Gender Issues in Mathematics Achievement in Tennessee:

Does Rural School Locale Matter?

A Dissertation

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ABSTRACT

The purpose of this study was to investigate achievement differences of middle school and high school students in Tennessee as well as high school mathematics course enrollment as related to gender, school locale, school location, and Socio-economic Status (SES). Using data accessed from the Tennessee Department of Education's 2003 Report Card, median male and female mathematics scores from the Tennessee Comprehensive Assessment Program (TCAP) were used to examine middle school students' achievement. Scores from the ACT Mathematics subtest were obtained from students completing the test during the 2002-2003 school year to explore achievement differences at the high school level. Finally, surveys were sent to each high school in Tennessee to study mathematics course enrollment figures.

Collected data were analyzed using the General Linear Model Repeated Measures Test to investigate differences in gender over school locale (Rural, Large Central City, Other Nonrural), location (Appalachian or Non Appalachian), and SES. A school's SES was categorized by the percentage of disadvantaged students, those receiving free or reduced lunch, as low to moderate (less than 50 percent of students receiving free or reduced lunch), high (50 to 74.99 percent) and highest (75 percent or more).

Analysis of the middle school data revealed females significantly outscore males at grades six, seven and eight on the mathematics portion of the TCAP, regardless of school locale, location, or SES with one exception. For seventh grade students, schools in Other Nonrural locales, males slightly outscored females. Analysis also showed that for

schools with high and highest percentages of disadvantaged students, Rural schools outscored both Large Central City and Other Nonrural schools.

Review of the ACT mathematics subtest scores showed comparable results in terms of school locale. Schools with high or highest percentages of disadvantaged students in Rural locales outscored Large Central City and Other Nonrural. The finding for gender differences, however, was opposite that of the middle schools, with males outscoring females across locale, location and SES.

Finally, course enrollment showed significantly more males enrolled in the entry level mathematics courses, Foundations I and II. Females enrolled at higher percentages in Algebra II, Geometry, Advanced Algebra, and Precalculus. No gender differences were found for Calculus or Calculus AB. Although the percentage differences in enrollment were statistically significant, they were not large. Of interest is the manner in which the positive difference in enrollment percentages that females have in Algebra II and Geometry courses decreases through the mathematics sequence, until no significant difference is found for the calculus courses.

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Chapter I

INTRODUCTION

Gender issues have long been a topic of educational research, particularly in the area of mathematics. Past studies have shown females following behind males in terms of the amount of mathematics studied and achievement in mathematics. For example, Chipman (1996) found in 1950, only 24 percent of Bachelor of Arts (BA) degrees in mathematics were awarded to women. However, by 1991, nearly half of these degrees were awarded to females. With these gains in the number of degrees as well as a decrease in the difference on achievement tests (Ansell & Doerr, 2000), a recent trend in popular literature, such as the periodical *Newsweek*, has been to question what harm has been done to males in the effort to equalize educational opportunities for females over the past several decades. With females graduating universities at higher rates than males, Conlin (2003) states for every 100 men earning a Bachelor's Degree in all subjects in 1999-2000, 133 Bachelor's Degrees in all subjects were earned by women, and the number projected to rise to 142 by 2009-2010, some are dismissing the notion that females are being shortchanged.

Just as gender has been a topic of educational research, rural issues, as a result of the Rural Systemic Initiative funded by the National Science Foundation, have been a focus of educational research. Projects such as the Rural Systemic Initiative and the Annenburg Rural Trust, now named The Rural School and Community Trust (Rural Trust) have brought an increased focus on issues facing rural educators and students living in rural areas. Reflecting popular culture that depicts rural populations as anything but intellectual or education-minded (*Hee-Haw*, *The Beverly Hillbillies, You Might Be A Redneck If…*), initial efforts involving the study of rural educational issues worked through a deficit-model lens. The deficit model purports that the education received by students in rural schools is substandard when compared with students attending urban or suburban schools (Edington & Koehler, 1987). However, more recent research highlights many of the positive aspects of rural education (Herzog & Pittman, 1995; Lee & McIntire, 1999; Winters, 2003).

According to noted rural educator Craig Howley, the intersection of mathematics education and rural education research is very small (Howley, 2002; Schultz, 2002). The information in *The Nation's Report Card: Mathematics 2000* (Braswell, Lutkus, Grigg, Sanatpau, Tay-Lim, & Johnson, 2001) show that in all grades tested (4, 8, and 12) that the mathematics achievement of students attending schools in locales denoted as urban fringe/large town exceeded the mathematics achievement of students attending schools in urban/central city as well as rural/small town. For grades 4 and 8, students in rural/small town schools outperformed students from school in urban/central city locales in mathematics achievement. In the August 2003 issue of the *ERIC Clearinghouse on Rural Education and Small Schools*, Howley (2003) concludes from his assessment of rural mathematics achievement, that there are no national rural/nonrural achievement differences in mathematics achievement, nor are there national differences in rural/urban or rural/suburban. Nationally, there may be no difference in mathematics achievement, but other research has shown there are differences on the state level. Lee and McIntire (2000) found that differences do exist at the state levels with approximately equal numbers of states showing rural schools scoring higher on mathematics achievement as states showing lower scores for rural schools.

This study seeks to help develop the knowledge base of the intersection of rural, (specifically rural Appalachia), mathematics, and gender by examining the relationships as they exist in Tennessee.

Purpose of the Study

The purpose of this study is to determine how females in rural areas compare with females in nonrural areas specifically in terms of the percentages of males and females in selected high school mathematics courses as well as differences in achievement on college entrance exams. Additionally, achievement test scores for students in grades six through eight will be analyzed to discover any differences between the scores of rural and nonrural students, both male and female.

Research Questions

1.) Are the percentages of females and males in the following high school mathematics courses: Competency Mathematics, Foundations I and II, Algebra I and II, Geometry, Advanced Algebra with Trigonometry, PreCalculus, Statistics, Calculus, Calculus AB, Calculus BC, and AP Statistics in rural Tennessee significantly different than the percentages of females and males in nonrural areas in Tennessee?

2.) Are there significant differences in mathematics achievement as measured by the ACT with regards to gender, locale, and location?

3.) Are there significant differences in mathematics achievement as measured by the TCAP test for males and females in grades six through eight by locale or location?

4.) When accounting for SES, are there significant differences in mathematics achievement as measured by the ACT for male and female students by locale or location?

5.) When accounting for SES, are there significant differences in mathematics achievement as measured by the TCAP for middle school male and female students by locale or location?

Significance

This study provides information concerning gender issues in mathematics across the state of Tennessee. Aside from providing information about the general differences in male and female achievement in the state, specific information concerning how these differences occur based on locale and location is indicated. This study adds to the knowledge base of rural mathematics education, which, as stated previously, is minimal. The study does so by focusing on an even less researched area, gender issues as they relate to rural schools.

Assumptions

This study assumes that the survey results reporting course enrollment by gender, ACT scores by gender, as well as enrollment in the schools by gender are accurately reported by the schools. Additionally, the assumption was made that the 33.3 percent of surveys returned are representative of the entire state.

TCAP test scores are available from the state department of education website by gender for each public school in the state of Tennessee, however, socioeconomic status of some schools was not reported. The assumption was made that results of the analysis omitting the schools for which data was not complete would not affect the overall results.

It was necessary to omit 43 schools out of 647 in the analysis which included SES as a factor due to missing socioeconomic status for the middle grades and 12 out of 271 of the high schools.

Summary

The issue of mathematics achievement by gender has been studied through out the past several decades. However, little attention has been paid to the differences in achievement between rural and nonrural female students, and whether achievement differences by males and females vary by locale. This study looks at middle school mathematics achievement scores for male and female students in grades six through eight as measured by the TCAP Examination as well as high school mathematics achievement as measured by the ACT college entrance examination.

Although enrollment in high school mathematics courses has become more evenly divided among male and female students, this study investigates how the male/female ratio may or may not differ by locales.

This study begins with a review of literature focusing of gender issues in mathematics education, both in terms of achievement and enrollment; rural educational issues; and socioeconomic issues in mathematics achievement as well as in rural education. Chapter III delineates the approach to answering the research questions that was taken, including how information was collected and analyzed. The results of the study are described in Chapter IV. The findings are discussed in the final chapter and the implications of the results are also presented.

Definitions

ACT	The ACT Assessment is a four subject area test for high school students that measures "general educational development and their ability to complete college level work" (www.act.org/aap/). For the purpose of this study, scores will be narrowed to the mathematics subtest only.
Appalachian	A county in Tennessee is designated Appalachian based on the definition provided by the Appalachian Regional Commission (ARC) available at http: www.arc.gov/index.do?nodeId=27
Locale	The locale of a school refers to one of the eight designations provided by the National Center for Educational Statistics (NCES). The locales are: Large Central City, Mid-Size Central City, Urban Fringe of Large Central City, Urban Fringe of Mid-Size Central City, Large Town, Small Town, Rural outside a Metropolitan Statistical Area (MSA), and Rural inside an MSA (NCES, http://www.nces.ed.gov/ccd/schoolsearch). For the purposes of this study the eight locales were divided into three categories: Large Central City; Other Nonrural (Mid-Size Central City, Urban Fringe of Large Central City, Urban Fringe of Mid-size Central City, Large Town); and Rural (Small Town, Rural outside MSA, Rural inside MSA).
Location	This refers to whether or not the school resides in a county defined by ARC as Appalachian.
Nonrural	Schools designated by NCES as Large Central City, Mid-size Central City, Urban Fringe of Large Central City or Mid-size City or Large Town are classified as nonrural (Howley, 2002).
Rural	Schools designated by NCES as Small Town, Rural Inside or Outside MSA are classified as rural for purposes of this study (Howley, 2002).

SES	For the purposes of this report, SES is defined by the percentage of economically disadvantaged students in a school. This percentage refers to the percentage of students receiving free or reduced lunch (J. Beam, personal communication, February 18, 2004).
TCAP	The TCAP test, designed by CTB McGraw-Hill is administered to Tennessee students grades 3-8 in the spring of the year. TCAP consists of many subtests but only the mathematics Composite subtest score will be used for this study (Tennessee State Department of Education: www.state.tn.us/education/wmTCAP.htm).

Chapter II

REVIEW OF THE LITERATURE

Introduction

This study examines gender differences in the study of mathematics for middle and high school students in Tennessee. These differences will be studied in terms of the school locale (Large Central City, Rural, Other Nonrural) and school location (Appalachian or Non Appalachian). Additional questions will investigate the interaction of gender, locale, and location in terms of school SES. In the review of literature that follows, attention will be given to gender issues with regards to mathematics; rural issues in education; and the effects of SES on mathematics achievement.

Gender Issues in Mathematics

> "Women's brains are too cold and too soft to sustain rigorous theory; that the female cranium is too small to hold a powerful brain; that mathematics requires a 'virile' mind, properly cleansed of femininity; and that exercising women's brains would shrink their ovaries" (Simon, 2000, 782)

Women have not always been welcome in the field of mathematics. The Renaissance Era "theories" listed above kept most women from the study of mathematics. In fact, mathematicians such as Bacon and Descartes are reported to never deigned to converse with women, as it was feared that contact with women hindered the abilities of the mind (Simon, 2000).

Times have changed, however. The launch of Sputnik in 1957 served to help encourage women to enter the field of mathematics by calling for increased studies in mathematics and science by *all*. The National Defense Education Act, passed in 1958 as a direct result of the launch of Sputnik, stated, “the security of the Nation requires fullest development of the mental resources and technical skills of its young men and women” (Marshall, Sears & Schubert, 2000, 43). The specific inclusion of women is important in that girls, at that time, were not encouraged to participate and certainly not expected to excel in the field of mathematics. In fact, as late as the 1940s, females were barred from taking advanced mathematics classes at some high schools (Chipman, 1996). This change towards the inclusion of women was a reflection of the increased national focus on the necessity for more mathematical study required to compete with the former Soviet Union in the space race. In addition, there was a fear that communism would spread should the Soviets gain too much of an advantage over the United States.

With the release of Helen Gurley Brown’s *Sex and the Single Girl* in 1962, the feminist movement began a new wave in the United States. In Brown’s book were the “startling stirrings of female liberation” (Douglas, 1994), which, when coupled with the call for increased mathematics for males and females greatly changed the level of participation in mathematics, as well as other scientific fields. In 1950, only 24 percent of BA degrees were awarded to women, by 1977 that percent had increased to 46.1 (Chipman, 1996). Additionally, the percent of BA degrees awarded to women in mathematics rose from 22.6 to 41.5 percent (Chipman, 1996). By 1991, over half of the BA degrees were awarded to women and nearly half of the mathematics BAs as well (Chipman, 1996). This large increase is a reflection of the societal changes wrought by the feminist movement and the Cold War’s space race.

The gender inequity with regards to mathematics education has generated several hypotheses according to Mary Gray, Department of Mathematics and Statistics, American University. Perhaps the most strongly contested hypothesis is that women cannot do mathematics (Gray, 1996). This hypothesis, perpetuated in society (remember the Barbie that briefly said, “Math is tough”?) encourages the belief that women are not as capable in mathematics as men are (Chipman, 1996; Damarin, 1994). The hypothesis that females cannot do mathematics strongly affects females’ self-confidences. Females, for example, are more likely to attribute success in math to luck, rather than ability, while males attribute their success to ability (Sanders, 1997).

A second hypothesis affecting the gender issue in mathematics, as outlined by Gray (1996), is that women do mathematics differently than men. In reply to the claim that females perform better on rote skills while males perform better on problems requiring a variation of a set problem-solving procedure Gray (1996, 29) states, “There is no real evidence that females are inherently inclined to such a limited way of mathematics.” Some feminists believe that different ways of learning exist, and they promote a segregation perspective of mathematics education. The segregation perspective calls for single gender classrooms for the study of mathematics. “As boys and girls have different ways of learning and that they are better taught separately,” assert some feminists (Mura, 1995, 186). This belief has led to the formation of segregated mathematics classes in some institutional settings. Calls for segregation of the sexes were met with agreement by other researchers, but for a reason different than varying learning styles. These researchers believed that it is necessary to separate the sexes due to the fact that in a coeducational classroom setting, boys receive more attention than do girls (Morrow & Morrow, 1995; Fennema, 1996). Others dispute this difference, finding no difference in the feedback given to boys and girls (Heller & Parsons, 1981).

Both of these hypotheses have contributed to the fight for gender equity in the mathematics classroom. But Chipman (1996), argues the field of mathematics has become the closest field of study, proportionally, to being gender neutral. In 1991 nearly half of the mathematics BA degrees were awarded to women, comparable to the fact that just over half of all Bachelor of Arts degrees were awarded to women. Perhaps this increase in percentage, both in the program overall, as well as the mathematics field specifically, is due to the expectations of women preparing to pursue lifelong employment (Chipman, 1996). However, despite comprising nearly half of the mathematics Bachelor of Art degrees, females still find themselves in the minority of most mathematics courses due to the presence of students from the male dominated fields of physics and engineering (Morrow & Morrow, 1995). This points to the possibility that the gender equity issue is not primarily a mathematics related issue. If mathematics were the sole cause of the lower percentage of females in engineering and science, it would seem likely that the percentages of females in mathematics would be similarly low. Although there has been a tremendous increase in the percentage of females pursuing mathematics fields, there has not been a comparable increase in other male-dominated fields, nor in advanced mathematics programs of study. Gray (1996) notes that at UC Berkley, the percent of female mathematics faculty decreased from 20 percent in 1928 to 0 percent in 1968, and since 1968 the percentage has not even reached the 1948 level of 7 percent. Chipman (1996) adds that the percent of females receiving Doctor of Philosophy Degrees in mathematics is not proportional to the overall number of doctoral degrees awarded to women, as 36 percent of doctoral degrees went to females while only 18 percent of mathematics doctoral degrees were awarded to females. Additionally, in the 1970s, women who held a Ph.D. were three times as likely to be unemployed as their male counterparts (Chipman, 1996).

Larger societal influences are at work here, not merely those specific to the study of mathematics. Spender (1982) argues that men are frightened that opening doors to females will mean the end of male control and privilege. Supporting the conflict theory of men versus women, Leder (1996) states the only way for men to assert their manhood (if lacking wealth or power) is by controlling women. Career pursuits reflect the power conflict between men and women. Research has shown that the more mathematics necessary for a career, the greater the pay, and the lower the rate of female involvement (Morrow & Morrow, 1995). In colleges, programs with lower status (and lower paying jobs) find female enrollees in the majority (Sadker, 1996). The power struggle between male and female over who will control the wealth follows directly the Karl Marx theory of power struggle between the "haves" and "have-nots" of a society. Marx believed that educational systems continue to reinforce the existing class structure (Ballantine, 1997). Radical feminists go a step further by claiming schools perpetuate women's sexual subordination and that patriarchal curricula cause alienation among women (Middleton, 1993). Most of society's beliefs are based on the male perspective (Fennema, 1996), thereby rendering women and girls invisible (Middleton, 1993). Perhaps the pervasiveness of these beliefs in society has affected women's career choices. Rather than selecting male-dominated fields such as physics and engineering, women enter lower paying careers that can also be perceived as lower status, like education. Even in higher paying fields, which are often perceived as more prestigious, one can find stratification (Koblitz, 1996). For example, in the field of mathematics at the collegiate level, females are more likely to be instructors of mathematics and males are more likely to conduct research. In Mexico, when many males left the universities for better paying jobs in the private sector, there was an increase in the percentage of female faculty, as well as a decrease in prestige and salary in the position (Koblitz, 1996). With occurrences like this, it is easy to understand why men control 99 percent of the world's wealth and women only 1 percent (Spender, 1992). It also reinforces the Marxist attitude of the radical feminists in the "haves" (males) versus "have-nots" (females) fight for equity, not only in mathematics classrooms, but in the workforce and society as a whole.

Gender and Mathematics Achievement

Much has been written about the differences in mathematics achievement between males and females. The gender gap in mathematics has been decreasing in recent decades and is now quite small (Fennema, 1996; Gray, 1996; Hanna, 2003; Wellesley College, 1992). Leahy and Guo (2001) note that the difference on the ACT mathematics subtest has declined from 2.3 in 1967 to 1.2 in 1996. The research on gender-related mathematics achievement differences have found instances where no difference exists, where differences favor males, and instances where the differences favor females.

In a study of gifted students in grades one through five, Sprigler and Alsup (2003) found no gender differences in the mathematical reasoning of the students, agreeing with Fennema's (1976) study showing no differences in achievement for elementary school children. However, differences in elementary school performance have been found by others. Marsh (1989) found males in grades two through nine had higher scores in math concepts than females. A study of talented elementary students (talented as defined in this study was those students "who scored at least one deviation above their respective age-gender group mean") corroborates Marsh's for students aged eight to ten, but found that females outperformed males in the four to seven year age group (Leahy & Guo, 2001). The same study showed that although similar differences occurred within reasoning skills, the differences, favoring the females in the earlier ages and the males in the eight to ten year age group, were not statistically significant. The study concluded, in general, that females outperformed males until approximately age eleven. These reports are contradicted by 1996 NAEP data which show males outscore females in the Measurement, Geometry and Spatial Sense, and Number Sense, Properties and Operations content strands in grade four (Ansell & Doerr, 2000).

Past research has shown that once reaching the middle grades, achievement differences in mathematics, although small, tend to favor males (Fennema, 1976; Leahy & Guo, 2001; Marsh, 1989). However, more recent NAEP data indicates the differences have disappeared. At the eighth grade, the results of the NAEP show the average male and female score even, with no statistically significant differences in any of the five content strands (Ansell & Doerr, 2000). In her 1989 meta-analysis of gender studies completed since 1974, Friedman found that gender differences in mathematics achievement have decreased. Although finding a moderate correlation between mathematics achievement and gender in gifted junior high school students favoring males, she found that when mixing all ability levels, the effect of gender on achievement was minimal. This differs from earlier findings from Maccoby and Jacklin (1974), which indicated a moderate effect of gender on mathematics achievement. Friedman does state that if she limits her analysis to high school students as Maccoby and Jacklin did, there is an effect favoring males, but the effect she finds is nearly half of that found by Maccoby and Jacklin. The fact that the Maccoby and Jacklin study was completed in 1974 and her own study was completed in 1989 led Friedman to the conclusion that sex differences are decreasing.

At the high school level, research has found that differences tend to favor the males in terms of mathematics achievement. Males have higher scores on tests measuring mathematical concepts and problem solving (Marsh, 1989) and on tests of advanced mathematics (Schreiber, 2002). In her meta-analysis of gender differences, Hyde (1990) found only minor gender differences in cognitive ability but did find a moderate difference on one aspect of spatial ability (mental rotations). Differences in mathematical performance were moderate and favored males (Hyde, 1990). Ansell and Doerr (2000) report that NAEP data show no statistically significant difference between the overall average male and female score, although males did outscore females significantly in two of the content strands (Measurement, Geometry and Spatial Sense).

Scores on the SAT-M and the mathematics portion of the ACT indicate differences in favor of males. On the SAT-M the difference between male and female scores was 38 points in 1972 and 34 points in 2003, showing a decrease in the difference between scores, but still a significant difference (SAT, 2003). The difference in ACT scores between males and females have remained similar over the testing in years 1997-2003 at approximately 1.1 points (ACT, 2003).

The possibility exists that gender differences in mathematics achievement might be attributed, at least in part, to the differences in achievement of the top achieving subgroups in each gender. In a study of gender differences of high-achieving students (scoring in the top ten percent of the math standardized tests by NCES), Reis and Park (2001) found that although the ratio of males to females in the sample pool from which they drew was nearly even (48.5 percent male to 51.5 percent female), the sample of high achieving mathematics students was comprised of more high-achieving males than females (53.2 percent to 46.8 percent). An even wider gap of 61 percent males to 39 percent females was reported by Campbell and Beaudry (1998) in his study of high achieving (at or above 70th percentile) mathematics students. Gray (1996) notes that 96 percent of the perfect 800 scores on the mathematics portion of the SAT were made by males.

An analysis of the 2003 SAT-M data, shows that three percent of the males tested scored in the 750-800 range (800 is the highest possible score) while only one percent of the females tested did. Six percent of the males tested scored in the 700-749 range and thirteen percent scored in the 650-699 range compared with three percent and seven percent of females respectively (SAT, 2003). Similar percentages are found when analyzing ACT data for the 2002-2003 school year (ACT, 2003). Three percent of tested males compared with one percent of tested females scored at the highest mathematics achievement level, 33-36 (36 is the highest possible score). In the next two score levels, 28-32 and 24-27, we find the percentages of males to females to be 11 to 7 and 20 to 17 respectively. With an overall SAT-M gender difference of 34 points and an ACT gender difference of 1.1 points, the possibility is credible that the top scoring males versus the top scoring females generated the entire difference.

In studies by Benbow and Stanley (1980, 1983), a significant difference was found in the achievement of males and females in mathematics. Males scored higher, particularly in the upper ranges of reasoning. In reporting students scoring a 700 or more on the SAT-M, Benbow and Stanley noted that the ratio of males to females was nearly 13 to 1. They continue, “males dominate the highest ranges of mathematics reasoning before they enter adolescence” (Benbow & Stanley, 1983, 1031). They surmise that this indicates that the differences in mathematics achievement by gender cannot be explained by differential course taking alone and that biological factors must be at work. Results of the Second International Mathematics Study showed more variation across countries than by gender, with five countries showing females outscoring males in one or two subtests, five countries where males outscored females in one or two subtests, five countries in which males outscored females in three to five subtests, and five countries in which there were no gender differences found. This led Hanna (1989) to conclude that as it is unlikely that biological differences among gender vary across nations, biological differences are not the reason for differences in mathematics achievement. Pallas and Alexander (1983) also disagree with Benbow and Stanley, finding that performance on the SAT-M is closely tied to course enrollment. Their study showed that mathematics achievement of males and females entering high school did not differ significantly. Additionally, the initial difference of 35 points on the SAT-M between males and females, drops to 14 points when controlling for differences in coursework.

Gender and Course Enrollment

Jones (1987) reports that course enrollment makes a sizeable contribution to mathematics achievement in all students, beyond the contribution of either SES or earlier test performance. His findings show much higher scores for students taking four to five high school credits in advanced mathematics or three years of mathematics (including calculus) than for students taking three courses of mathematics or less. Ethington and Wolfle (1984) found that formal exposure to mathematics in the classroom (course enrollment) explained most of the variation between male and female achievement scores. As stated previously, the effect of course enrollment on gender gaps in mathematics achievement of high school students has been promoted by Pallas and Alexander (1983a, 1983b) and disdained by Benbow and Stanley (1980, 1983) and, therefore, mathematics enrollment should be further investigated in terms of gender effect.

The gender differences in course enrollments in courses beyond Algebra II were significant and favored males (Fennema 1976). Males enrolled in PreCalculus, Trigonometry, Analytical Geometry, Probability/Statistics, Computer Mathematics, and

Calculus at much higher rates (two to three times as high) than did females. Recent NAEP data indicates this trend in enrollment has changed over the past thirty years. In their analysis of NAEP data from 1996, Ansell and Doerr (2000) found significantly more females than males have studied Algebra I, II and Geometry, while the percentages of male and females enrolled in Trigonometry, PreCalculus, and Calculus did not differ statistically. Other studies have concurred that course enrollments no longer differ significantly by gender (Hoffer, Rasinski &Moore, 1995). While Ansell and Doerr found no significant differences at the upper level, in terms of enrollment, they did find that while 43 percent of males studied eight or more semesters of mathematics, only 39 percent of females did the same (Ansell & Doerr, 2000).

Data collected by SAT showed enrollment in courses for those students taking the SAT in the 2002-2003 school year was approximately gender equal in all courses, with females the higher percentage in all courses but Computer Mathematics (males comprised 60 percent of those enrolled) (SAT, 2003). Course enrollment data is shown in Table 2.1. While the numbers reported by SAT seem to show that course enrollment now favors females, it should be noted that the information was collected from test takers, 53 percent of whom were female. Therefore, expectations are that for all courses the female to male ratio should be 53 to 47 to reflect the population questioned.

Rural Issues in Education

There is a perception, promoted by the media, that people living in rural areas are slow-witted hillbillies with little education and uninformed views about what goes on in the "real world". Such perceptions are prevalent not only in television shows such as *The*

Table 2.1 *Percentage of Males and Females in High School Mathematics Courses as Reported by SAT (2003)*

Course	**Percent Male**	**Percent Female**
Algebra	44	56
Geometry	44	56
Trigonometry	46	54
Precalculus	46	54
Other	42	58
Calculus	49	51
Computer Math	60	40
Honors	45	55

Beverly Hillbillies, but in the media in general. The negative attitudes towards "country people" can be traced back much further than the media stated previously. Theobald (1997) mentions the negative stereotype of individuals living in rural areas was prevalent as early as the Enlightenment in the 18^{th} century, where the idea was promoted by philosophers. This continual trend in the belief of the inadequacy of rural peoples has led to a corresponding belief in the inadequacy of the educational opportunities in said regions. Edington and Koehler (1987) describe the belief of inferior education in rural areas as a belief held not only by the general public, but by many educators, legislators, and state board of education members. Herzog and Pittman (1995, 2) agree, stating "rural schools have image problems that stem from long-standing negative attitudes towards 'country people.'" This common view of rural communities and their educational opportunities has led to the use of a deficit model approach to the study of educational issues in rural areas.

The question remains as to whether the deficit model of rural education is an accurate model. If one looks only to popular media, the answer is a resounding yes. However, when studying more closely what is actually happening in rural areas, the answer is not quite as clear. Several researchers have found areas of deficit in particular educational aspects of rural education. Among these areas are: lack of funding, lack of varied curriculum, and lower scores on achievement tests. Campbell and Silver (1999) report high school drop out rates are higher in rural areas than they are in urban areas. Barker's study (1985) showed that small schools have fewer art, business, foreign language, and mathematics course offerings for students than do larger schools and Herzog (1996) reports the gap in college completion rates between rural and metro students has increased in the years between 1960 and 1990. Several studies show that achievement in rural areas is not quite as problematic as popular culture and other studies might lead one to believe.

Achievement in Rural Areas

Several studies have found no significant differences when comparing students in rural and nonrural schools (Edington & Koehler, 1987; Howley & Gunn 2003; Lee & McIntire, 1999; Winters 2003). Winters (2003), in his study of mathematics achievement in 8th and 12th grade students in Tennessee, found that the mean scores of rural schools were actually higher than nonrural schools on the three instruments used to measure achievement, although the difference was significant for only one of these measures. Winter's results were similar to those of Lee and McIntire (1999) who state that since the 1980s rural students have scored at levels analogous to the national average in nearly all subjects tested. Reviewing mathematics achievement data, Howley and Gunn (2003) found there has been little change in the performance of rural students in mathematics and that rural students differ little from the national average. Their conclusion: “On the basis of nearly 25 years of NAEP data, there is little evidence for the claim that rural mathematics achievement is deficient” (Howley & Gunn, 2003, 89).

Other studies are not so positive. One report states, “students living in rural areas of the United States exhibit lower levels of educational achievement and a higher likelihood of dropping out of high school than do their nonrural counterparts” (Roscigno & Crowley, 2001, 268). SAT data for 2003 appear to confirm this achievement gap (SAT, 2003). The average SAT-M scores for the nation and the state of Tennessee for different locales are found in Table 2.2.

Small Town and Rural, might, when combined, surpass the Large City mean, but data were not provided. Several other researchers agree with Roscigno and Crowley that rural education is lacking (Hobbs, 1981; Mare, 1980; Webster & Fisher, 2000). Webster and Fisher (2000), using data from TIMMS (1994), found that living in rural areas had a negative effect on the achievement of Australian students. Mare (1980) found a farm background negatively affects the amount of schooling a student will pursue, and Hobbs (1981) in an analysis of NAEP data from 1977 found that students categorized as extremely rural scored well below the national average in reading writing, mathematics, and science.

Table 2.2 *National and Tennessee State SAT-M Averages for Different Locales*

Locale	National	Tennessee
Large City	506	558
Medium City	516	560
Small Town	512	571
Suburban	539	575
Rural	501	546

Howley and Gunn (2003) counter Hobbs 1977 analysis of the NAEP data involving Extreme Rural. According to Howley, the category Extreme Rural, removed from NAEP research since 1996, created a false picture of rural by including only a subset of rural which included only rural areas of extreme poverty. The issue of economics is a confounding one when studying achievement issues in rural areas as the effects of socio-economic status (SES) on achievement are well noted.

Herzog and Pittman (1995) noted that rural schools tend to have qualities that critics of education are now promoting: positive feelings of being connected to school and community, as well as feelings of peace, safety, and caring. Bickel and Howley noted that the quality of neighborhood has an independent, positive effect on mathematics achievement, finding “elementary schools in poor, *rural* areas were more effective as those in poor, *nonrural* areas in promoting math achievement growth” (emphasis added by author) (Bickel & Howley, 2003, 101). In rural areas, the school community is an integral part of people’s lives (Mathis 2003), which can be positive in instances like those mentioned above but can also be a detriment to achievement.

Both Howley (2003) and Lange and Bickel (1997) illustrate some of the negative influences the community can have in terms of educational attainment. Howley reports that rural community members are skeptical about increased spending to provide an education beyond the basics (2003). She continues by stating that often times the curriculum goals of the school can devalue the circumstances of the community within which the school lies. Lange and Bickel concur with the belief that high levels of educational attainment are contrary to the organization and structure of the surrounding community (1997). The consequences to higher levels of education can be perceived as negative. If the community economy cannot support the more highly educated members, these members will leave. Out-migration, as the phenomenon is called, is the loss of community members with highly developed skills which can have negative outcomes for the community (Smith & DeYoung, 1992). If there is a local demand for technical skills or analytic capabilities, there will be an increased demand for excellence in public education, Smith and DeYoung continue, and inmovers (people moving into the community) can create an impetus for improving education

Socioeconomic Status (SES)

Another factor to consider in studying the mathematics achievement levels of rural students is the socioeconomic status of the schools. In the state of Tennessee, over two million people live in rural areas with 14.7 percent of the children in rural areas in the state living in poverty (The Rural School and Community Trust, 2003). Across the country, rural locations have a larger share of people living in or close to poverty than nonrural areas (United States Department of Agriculture, 2000), and although poverty levels were lower for rural America in the 1990s than in previous years, the levels were still higher than the levels in urban areas (United States Department of Agriculture, 2002). Many researchers (Caldas & Bankston, 1997; Campbell & Silver) show a connection between low SES (as based on the percentage of students enrolled in the federal free and reduced lunch program) and lower achievement on state and national tests. Given the connection between lower SES and lower achievement, care must be taken when studying achievement in rural areas in that any differences that arise might be attributable to SES rather than school locale or location.

SES and Achievement

Many studies have corroborated the theory of the negative effects of SES on educational matters (Alwin & Thornton, 1984; Guo, 1998; Lubienski, 2001; Mandeville & Kennedy, 1993; O'Brien, Martinez-Pons &Kopala, 1999; Tate, 1997). In terms of achievement on SAT-M, Tate (1997) noticed that the average score of students whose family income was less than $10,000 was 419, while students with family incomes in the $30,000 to $40,000 range scored a full fifty points higher. Students in the highest income category ($70,000 and over) scored an average of 527, more than 100 points higher than those students in the lowest income bracket. More recent SAT data (2003) follows this trend: students whose family earns under $10,000 score an average of 444, in the $30,000-$40,000 the average score was 484, and in the highest income category, over $100,000, the average SAT-M score was 568 (SAT, 2003).

Guo (1998) examined the cumulative effects of poverty on both cognitive development and achievement and found that whether poverty began early in life or in adolescence, there was a significant negative effect. Poverty in adolescence has a much greater effect on measures of achievement than does childhood poverty while childhood poverty has a much more damaging effect upon the development of cognitive ability.

Alwin and Thorton (1984) noted that regardless of the time period of poverty in the life of the child, there are negative consequences in terms of verbal achievement, amount of schooling, and curriculum placement. Mandeville and Kennedy (1993) found similar negative effects for mathematics achievement. They found that as the percentage of low SES students in South Carolina schools declined, the average achievement of the school increased. Studies involving the effects of poverty are not limited to public schools. In a study of 415 eleventh grade parochial students, O'Brien, Martinez-Pons, and Kopala (1999) found a significant correlation between SES and PSAT scores, with students with lower SES scoring lower on the PSAT than their more affluent peers.

Studies of NAEP data by Lubienski in 2001 and 2002 investigated SES affecting achievement. Her conclusions were: (1) achievement gaps between high SES and low SES students exist, regardless of race, (2) racial gaps in achievement were larger for students eligible for free or reduced lunch, and (3) teachers of lower SES students focused less on algebra and reasoning skills than teachers of other SES groups.

While the negative effects of low SES have been well-documented, SES does not tell the entire story in terms of achievement. Crane (1996) claims that the effects of home environment factors are greater than the effects of SES in terms of students' achievement. Home environment factors include the quality of the child's relationship with his/her parents, number of stimulating toys, etc.). Howley, Strange, and Bickel

(2000) noted that although SES still has an effect, the relationship between SES and achievement is not as large in smaller schools.

SES and Enrollment

Several studies have explored the interaction of SES and course selection of high school students. Again, students with lower SES are negatively impacted. Studies have found an inverse relationship between SES and the number of mathematics courses and types of mathematics courses taken in high school (Hoffer, Rasinksi& Moore, 1995; Lubienski, 2002; Mandeville & Kennedy, 1993). In a study of the National Education Longitudinal Study of 1988 (NELS) data from 1988, Hoffer, Rasinski, and Moore found that students with highest SES complete approximately one and one-third more Carnegie units of mathematics than do students in the lowest SES group. Mandeville and Kennedy (1993) noticed a decline in the enrollment of advanced mathematics courses in high schools with a higher percentage of low SES students when compared with schools having a lower percentage of low SES students. Lubienski (2002) noted that amongst lowest SES students, more black students than white students took Precalculus (14 percent vs. 11 percent) while in the highest SES more white than black students took precalculus (35 percent vs. 23 percent). Regardless, she concluded that course taking at the high school level was more closely related to SES than race (Lubienski, 2002). In a previous study, Lubienski (2001) found a significant gap in the percentage of students taking algebra prior to ninth grade between higher and lower SES students.

Interaction among Gender, Rural, and SES

Research on the interaction of gender, rural, and SES in terms of mathematics achievement and course selection is minimal and part of the motivation for this research study. Several studies speak to the interaction of SES and gender (Campbell & Beaudry, 1998; Verna, Campbell & Beasley, 1997; Wellesley College, 1992). The Wellesley College (1992) findings were that low SES females were less likely to be below grade level than their male counterparts. Conversely, high SES females were less likely to be above grade level than high SES males. However, overall the effect of SES was the same for males and females (the higher the SES, the higher the achievement) and a significant predictor of success for both genders (Wellesley College, 1992; Campbell & Beaudry, 1998).

Several reports have investigated the interaction between rural and SES. With 244 of the 250 poorest counties classified as rural (Mathis, 2003), understanding the interaction between SES and rural is imperative. Rural schools have lower per-pupil expenditures and a greater concentration of lower SES students (Roscigno & Crowley, 2001). However, examining mathematics achievement in rural Ohio, for example, researchers found that when holding for SES, rural Appalachian districts' mathematics achievement levels were at the same level as other nonrural districts in the state (Howley, Howley, & Hopkins, 2003). Webster and Fisher (2000) found the opposite in Australia when controlling for SES. Their study showed that rural schools in Australia performed at lower levels than urban schools, although the differences were small. Young (1998) discovered similar negative rural results when controlling for SES in his study of achievement of Australian schools, calculating 37.6 percent of the variance in achievement levels between schools was due to school locale.

Fewer studies investigated the interaction between gender and rural. Vermeuler and Minor (1998) in their study investigating schooling and career choices of females in the top ten percent of their graduating class in a rural Midwestern town, found the majority of women (95 percent) dreamed of marriage and children, and therefore, made educational and occupational choices with this in mind. The study, which involved interviews with women who graduated in the 1950s, '60s, '70s, and '80s, found that participants graduating after 1964 added a work commitment to their plans. As this study did not have a control group of nonrural, high-achieving females, it is impossible to tell whether the strong family commitment and resulting career and educational choices are due to the rural location in which the women schooled or rather a reflection of the time period in which they were raised.

Conclusions

In terms of gender issues related to mathematics achievement, the majority of studies conclude that females are closing the achievement gap with males (Hanna, 2003; Gray, 1996; Fennema, 1996; Leahy & Guo, 2001; Wellesley College, 1992). Several studies show that at the elementary and middle school levels females have surpassed males in mathematics achievement (Ansell & Doerr, 2000; Fennema, 1976; Friedman, 1989; Sprigler & Alsup, 2003), although other studies notice moderately higher mathematics achievement for males (Hyde, 1990; Marsh, 1989; Maccoby & Jacklin, 1974). At the high school level, males continue to significantly outscore females on the widely used college entrance exams, the ACT and SAT, although the gap has narrowed over the years (ACT, 2003; SAT 2003).

One of the earlier theories of the mathematics achievement gap between genders was differential course enrollment (Fennema, 1976), a theory disputed by others (Benbow & Stanley, 1980, 1983) who theorized that biological factors played a role in mathematics achievement differences more so than differential course enrollment. Other researchers dispute the work of Benbow and Stanley, questioning their use of only high achieving students (Hanna, 1989; Pallas & Alexander, 1983a). Several studies have shown that among higher ability students, males significantly outperform females in measures of mathematical achievement (ACT, 2003; Campbell & Beaudry, 1998; Gray, 1996; Reis, 2001; SAT, 2003).

Nearly thirty years ago, research by Fennema (1976) showed that males enrolled in mathematics courses beyond Algebra II at a significantly higher numbers than did females. More recent studies show that enrollment differences by gender are no longer significant (Ansell & Doerr, 2000; SAT, 2003).

The research on rural education is mixed. Certainly popular culture views rural education as a deficit model, and some researchers indicates there are deficit areas present in rural education (Barker, 1985; Campbell & Silver, 1999; Herzog, 1996; Hobbs, 1981; Webster & Fisher, 2000). Other research finds no differences in the achievement of rural and nonrural students (Edington & Koehler, 1987; Howley & Gunn, 2003; Winters, 2003). Sometimes deficit, sometimes neutral, sometimes positive: Perhaps the best summary of rural education is the work of Lee & McIntire (1999), who found that rural school achievement varies across states, and so therefore no definitive study can apply to all rural areas.

Chapter III

METHODS AND PROCEDURES

Proposed Methodology

Initially, several qualitative methodologies were examined in an effort to answer the broader question of what it means to be a female in a rural setting, studying mathematics. A phenomenological study of a rural community would provide valuable information on what it means to be said female. Another possible methodology deliberated was grounded theory. The goal in this scenario being that a theory of why rural females were not pursuing as much mathematics, or achieving at the same level as males, would provide insight that could improve conditions for rural females.

However, through continued research and reading, the conclusion was reached that both qualitative approaches discussed above involved the researcher looking through deficit model lenses. Upon the realization that the study viewed rural mathematics with the assumption that rural was somewhat lacking when compared to nonrural areas, the question arose as to whether the assumption that rural females scored lower than nonrural females was true, or that the difference in male and female achievement was greater in rural areas as opposed to nonrural areas. The determination was made that a quantitative study was needed to answer the question as to whether such differences existed. Therefore, this study will be quantitative.

Research Questions

The purpose of this study is to look at the intersection between gender, school locale, school location and SES in terms of mathematics achievement of middle school students, high school students as well as the effect, if any, those variables have on enrollment high school mathematics courses. The specific questions follow.

1.) Are the percentages of females and males in the following high school mathematics courses: Competency Mathematics, Foundations I and II, Algebra I and II, Geometry, Advanced Algebra with Trigonometry, PreCalculus, Statistics, Calculus, Calculus AB, Calculus BC, and AP Statistics in rural Tennessee significantly different than the percentages of females and males in nonrural areas in Tennessee?
2.) Are there significant differences in mathematics achievement as measured by the ACT with regards to gender, locale, and location?
3.) Are there significant differences in mathematics achievement as measured by the TCAP test for males and females in grades six through eight by locale or location?
4.) When accounting for SES, are there significant differences in mathematics achievement as measured by the ACT for male and female students by locale or location?
5.) When accounting for SES, are there significant differences in mathematics achievement as measured by the TCAP for middle school male and female students by locale or location?

Participants

To answer the questions pertaining to middle school mathematics achievement, the participants for this study included all public schools in Tennessee that contain sixth, seventh, and/or eighth grade students and whose scores were available via the 2003 State Report Card. Alternative schools and special education schools were not included in the analysis. The breakdown of locale and location of each of the remaining 647 schools is found in Table 3.1.

Table 3.1 *Number of Public Schools in Tennessee Containing Sixth, Seventh, and/or Eighth Grade Students Used in the Analysis*

		Locale		**Total**
		Rural	Nonrural	
Location	Non Appalachian	165	191	356
	Appalachian	207	84	291
Total		372	275	647

Surveys were sent to each of the 284 public high schools in Tennessee to garner information concerning school size and course enrollment, by gender, of mathematics courses taught at each school. The survey also requested ACT data, by gender, of the mathematics subtest. Of the 284 schools which were sent surveys, thirteen were omitted from final analysis due to identification as a special education school, alternative school, or because they were new schools and did not have ACT data from the prior year. The breakdown of locale and location status is shown in Table 3.2.

Procedures

Of the five research questions posed, two dealt with achievement scores in middle schools. To collect the data to answer the questions, the Tennessee State Department of Education's Report Card 2003 was accessed via the internet (http://evaas.sasinschool.com/tn_reportcard/welcome.jsp). At this site, median national percentile scores are available, disaggregated by gender, for each subject area tested by the TCAP test, administered each spring to all Tennessee public school students in grades three through eight. For the purposes of this study, scores for all schools containing

Table 3.2 *Number of Public High Schools from the State of Tennessee Included in the Study*

		Locale		Total
		Rural	Nonrural	
Location	Non Appalachian	72	83	155
	Appalachian	69	47	116
Total		141	130	271

grades six, seven, and/or eight were recorded into an SPSS spreadsheet. Also collected from the Report Card 2003 was the percentage of economically disadvantaged students (those receiving free or reduced lunch) for each school. This information was entered into the spreadsheet as well.

In terms of descriptions of the schools in reference to locale and location, the National Center for Educational Statistics (NCES) was accessed to determine the locale of each school (http://www.nces.ed.gov/ccd/schoolsearch) and Appalachian Regional Commission (ARC) provided information as to which counties in Tennessee are Appalachian (www.arc.gov/index.do?nodeId=27) for both the middle school and high school data. Appalachian counties are shown in Figure 3.1.

In terms of school locale, information was acquired via the National Center for Educational Statistics (NCES) web site. Accordingly, all Tennessee schools will be coded as either: Large Central City, Other Nonrural (Mid-Size Central City, Urban Fringe of

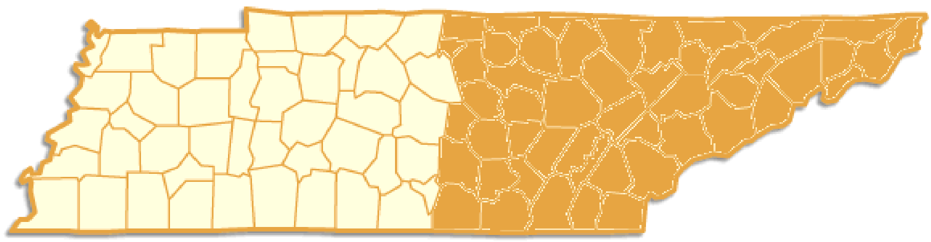

Figure 3.1 *Tennessee Counties: Appalachian Counties are Shown Shaded*

Large City, Urban Fringe of Midsize City, Large Town), and Rural (Small Town, Rural (Outside Metropolitan Statistical Area), Rural (Inside Metropolitan Statistical Area)).

Additional data was collected through the use of a questionnaire, which was mailed to the principal of each high school in Tennessee to answer the remaining research questions. Information collected from the high schools included: the number of males and females in the school; the number of males and females in each mathematics course offered by the school for the 2003-2004 school year; the mean scores of males and females on the ACT. The courses listed on the survey included those courses indicated earlier. A second questionnaire was sent to schools that did not respond to the initial request for data. Difficulties arose when schools reported that ACT scores by gender were not available at their school. To circumvent the deficit of ACT scores by gender, permission was obtained via the State Department of Education to have ACT release the ACT scores for each school by gender.

Instrumentation

Three instruments were used to answer the research questions: Tennessee Comprehensive Assessment Program Achievement Test (TCAP), the ACT, and a survey created by the researcher (Appendix A). The TCAP, a timed, multiple-choice test, is given to Tennessee students in grades three through eight every spring. In the middle school grades, tested subject areas include mathematics, language arts, reading, science, and social studies. The mathematics composite score, used in this study, is comprised of two subtests: mathematics and mathematics computation. Although students receive reports that provide both norm-referenced and criterion-referenced score interpretations (Tennessee Department of Education, 2003) of their individual test results, the state published only the norm-referenced score interpretations for each gender at each school.

First administered in the fall of 1959, the ACT Assessment is a college entrance testing program which is curriculum based and tests in the following subject areas: mathematics, English, reading, and science (ACT, 2003). The test is currently offered on five dates throughout the year: October, December, February, April, and June). The mathematics subtest, which scores were used for this study, is time limited as are the rest of the subtests, and is comprised of 60 questions which must be answered in 60 minutes. The 60 questions consists of 24 prealgebra/elementary algebra questions, 18 questions related to intermediate algebra/coordinate geometry, and 19 questions testing plane geometry/trigonometry (ACT, 2003). In Tennessee, 74 percent of high school students were tested via the ACT Assessment during the 2002-2003 school year (ACT, 2003).

Null Hypotheses

The questions included in this report are in three parts. Part One has questions pertaining to achievement differences in mathematics as measured by the TCAP Achievement Test among middle school students in relation to gender, locale, location, and SES, and any interactions among these variables. Part Two asks the same questions in regards to mathematics achievement by high school students as measured by the ACT. Part Three of the study questions differences in enrollment by gender in high school mathematics courses with regard to school locale and location.

Part One Hypotheses

$H_{0part1A}$: There is no significant difference in mathematics achievement of students in sixth, seventh, or eighth in Tennessee with respect to gender, school locale, or school location as measured by the TCAP.

$H_{0part1B}$: Controlling for SES, there is no significant difference in mathematics achievement of Tennessee students in grades sixth, seventh, or eighth with respect to gender, school locale, or school location as measured by the TCAP.

Part Two Hypotheses

$H_{0part2A}$: There is no significant difference on ACT scores in Tennessee on the mathematics subtest with respect to gender, school locale, or school location.

$H_{0part2B}$: Controlling for SES, there is no significant difference on ACT scores in Tennessee on the mathematics subtest of the ACT with respect to gender, school locale, or school location.

Part Three Hypothesis

The hypothesis in part three will be tested for the following courses: Competency Mathematics, Foundations I and II, Algebra I and II, Geometry, Advanced Algebra with Trigonometry, PreCalculus, Statistics, Calculus, Calculus AB, Calculus BC, and AP Statistics. The term mathematics course will be used as a generic term to represent these courses.

H_{0part3}: There is no significant difference in the enrollment of a high school mathematics course in Tennessee by gender, school locale, school location or SES.

Data Analysis

Data was analyzed using SPSS (version 12.0). The primary statistical test run was a General Linear Model (GLM) Repeated Measures. Before testing the middle school data for gender differences, the data were graphed to test for normality of distribution. As the data were normally distribute, the GLM Repeated Measures Test was used to test the hypotheses involving middle school mathematics achievement, the school's median score by gender was selected as the within-subject factor, while locale and location were selected as between-subject factors. The tests were then rerun with SES as an additional between-subject factor.

To test the hypotheses relating to mathematics achievement of high school students, as measured by the ACT, a GLM Repeated Measures was run with ACT score by gender as the within-subject factor and location and locale as the between-subject factors. Again the analysis was rerun with SES added as a between-subject matters.

Finally, to look at course enrollment, a repeated measures general linear model was run with the enrollment by gender of the named course as the within-subject factor and locale and location as the between-subject factors.

Chapter IV

RESULTS

Introduction

The presentation and analysis of the data are shared in this chapter. Data was analyzed using the Statistical Package for the Social Sciences (SPSS v. 12.0). In order to answer the research questions posed and to test the null hypotheses, both descriptive and inferential statistics were used. The analysis will be divided into three parts. Part One will examine the intersection of gender and mathematics achievement involving students in grades six through eight. Part Two will examine the intersection of gender and mathematics achievement of high school students. Finally, Part Three will address gender and mathematics in terms of course enrollment in high school mathematics courses. The survey used to collect data for Part Three can be found in Appendix A.

Defining Nonrural

When a preliminary analysis of the data was completed a question arose in terms of Nonrural. Initially, schools designated as Large Central City, Mid-size Central City, Urban Fringe of Large Central City or Mid-size City and Large Town were classified as Nonrural. There was concern that the schools classified as Large Central City were all Non Appalachian, with no corresponding Large Central Appalachian City with which to compare. The decision was made to run the analysis with three locales, Large Central City, Other Nonrural (comprised of Mid-size Central City, Urban Fringe of Large Central City or Mid-size City, and Large Town), and Rural (comprised of Small Town, Rural

Inside Metropolitan Statistical Area (MSA), and Rural Outside MSA), and, should significant location effects be discovered, to analyze the data again, omitting Large Central City schools to see if location effects remain.

Part One

Research Questions:

1.) Are there significant differences in mathematics achievement as measured by the TCAP test for males and females in grades six through eight by locale or location?
2.) When accounting for SES, are there significant differences in mathematics achievement as measured by the TCAP for middle school male and female students by locale or location?

Null Hypotheses:

1.) There is no significant difference in mathematics achievement of students in sixth, seventh, or eighth in Tennessee with respect to gender, school locale, or school location as measured by the TCAP.
2.) Controlling for SES, there is no significant difference in mathematics achievement of Tennessee students in grades sixth, seventh, or eighth with respect to gender, school locale, or school location as measured by the TCAP.

A General Linear Model (GLM) Repeated Measures Test was run to investigate the differences in mathematics achievement, as measured by the TCAP, by gender, school locale, and school location for sixth grade students. The dependent variable was gender (gender) and the between-subject factors were school locale (locale4) and school location (location). The categories in locale 4 were Large Central City (1), Other Nonrural (2), and Rural (3). Location 0 represented those schools not located in Appalachian counties (Non Appalachian) and Location 1 represented Appalachian schools.

Sixth Grade: Hypothesis 1

The results of the test with sixth grade scores showed that there was a significant effect for gender ($p < 0.001$), with females scoring higher regardless of school locale or location. See Figures 4.1 and 4. 2.

There were no significant interactions between gender, locale, and/or location for sixth grade students. There were significant between-subjects effects. Location ($p = 0.007$) and locale4 ($p < 0.001$) were both significant as was the interaction between locale and location ($p = 0.007$). Figure 4.3 illustrates that for Non Appalachian schools, Large Central City scored significantly lower than both Other Non Rural (+15.85) and Rural schools (+14.35) as measured by Tukey HSD post hoc test. In the Appalachian region, Rural outscored Other Nonrural, but the difference was not statistically significant.

Sixth Grade: Hypothesis 2

To control for SES, the percentage of disadvantaged students (pdisadv) were categorized and then used as a between-subject factor along with locale4 and location. The results showed that gender remained a significant effect ($p < 0.001$), with females outscoring males (See Figure 4.4).

There were no significant interactions among gender and the other variables. However, several significant effects and interactions were discovered in the between-subjects effects. These are summarized in Table 4.1.

For sixth grade students, the effects of locale4 ($p < 0.001$), pdisadv ($p < 0.001$), location*locale ($p = 0.035$) and locale4*pdisadv ($p = 0.045$), were all significant. A Tukey post hoc test showed that for locale4, schools in Large Central City (1) had a

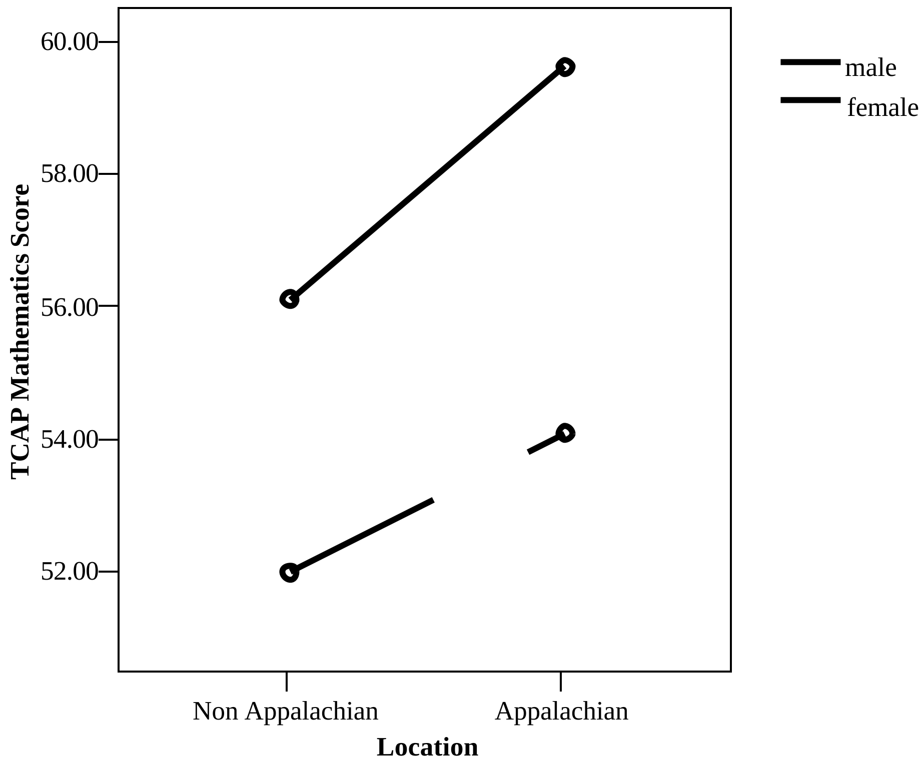

Figure 4.1 *Comparison of Sixth Grade Mathematics Achievement as Measured by TCAP 2003 by Gender and Location*

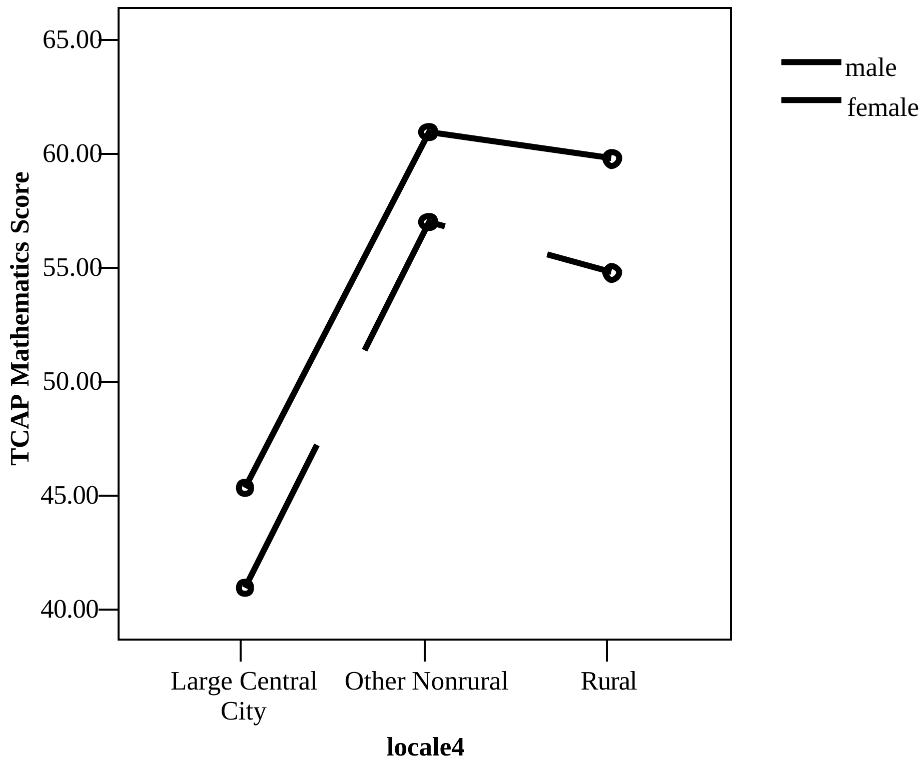

Figure 4.2 *Comparison of Sixth Grade Mathematics Achievement as Measured by TCAP 2003 by Gender and Locale*

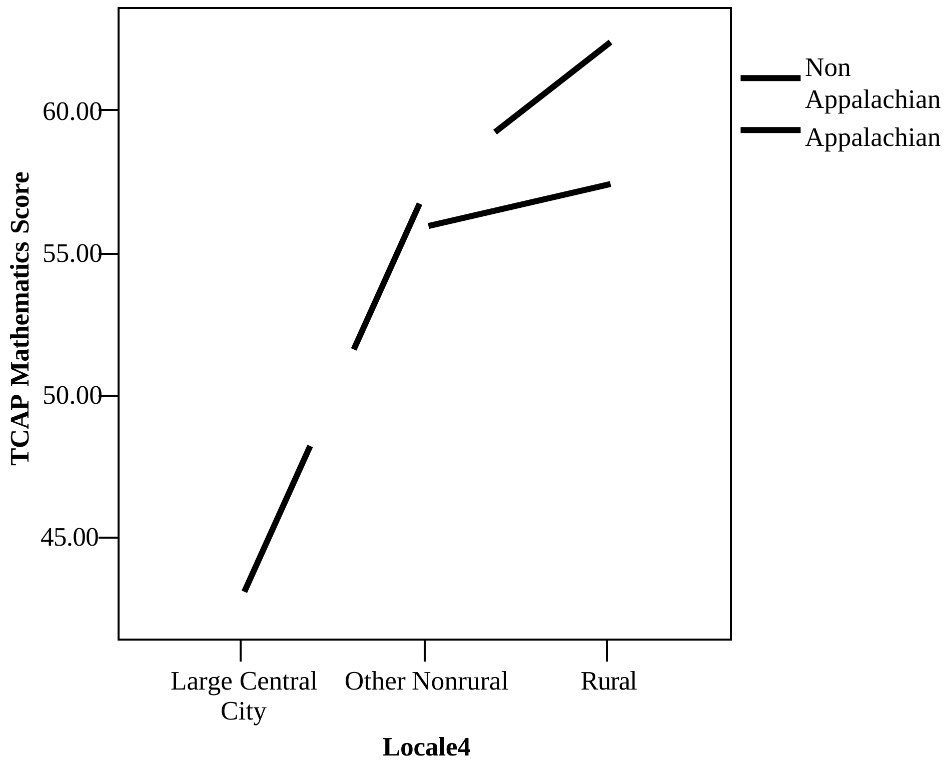

Figure 4.3 *Between-Subjects Interaction on Sixth Grade Mathematics Achievement between School Locale and School Location*

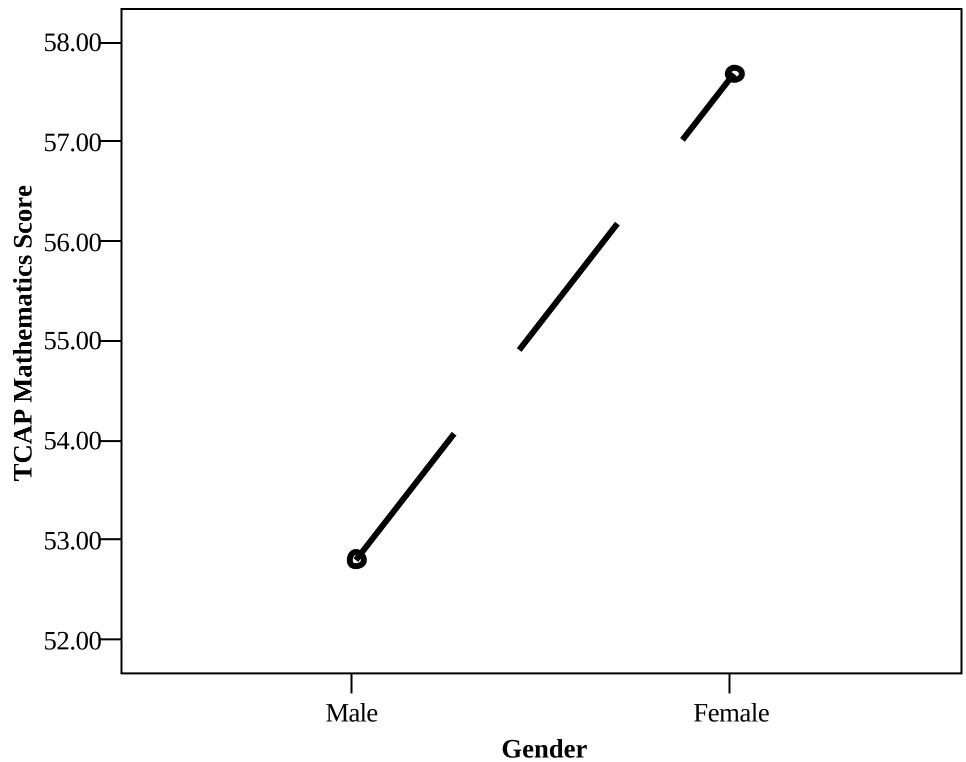

Figure 4.4 *Comparison of Sixth Grade Mathematics Achievement Scores by Gender with Percent Disadvantaged as a Between-Subjects Factor*

Table 4.1 *Summary of the Between-Subjects Effects for Sixth Grade Students with Percent Disadvantaged as a Factor*

Source	Type III Sum of Squares	Df	Mean Square	F	Sig
Intercept	1296474.845	1	296474.8 45	6096.209	.000
location	1.010	1	1.010	.005	.945
locale4	5012.622	2	506.311	11.785	.000
pdisadv	24909.888	2	2454.944	58.565	.000
location * locale4	947.882	1	47.882	4.457	.035
location * pdisadv	278.833	2	39.416	.656	.520
locale4 * pdisadv	2087.575	4	521.894	2.454	.045
location * locale4 * pdisadv	1040.671	2	520.335	2.447	.088
Error	109737.226	516	212.669		

lower score than Other Nonrural (2) or Rural (3). The average score for Large Central City was 42.6, followed by 56.85 for Rural, and 58.80 for Other Nonrural. The difference between Rural and other Nonrural was not significant. Figure 4.5 illustrates the differences in scores by locale.

The percentage of students labeled disadvantaged (pdisadv) also had a significant effect on the mathematics achievement of sixth grade students. Schools with the highest percentage of disadvantaged students (75 percent or more) had an average score of 42.86. Schools with a high percentage of disadvantaged students (50 percent to 74.99 percent) scored a 54.34. Schools with a low to moderate percentage of disadvantaged students (below 50 percent) scored the highest, 61.85. The differences between each group were tested using the Tukey HSD post hoc test and found to be significant at $p < 0.001$. Figure 4.6 illustrates these differences.

Two significant between-subjects interactions surfaced while analyzing the sixth grade data. The first, location*locale, is illustrated in Figure 4.7. For the category Other Nonrural, scores were higher by nearly five points for Non Appalachian schools. For the category Rural, however, scores were nearly identical, with Appalachian schools averaging 56.83 and Non Appalachian schools scoring 56.86.

The second significant interaction was locale*pdisadv. Figure 4.8 has a graphical representation of this interaction. For schools with low to moderate levels of disadvantaged students, scores varied little across locales, with Large Central City

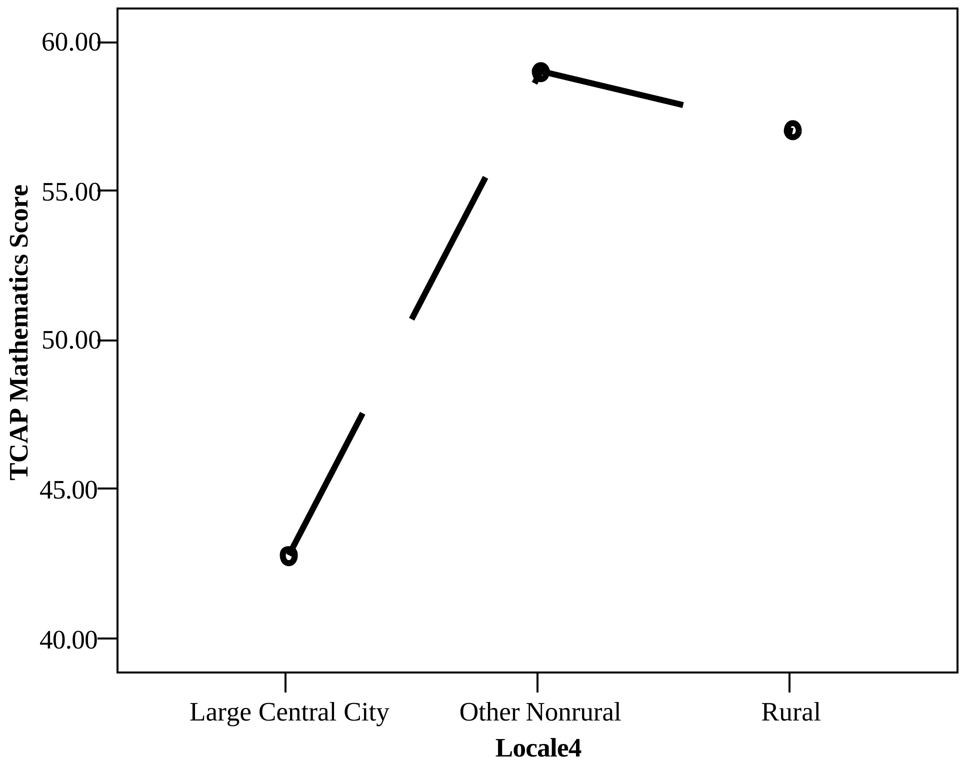

Figure 4.5 *Comparison of Sixth Grade Mathematics Achievement as Measured by TCAP with Percent Disadvantaged as a Factor, by Locale*

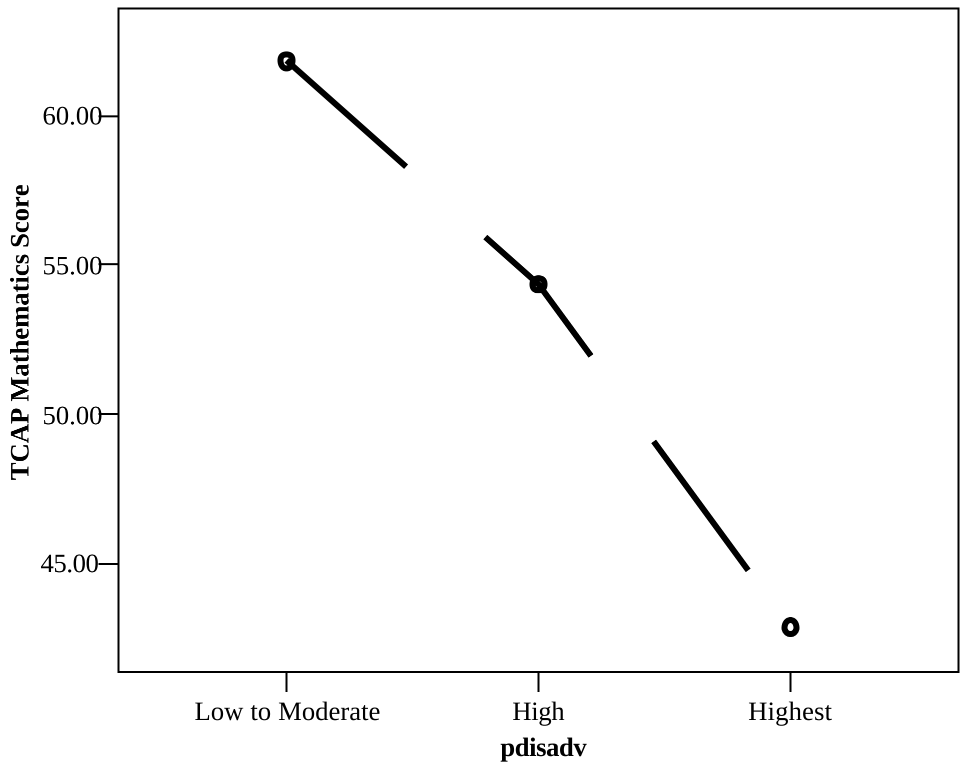

Figure 4.6 *Comparison of Mathematics Achievement Scores for Sixth Grade Students by Percentage of Disadvantaged Students*

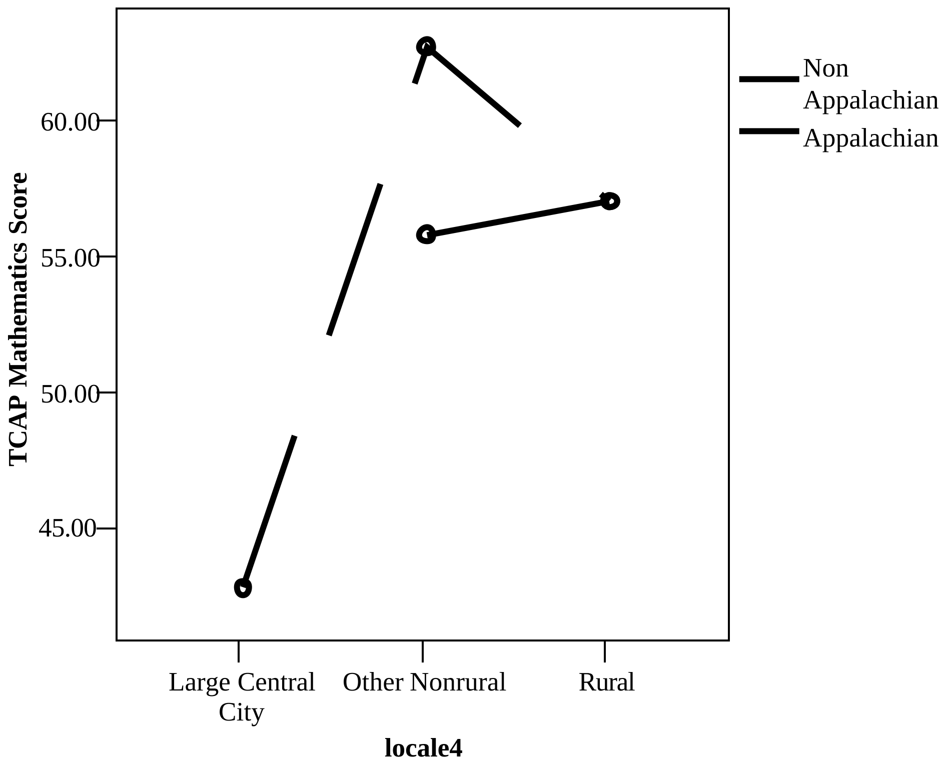

Figure 4.7 *Comparison of Appalachian and Non Appalachian Mathematics Achievement Scores for Sixth Grade Student across Locales*

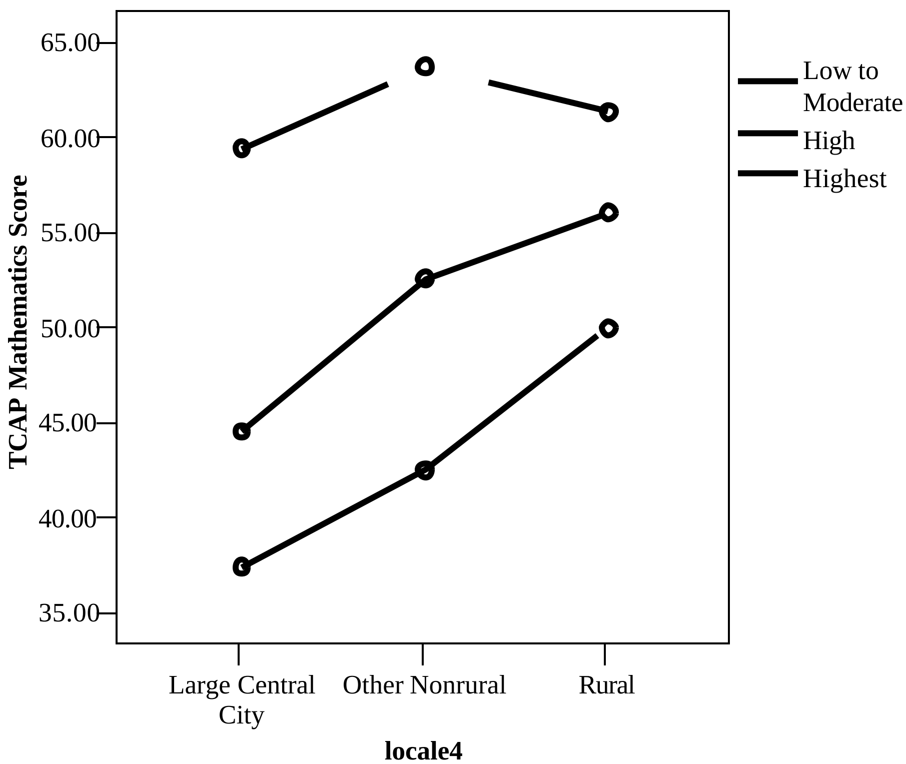

Table 4.8 *Comparison of Sixth Grade Mathematics Achievement by Locale and Percent of Disadvantaged Students*

schools scoring the lowest followed by Rural and then Other Nonrural. Schools in the High or Highest category of percent disadvantaged show a greater gap between the Large Central City Schools and Other Nonrural and Rural. Additionally, Rural outscores Other Nonrural for these schools with higher percentages of disadvantaged students.

Seventh Grade: Hypothesis 1

A GLM Repeated-Measures test was run to investigate gender in terms of school locale and location. Again, gender was a significant factor ($p = 0.012$) in mathematics achievement as measured by the TCAP, with females outscoring males. There was an interaction between gender and locale for seventh grade students. This effect was significant with $p = 0.022$, showing that females outscored males in Large Central City and Rural schools, while males outscored females in Other Non Rural schools. These differences can be seen in Figure 4.9.

The only statistically significant between-subjects effect for seventh grade mathematics achievement on TCAP was found with locale ($p < 0.001$). The Tukey HSD Post Hoc showed schools in Large Central Cities were found to be significantly lower than both Other Non Rural (+22.78) and Rural schools (+20.30). The difference between Rural schools and Other Nonrural was not significant. These findings are summarized in Table 4.2.

Seventh Grade: Hypothesis 2

When categorizing schools according to the percent of students disadvantaged, results for the seventh grade were similar to the results in sixth grade with the exception

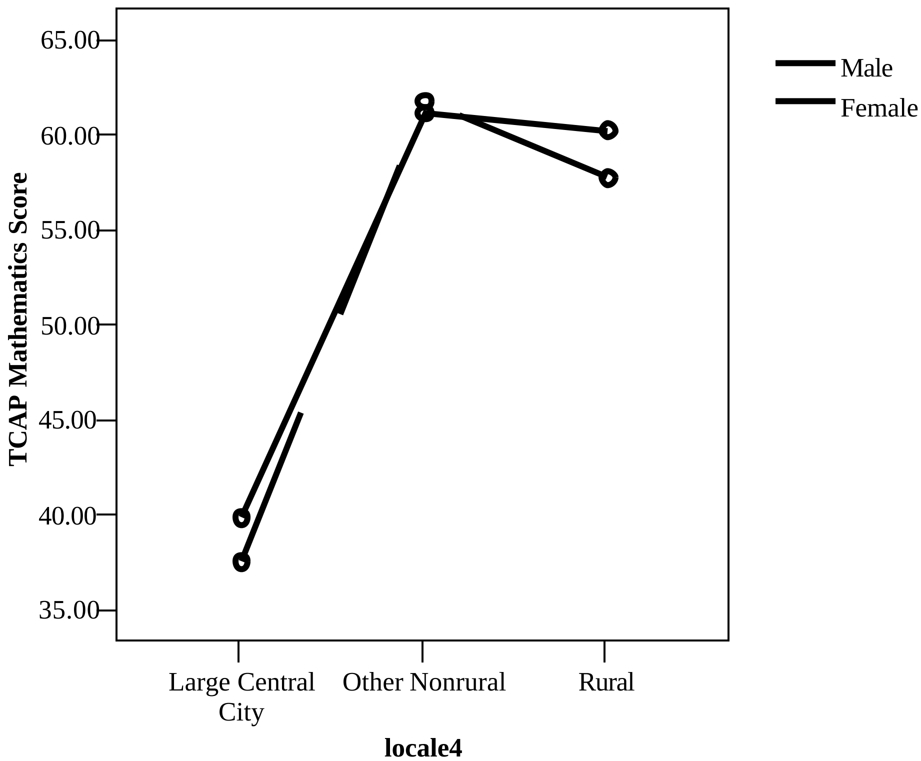

Figure 4.9 *Comparison of Seventh Grade Mathematics Achievement by Gender across Locales*

Table 4.2 *Summary of Tukey HSD Post Hoc Test Comparing Seventh Grade Mathematics Achievement by Locale*

Tukey HSD

Locale4	N	Subset	
		1	2
Large Central City	71	38.41	
Rural	323		58.71
Other Nonrural	128		61.19
Significance		1.000	.328

Means for groups in homogeneous subsets are displayed. Based on Type III Sum of Squares The error term is Mean Square(Error) = 180.495.

a Uses Harmonic Mean Sample Size = 120.034.

b Alpha = .05.

of a location*locale interaction which existed in the sixth grade, but not the seventh. Again, gender was significant ($p = 0.024$) with females scoring higher than males. There were no significant gender interactions with locale4, location or pdisadv. There were between-subject effects for locale4 and pdisadv, as well as an interaction between the two variables. In each case, $p < 0.001$ as shown in Table 4.3

Analysis using Tukey HSD for locale4 found schools in Large Central City (37.21) scoring significantly different than Rural (58.26) and Other Nonrural (61.22). The differences between Rural and Other Nonrural were not significant. Post hoc analysis of pdisadv showed schools with highest percentage of disadvantaged scored the lowest (40.38), followed by schools with a high percentage of disadvantaged students (54.78), and finally schools with a low to moderate percentage of disadvantaged students (64.33). Differences were significant ($p < 0.001$) between each category. Summary of the Tukey

Table 4.3 *Summary of Between-Subjects Effects on Mathematics Achievement for Seventh Grade Students*

Source	Type III Sum of Squares	df	Mean Square	F	Sig
Intercept	1059063.724	1	1059063.724	4286.781	.000
location	222.544	1	22.544	.901	.343
locale4	10235.323	2	5117.661	20.715	.000
pdisadv	43523.655	2	21761.828	88.086	.000
location * locale4	50.972	1	50.972	.206	.650
location * pdisadv	1078.571	2	539.285	2.183	.114
locale4 * pdisadv	10437.679	4	2609.420	10.562	.000
location * locale4 * pdisadv	1186.653	2	593.327	2.402	.092
Error	113644.554	460	47.053		

HSD post hoc tests for locale4 and pdisadv can be found in Tables 4.4 and 4.5, respectively.

For the seventh grade data, there also existed a significant interaction between locale4 and pdisadv. This interaction is shown in Figure 4.10. As with sixth grade, there is little differences in scores for those schools with low to moderate percentages of disadvantaged students. For schools with high or highest percentages there are large differences. For schools with high percentages of disadvantaged students, those located in Large Central City scored the lowest. Other Nonrural scored approximately ten points higher and schools located in Rural areas an additional five points. For those schools with the highest percentages of disadvantaged students, the gap between Large Central City and Other Nonrural was less than five points, while the difference between Other Nonrural and Rural was nearly twenty points higher for Rural schools.

Table 4.4 *Summary of Tukey HSD Post Hoc Test of Seventh Grade Mathematics Achievement Scores by Locale*

Tukey HSD

Locale4	N	Subset	
		1	2
Large Central City	59	37.21	
Rural	298		58.60
Other Nonrural	118		61.22
Significance		1.000	.204

Means for groups in homogeneous subsets are displayed. Based on Type III Sum of Squares The error term is Mean Square(Error) = 123.527.

a Uses Harmonic Mean Sample Size = 104.241.

b Alpha = .05.

Table 4.5 *Summary of Tukey HSD Post Hoc Test for Seventh Grade Mathematics Achievement by Percentage of Disadvantaged Students*

Tukey HSD

Pdisadv	N	Subset		
		1	2	3
Highest	78	40.38		
High	189		54.78	
Low to Moderate	208			64.33
Significance		1.000	.000	1.000

Means for groups in homogeneous subsets are displayed. Based on Type III Sum of Squares The error term is Mean Square(Error) = 123.527.

a Uses Harmonic Mean Sample Size = 130.895.

b Alpha = .05.

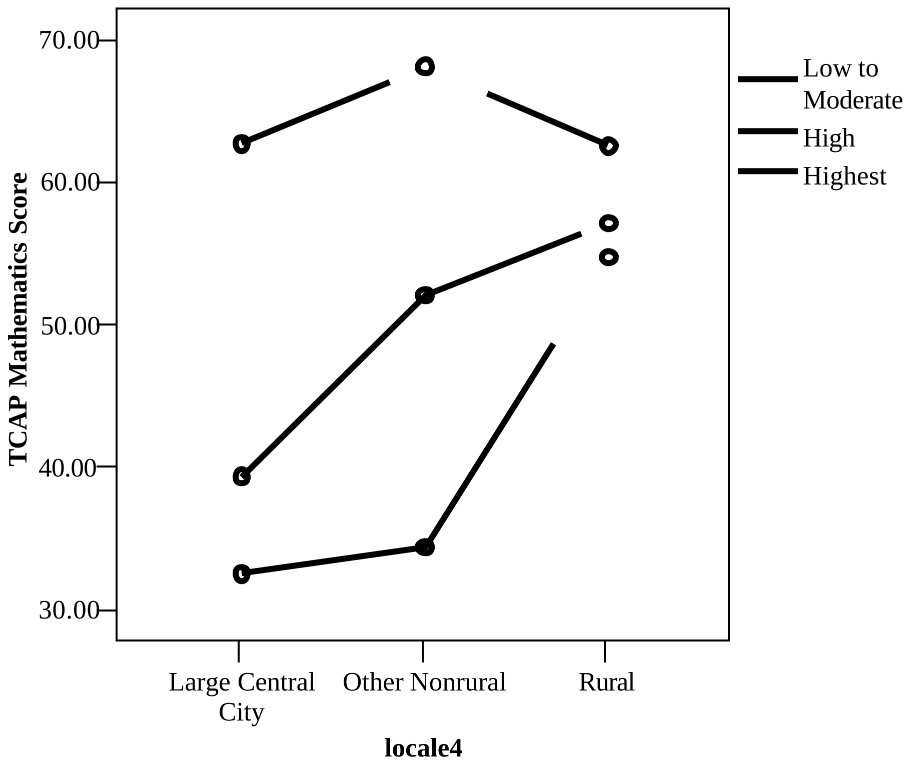

Figure 4.10 *Comparison of Seventh Grade Mathematics Achievement by Locale and Percent of Disadvantaged Students*

Eighth Grade: Hypothesis 1

Results for mathematics achievement in eighth grade followed a similar pattern. Again, there was a significant effect ($p < 0.001$) for gender, with females scoring higher than males. There were no significant interactions between gender, locale4, and/or location. between-subjects effects were significant for location ($p = 0.036$) and locale4 ($p < 0.001$). Table 4.6 shows the summary of the Tukey HSD post hoc analysis for locale4.

As with grades six and seven, schools in Large Central City (39.23) scored lower than Other Nonrural (61.05) and Rural (59.02). In terms of location, schools in Appalachia scored higher than schools in Non Appalachia. Due to the significantly lower scores of Large Central City schools and the fact that all of these schools are located in Non Appalachian counties, the analysis was run excluding the schools categorized as Large Central City. When excluding the Non Central Cities scores from the analysis, the approximately three point difference in scores in favor of Appalachian schools becomes a nearly four point difference in favor of the Non Appalachian schools (see Figure 4.11).

Eighth Grade: Hypothesis Two

Results of the analysis of eighth grade mathematics achievement while including percentage of economically disadvantaged students in the school (pdisadv) as a between-subject factor yielded similar results as the analysis of seventh grade data. Namely, there were significant main effects for gender, locale4, and pdisadv students as well as a significant interaction for locale4*pdisadv. The effect of gender was significant with $p < 0.001$. Females outscored males by approximately three points. Results for locale4 and pdisadv followed the same pattern as was calculated for sixth and seventh grades. Large

Table 4.6 *Summary of Tukey HSD Post Hoc Test of Eighth Grade Mathematics Achievement by Locale*

Tukey HSD

Locale4	N	Subset	
		1	2
Large Central City	70	39.23	
Rural	324		59.02
Other Nonrural	129		61.05
Significance		1.000	.517

Means for groups in homogeneous subsets are displayed. Based on Type III Sum of Squares The error term is Mean Square(Error) = 204.809.

a Uses Harmonic Mean Sample Size = 119.407.

b Alpha = .05.

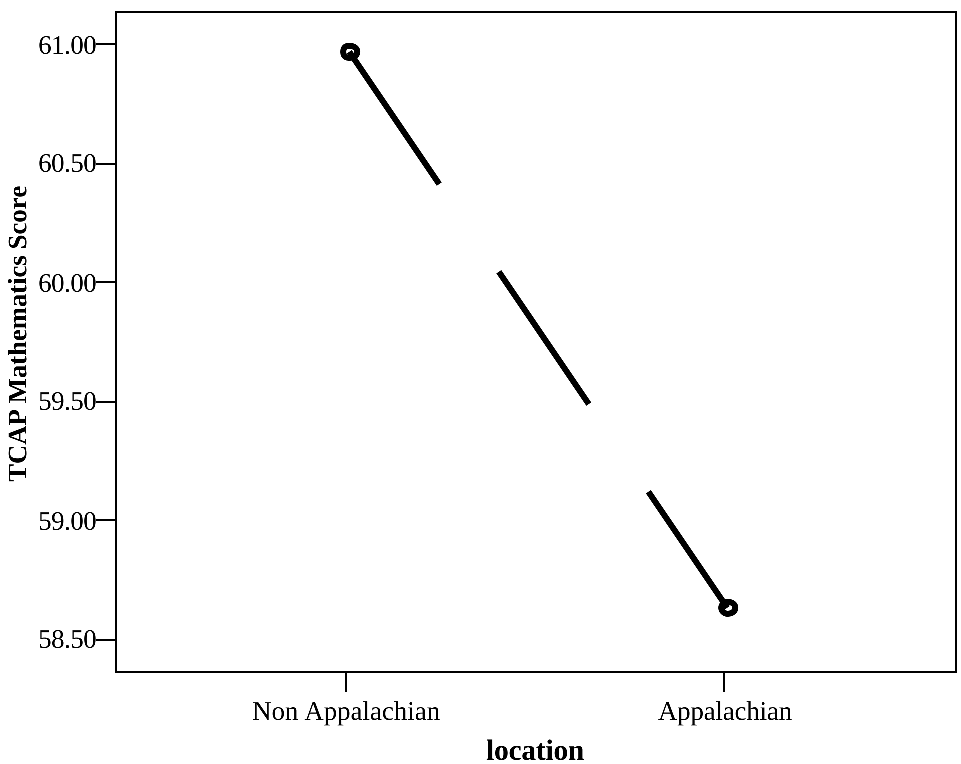

Figure 4.11 *Comparison of Eighth Grade Mathematics Achievement by Location, excluding Large Central City Schools*

Central City scored significantly lower than the other two locales (see Table 4.7) while there was not a significant difference for the Rural and Other Nonrural locales. For pdisadv, the schools with highest percentage disadvantaged saw the lowest average score (39.29) which was significantly lower than both high percentage (average score 55.51) and low to moderate percentages (average score 65.26) of disadvantaged students. This data is summarized in Table 4.8.

Again, the interaction of locale4 and pdisadv was significant ($p < 0.001$). As was the case with grades six and seven, little differences were found in achievement levels across the locales for school with low to moderate percentages of disadvantaged students. Large Central City and Rural scored similarly with Other Nonrural scoring slightly higher. For schools with high or highest percentages of disadvantaged students, schools in Rural locales scored higher than both Other Nonrural and Large Central City (See Figure 4.12).

Part Two

Research Questions:

1.) Are there significant differences in mathematics achievement as measured by the ACT with regards to gender, locale, and location?
2.) When accounting for SES, are there significant differences in mathematics achievement as measured by the ACT for male and female students by locale or location?

Null Hypotheses:

1.) There is no significant difference on ACT scores in Tennessee on the mathematics subtest with respect to gender, school locale, or school location.
2.) Holding for SES, there is no significant difference on ACT scores in Tennessee on the mathematics subtest of the ACT with respect to gender, school locale, or school location.

Table 4.7 *Summary of Tukey HSD Post Hoc Test for Eighth Grade Mathematics Achievement by Locale*

Tukey HSD

Locale4	N	Subset	
		1	2
Large Central City	58	38.70	
Rural	299		59.08
Other Nonrural	118		61.42
Significance		1.000	.324

Means for groups in homogeneous subsets are displayed. Based on Type III Sum of Squares The error term is Mean Square(Error) = 137.476.

a Uses Harmonic Mean Sample Size = 103.233.

b Alpha = .05.

Table 4.8 *Summary of Tukey HSD Post Hoc Test for Eighth Grade Mathematics Achievement by Percentage of Disadvantaged Students*

Tukey HSD

Pdisadv	N	Subset		
		1	2	3
Highest	77	39.29		
High	189		55.51	
Low to Moderate	209			65.26
Significance		1.000	1.000	1.000

Means for groups in homogeneous subsets are displayed. Based on Type III Sum of Squares The error term is Mean Square(Error) = 137.476.

a Uses Harmonic Mean Sample Size = 130.080.

b Alpha = .05.

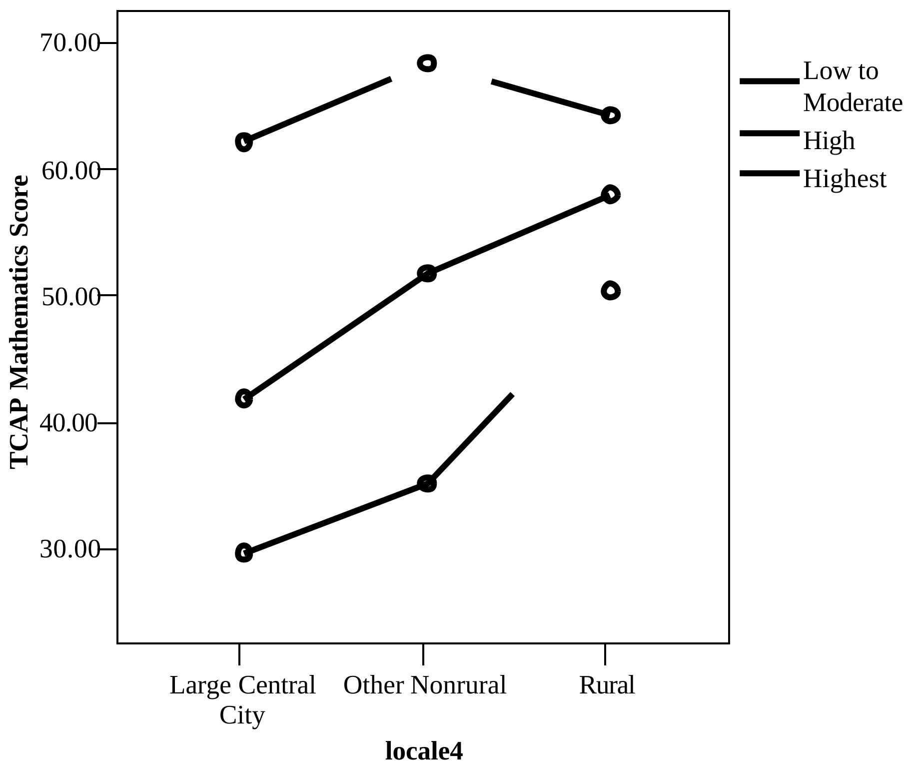

Figure 4.12 *Comparison of Eighth Grade Mathematics Achievement by Locale and Percent of Disadvantaged Students*

Hypothesis 1

A GLM Repeated Measures was run to test for gender differences in mathematics achievement with regards to school locale and school location as measured by the ACT Mathematics Subtest. For this test, the within-subject factor was gender (gender) and the Between-Subject Factors were school locale (locale4) consisting of Large Central City (1), Other Nonrural (2), and Rural(3) and school location (location) consisting of Non Appalachian (0) and Appalachian (1). The results of the analysis showed a significant effect for gender ($p < 0.001$) with males outscoring females, a moderate effect for gender by location interaction ($p = 0.049$) and gender by locale4 interaction ($p = 0.006$). These values are summarized in Table 4.9.

The interaction of gender and location, although statistically significant, is barely discernible when looking at the plots of male versus female scores (See Figure 4.13). The more statistically significant interaction of gender and locale4 shows a narrower gap between male and female scores within schools located in Large Central Cities while the difference in achievement for males and females in Other Non Rural and Rural areas is greater.(See Figure 4.14).

What can also be seen in Figure 4.14 is the effect of locale4 in general. For both genders, students residing in Large Central Cities score significantly lower ($p < 0.001$) than their Other Non Rural and Rural counterparts, and Rural schools have a significantly ($p = 0.007$) lower average ACT mathematics score than Other Nonrural schools. A summary of this data is shown in Table 4.10. As with the middle school data, the lower Large Central City scores significantly impact the Appalachian versus Non Appalachian

Table 4.9 *Within-Subjects Contrasts for ACT Mathematics Subtest Scores for Tennessee High Schools, 2003*

Source	gender	Type III Sum of Squares	df	F	Sig
gender	Linear	103.828	1	239.902	.000
gender * location	Linear	1.689	1	3.903	.049
gender * locale4	Linear	4.520	2	5.222	.006
gender * location * locale4	Linear	.360	1	.831	.363
Error(gender)	Linear	111.660	258		

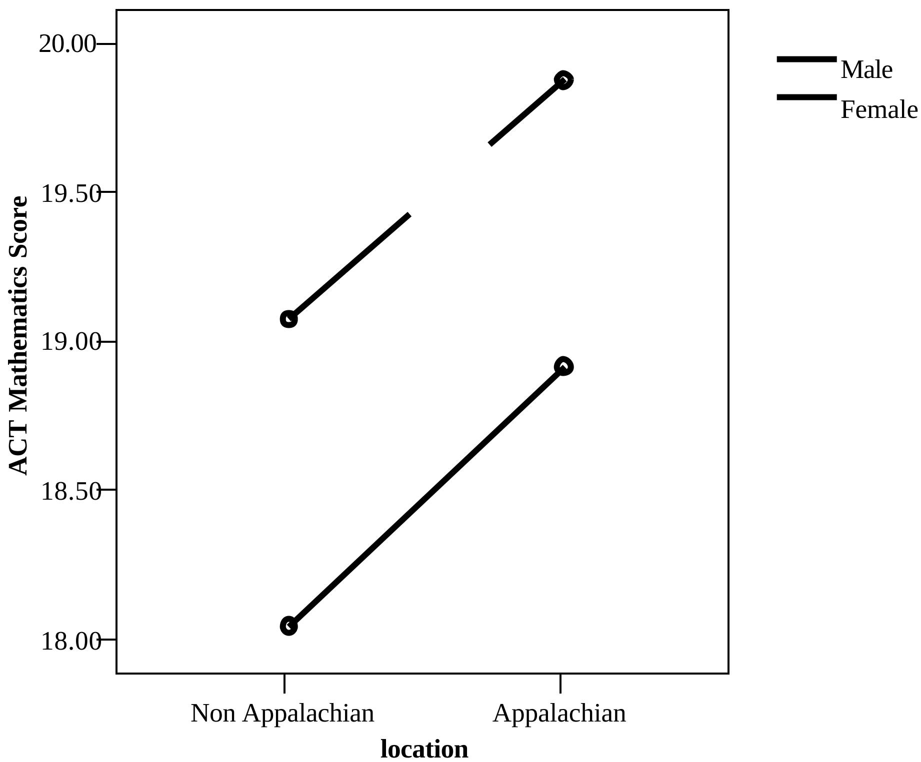

Figure 4.13 *Comparison of Mathematics Achievement of High School Students as Measured by the ACT by Gender and School Location*

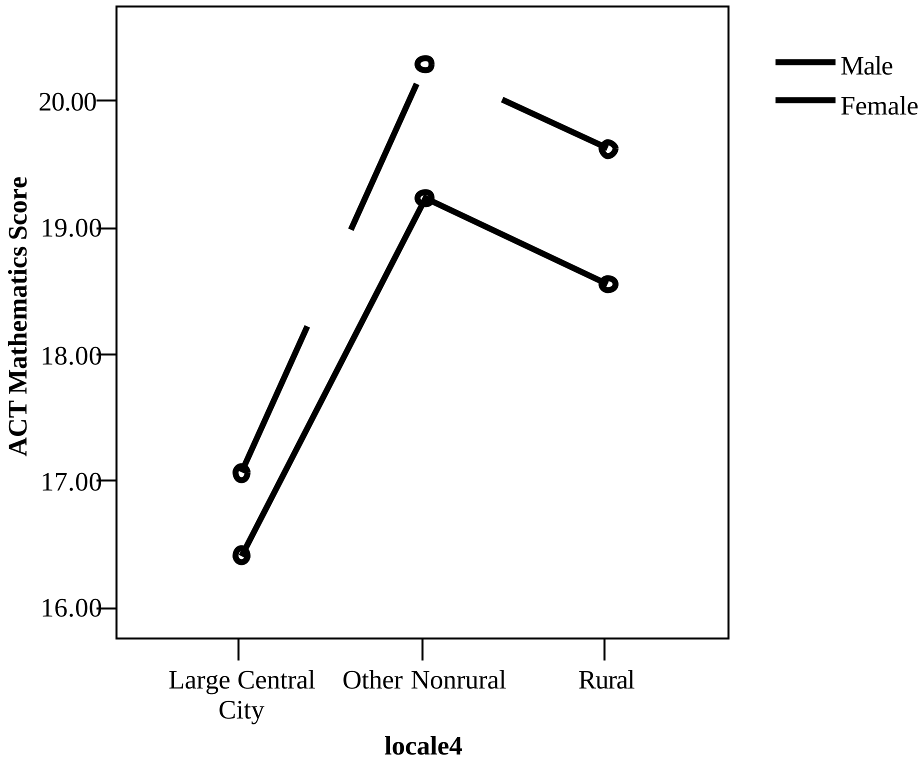

Figure 4.14 *Comparison of Mathematics Achievement of High School Students as Measured by the ACT by Gender and School Locale*

Table 4.10 *Summary of Average ACT Scores on the Mathematics Portion of the ACT by Locale*

Tukey HSD

Locale4	N	Subset		
		1	2	3
Large Central City	42	16.7079		
Rural	137		19.0562	
Other Nonrural	84			19.7326
Significance		1.000	1.000	1.000

Means for groups in homogeneous subsets are displayed. Based on Type III Sum of Squares The error term is Mean Square(Error) = 2.569.

a Uses Harmonic Mean Sample Size = 69.745.

b Alpha = .05.

(location) data, as all Large Central City schools were in the Non Appalachian category. The data were analyzed again, omitting the data from the Large Central City to determine the effect those scores had on the overall location effect. Upon a second analysis, the gender by locale interaction effect that existed when all three types of systems were analyzed disappears and the minimal gender by location interaction effect is no longer significant. The significant effects that do remain are gender (with males outscoring females, see Figure 4.15) and locale (with Other Nonrural (2) outscoring Rural (3), see Figure 4.16).

Hypothesis Two

The ACT data collected for Tennessee high schools were analyzed again this time including SES categories based on the percentage of disadvantaged (pdisadva) students enrolled at each school. A significant effect was found for gender ($p < 0.001$) as well as a gender*pdisadva ($p = 0.004$). Males scored higher than females on the mathematics

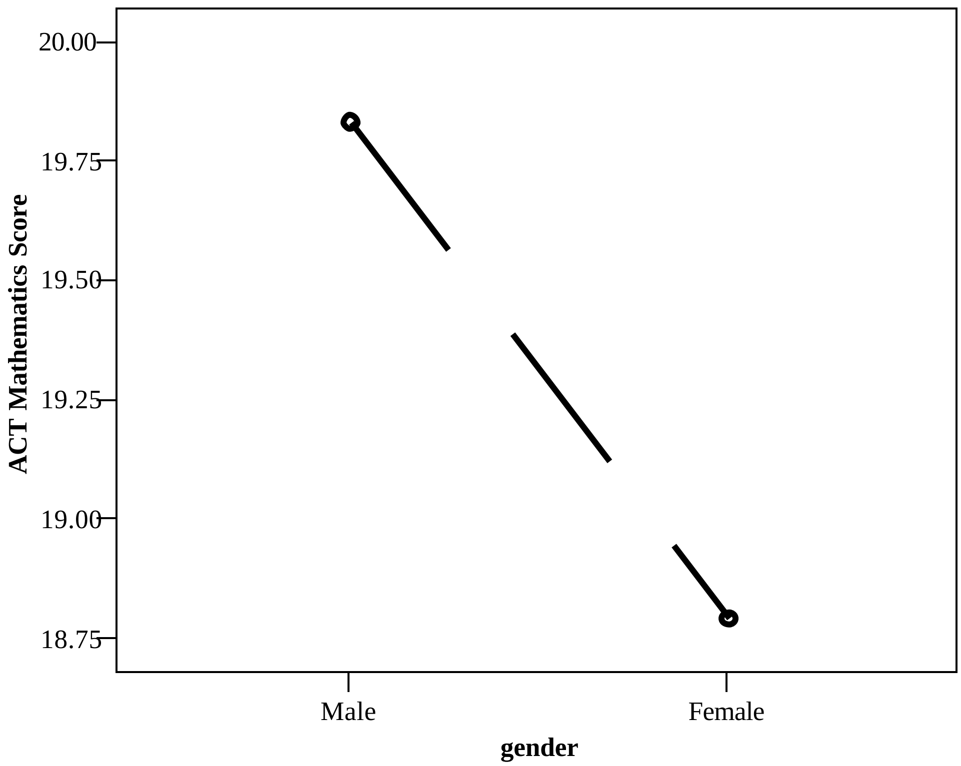

Figure 4.15 *Comparison of Male and Female Mathematics Achievement as Measured by the ACT, excluding Large Central Cities*

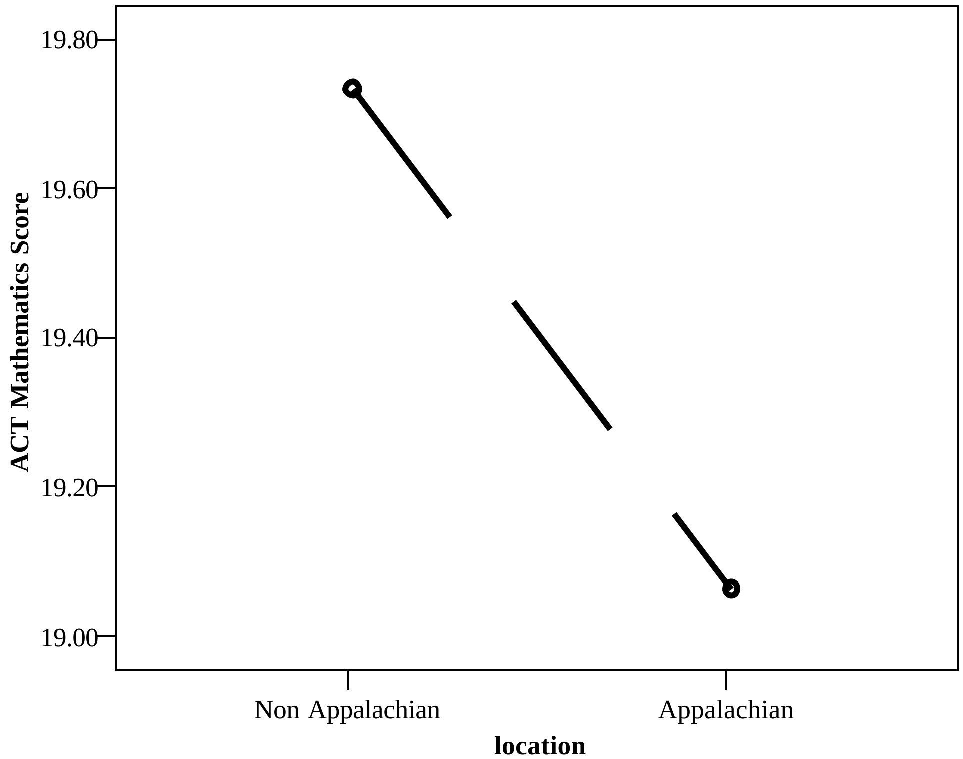

Figure 4.16 *Comparison of Mathematics Achievement as Measured by the ACT, by Locale, excluding Large Central Cities*

portion of the ACT (Figure 4.17) by approximately one point. No other significant within-subject differences were found (Table 4.11).

The interaction between gender and pdisadva is illustrated in Figure 4.18. The difference between genders in terms of mathematics achievement measured by the ACT, is greatest in those schools with low to moderate percentages of disadvantaged students. For schools with high percentages, the differences are slightly less. For schools with the highest percentages of disadvantaged students, the difference between male and female ACT scores is the least.

The test for between-subject effects found significant effect for locale4, pdisadva, location*pdisadva, and locale4*psdisadv (See Table 4.12). A Tukey HSD post hoc test was run to investigate differences for locale4 and pdisadva. Schools in Large Central Cities (l) averaged a 16.70 on the ACT, while schools in Rural (3) locales averaged a 19.07 and schools in Other Nonrural (2) scored the highest, 19.73. The differences between each locale were significant at $p < 0.001$. A summary of the Tukey HSD post hoc analysis can be found in Table 4.13.

Results for the effect of pdisadva on mathematics achievement in high school followed the pattern found in the middle school data. The greater the percentage of disadvantaged students (low to moderate, high, highest) the lower the achievement in mathematics as measured by the ACT. A summary of the Tukey HSD is found in Table 4.14.

The interaction between location*pdisadva is illustrated in Figure 4.19. For each category of percentage of disadvantaged students, Appalachian schools scored higher

Figure 4.17 *Comparison of High School ACT Scores on the Mathematics Subtest by Gender*

Table 4.11 *Summary of Within-Subjects Factors for Mathematics Achievement as Measured by the ACT*

Source	Gender	Type III Sum of Squares	df	Mean Square	F	Sig
Gender	Linear	72.608	1	72.608	178.111	.000
Gender * location	Linear	.966	1	.966	2.370	.125
Gender * locale4	Linear	.859	2	.429	1.053	.350
Gender * pdisadva	Linear	4.582	2	2.291	5.620	.004
Gender * location *locale4	Linear	.581	1	.581	1.424	.234
Gender * location *pdisadva	Linear	.362	2	.181	.444	.642
Gender * locale4 *pdisadva	Linear	.711	4	.178	.436	.783
Gender * location *locale4 * pdisadva	Linear	.934	2	.467	1.146	.320
Error(gender)	Linear	98.246	241	.408		

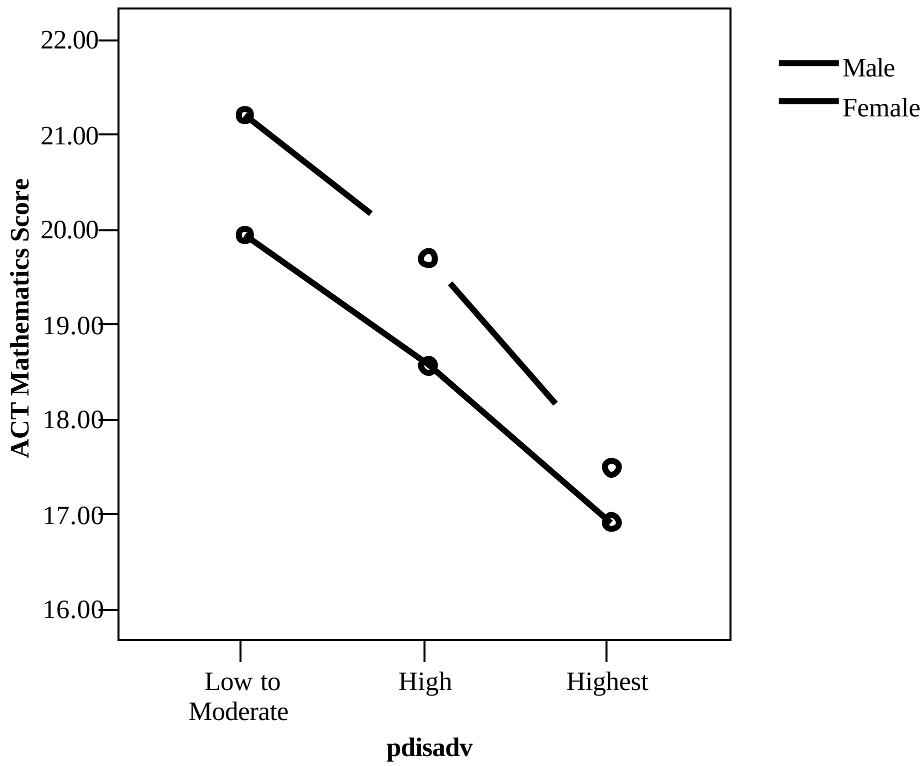

Figure 4.18 *Comparison of Male and Female ACT scores on the Mathematics Subtest by the Percentage of Disadvantaged Students*

Table 4.12 *Summary of Between-Subjects Effects on Mathematics Achievement as Measured by the ACT Mathematics Subtest*

Source	Type III Sum of Squares	Df	Mean Square	F	Sig
Intercept	107510.930	1	107510.930	39562.066	.000
location	2.223	1	2.223	.818	.367
Locale4	34.567	2	17.284	6.360	.002
pdisadva	488.907	2	244.453	89.954	.000
location * locale4	6.852	1	6.852	2.521	.114
location * pdisadva	25.516	2	12.758	4.695	.010
Locale4 * pdisadva	183.426	4	45.857	16.874	.000
location * locale4 * pdisadva	15.333	2	7.667	2.821	.062
Error	654.924	241	2.718		

Table 4.13 *Summary of Tukey HSD Post Hoc Test for Mathematics Achievement as Measured by the ACT Mathematics Subtest by School Locale*

Locale4	N	Subset		
		1	2	3
Large Central City	41	16.7017		
Rural	133		19.0697	
Other Nonrural	82			19.7279
Significance		.000	1.000	1.000

Means for groups in homogeneous subsets are displayed. Based on Type III Sum of Squares The error term is Mean Square(Error) = 1.359.

a Uses Harmonic Mean Sample Size = 68.021.

b Alpha = .05.

Table 4.14 *Summary of Tukey HSD Post Hoc Test for Mathematics Achievement as Measured by the ACT Mathematics Subtest by Percentage of Disadvantaged Students*

Pdisadva	N	Subset		
		1	2	3
High	69	17.1489		
Moderate	126		19.0759	
Low to Moderate	61			20.5226
Sig.		1.000	1.000	1.000

Means for groups in homogeneous subsets are displayed. Based on Type III Sum of Squares The error term is Mean Square(Error) = 1.359.

a Uses Harmonic Mean Sample Size = 77.274.

b Alpha = .05.

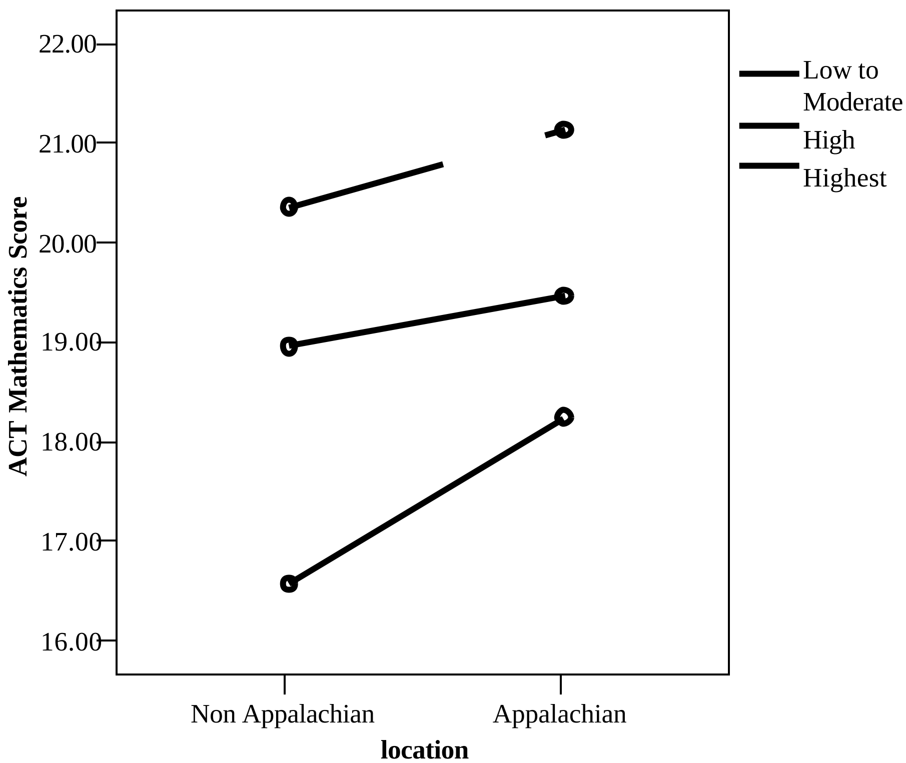

Figure 4.19 *Comparison of High School Mathematics Achievement by Location and Percentage of Disadvantaged Students*

than did Non Appalachian schools. The difference between Appalachian and Non Appalachian schools is greatest for schools with a high percentage of disadvantaged students. However, due to the significant negative effect of Large Central City schools, and the lack of any of these schools in the Appalachian region, there was concern that this difference between locations was due to the negative effect of Large Central City scores on the average for Non Appalachian schools. The analysis was run again omitting Large Central City scores. The results are shown in Figure 4.20. For schools with a low to moderate percentage of disadvantaged students, Appalachian schools still outscored Non Appalachian schools. For schools with a high percentage of disadvantaged students, Appalachian schools outscored Non Appalachian schools, but the difference was less pronounced. For schools with the highest percentage of disadvantaged students, once Large Central City schools are omitted, Non Appalachian schools scored higher than Appalachian schools.

The final significant interaction between locale4 and pdisadva is illustrated in Figure 4.21. In all locales, schools with low to moderate percentages of disadvantage scored the highest, followed by schools with high percentages with schools having the highest percentages of disadvantaged students scoring the lowest. The difference between the categories of disadvantaged students is most pronounced in Large Central Cities, followed by Other Non Rural. The difference between economic categories in Rural areas is the least, with the highest performing high-percentage disadvantage schools and the lowest performing low to moderate percentage disadvantage schools.

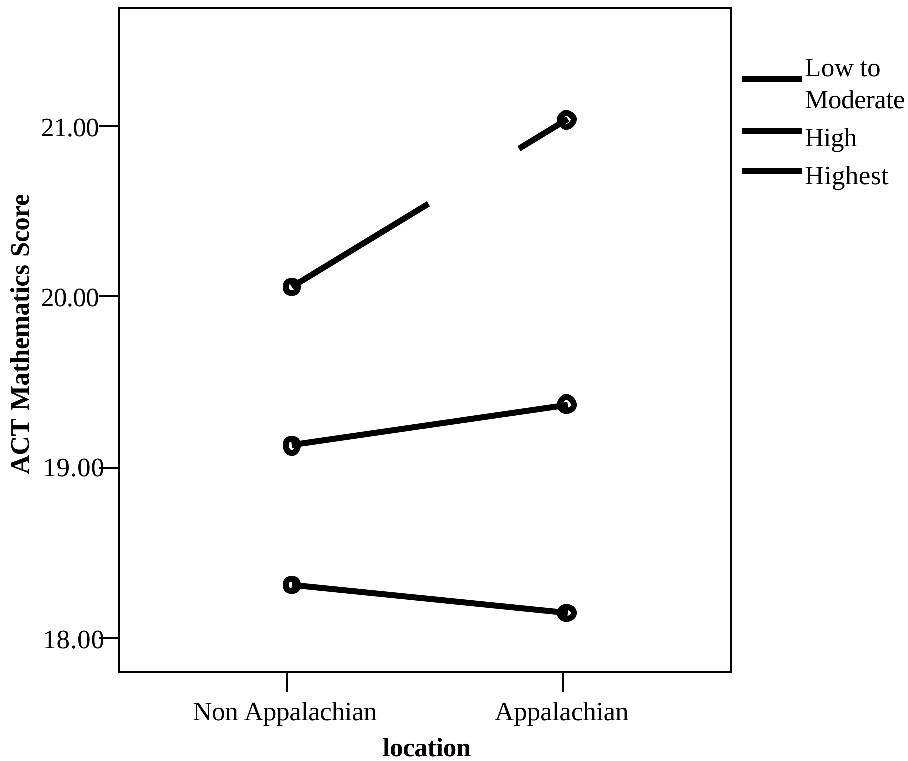

Figure 4.20 *Comparison of High School Mathematics Achievement by Location and Percentage of Disadvantaged Students, Omitting Large Central City Schools*

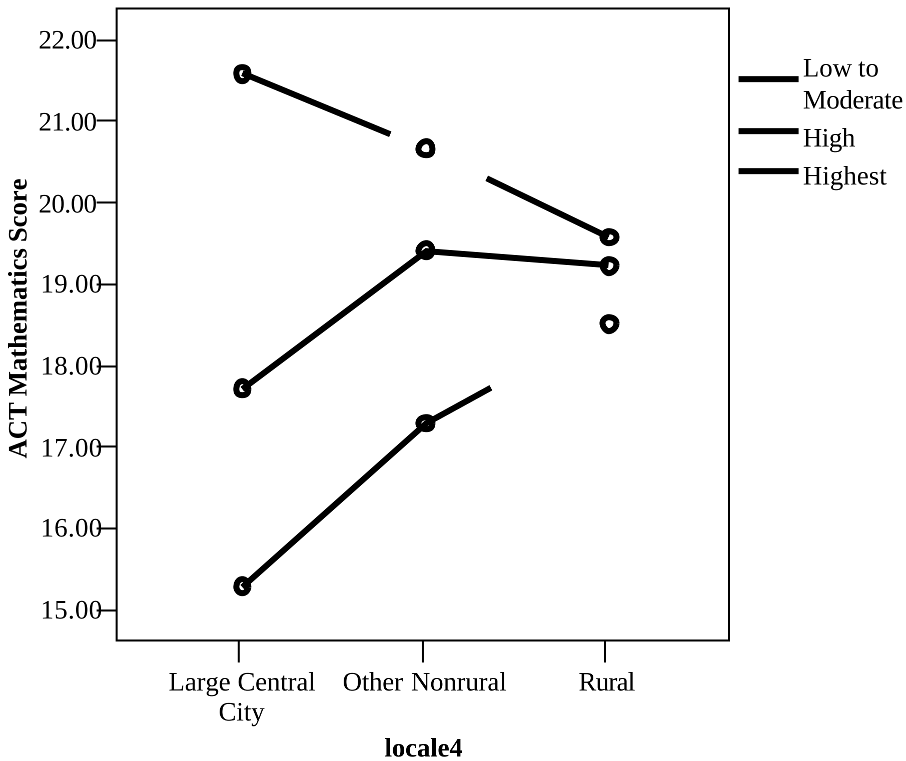

Figure 4.21 *Comparison of High School Mathematics Achievement by Locale and Percentage of Disadvantaged Students*

Part Three

Research Question:

> Are the percentages of females and males in the following high school mathematics courses: Competency Mathematics, Foundations I and II, Algebra I and II, Geometry, Advanced Algebra with Trigonometry, PreCalculus, Statistics, Calculus, Calculus AB, Calculus BC, and AP Statistics in rural Tennessee significantly different than the percentages of females and males in nonrural areas in Tennessee?

Null Hypothesis:

The hypothesis in part three will be tested for the following courses: Competency Mathematics, Foundations I and II, Algebra I and II, Geometry, Advanced Algebra with Trigonometry, PreCalculus, Statistics, Calculus, Calculus AB, Calculus BC, and AP Statistics. The term mathematics course will be used as a generic term to represent these courses.

> There is no significant difference in the enrollment of a high school mathematics course in Tennessee by gender, school locale, school location or SES.

Although the response rate to the survey requesting the data was 33.3 percent (92 out of 276), many schools did not offer several of the courses. Therefore, the percent of responses included for testing varied from 2.2 percent to 33.3 percent. Due to the low number of schools reporting enrollment the following courses were not analyzed: Competency Mathematics, Statistics, Calculus BC, and AP Statistics. In each of these cases the percentage of schools reporting enrollment was less than ten percent. Again, the GLM Repeated-Measures test was run to compare the percentages of females and males enrolled in these courses. Gender was the Within-Subject Factor while school locale (locale4) and school location were the between-subject factors. Locale4 initially consisted of three categories, Large Central City (1), Other Nonrural (2), and Rural (3) and location was again comprised of Non Appalachian (0) and Appalachian (1). However, due to minimal response by schools designated Large Central City (only three), the data was analyzed using only Other Non Rural (2) and Rural (3) categories for school locale.

Foundations I

The analysis of enrollment percentages for Foundations I showed a significant gender effect. No significant interactions were found, nor were any between-subject effects for locale4 or location. Table 4.15 shows that the differences between males and females differed significantly, with $p < 0.001$. The enrollment for males, as a percentage of total school enrollment (9.650), was 2.7 percent greater than the enrollment percentage of girls (6.939).

Table 4.15 *Comparison of Male and Female Enrollment (as a percentage of school enrollment) for Foundations I*

(I) gender	(J) gender	Mean Difference (I-J)	Sig.[a]
Males	Females	2.711(*)	.000
Females	Males	-2.711(*)	.000

Based on estimated marginal means
* The mean difference is significant at the .05 level.
[a] Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Foundations II

As with Foundations I, the only significant effect found for Foundations II was a gender effect. Table 4.16 shows that the enrollment percentage was again greater for males (15.541), with nearly 2 percent more of the male population taking the course than of the female percentage (13.546).

Algebra I

No significant main effects or interactions were found when analyzing data for Algebra I.

Algebra II

While no interaction effects were discovered for Algebra II there were significant gender and location effects. Females enrolled in Algebra II at a higher rate than did males. As a percentage of total gender population, females (17.711) enrolled at a 2.3 percent higher rate than did males (15.448) (see Table 4.17).

Table 4.16 *Comparison of Male and Female Enrollment (as a percentage of school enrollment) for Foundations II*

(I) gender	(J) gender	Mean Difference (I-J)	Sig.[a]
Males	Females	1.995(*)	.000
Females	Males	-1.995(*)	.000

Based on estimated marginal means
* The mean difference is significant at the .05 level.
[a] Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Table 4.17 *Comparison of Male and Female Enrollment (as a percentage of school enrollment) for Algebra II*

(I) gender	(J) gender	Mean Difference (I-J)	Sig.[a]
Males	Females	-2.263(*)	.000
Females	Males	2.263(*)	.000

Based on estimated marginal means
* The mean difference is significant at the .05 level.
[a] Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

A higher percentage of Non Appalachian students enrolled in Algebra II (17.912) than Appalachian students (15.247). The difference in enrollment can be found in Table 4.18. The rate of enrollment for Non Appalachian schools was nearly three percent greater than for Appalachian schools.

Geometry

Analyzing the Geometry data showed a significant gender effect. Again, females (18.092 percent) were enrolled at a higher rate than were males (15.679 percent). This is significant at $p < 0.001$ (See Table 4.19).

Advanced Algebra

The data for Advanced Algebra yielded a moderate gender effect ($p = 0.042$) with females enrolling at an approximately one percent higher rate (5.238) than did males (4.463) (See Table 4.20). There were no other significant main effects or interactions.

Table 4.18 *Comparison of Appalachian and Non Appalachian Enrollment (as a percentage of school enrollment) for Algebra II*

(I) location	(J) location	Mean Difference (I-J)	Sig.[a]
Non Appalachian	Appalachian	2.666(*)	.020
Appalachian	Non Appalachian	-2.666(*)	.020

Based on estimated marginal means
* The mean difference is significant at the .05 level.
[a] Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Table 4.19 *Comparison of Male and Female Enrollment (as a percentage of school enrollment) for Geometry*

(I) gender	(J) gender	Mean Difference (I-J)	Sig.[a]
Males	Females	-2.414(*)	.000
Females	Males	2.414(*)	.000

Based on estimated marginal means
* The mean difference is significant at the .05 level.
[a] Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Table 4.20 *Comparison of Male and Female Enrollment (as a percentage of school enrollment) for Advanced Algebra*

(I) gender	(J) gender	Mean Difference (I-J)	Sig.[(a)]
male	Females	-.775(*)	.042
females	Males	.775(*)	.042

Based on estimated marginal means
* The mean difference is significant at the .05 level.
[a] Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Precalculus

The analysis of the data for Precalculus generated results similar to that of Advanced Algebra. The only significant effect was gender and the difference in enrollment between males and females was approximately one percent (See Table 4.21), with females (5.542) enrolling at a higher rate than males (4.571).

Calculus

There was no gender effect for calculus enrollment nor any interaction effects between gender, locale, and location. There was, however, a significant location effect.

Students enrolled in Calculus in Non Appalachian schools were 3.776 percent of the total school population while students enrolled in Calculus in Appalachian schools comprised only 1.99 percent of the student population (See Table 4.22).

Table 4.21 *Comparison of Male and Female Enrollment (as a percentage of school enrollment) for Precalculus*

(I) gender	(J) gender	Mean Difference (I-J)	Sig.[a]
males	Females	-.970(*)	.002
females	Males	.970(*)	.002

Based on estimated marginal means
* The mean difference is significant at the .05 level.
[a] Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Table 4.22 *Comparison of Appalachian and Non Appalachian Enrollment (as a percentage of school enrollment) for Calculus*

(I) location	(J) location	Mean Difference (I-J)	Sig.[a]
Non Appalachian	Appalachian	1.786(*)	.028
Appalachian	Non Appalachian	-1.786(*)	.028

Based on estimated marginal means
* The mean difference is significant at the .05 level.
[a] Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Calculus AB

There were no significant gender, locale, location, or interaction effects involving enrollment in Calculus AB.

Summary

Chapter IV provided a presentation of the results of the analysis of data in three parts. Part One examined mathematics achievement of students in grades six through eight, in terms of gender, school locale, and school location. Across all three grade levels, females significantly outscored males. Additionally, in each grade, schools in Large Central Cities scored significantly lower than schools in Other Nonrural or Rural schools. In the sixth grade, rural students scored the same whether located in Appalachia or not, while Non Appalachian, Other Nonrural schools outscored Appalachian, Rural schools. In the seventh grade, a significant gender*locale4 interaction was discovered. Females outscored males in Large Central City and Rural schools while males outscored females in Other Nonrural schools. Eighth grade analysis showed Appalachian schools significantly outscoring Non Appalachian schools, although when the Large Central City schools were omitted from the analysis, the results reversed, with Non Appalachian schools outscoring Appalachian schools.

When the analysis was repeated adding another between-subjects factor (percentage of disadvantaged students), females still significantly outscored males at all grade levels, schools with higher percentages of disadvantaged students scored lower, and there was a significant interaction between locale and percentage of disadvantaged students. For schools with high and highest percentages of disadvantaged students, Rural schools outscored both Other Nonrural and Large Central City. For schools with low to moderate percentages of disadvantaged students, schools in the Other Nonrural locales scored higher than Large Central Cities and Rural schools, although the differences are not great.

Part Two investigated mathematics achievement in high school students as measured by the ACT. Males scored significantly higher than females. Although moderate gender*locale and gender*location appeared initially, when omitting schools from Large Central Cities (none of which were Appalachian) these differences ceased to exist. When categories based on the percentages of disadvantaged students were added as a third between-subject factor, the gender main effect was still significant, with males outscoring females. The gap between male and female achievement varied by percentage of disadvantaged students, with the greatest gap occurring in schools with low to moderate percentages of disadvantaged students and the smallest gap occurring between schools with the highest percentages of disadvantaged students. For schools with the highest percentages of disadvantaged students, Rural schools outscored Other Nonrural and Large Central City schools. For schools with low to moderate percentages of disadvantaged students, schools in Large Central City scored higher than Other Nonrural and Rural schools.

Part Three of the study explored course enrollment percentages in high school mathematics courses with respect to gender, locale, and location. No significant effects or interactions were found for Algebra I or Calculus AB. For basic courses Foundations I and Foundations II, males enrolled at higher rates, while females enrolled at higher rates in Algebra II, Geometry, Advanced Algebra, and Precalculus. Enrollment was higher for Non Appalachian students than Appalachian students in Algebra II and Calculus. No significant locale effects were found, nor any significant interactions between gender, locale, and/or location.

Chapter V

CONCLUSIONS

Gender issues have long been a topic of educational research, particularly in the area of mathematics. However, there has been little research involving the intersection of gender equity in mathematics within a rural school setting. The purpose of this study was to explore the juxtaposition of gender, school locale and location with respect to mathematics education in order to better understand what it means to be a female studying mathematics in rural Appalachia. With the federal legislation *No Child Left Behind* putting more emphasis on student achievement for all students, studying gender issues in mathematics as well as locale and location can provide insight to help move toward the goals specifically outlined in the legislation. The information presented in this study will provide more insight into an understudied population of students.

This study looked at gender issues in mathematics in terms of school locale, location, and SES. SES in this study is defined by the percent of economically disadvantaged students (those receiving Free/Reduced Lunch) attending a school. Using data collected from the 2003 Tennessee School Report Card, the Tennessee State Department of Education, and survey results, gender issues were investigated in three areas. These areas were middle school achievement as measured by the Tennessee Comprehensive Assessment Program (TCAP); high school achievement as measured by the ACT; and high school mathematics course enrollment.

Summary of Study

With few studies focused on the intersection of mathematics and rural education, this study was undertaken to increase the knowledge base in this area with an emphasis on gender issues. With a focus on gender differences, the variables of school locale, school location, and SES were examined.

Part One of the study used data from students enrolled in grades 6-8 during the 2002-2003 school year to answer questions involving achievement at the middle school level. A school's mathematics achievement data, as measured by TCAP, was accessed from the State Report Card on the Tennessee State Department of Education website. The data were used to examine the effects of gender, locale (Rural, Large Central City, Other Nonrural), location (Appalachian, Non Appalachian), SES (highest, high, low to moderate percentages of disadvantaged students), as well as interactions between these variables.

For Part Two of the study, the Tennessee State Department of Education made available ACT scores for students tested during the 2002-2003 school year. The data were used to study mathematics achievement at the high school level. The variables gender, locale, location, SES, and their interactions were studied to determine any impact on mathematics achievement.

For Part Three, a survey (Appendix A) was sent to each high school in Tennessee to collect data for course enrollment by gender for the 2003-2004 school year. This survey requested information including school enrollment by grade and gender, course enrollment by gender, and ACT scores by gender. These data were analyzed to investigate gender, locale, location, SES and their interactions on course enrollment.

Findings

The findings of the analysis completed in Chapter IV are presented in this section. The findings will be presented based on the overall gender differences in mathematics achievement together with the interaction of gender, locale, location, and SES for both middle schools and high schools in Tennessee. A summary of the relationship between mathematics course enrollment and the aforementioned variables is also reported.

Gender and Mathematics Achievement

Analysis of the middle school data showed that females significantly outscored males in grades six, seven and eight, in concurrence with the analysis of NAEP data reported by Ansell and Doerr (2000) and in conflict with other studies which found small differences favoring males (Leahy & Guo, 2001; Fennema, 1976; Marsh, 1989). Middle school females scored significantly higher than males regardless of school locale, school location, or the percentage of disadvantaged students attending the school.

Analysis of ACT scores showed the mathematics achievement of males significantly greater than that of females. This supports earlier studies by Marsh (1989) and Schreiber (2002) as well as Hyde’s 1990 meta-analysis of mathematics achievement. This study of Tennessee high school students found a difference of approximately one point between males and females on the mathematics subtest of the ACT. This result is similar to the gender difference reported nationally of 1.1 points for high school students taking the ACT (ACT 2003).

Locale, Location and Mathematics Achievement

The interaction between gender and locale and/or location was significant for seventh grade students. Females outscored males in Large Central City and Rural locales while males outscored females in Other Nonrural locales. These differences were no longer significant when SES (percentage of disadvantaged students) was included as a variable. No significant gender and locale and/or location interactions were present for sixth or eighth grade.

At the high school level, there were significant gender/locale and gender/location interactions. In terms of location, the gender difference between males and females, favoring males, was marginally greater for students in Non Appalachian schools than Appalachian schools. However, when schools in the Large Central City were omitted, as all were Non Appalachian, no significant differences are present between the mathematics achievement of Appalachian and Non Appalachian students. Analysis of the gender/locale interaction showed gender differences, favoring males, in mathematics achievement were greater in Rural and Other Nonrural locales than in Large Central City locales at the high school level.

Across all three middle school grades, the effect of locale was significant with students in schools located in Other Nonrural and Rural locales when compared with Large Central City schools. While Other Nonrural and Rural schools did not differ significantly, Other Nonrural schools scored higher. This contradicts both Hobbs (1981), who in an analysis of NAEP data, found that rural students scored well below the national average in mathematics and Webster and Fisher (2001), who found urban schools significantly outscored rural schools although differences were small. The results of this study support other studies that have found no significant differences when comparing rural and nonrural students (Edington & Koehler, 1987; Howley & Gunn, 2003; Winters, 2003).

At the high school level, significant locale differences existed on the mathematics subtest of the ACT, with Large Central Cities scoring the lowest, followed by Rural and Other Nonrural. While differences between Rural and Other Nonrural were not significant at the middle school levels, at the high school level the differences were significant. These differences support the findings of Webster and Fisher (2000) and Hobbs (1997).

SES and Mathematics Achievement

The results of the analysis of data were consistent among all three middle school grades as well as at the high school level, supporting the multitude of research about the negative effects of low SES on achievement (Alwin & Thornton, 1984; Guo, 1998; Israel, Beaulieu, & Hartless, 2001). At each grade level, schools with highest percentage of economically disadvantaged scored significantly lower than schools with a high percentage of economically disadvantaged, which in turn scored significantly lower than schools with low to moderate percentages of economically disadvantaged students.

A consistent, significant interaction between SES and locale was found for all three middle school grades as well as high school in terms of mathematics achievement. For students in schools with the highest percentages of disadvantaged students, Rural students outscored Other Nonrural and Large Central City schools. Additionally, the gaps in achievement among the different categories of economically disadvantaged students are narrowest among Rural schools and widest across the Large Central City schools.

High School Mathematics Course Enrollment

Analysis of mathematics course enrollment found a greater percentage of males enrolled in the basic courses of Foundations I and II, while females enrolled in Geometry, Algebra II, Advanced Algebra, and Precalculus courses at a significantly higher rate than males. These findings are comparable to data collected by SAT (2003) which found females slightly outnumbering males in high school mathematics courses, but contradict findings of no gender difference in Precalculus by Ansell and Doerr (2000). The difference in enrollment percentages between males and females in courses beyond Algebra I becomes smaller through the mathematics sequence and upon reaching Calculus and Calculus AB, ceases to exist. This supports the findings of Ansell and Doerr (2000) in their study of NAEP data, where a greater percentage of males completed eight or more semesters of mathematics than did females.

No locale differences were found for course enrollment, although location differences were found for two courses: Algebra II and Calculus. In those courses, enrollment was greater in Non Appalachian schools. Barker (1985) investigated course offerings in rural school and found differences in the percentage of schools offering Calculus, but the difference found was much greater than the difference in this study. Although all of the schools in the study offered Calculus, it is possible that larger schools were able to offer more sections of the course and enroll a greater percentage of students.

Limitations

There are several limitations to this study. Overarching limitations will be described first, followed by limitations for each part of the study

Overarching Limitations

The information acquired from the Tennessee Department of Education's 2003 Report Card did not provide the percentage of economically disadvantaged students for all schools. Additionally, schools in their first year of operation had no data from the 2002-2003 school year, nor was data available from schools that closed after the 2002-2003. However, the percentage of schools with missing economic data was minimal and it was assumed that the schools with full data accurately represented the entire state.

Parts One and Two

Forty-three of the 647 schools enrolling sixth, seventh, and/or eighth grade students did not have data available of the percentage of economically disadvantaged students. Twelve of the 276 high schools did not report the percentage of economically disadvantaged students. In both instances, over ninety percent of the schools had complete data in terms of achievement scores.

Part Three

Results of course enrollment are limited by the low response rate of 33.3 percent. Additionally, so few schools in the Large Central City locale category replied that no analysis with those schools could be completed. Another limitation is that several of the schools operating on the block schedule reported enrollment numbers for only one semester of courses rather than the entire year. The possibility exists that although schools from Rural and Other Nonrural locales, Appalachian and Non Appalachian, and varying economical levels were included, the sample does not accurately portray enrollment levels statewide.

Discussion

At the middle school level in Tennessee, the question of gender equity continues to exist. However, with females outscoring males at each grade level in middle school, the focus of the question shifts from how educators can better meet the needs of females to how they can better meet the needs of male students. This gender difference in mathematics achievement is pervasive across SES levels, school locale and school location.

The emphasis of gender equity issues over the past thirty years has perhaps enabled this progress in female achievement, with more teachers aware of prior practices that were not equitable. With an increased awareness that females have not been treated equally in the mathematics classroom in the past, the possibility that more teachers are making a special effort to draw females more actively into the mathematics classroom is likely. There are several other factors that could be responsible for the higher achievement of females in the middle grades. One is the desire of females to please their teachers. A desire to do well would mean females were more diligent about their work and understanding than males. Another reason might be that it is more socially acceptable by peers for females to study and apply themselves in the classroom than for males to do the same.

An interesting interaction between school locale and percent of disadvantaged students found that for the most disadvantaged schools, a rural locale was an advantage to mathematics achievement. This rural advantage disappeared for schools with moderate to low percentages of disadvantaged students. The question as to why this interaction occurs remains unanswered. Smaller schools and a greater sense of community could positively impact achievement, explaining why for economically disadvantaged schools in rural areas perform better. Community involvement, smaller schools, smaller classes provide a more nurturing, caring attitude which can enable students to excel. However, this locale difference does not exist when schools have low to moderate levels of economically disadvantaged students. The question remains as to why a rural locale appears beneficial for the schools with the lowest SES and not the highest.

Class enrollment in high school mathematics courses also reinforce the gender differential, with, in some cases, females even surpassing males. Males enroll in the basic courses, Foundations I and II, at a higher rate than females. These courses are entry level, basic mathematics courses generally taken by freshman or sophomore students. A higher level of enrollment in these courses by males is logical considering that males in middle schools are outscored by females in state measures of mathematics achievement.

Equivalent enrollment levels in Algebra were expected. With the state of Tennessee requiring students to pass an Algebra I test as part of graduation requirements, equal percentages of males and females will take Algebra. Differences in enrollment in courses beyond Algebra show females enrolling at higher percentages than males. The interesting aspect of this gender gap is the difference favoring females decreases as the students progress through the courses. The enrollments drop from an over two percentage point difference, in Algebra II and Geometry, to less than one point for Advanced Algebra and Precalculus, to no significant differences for Calculus and Calculus AB. Perhaps females do not feel the need to pursue mathematics as far as males because they do not see the need or due to their choice of future career.

Enrollment rates in Algebra II and Calculus varied by location. Students in Non Appalachian schools took the courses at a higher rate than did students in Appalachian schools. The difference in enrollment, while significant is small. It is interesting that this difference in enrollment rates does not follow for Precalculus, a course typically occurring between Algebra II and Calculus in the high school sequence. As the enrollment rates in Calculus AB do not differ significantly, perhaps the difference in Calculus enrollment rates can be attributed to fewer Appalachian schools offering both a Calculus and Calculus AB course.

No differences were discovered in course enrollment across locale. Although earlier research found difference in course offerings in rural versus nonrural schools, the basis of these were often school size more than locale. With many rural areas consolidating high schools, the ability to offer a wider variety of courses and more sections of courses has become possible.

The issue of enrollment differences is important as differential course enrollment is often cited as the reason for differing mathematics achievement levels of males and females at the high school level. This study discovered males significantly outscored females in mathematics achievement as measured by the ACT, regardless of location, locale, or SES. With females enrolling in courses beyond Algebra through Precalculus at a higher rate than do males and no gender difference in Calculus, differential enrollment can not explain the achievement difference. There are other factors that could explain the gender difference in mathematics achievement, as measured by the ACT. Perhaps it is more socially acceptable among peers for males to excel in school, mathematics in particular, at the high school level. Equally possible is that it is not as socially acceptable among peers for females to continue to excel in mathematics at this level. Another possibility is the decreased level of self-efficacy females develop towards mathematics as they proceed through the middle grades.

The interaction between the percentage of disadvantaged students and school locale repeated the pattern seen in middle school. Again, in schools with the highest levels of economically disadvantaged students, Rural schools outscored both Other Nonrural and Large Central City schools. In schools with low to moderate percentages of economically disadvantaged students, Other Nonrural school students outscored Rural and Large Central City. With this pattern prevalent over both middle and high schools, it is apparent that there are characteristics of rural schools that improve achievement among the most disadvantaged schools. Exactly what these characteristics are and how they are affecting rural achievement are still unclear. Smaller schools, a sense of community or belonging, and/or smaller class sizes are all possible reasons for higher scores. The most puzzling aspect might not be what these characteristics are, but why are they not producing the same results for rural schools that are not as economically disadvantaged. Perhaps these positive characteristics of rural schools disappear as affluence appears, or perhaps their positive effect is outweighed by a more positive characteristic found in nonrural schools.

The interaction between locale and gender on ACT achievement found the gender achievement gap is significantly smaller for schools in Large Central Cities than in Other Nonrural and Rural locales. The possibility exists that males do not achieve as well in Large Central Cities due to fewer positive male role models. Equally likely is with many households headed by single mothers, females achieving, leading, and having authority might make females in Large Central Cities feel more empowered and more determined to succeed than their male counterparts.

Conclusions

This study adds to the gender issue research base with a focus on mathematics achievement and enrollment in terms of the locale and location. In the past, little research has focused on gender issues in mathematics with a rural slant. The research indicates that females are achieving higher in mathematics in the middle school years while males are achieving higher at the high school level. Course enrollment in the state of Tennessee shows females enrolling at higher percentages than males in courses beyond Algebra II through Precalculus, and no gender difference for Calculus. In terms of rural education, the study found the stereotype of "ignorant" incorrect, with schools in rural locales scoring as well as nonrural schools. In schools with the highest levels of economically disadvantaged students, rural schools outscored nonrural schools (both Large Central City and Other Nonrural).

Implications for Further Research

With the results of this study as a guide, future research can be directed towards answering the broader, qualitative questions concerning what it means to be a female mathematics student residing in rural Appalachia. In addition, deeper investigations of Rural and Other Nonrural schools with varying levels of economically disadvantaged students.

General Research

1.) Replication of this study in other Appalachian States.

2.) Replication of this study in states outside the Appalachian region.

Middle School Mathematics Achievement Research

1.) An analysis of middle school mathematics classes to investigate the differences in male and female achievement.

2.) More detailed comparison of rural and other nonrural schools with highest percentage of economically disadvantaged to investigate differences in achievement.

High School Mathematics Achievement Research

1.) Case studies of schools where females are scoring higher on the ACT mathematics subtest than males.

2.) Specific examination into Large Central City schools to determine why gender differences are less than in Other Nonrural or Rural locales.

Course Enrollment Research

1.) Interview study of males and females to determine why more females enroll in Geometry, Algebra II, and Precalculus.

2.) Longitudinal study of females to investigate differences between females that continue the full mathematics sequence to those who do not.

REFERENCES

References

ACT (2003). *Facts about the ACT assessment*. Retrieved April 7, 2004 from http://www.act.org/news/aapfacts.html.

Alwin, D. F. & Thornton, A. (1984). Family origins and the schooling process: Early versus late influence of parental characteristics. *American Sociological Review, 49*, 784-802.

Ansell, E. & Doerr, H. M. (2000). NAEP findings regarding gender: Achievement, affect, and instructional experiences. In E. A. Silver & P. A. Kenney (Eds.), *Results from the seventh mathematics assessment of the National Assessment of Educational Progress* (pp. 73-106). Reston, VA: National Council of Teachers of Mathematics, Incorporated.

Ballantine, J. H. (1997). *The sociology of education: A systematic analysis* (4th ed., pp. 6-9). Upper Saddle River, NJ: Prentice Hall.

Barker, B. (1985). *A study reporting secondary course offerings in small and large high schools.* Paper presented at a conference at the Rhode Island Department of Education, Providence, RI. (ERIC Document Reproduction Service No. ED 256 547).

Benbow, C. P. & Stanley, J. C. (1983). Sex differences in mathematical reasoning ability: More facts. *Science, 222*, 1029-1031.

Benbow, C. P. & Stanley, J. C. (1980). Sex differences in mathematical ability: Fact or Artifact? *Science, 210*, 1262-1264.

Bickel, R. & Howley, C. (2003). Math achievement and the development of poor, rural areas: Effects of contextual factors intrinsic to the modern world. *Educational Foundations, 17*(4), 83-104.

Braswell, J. S., Lutkus, A. D., Grigg, W. S., Santapau, S. L., Tay-Lim, B., & Johnson, M (2001). Subgroup results for the nation and states. In *The nation's report card: Mathematics 2000.* (pp. 53-110). Retrieved October 30, 2003 from, http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2001517

Caldas, S. J. & Bankston, C. (1997). Effect of school population socioeconomic status on individual academic achievement. *Journal for Educational Research, 90*, 269-277.

Campbell, J. R. & Beaudry, J. S. (1998). Gender gap linked to differential socialization for high-achieving senior mathematics students. *Journal for Educational Research, 91*, 140-148.

Campbell, P. F. & Silver, E. A. (1999). *Teaching and learning mathematics in poor communities.* (ERIC Document Reproduction Service No. ED 452 288).

Chipman, S. F. (1996). Female participation in the study of mathematics: The U.S. situation. In G. Hanna (Ed) *Towards gender equity in mathematics education* (pp. 285-296). Norwell, MA: Kluwer Academic Publishers.

Conlin, M. (2003). The new gender gap: From kindergarten to grad school, boys are becoming the second sex. *BusinessWeek*, May 26, 2003, 74-82.

Crane, J. (1996). Effects of home environment, SES, and maternal test scores on mathematics achievement. *Journal of Educational Research, 89*, 305-315.

Damarin, S. (1994). *Genders, mathematics, and feminisms.* (ERIC Document Reproduction Service No. ED 400 170)

Douglas, S. J. (1994). *Where the girls are: Growing up female with the mass media.* New York: Three Rivers Press.

Edington, E. D. & Koehler, L. (1987). *Are there rural-urban differences in student achievement?* (ERIC Document Reproduction Service No. ED 289 658).

Ethington, C. A. & Wolfle, L. M. (1984). Sex differences in causal model of mathematics achievement. *Journal for Research in Mathematics Education, 15*, 361-377.

Fennema, E. (1996). Mathematics, gender and research. In G. Hanna (Ed) *Towards gender equity in mathematics education* (pp. 9-26). Norwell, MA: Kluwer Academic Publishers.

Fennema, E. (1976). *Influences of selected cognitive, affective, and educational variables on sex-related differences in mathematics learning and studying.* Paper presented at the Annual Meeting of the American Educational Research Association (San Francisco, California, 1976). (ERIC Document Reproduction Service No. ED142906)

Friedman, L. (1989). Mathematics and the gender gap: A meta-analysis of recent studies on sex differences in mathematical tasks. *Review of Educational Research, 59*, 185-213.

Gray, M. (1996). Gender and mathematics: Mythology and misogyny. In G. Hanna (Ed) *Towards gender equity in mathematics education* (pp. 27-38). Norwell, MA: Kluwer Academic Publishers.

Guo, Guang (1998). The timing of the influences of cumulative poverty on children's cognitive ability and achievement. *Social Forces, 777*, 257-288.

Hanna, G. (1989). Mathematics achievement of girls and boys in grade eight: Results from twenty countries. *Educational Studies in Mathematics, 20*, 225-232.

Hanna, G. (2003). Reaching gender equity in mathematics education. *The Education Forum, 67*, 204-214.

Heller, K. A. & Parsons, J. E. (1981). Sex differences in teachers' evaluative feedback and students' expectancies for success in mathematics. *Child Development, 52*, 1015-1019.

Herzog, M. J. R. (1996). *Conditions, attitudes and concerns in rural education: An examination of the Appalachian counties of North Carolina.* Paper presented at the Annual Meeting of the National Rural Education Association, San Antonio, Texas. (ERIC Document Reproduction Service No. ED 411 104)

Herzog, M. J. R. & Pittman, R. B. (1995). *Home, family, and community: Ingredients in the rural education equation.* (ERIC Document Reproduction Service No. ED 388 463)

Hobbs, D. (1981). Rural education: The problems and potential of smallness. *The High School Journal, 64*(7), 292-298.

Hoffer, T. B., Rasinski, K. A. & Moore, W. (1995). *Social background differences in high school mathematics and science courstaking and achievement* (Report No. NCES-95-206).Washington, D. C.: National Center for Educational Statistics. (ERIC Document Reproduction Service No. ED 389533)

Howley, A. (2003). Tried and true: The rural school curriculum in the age of accountability. *The Educational Forum, 16*(1), 14-23.

Howley, C. B. (2002). *A mathematics education researcher's brief guide to understanding rural education research.* Obtained from http://kant.citl.ohiou.edu/ACCLAIM/rc/rc_sub/vlibrary/Guides/MER's%20%guide%20to%20RER.htm

Howley, C. B. & Gunn, E. (2003). Research about mathematics achievement in the rural circumstance. *Journal of Research in Rural Education, 18*(2), 86-95.

Howley, C. B., Howley, A. A., & Hopkins, T. (2003). *Does place influence mathematics achievement outcomes? An investigation of the standing of Appalachian Ohio school districts.* Paper presented at the annual conference of the International Society for Educational Planning, Seattle, WA, October 2003.

Howley, C. B., Strange, M. & Bickel, R. (2000). *Research about school size and school performance in impoverished communities.* West Virginia (Eric Document Reproduction Service No. ED 448968)

Hyde, J. S. (1990). Meta-analysis and the psychology of gender. *Signs: Journal of Women in Culture and Society 16,* 55-72.

Hyde, J. S. & Kling, K. C. (2001). Women, motivation, and achievement. *Psychology of Women Quarterly 25,* 364-378.

Israel, G. D., Beaulieu, L. J. & Hartless, G. (2001). The influence of family and community social capital on educational achievement. *Rural Sociology 66*(1), 43-69.

Jones, L. V. (1987). The influence of mathematics test scores, by ethnicity and sex, of prior achievement and high school mathematics courses. *Journal for Research in Mathematics Education 18*(3), 180-186.

Koblitz, A. H. (1996). Mathematics and gender: Some cross-cultural observations. In G. Hanna (Ed) *Towards gender equity in mathematics education* (pp. 93-110). Norwell, MA: Kluwer Academic Publishers.

Lange, L. & Bickel, R. (1997). *Adolescent stress, coping, and academic persistence in rural Appalachia: The unacknowledged import of early adolescent pregnancy.* Proceedings of the Annual NREA Convention (Tuscon, AZ, 1997) (Eric Document Reproduction Service No. ED 413155)

Leahy, E. & Guo, G. (2001). Gender differences in mathematical trajectories. *Social Forces 80,* 713-733.

Leder, G. C. (1996). Gender equity: A reappraisal. In G. Hanna (Ed) *Towards gender equity in mathematics education* (pp. 39-48). Norwell, MA: Kluwer Academic Publishers.

Leder, G. C. (1992). Mathematics and gender: Changing perspectives. In D. A. Grouws (Ed.) *Handbook of Research on Mathematics Teaching and Learning: A Project of the National Council of Teachers of Mathematics* (pp. 597-622). New York: Macmillan Publishing Company.

Lee, J. & McIntire, W. G. (2000). Interstate variation in the mathematics achievement of rural and nonrural students. *Journal of Research in Rural Education, 16*(3), 168-181.

Lee, J. & McIntire, W. G. (1999). *Understanding rural student achievement: Identifying instructional and organizational differences between rural and nonrural schools.* Paper presented at the Annual Meeting of the American Educational Research Association, Montreal, Quebec, Canada. (ERIC Document Reproduction Service No. ED 430 755).

Lubienski, S. T. (2002). Are we achieving "mathematical power for all?" A decade of national data on instruction and achievement. Paper presented at the Annual Meeting of the American Educational Research Association (New Orleans, LA, 1992) (Eric Document Reproduction Service No. ED 463166)

Lubienski, S. T. (2001). *Are the NCTM Standards reaching all students? An examination of race, class, and instructional practices.* Paper presented at the Annual Meeting of the American Educational Research Association (Seattle, WA, 2001) (Eric Document Reproduction Service No. ED 460862)

Maccoby, E. E. & Jacklin, C. N. (1974). *The psychology of sex differences.* Stanford, CA: Stanford University Press.

Mandeville, G. K. & Kennedy, E. (1993). *A longitudinal study of the social distribution of mathematics achievement for a cohort of public high school students.* Paper presented at the Annual Meeting of the American Educational Research Association (Atlanta, GA, 1993) (Eric Document Reproduction Service No. ED 365517)

Mare, R. D. (1980). Social background and school continuation decisions. *Journal of the American Statistical Association 75*(370), 295-305.

Marsh, H. W. (1989). Age and sex effects in multiple dimensions of self-concept preadolescence to early adulthood. *Journal of Educational Psychology 81*, 417-430.

Marshall, C., Sears, J. T. & Schubert, W. H. (2000). *Turning points in curriculum: A contemporary American memoir.* Upper Saddle River, NJ: Prentice Hall.

Mathis, W. J. (2003). Financial challenges, adequacy, and equity in rural schools and communities. *Journal of Education Finance 29*, 119-136.

Middleton, S. (1993). *Educating feminists: Life histories and pedagogy*. New York: Teachers College Press.

Morrow, C. & Morrow, J. (1995). Connecting women with mathematics. In P. Roberts and G. Kaiser (Eds) *Equity in mathematics education: Influences of feminism and culture.* (pp. 13-26). (ERIC Document Reproduction Service No. ED 391 849)

Mura, R. (1995). Feminist pedagogy in mathematics education. In P. Roberts and G. Kaiser (Eds) *Equity in mathematics education: Influences of feminism and culture*. (pp. 155-161). (ERIC Document Reproduction Service No. ED 391 849)

O'Brien, V., Martinez-Pons, M. & Kopala, M. (1999). Mathematics self-efficacy, ethnic identity, gender, and career interests related to mathematics and science. *Journal of Educational Research 92*, 231-236.

Pallas, A. M. & Alexander, K. L. (1983). Sex differences in quantitative SAT performance: New evidence on the differential coursework hypothesis. *American Educational Research Journal 20*, 165-182.

Reis, S. M. & Park, S. (2001). Gender differences in high-achieving students in math and science. *Journal for the Education of the Gifted 25*, 52-73.

Roscigno, V. J. & Crowley, M. L. (2001). Rurality, institutional disadvantage, and achievement/attainment. *Rural Sociology 66*, 268-293.

Rural School and Community Trust, The (2003). *Why rural matters 2003: The continuing need for every state to take action on rural education,* February 2003. Retrieved November 6, 2003, from http://ruraledu.org/streport/pdf/WRM_2003.

Sadker, D. (1996). Where the girls are. In *Thoughtful teachers, thoughtful schools: Issues and insights in education today* (3rd ed. pp. 28-30). Boston, MA: Allyn and Bacon.

SAT (2003). *College-bound seniors: A profile of SAT program test takers*. Available online http://www.collegeboard.com/about/news_info/cbsenior/yr2003/html/2003reports.html

Schreiber, J. B. (2002). Institutional and student factors and their influence on advanced mathematics achievement. *The journal of educational research 95*(5), 274-286

Schultz. J. (2002). *Mathematics education in rural communities in light of current trends in mathematics education.* Appalachian Center for Learning, Assessment, and Instruction in Mathematics, Working papers obtained February 24, 2003 from http://kant.citl.ohiou.edu/ACCLAIM

Simon, M. K. (2000). The evolving role of women in mathematics. *Mathematics Teacher 93*, 782-786.

Smith, E. D. & DeYoung, A. J. (1992). *Exploratory studies of occupational structure of the workforce and support of public education in rural Appalachia.* Published by Southern Rural Development Center, Mississippi State (Eric Document Reproduction Service No. ED 392586)

Spender, D. (1982). *Invisible women: The schooling scandal.* London: Writers and Readers Publishing Cooperation Society Ltd.

Sprigler, D. M, & Alsup, J. K. (2003). An analysis of gender and mathematical reasoning ability sub-skill of analysis-sythesis. *Education 123*, 763-769.

Tate, W. F. (1997). *Race, SES, gender, and language proficiency trends in mathematics achievement: An update. Research monograph.* National Institute for Science Education (Eric Document Reproduction Service No. ED 472714)

Tennessee Department of Education (2003). *Understanding TCAP achievement test results.* Available at www.state.tn.us/education/tsachgti.pdf

Theobald, P. (1997). *Teaching the commons.* Boulder, CO: Westview Press, a Member of the Perseus Books Group.

United States Department of Agriculture. (2002). *Rural America at a glance.* Retrieved November 6, 2003, from http://www.ers.usda.gov/Publications/rdrr94-1/rdrr94-1.pdf

United States Department of Agriculture (2000). Rural poverty rate declines, while family income grows. *Rural conditions and trends, 11*(2). Retrieved November 6, 2003, from www.ers.usda.gov/Publications/Rcat/Rcat112/rcat112j.pdf

Vermeulen, M. E. & Minor, C. W. (1998). Context of career decisions: Women reared in a rural community. *The Career Development Quarterly 46*, 230-245.

Verna, M. A., Campbell, J. R. & Beasley, M. (1997). *Family processes, SES, and family structure differentially affect academic self-concepts and achievement of gifted high school students.* Paper presented at the Annual Meeting of the American Educational Research Association (Chicago, IL, 1997) (Eric Document Reproduction Service No. ED 410727)

Webster, B. J. & Fisher, D. L. (2000). Accounting for variation in science and mathematics achievement: A multilevel analysis of Australian data. Third International Mathematics and Science Study (TIMSS). *School Effectiveness and School Improvement, 11*, 339-360.

Wellesly College (1992). *How schools shortchange girls. A study of major findings on girls and education. The AAUW Report.* American Association of University Women Educational Foundation, Washington, D. C. (Eric Document Reproduction Service No. ED 339674)

Winters, J. J. (2003). *An examination of eighth and twelfth grade students' mathematics achievement in relation to school locale, county location, looping status, SES, grade and class size, and access to upper-level mathematics courses in Tennessee.* (Doctoral Dissertation, The University of Tennessee at Knoxville, 2003).

Young, D. J. (1998). Rural and urban differences in student achievement in science and mathematics: A multilevel analysis. *School Effectiveness and School Improvement 9*, 386-418.

APPENDICES

Appendix A

Survey Number _____

Student Population by Grade:

Number of Males:	Grade 9:______	Grade 10:_________
	Grade 11:______	Grade 12:_________
Number of Females:	Grade 9:______	Grade 10:_________
	Grade 11:______	Grade 12:_________

Student Population by Mathematics Course:

Course	Males	Females	Not offered
Competency Mathematics (3101)	_____	_____	_____
Foundations I (3130)	_____	_____	_____
Foundations II (3131)	_____	_____	_____
Algebra I (3102)	_____	_____	_____
Algebra II (3103)	_____	_____	_____
Geometry (3108)	_____	_____	____
Advanced Algebra with Trigonometry (3124)	_____	_____	_____
PreCalculus (3126)	_____	_____	_____
Statistics (not AP) (3136)	_____	_____	_____
Calculus (not AP) (3133)	_____	_____	_____
Advanced Placement Courses:			
Calculus AB (3127)	_____	_____	_____
Calculus BC (3128)	_____	_____	_____
Statistics (3129)	_____	_____	_____

Testing Data

ACT	Males	Females
Number of Students	_____	_____
Average Mathematics Subtest Score	_____	_____
Standard Deviation	_____	_____

Summary of Research Results:

Please indicate whether your school would like a summary of the research results when they become available:

__________Yes, our school would like a copy of the results. Please send them by US Mail to our school address.

__________Yes, our school would like an electronic copy of the results. Please send them to our school e-mail address:

__________No, our school does not request a copy of the results.

Appendix B

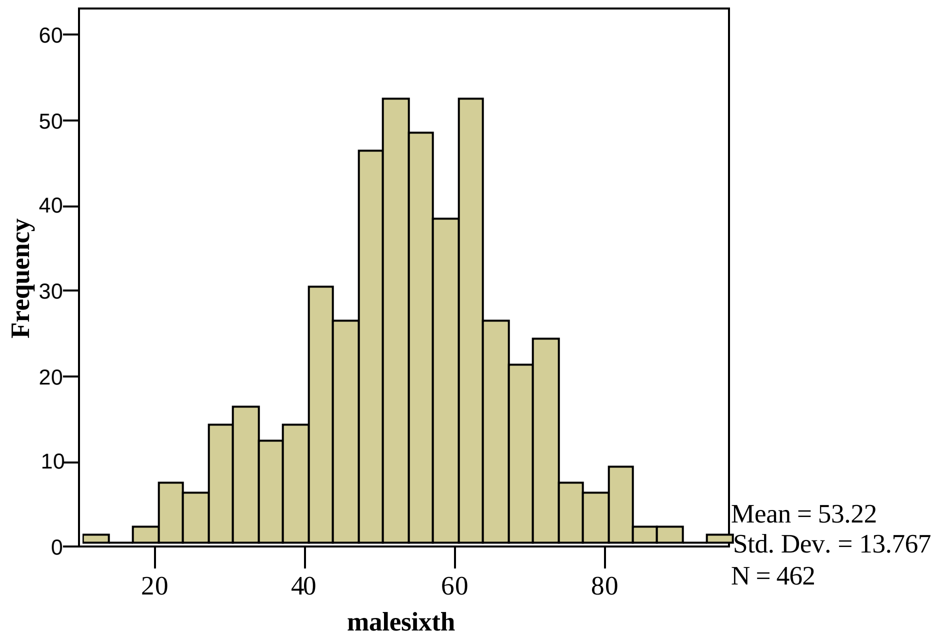

Figure B.1 *Histogram of Male, Sixth Grade TCAP Data*

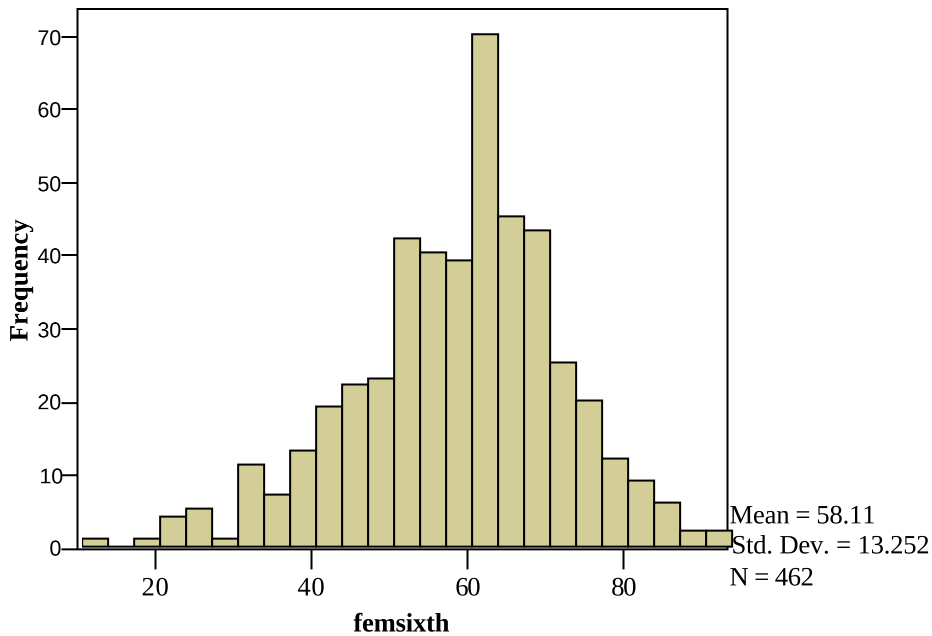

Figure B.2 *Histogram of Female, Sixth Grade TCAP Data*

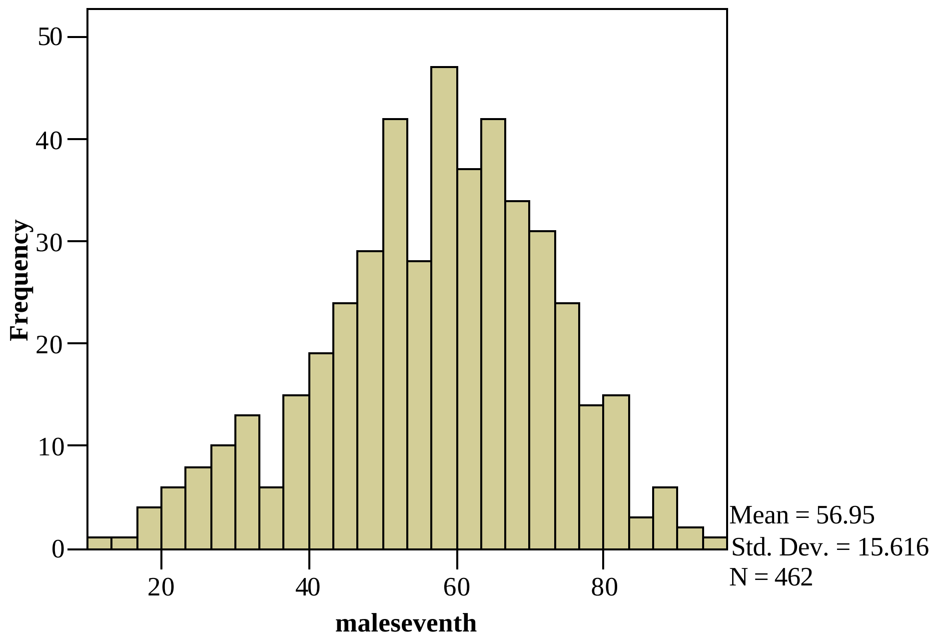

Figure B.3 *Histogram of Male, Seventh Grade TCAP Data*

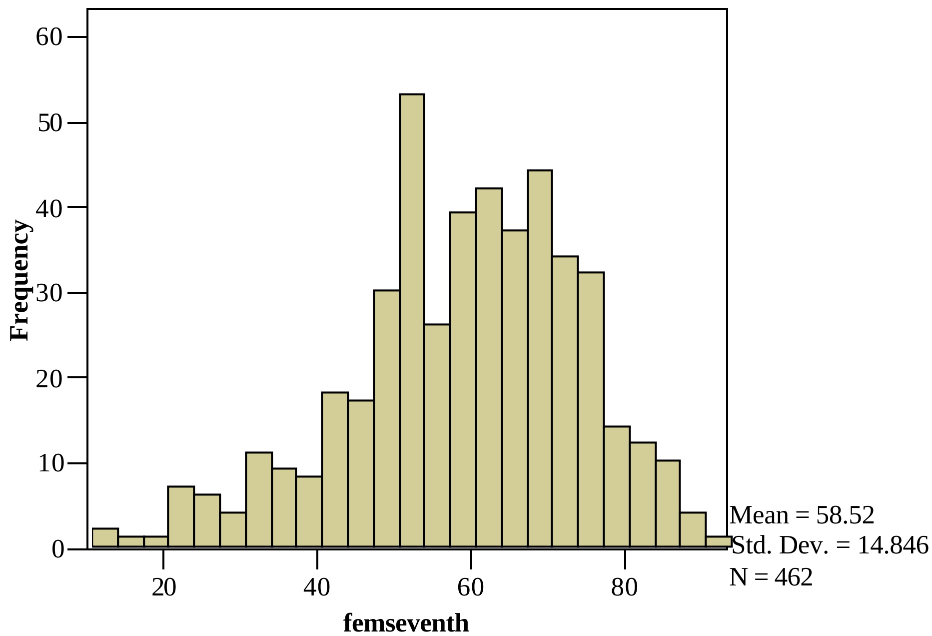

Figure B.4 *Histogram of Female, Seventh Grade TCAP Data*

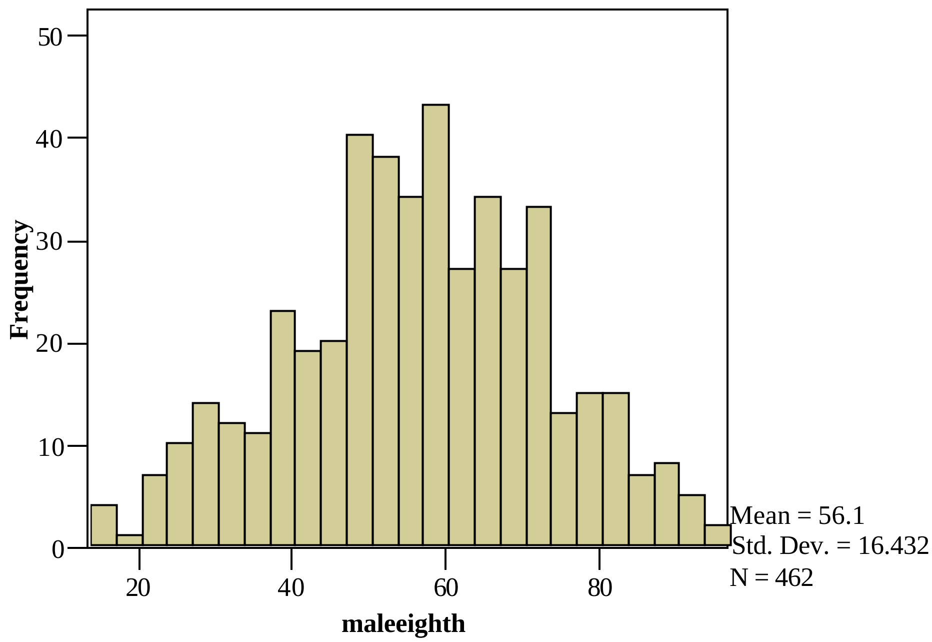

Figure B.5 *Histogram of Male, Eighth Grade TCAP Data*

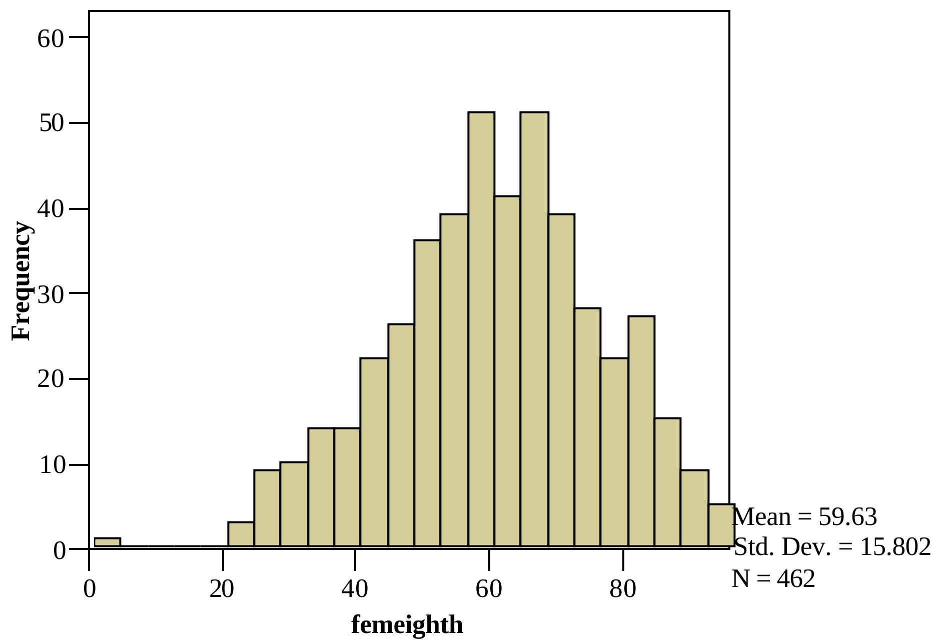

Figure B.6 *Histogram of Female, Eighth Grade TCAP Data*

VITA

Theresa Mandzak Hopkins (Terri) was born in Louisville, Kentucky. She attended school at Washington Elementary in Penn Hills, Pennsylvania; Mill Middle in Williamsville, New York; and Morristown West High School in Tennessee. She received her Baccalaureate Degree in Teaching Mathematics from the University of Tennessee in 1987.

Upon graduation Terri began teaching at North Junior High School (now H. Louis Scott Junior High School) in Decherd Tennessee. During her eight years at North, she taught arithmetic, algebra and honors geometry. Terri left North Junior High to accept a position at Tullahoma High School teaching Honors Probability and Statistics, Algebra II, and Math IV. During her four years at Tullahoma she also taught Foundations II, Honors Geometry, and Precalculus.

In 2000, the Hopkins family moved back to Knoxville, where Terri returned to the University of Tennessee to complete her Master's degree in mathematics education. In her job as a graduate assistant evaluating and working with student interns, she found her true calling. Upon completing her Master's degree, she began her PhD studies in teacher education. After graduating in 2004, Terri accepted a Post Doctoral position at the University of Tennessee.

Terri has been married to John A. Hopkins since 1987. They have one child, Mindy, who is a middle school student with a passion for soccer.