of the rural region would change the results of the tests conducted in this study. A future study could look at the number of rural, or urban, school districts that did not offer Calculus and determine if those districts made a large enough gap to create a statistical difference. The lack of advanced, college-preparatory mathematics courses would handicap both male and female students and would make pursuing a degree in a mathematics-related fields more difficult.

Another recommendation would be to study the funnel effect that may occur while females progress through the four years of high school. Since there are, on average, fewer females than males during the freshman year, there is a smaller female pool from which to pull during the sophomore year. Higher level classes, in general, have an attrition rate and when this rate affects already uneven numbers between male and female enrollment, it may cause the ratio of males to females to move farther toward the male's side. However, when looking at the ratios of males and females enrolled in advanced placement mathematics courses in this study, ninth grade: 1.0987; tenth grade: 1.0525; eleventh grade: 1.0308; and twelfth grade: 1.0235; the state of Missouri appeared to be progressing to a more gender equal environment as the students progressed through school. Since there were fewer females enrolled in freshman level mathematics courses one year prior to the traditional enrollment period, these ratios indicated that more males dropped out of advanced placement mathematics programs in the state of Missouri than females; thus showing the attrition rates of males and females were different. Females, though fewer, had a smaller attrition rate in the advanced placement enrollment mathematics courses in high school, which could also be studied more closely.

Yet another recommendation would be to perform this test in another state. A state that had a wider variance in rural and urban cultural characteristics may yield different results, even though the tests done by Pope and Sydnor (2010) showed no statistical difference in culture between the states themselves. Missouri's regions may be like the states in Pope and Sydnor's study and have no significant cultural differences; however, a more diverse state may be more like the cultural comparison of countries in the Guiso, Sapienza, and Zingales, (2006) study and yield a significant measureable difference in cultural characteristics.

Implications of Teachers' Gender on Student Enrollment

The literature review in chapter two referred to several psychological studies indicating that a female student's psyche suffered ridicule by fellow students when she got a wrong answer and was belittled by adults who told her to pick a non-man's field of study for her future career (Lloyd, 2005; Lloyd, 2005; Powell, 2001; Walsh, & Yailagh, 2005). Other studies said females did not excel in mathematics because they had male teachers and were therefore trained to view mathematics as a male's subject of expertise (Geist & King, 2005; Warrington & Younger, 2000).

The thought that the ratio of male to female mathematics teachers could affect the ratio of male to female enrollment in advanced mathematics in high school prompted the second research question; does the ratio of male to female mathematics teachers correlate with the ratio of male to female mathematics students in Calculus? Testing the null hypothesis, there will be no relationship between the ratio of male to female students in Calculus and the ratio of male to female mathematics teachers, found there was a non-significant mild positive correlation between the ratio of male to female mathematics teachers and the ratio of male to female mathematics students. This suggests an observable trend that when the number of male mathematics teachers in a high school rises, so does the number of male advanced placed mathematics students. This should raise concerns in districts across the state that hire a larger proportion of male mathematics teachers than females; however, in the sample used for this study, primarily rural districts hired more males and urban and suburban districts consistently hired more females. The number of female mathematics teachers in the urban and suburban samples was almost double the number of male mathematics teachers. The urban samples had observably more female Calculus students then male Calculus students, which may be an effect of the higher number of female mathematics teachers in urban areas. The correlation between teacher and student gender ratios may be observable, but were not statistically significant in this study. This showed that the gender of a student's mathematics teacher did not affect the student's ability to excel in college-preparatory mathematics in high school.

Recommendations. The two largest urban districts where not represented in this study because they did not list their teachers by subject area and had too many high schools for their human resources department to provide gender tracking information to outside researchers. Seventeen out of 65 districts did not have a web page, did not list their teachers by department, nor did not know the ratio of male to female mathematics teachers when contacted by phone. The researcher recommends a larger representation of schools, which may prove a positive correlation when compared in a study similar to this one. Also, mixed methods data would significantly help in determining if there is a correlation between the gender of the mathematics teacher and the number of females enrolled in advanced placement mathematics courses, especially since most of the research conducted on the psychology of female students could be obtained through interviews rather than anonymous, unbiased statistics. For both methods, a larger sample size should be used; some of the previous studies, which conducted interviews, only observed classes in a single school and the data for this study only utilized 47 districts from a single state for the analysis of teacher gender ratios.

Implications of Comparing Grade-level Enrollment Ratios

Research question three, does the ratio of males to females in advanced mathematics classes change as they progress through their four years of high school, was divided into 6 tests, which compared all combinations of grade-level enrollment. All of the null hypotheses, there will be no difference between the ratios of males to females enrolled in advanced placed mathematics classes as the students progress through the four years of high school for each pairing of sequential courses, were rejected indicating that there was no difference in the year-to-year comparisons and there was not enough evidence to statistically support the claim that female enrollment in advanced placed mathematics courses, declined over the four years of high school. However, the positive and negative trends shown in the test values intrigued the researcher and suggest further investigation would be valuable in a future study.

Recommendations. The z-test for proportions yielded a negative test number when comparing 9th to 10th, 10th to 11th, and 9th to 11th graders. This suggests the number of male students enrolled in advanced placed mathematics courses was decreasing as the students progressed from 9th grade to 11th grade. The test value swings to positive when comparing 11th to 12th and 9th to 12th graders. The positive value suggested a decrease of female enrollment in Calculus when compared to Pre-Calculus or even compared to the freshman class of advanced placement mathematics students. This may be caused by the fact that it was not required to take a fourth year of mathematics in Missouri high schools to obtain a high school diploma, which may lead to females deciding they did not want to pursue a mathematics field. For this reason, many Missouri females may have stopped studying mathematics in high school after obtaining the required three years of mathematics credit. The researcher recommends a mixed methods study to determine the reasons for decrease in male student enrollment during the first three years of high school and female enrollment decrease in the last year of high school. Grassi (2004) said the gender gap starts in middle school and the universities say that it is obvious by college. This one positive test value may shed some light on precisely when female students no longer enroll in advanced placement mathematics courses. Further investigation is suggested.

Implications of District Funding on Student Enrollment

The final research question, does the school budget have any effect on the ratio of males to females enrolled in Calculus in high school, was addressed by comparing the ratio of male to female Calculus students to the expenditure per average daily attendance, the amount of money spent daily on students. The null hypothesis, there is no relationship between the ratio of males to females enrolled in Calculus and the district funding, was not rejected. There was a non-significant mild negative correlation, which may suggest a decrease in the ratio when the funding decreases, but this theory is not statistically supported.

Recommendations. The researcher recommends further quantitative investigation. The expenditure per average daily attendance shows how much a district spends on the students in attendance each day. The money spent on the students comes from state funding, district funding, tax levies, and loans. There may be a stronger negative correlation if a future study uses only the funds received by the district and does not incorporate loans.

Unexpected findings: Cultural Connections to Female Enrollment

Before the Census in 2000, the U.S. Census Bureau classified rural as any region with a population of less than 2,500 people per square mile. This definition of rural region was changed for the 2010 census, and rural regions were no longer classified as those with a population of less than 2,500 people per square mile. The category of suburban was added (U.S. Census, 2010). For the purpose of this study, suburban counties where taken out of the rural classification and moved into a classification of their own, 1,000 – 2,500 people per square mile. The reason for this new classification was based on the fact that suburban counties earned more money per year than their urban or rural counterparts (Figure 5) and had observably larger school districts than rural, but smaller school districts than urban counties. The different monetary attributes led the researcher to believe there would be a difference in ratios when comparing enrollment of males to females in high school Calculus among the three regions. The researcher's opinion was that the suburban districts would not be as gender biased toward males as the urban and rural districts. The close alignment of the suburban and rural districts was an unexpected finding by the researcher.

Implications. The census was not the only demographic classification that placed suburban and rural districts together. Both regions in Missouri voted primarily Republican (Figure 4) and therefore shared a more conservative mindset than their urban counterparts. The Republican platform at the time this data was collected was based on family values and bringing the country back to the days of glory. Taking society back to the way it used to be may hinder women's rights and freedoms and inadvertently teach young women to be satisfied with a life as a homemaker rather than pursuing a greater level of education. This mindset might also affect choice of the field of study and likely not promote study in the fields of mathematics, science, technology, and engineering for women.

Missouri, in general, was not a very diverse state (Table 4) and most of the racial minorities tended to cluster around the urban areas. The main urban district in Missouri, St. Louis, had several ghettos comprised of Italian, Bosnian, Jewish, or African-American populations. However, both the rural and suburban regions did not have these ghettos and were both comprised of a predominantly Caucasian population (MODESE, 2010).

Another cultural trait shared by the rural and suburban regions was involvement in religion. Both regions, possibly due to the lower population or attributed to conservatism, shared a fundamentalist view on religion. Rural and suburban regions followed religious doctrine unlike their urban counterparts who made the religion work for the current demands of society on an individual's available time (Nelsen & Potvin, 1977).

Resources for learning, working, and creating new businesses differed among urban, rural, and suburban cultures. Women, and people in general, had more colleges, hospitals, and places of employment to choose from in urban regions than in either rural or suburban. The advantage of the suburban communities was that of proximity to urban areas. Suburban residents could drive to urban areas for higher levels of education or to work. However, rural communities did not have this advantage. Both rural and suburban regions had a smaller population and therefore a smaller chance of creating and running a business (Table 5), which contributed to the list of disadvantages women faced while living in a rural or suburban culture. The smaller likelihood of starting up and maintaining a business did not motivate a female to choose a mathematics or business-related field of study in the higher education setting, nor the study of college-preparatory mathematics in high school.

This study found that the ratios of males to females enrolled in Calculus a year before expected traditional enrollment in rural and suburban regions were very similar to each other (Table 6). This finding, coupled with the demographic and cultural similarities of the two regions support Guiso, Monte, Sapienza, and Zingales's (2008) hypothesis that the culture of the environment affects women's abilities to advance in mathematics related courses. Therefore, it is possible that cultural factors, to a small extent, may affect a female's choice in enrollment in college-preparatory mathematics coursework in high school, especially in an advanced manner by taking the course a year ahead of the traditionally expected year in high school.

Recommendations. The researcher recommends further qualitative investigation to determine any hidden cultural traits which may exist in both regions, thus causing the decrease in female participation in advanced mathematics.

Implications. The data in this study showed an observable, though not statistical, difference in the ratio of males to females enrolled in Calculus in urban high schools. This category, unlike its rural and suburban counterparts, showed, on average, a larger female than male enrollment. The observable difference showed that, in the state of Missouri, the urban schools had a larger number of females enrolled in Calculus class one year before they would traditionally enroll, than their male counterparts. This difference may be caused by the more liberal, or more accepting, mind set of urban living. The advancement of females in an urban setting was unexpected to the researcher because of the perceived materialistic and conformist mindset of urban adolescents. Watching students compete for the latest phone and newest sneakers did not correlate, in the researcher's mind, with breaking educational barriers.

Recommendations. The researcher recommends further qualitative investigation to determine why urban female adolescents seemed visually, but not educationally, to conform to their fellow students.

Conclusion

When research began in 2008 for this study, the question was so far removed from the current literature that there was nothing to support asking if there was a difference in gender proportion when comparing urban, suburban, and rural school districts. Enough studies on the gender gap in mathematics and reading where written by 2010 that MODESE decided to start requiring gender enrollment data. Also, in 2010, studies comparing the differences in urban and rural communities were published that lent support to the idea that education may be affected by the community in which the high school resides (Pope & Justin, 2010). The studies in chapter two, of smaller populations, showed that there was a difference between the culture of urban and rural communities, male and female achievement in mathematics, and a female student's ability to learn from a male or female teacher (Grassi, 2004; Reineke, 2011). Yet, this study demonstrated no relationship between student and teacher gender ratios or district funding and no difference between geographical regions or grade-level. This may be due to the larger population used in this study. With so many districts in the state of Missouri, individual districts that showed more female achievement did not get attention because they were averaged in with districts that had little to no female achievement. The researcher suggests that the ability for females to advance in mathematics lies within the individual. This study shows that female enrollment numbers are not affected by outside forces; therefore it is up to females to inspire themselves and other females to progress in the fields of mathematics.

In 2006, the male to female ratio at the Missouri School of Science and Technology was three to one; however, many student leadership positions were held by women (Missouri School of Science and Technology, 2006). The president and at least two vice-presidents' advice to girls was, 'Go for it'. They felt the status of women in the minority should not prevent them from showing their skills (Missouri School of Science and Technology, 2006). These women may be the inspiration high school junior females need to enroll in Calculus and look into mathematical fields of study in higher education.

The data in this study demonstrated a slight increase in female enrollment in Calculus in the urban districts. This was surprising to the researcher; however, urban environments provide more career opportunities for females in mathematics and therefore more female role models. The educational community was focused on closing the achievement gap, and had consequently started to hold districts accountable for their students' advancement. Future research may be done on the ability to raise the number of females enrolled in advanced placement mathematics courses, such as Calculus, by providing schools yielding a greater than one ratio of males to females with a greater number of female mathematical role models.

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Appendix

Survey of Calculus Teachers
2009-2010 School Year

1.) Number of students taking Calculus

Female ____________________

Male ______________________

2.) Number of students taking Calculus and seeking a post secondary degree in a mathematics related field

Female ____________________

Male ______________________

3.) Number of students in your schools senior class

Female ____________________

Male ______________________

4.) Number of teachers in the mathematics department

Female ____________________

Male ______________________

5.) Number of high school teachers

Female ____________________

Male ______________________

6.) Number of students in Pre-Algebra

Female ____________________

Male ______________________

Vitae

Mary Anne LaTragna was born in South St. Louis City, Missouri on August 13th, 1983, the daughter of Anne and Frank LaTragna. After completing high school at Oakville Sr. High School in St. Louis County, she attended Fontbonne University in Clayton, Missouri from 2001-2004. She graduated with a Bachelor of Science degree, along with two mathematics teaching certificates for middle school and high school. She then entered Lindenwood University in 2005 and completed her Masters in Educational Administration in 2006, receiving certifications for middle school and high school. She has served as a mathematics teacher for the past ten years. She currently lives in South St. Louis City, Missouri.