A STUDY OF THE EFFECTS OF GENDER ON MATHEMATICS PERFORMANCE

REGINA MARY WEBSTER

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Allan S. Williams

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A STUDY OF THE EFFECTS OF GENDER ON MATHEMATICS PERFORMANCE

An Abstract

Presented to the

Graduate and Research Council of

Austin Peay State University

In Partial Fulfillment

of the Requirements for the Degree

Education Specialist

by

Regina Mary Webster

March 1996

ABSTRACT

A study was conducted to determine the effects of gender on mathematics performance. Two areas of information were examined. First, professional literature was reviewed. Secondly, past records of Dickson County Senior High School students were studied.

Through the review of literature, it was determined that there is a difference in the mathematical performance of males and females in many areas. This difference was established through the administration of standardized mathematics tests. In each examined study, males consistently outscored females on these tests. Gender differences were also identified through revealed attitudes of males and females. The studies determined that most male students have greater confidence in their mathematical ability.

When past records of DCHS students were examined, the results did not support past studies. It was determined that a greater percentage of female students enrolled in higher level mathematics courses at DCHS. It was also established that female students received higher grades in each of five categories of higher level mathematics courses. Furthermore, in a comparison of the mathematics portion of the standardized TCAP test, it was determined that females again outscored their male counterparts.

Several suggestions were made for the improvement of mathematics education. The most beneficial suggestion was to insure

that all students see the relevance of mathematics. Problem-solving activities should be designed so that students can see the practical purpose of the computations.

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CHAPTER 1

Introduction

Gender differences in mathematics achievement and attitudes have been the subject of much interest and debate in the last several decades. The ideas that males outperform females on standardized tests and that males show a more positive attitude towards mathematics have generally not been the focus of the debate. Rather, the debate has focused on the magnitude of the differences and the source of the differences (Randhawa, 1994). The ability of standardized tests to measure true mathematical achievement has also been a source of debate.

Some individuals subscribe to the idea that males are born with the ability to comprehend mathematics more easily than females. Psychologists have explained sex differences in mathematics achievement by underlying ability. Males and females are sometimes thought to have different styles of information processing involving storage and retrieval capacity and strategy, knowledge representation, planning, and execution (Randhawa, 1993).

Many feel that the attitudes of males and females focusing on mathematics which have been established by society affect mathematics achievement. Nearly everyone has heard the statement, "Males do better in math." Researchers have argued that stereotyping mathematics as a male topic may mediate sex differences (favoring males) in a variety of relevant attitudes such as confidence in learning mathematics and perceptions of its usefulness

(Cherian, 1993). Many researchers feel that attitudes play a critical role in maintaining a continued interest in mathematics. Society views good performance in mathematics of females or males as the exception to the rule, and males are expected to outperform females. Public acceptance of deficient standards are said to contribute significantly to poor performance in mathematics education. Furthermore, peer pressure often makes good performance in mathematics, especially by females, socially unacceptable (Steinback & Gwizdala, 1995).

Much research has pointed to evidence that teacher-student interaction favors males. In many classrooms, boys have received more teacher attention, more praise and blame, and were asked more higher level questions (Harris & Pickle, 1992). This teacher bias may affect the confidence level of female students, therefore, lowering achievement.

Although standardized tests are an accepted measuring device used by educators to assess ability, many have stated a concern that these tests may not accurately show a student's knowledge of a subject, including mathematics. Tests may be biased against females in regard to their construction as well as their administration. Research has suggested that questions are usually derived from the productive world, which is often associated with a male culture, rather than the reproductive world, which is often associated with a female culture (Harris & Pickle, 1992). Furthermore, most standardized tests are timed. Researchers such as Miller, Mitchell, and Van Ausdall (1994) have stated a belief that this time factor is an explanation for the apparent differences in mathematics achievement.

Parental encouragement may also be a source of performance discrepancies in males and females. Parents subscribing to society's beliefs that males are better mathematics students than females may encourage their sons to enroll in mathematics classes, while daughters are encouraged to take liberal arts courses (Steinback & Gwizdala, 1995).

Significance of Study

The need for the equitable treatment of females in the mathematics classroom is beyond dispute. Today, few women are able to stay home and care for children. Women are making up a greater share of the work force than ever before. Women must be prepared to fill a wide variety of positions in our increasingly technical world. Furthermore, if America is to remain competitive in the world market, women must be well trained in mathematical and scientific fields (Pollina, 1995).

Mathematics teachers must do their best to provide all of their students with necessary skills to be a contributing factor in the work force. In order to do this, mathematics educators should be aware of research related to their field. Through the examination of various studies, the determination of the source or sources of male-female mathematics achievement discrepancies can be determined. Research can indicate what factors increase or decrease performance of all students. Research also points to biases. Knowledge of biases is the first step in the elimination of biases.

Much of this study focuses on the students of Dickson County Senior High School in Dickson, Tennessee. The extent of male-female mathematics achievement differences was determined by examining teacher grades and scores received on the mathematics portion of the Tennessee Comprehensive Assessment Program test. Although the information gathered from DCHS will not greatly help educators from other school systems, it is of great benefit to the educators of Dickson County. Each state, each school system, and each school is unique, containing unique students and unique teachers. If a teacher is to provide the best possible education for his or her unique students, knowledge of local statistics can be a great source of information. These statistics pinpoint the strengths and weaknesses of the local program. Through the examination of this data, educators can determine if new techniques are necessary to create equity in their own classrooms.

Research Questions

The following research questions were investigated:

1. Is there a difference in the mathematical ability of males and females?

2. What are the attitudes and beliefs of female students compared to their male counterparts?

3. Do grades in mathematics courses of Dickson County Senior High School students indicate that males outperform females?

4. Do standardized test scores of select Dickson County Senior High School students indicate that males outperform females?

5. What can educators do to provide the best mathematics instruction for all students, regardless of gender?

In order to answer questions 1, 2, and 5, it was necessary to conduct a review of existing literature. Questions 3 and 4 were answered through the examination of student records at Dickson County Senior High School.

CHAPTER 2

Review of Literature

Teachers must attempt to provide the best possible education for all students regardless of sex, race, or socioeconomic background. In order to do this, it is necessary to have an understanding of how students' attitudes and thought processes affect their achievement.

The following is a culmination of the review of the professional literature which attempts to identify and alleviate sex differences in mathematics performance. The review summarizes several studies which were designed to explain how various sex-related characteristics affect performance.

Achievement Differences Based on Underlying Ability

Some psychologists subscribe to the idea that sex differences in mathematics achievement can be explained by underlying ability. In a 1987-88 study, Bikkar Randhawa and Jason Randhawa (1993) attempted to determine on what specific process components in mathematics are boys and girls similar and different.

Randhawa and Randhawa tested fifty-eight boys and sixty-six girls in 1987 and fifty-seven boys and seventy-two girls in 1988. These students were in Grade 10 in a midwestern Canadian province. In May of both years, these students were administered the reading comprehension and mathematics tests of the Canadian Test of Basic Skills. Standard instructions and time limits were strictly followed during the testing sessions.

Items of each test were grouped into content by skill components. The reading comprehension test consisted of two textbook categories and three everyday skill categories of fact, inference, and generalization. The mathematics test consisted of seven content categories: operations, equivalent forms and order, common applications, algebra, geometry and measurement, statistics, graphs and tables, and basic mathematical principles. The skill categories of the test were computation, concepts, and problem solving.

The number of items correctly answered in each microcomponent category of the two tests were counted. Also, content and process component scores for each test were obtained.

To understand the similarities and differences between boys and girls, three types of analyses were performed: factor analysis, regression, and multivariate and univariate analysis of variance. Factor analysis was done for the intercorrelation matrices of boys' and girls' microcomponent scores on the reading comprehension and mathematics tests. Regression analysis was performed using each of the three process components in turn as dependent variable and reading comprehension and the other two process components as predictor variables for boys' and girls' data separately. Three sets of multivariate and univariate analyses of variance were performed using the microcomponents, content components, and process components as dependent variables and sex and year as independent variables.

The results of these analyses suggested that for the problem solving abilities, boys and girls rely on different component processes.

It should be noted that in this study, boys and girls had similar means in reading comprehension. The study indicated that there are sex differences in the manner in which problem solving occurs. Boys seem to rely directly on reading comprehension for these processes whereas reading comprehension for girls serves indirectly through computation and conceptual processes. Girls, it seems, do not generally take advantage of their reading skills in solving mathematics problems.

Items from the test comprising computation were combined into two microcomponents. Boys had a higher mean than girls on computation and on each of the microcomponents. This suggests that there is a generalized difference in computational processes which favor boys in spite of similar mathematics experience and contextual background variables.

A simplistic explanation of sex differences in mathematics achievement from this particular study is that boys have acquired a generally enriched understanding of mathematical process by Grade 10. Cumulative advantage or deficit as a hypothesis for sex differences has already been used as a plausible reason for sociocultural advantages and disadvantages.

<u>Achievement Differences Based on Attitudes</u>

Many scholars feel that gender differences in mathematics achievement can be attributed to attitude differences in males and females. Several studies have attempted to investigate this idea.

One such study examined the gender differences in mathematics achievement, mathematics self-efficacy, and mathematics attitudes of Grade 12 students in Saskatchewan and

Western Australia. This study attempted to determine whether these gender differences are generalized or differentiated by locale.

The Saskatchewan sample consisted of ninety-nine boys and ninety-two girls enrolled in nine Algebra 30 classes (an academic Grade 12 course) in three high schools from two different school jurisdictions in a medium-size city. The age range of the students was seventeen to nineteen years. Students taking Algebra 30 generally have intentions of attending post secondary institutions after completing high school graduation requirements.

The Western Australian sample consisted of forty-nine boys and eighty-five girls enrolled in Mathematics I courses in two public and two private high schools. Mathematics I is one of four Grade 12 courses taught in high schools in Western Australia. The course is intended for those students who want to pursue studies in disciplines that require mathematics but do not require highly specialized mathematics containing calculus.

A mathematics achievement test and two rating scales were used in this study. The mathematics achievement test consisted of forty items. The cognitive level categories measured were: (1) identification of concepts, (2) computation, (3) comprehension of concepts, and (4) application and problem solving. The content areas were: (1) numbers and sets of numbers, (2) powers and radicals, (3) polynomials, (4) solving equations and inequalities, (5) systems of equations, and (6) functions, graphs, and variations.

The Mathematics Self-Efficacy Scale measured students' self-efficacy in performing everyday mathematics tasks, solving mathematics academic problems, and completing mathematics-related high school courses. Students indicated their confidence on a ten-point scale, ranging from "No confidence at all" to "Complete confidence."

The Mathematics Attitude Inventory developed by the Minnesota Research and Evaluation Project team in 1972 was used. It consisted of forty-eight items designed to measure students' attitudes towards mathematics in terms of the underlying factors of perception of their teachers, anxiety, value in society, perception of their abilities, enjoyment, motivation, and a residual factor. Students indicated whether they strongly agreed, agreed, disagreed, or strongly disagreed with each statement.

A multivariate analysis of variance with gender and locale as fixed factors and seven dependent variables was computed. The analysis showed that gender was a significant effect. Means of boys on the three subtests of the Mathematics Self-Efficacy Scale and the two mathematics achievement subtests were significantly higher than those of girls. This indicated that boys were more confident in their ability to do well in mathematics-related courses, to solve mathematics problems, and to be comfortable in applying their mathematical knowledge to daily tasks. Males also performed better than girls on both parts of the standardized mathematics tests. Results from the Mathematics Attitude Inventory indicated that boys have lower mathematical anxiety, put higher value on relevance of mathematics to society, and have higher perception of their ability in mathematics than girls.

In comparing the two countries, the students from Saskathewan had higher means on the mathematics achievement tests and the

Mathematics Attitude Inventory. In the area of self-efficacy, there was no statistically significant mean difference between the two locales.

The researchers of this study stated that confidence in doing a task and the confidence in one's ability in an area of endeavor are critical factors for motivation and persistence. Girls, as a group with significantly lower perceptions of mathematics self-efficacy, are at a greater risk of reduced motivation (Randhawa, 1994).

In 1986-87, another study investigated the effect of attitude on mathematics achievement. In 1986, it was announced that an all-female Catholic secondary school was in its last year of being a single-sex school. It was to be merged with a similar all-male school in the fall of 1987. This presented a unique opportunity to investigate student attitudes in mathematics before and after the change in the school environment. The investigation consisted of two parts. The first year, only female students' attitudes were surveyed using an investigator-constructed instrument. The questionnaire was administered to students in the all-female school as well as to female students in two private mixed-sex schools. Overall, the responses of the students reflected self-confidence in their mathematical ability. Respondents from the single-sex school, however, exhibited a significantly higher degree of self-confidence than those from the mixed-sex schools. When the female students in both settings were asked to express their feelings regarding being in mixed-sex classes, the students frequently mentioned or predicted feeling intimidated, dumb, uncomfortable, and hesitant. Girls from the mixed-sex schools stated that males get more attention than females in their mathematics classrooms.

learners of mathematics daily in the classroom and encourage their future study of mathematics (Steinback 7 Gwizdala, 1995).

In another study, Sherman (1976) reported both boys and girls in grades six to ten tended to view mathematics as a male domain, and girls at all grade levels exhibited less confidence in their mathematical competence than did boys. Further, Fennema and Sherman (1976) argued that stereotyping mathematics as a male topic may mediate sex differences favoring males in a variety of relevant attitudes such as confidence in learning mathematics and the perception of its usefulness. According to Cleveland and Bosworth (1967), mathematics achievement might be related to sex-related perception as early as grade six. These researchers found that girls with high arithmetic achievement scored lower on tests measuring feelings of self-worth, but no causal association was found.

Achievement Differences Based on Teacher-Student Interaction

Several studies have shown that females often have very different experiences in their classes than their male peers. In many classrooms, it has been reported that females receive significantly less praise and fewer direct questions and behavioral warning from their teachers (Cherian, 1993).

In the aforementioned study conducted by Steinback and Gwizdala (1995), both males and females reported that "teachers consider the boys smarter." If this statement is true, this will result in less attention and encouragement being given to females. Teachers may also expect less from the female students. Steinback and Gwizdala stated that the teachers' behaviors can affect the behaviors of the male students. The teacher is the key to establishing a learning environment where all students are encouraged to achieve and all feel safe to take risks so that all might learn.

Steinback and Gwizdala recommended that teachers reflect on their own perceptions of the mathematics classroom environment. Together with their colleagues, they can engage in conversations on these issues. Teachers can also discuss this with their students and share student concerns with fellow mathematics faculty members.

In studies conducted by Sadher, Sadher, and Klein (1986), it was also found that boys receive more teacher attention, more praise and blame, and were asked more higher level questions. On the positive side, it has been observed that teachers are willing to change their behavior when they see gender bias (Harris 7 Pickle, 1992).

Achievement Differences Based on Standardized Test Bias

In each study that was examined, males outperformed females on the standardized tests which were administered. However, many studies showed that on teacher-made tests, there were no significant differences or observed differences favored girls (Randhawa, 1994). This points to the idea that standardized tests may be gender-biased.

One area of bias could be in the actual standardized test questions. The questions on a standardized test may be derived from a male culture rather than a female one (Harris & Pickle, 1992).

Another area of bias could be in how the test is actually administered. Standardized tests are given as timed tests. In 1994, Miller, Mitchell, and Van Ausdall conducted a study to explore the effects of the factor of time on the performance of male and female algebra II and pre-calculus students on SAT-type practice exams. It was noted that although females have higher grade point averages than males in both high school and college, females score considerably lower than males on the SAT exam. The researchers felt that one explanation for this paradox was due to gender bias in the administration of the exam.

Prior research investigations have pointed to the idea that a difference exists in the way males and females solve problems. Fennema and Tarte (1985) concluded that girls tend to draw pictures more frequently than boys. Females are more inclined to place an emphasis on neatness when responding to an item and are more inclined to prefer a slower, more exacting approach. Studies also indicate that boys are more likely to guess at unfamiliar items. These differences could serve to inhibit or distort the achievement scores of females on an exam in which working quickly and educated guessing are important factors. This suggested to the researchers of this study that the time factor was one of the explanations for the differences between males and females in mathematics achievement as reflected by standardized scores.

In this investigation, sixty-four male and seventy-five female algebra II and pre-calculus students from four small, rural county high schools were administered SAT-type practice exams on two separate occasions. On one testing occasion, students were given the SAT practice exam and were limited to the suggested time of thirty minutes to complete the items. On another occasion, students were administered a parallel inventory, but were told there was no time limit.

When the tests were timed, males scored significantly higher than females. This was also true when the tests were not timed. However, the scores of females were significantly higher when time constraints were eliminated. This was not true for the males. This means that females significantly improved their achievement results when told to take as much time as they wanted.

While females' scores did significantly improve when an effort was made to eliminate time as a factor, there remained significant differences between the performance of males and females on the untimed tests which favored males. Since the grades of females in high school often exceed those of males, it is reasonable to conclude that many other gender biases remain (Miller & Mitchell & Van Ausdall, 1994).

Achievement Differences Based on Parental Encouragement

Many of the negative attitudes of females towards mathematics are directly related to the attitudes of society which are passed on by parents. Parents often discourage girls from studying mathematics because it is part of a masculine image. Mathematics is not generally viewed as useful for later careers of girls (Cherian, 1993).

Society (therefore parents) views good performance in mathematics as the exception rather than the rule and expects males to outperform females. Public acceptance of deficient standards contribute significantly to poor performance in mathematics education. Some even view good mathematics performance by females as socially unacceptable. The perception that males are more mathematically inclined may have a negative effect on females' ambition and confidence in mathematics (Steinback & Gwizdala, 1995).

Alleviation of Gender Differences in Mathematics Performance

All available research points to the idea that males outperform females on standardized mathematics tests. Since it is not generally accepted that males are born with more ability, problems may lie in the way girls are treated in the mathematics classroom. Several researchers have offered suggestions to alleviate performance discrepancies.

Harris and Pickle (1992) outlined several guidelines aimed at creating an equitable environment beginning in early grades. These guidelines were general and were not restricted to the mathematics classroom.

According to these researchers, building self esteem should be the fundamental step in the process of obtaining equity. The school must create an environment in which each person is valued and respected. Self esteem can be established by sharing hobbies, pets, special people, and favorite stories. Gender-inclusive language also bolsters self esteem. Adult role models can also be an important resource in the development of self esteem. Women and men in nontraditional roles should be introduced to students.

According to Harris and Pickle, the second step in creating an equitable environment is building cooperation and friendship. This should begin from the moment children enter the classroom each year. Teachers can do this by seating children in mixed gender groups. Teachers should help the groups develop solutions to problems and establish classroom practices that foster group spirit and cooperation. Competition should be reduced.

Finally, ideas and language that stereotype people should be actively and constructively challenged. If certain activities become too earmarked for children of one gender or another, teachers should intervene.

Practices designed specifically for the mathematics classroom have also been suggested. Ann Pollina (1995) stated, "Instead of trying to change the way our female students approach mathematics, science, and technology, we need to study the ways they do learn" (p. 30). Pollina outlined several tips for teaching mathematics in a way to benefit all students, both male and female.

First of all, connect mathematics, science, and technology to the real world. Connecting any subject to the lives of real people and the good of the world is a powerful tool for gaining and maintaining interest. Teachers should establish links with other disciplines and emphasize the usefulness of mathematics.

Secondly, teachers should choose metaphors carefully and allow students to develop their own. Most real world problems which are presented in mathematics classrooms are more closely tied to boys' life experiences. Teachers should present images of mathematics and science that are comfortable and meaningful to girls as well as boys.

Next, teachers should foster an atmosphere of true collaboration. Collaboration does not mean simply pulling desks in a circle. For group work to be effective, all group members must be taught to listen and should be responsible for each other's learning.

The fourth step is to encourage students to act as experts. When the teacher is the touchstone for all knowledge and answers, students are not able to develop self-confidence. Students should be given the opportunity to verify their own knowledge and to critique their own work.

Teachers should allow girls to have the opportunity to be in control of technology. Both boys and girls need to recognize the masculine cast of the computer industry. Girls should be made responsible for such things as making basic repairs on computers or teaching software.

Next, teachers should portray technology as a way to solve problems as well as a plaything. Girls use computers differently than do boys. According to Pollina, few girls will play with a computer just because it is there; most often, girls use computers as a tool. They need to see its relevance to their lives. Girls should be encouraged to play and explore.

According to Pollina, the seventh step in alleviating gender differences in the mathematics classroom is to capitalize on girls' verbal strengths. Students should be encouraged to express the logic behind their solutions in essay or picture form.

Next, teachers should experiment with testing and evaluation. Assessment methods should reflect the research suggesting that girls do not think in linear right/wrong categories. Multiple-choice testing that requires forced choices or contains questions unrelated to real world experiences make no use of girls' ability to synthesize, make connections, and use their practical intelligence.

Pollina stated that the ninth step is for teachers to give frequent feedback and to keep expectations high for all students. Girls may not expect to do well in mathematics and science; therefore, they tend to need more encouragement than do boys. The role of the teacher in praising students and verbalizing expectations is critical. Frequent feedback in the form of homework checks, quizzes, and comments serves to reinforce students' belief in their control of the material.

Finally, teachers should experiment with note-taking techniques. Girls often get so absorbed in taking down every note and diagram that they fail to take part in discussions. Several techniques can counter this tendency such as "no note taking allowed" to handing out copies of lecture notes.

Conclusion

All of the research examined indicated that males outperform females on standardized mathematics tests. However, the source or sources of this performance discrepancy cannot be pinpointed. When determining causes, all research relied on theory.

The male-female performance discrepancy may be caused by underlying ability of males and females. Thought processes may be developed in such a way that females are hindered from learning mathematics in traditional classrooms. Randhawa and Randhawa have researched this theory.

Many researchers stated that achievement differences are related to attitude. Randhawa has tested this theory in a study of two countries. Steinback and Gwizdala also conducted studies examining the effects of attitude.

Cherian, Harris, Pickle, Steinback, and Gwizdala felt that teacher behaviors could determine student achievement. Many students who were studied stated that teachers consider boys to be smarter.

Some researchers felt that females may not perform as well as males because they do not receive the same amount of parental encouragement. Children learn from their parents that mathematics is not a female domain.

There are also researchers who believe that there is no male-female mathematics ability discrepancy. Many feel that tests designed to measure mathematics achievement are biased in their construction and their administration. Miller, Mitchell, and Van Ausdall supported this theory.

Researchers agreed that steps should be taken to alleviate any real or perceived source of achievement discrepancy. Suggestions have been made to alleviate differences; however, until the accurate source of the discrepancy is found, it is not obvious which suggestions to follow.

CHAPTER 3

Methodology

Subjects

The subjects for this study were all students from Dickson County Senior High School who were enrolled in higher level mathematics courses from September of 1972 until May of 1995. 1972 was selected as the starting point because this was the year when Dickson County Senior High School (DCHS) opened.

The courses included in higher level mathematics categories changed as the mathematics department evolved. For the school years 72-73 and 73-74, Algebra II and Advanced Mathematics were the only two higher level mathematics courses. In 1974-75, Algebra II was split into two levels: regular and accelerated. Only Algebra II, Accelerated was considered as higher level. This split only lasted one school year. In the fall of 1976, Advanced Topics was added to the list of mathematics courses. In the fall of 1977, Advanced Mathematics was omitted from the list of upper division mathematics courses, and Trigonometry and Space Geometry were added. The higher level mathematics courses remained Algebra II, Trigonometry and Space Geometry, and Advanced Topics until the fall of 1987. During the school year 87-88, Probability and Statistics was added as a higher level mathematics course. In 1989, Algebra II was again split into two levels. Again, only the accelerated level was considered upper division. During the school year 90-91, Math IV was added to the list of course offerings. During this same year, Space Geometry became

Analytic Geometry. In the fall of 1993, the Dickson County Senior High School mathematics department made its final changes to date as Analytic Geometry became Pre-Calculus and Advanced Topics became Calculus.

For the purposes of this study, the mathematics students were placed in five categories:

Category 1: Students who were enrolled in Algebra II when only one level of algebra II existed and Algebra II, Accelerated when two levels existed.

Category 2: Students who were enrolled in Math IV.

Category 3: Students who were enrolled in Probability and Statistics.

Category 4: Students who were enrolled in Advanced Mathematics, students who were enrolled in Trigonometry and Space Geometry, students who were enrolled in Trigonometry and Analytic Geometry, and students who were enrolled in Trigonometry and Pre-Calculus.

Category 5: Students who were enrolled in Advanced Topics and Calculus.

Procedure

In order to determine the existence and extent of the male-female mathematics achievement discrepancy at Dickson County Senior High School, two sources of information were examined. These sources of information were past grades awarded in mathematics courses and Tennessee Comprehensive Assessment Program (TCAP) test scores.

First of all, past grades were examined. At Dickson County Senior High School, all teachers are required to return grade books at the end of each academic year. These grade books are kept in the records room in the main office of the high school building. With the permission of the superintendent of schools, the grade books of all teachers who taught a higher level mathematics course were examined. For each student enrolled in one of these courses dating from 1972 to 1995, a year average was calculated from the two semester averages that were recorded. For each year, a tally sheet was made to record results. Each tally sheet was divided into a male section and a female section. Averages were tallied for each sex using the following grade categories: 90 to 100, 80 to 89, 70 to 79, 60 to 69, and below 60. These grade categories were used because they corresponded to the standard grading scale which was used in the mathematics department. When making tallies, it was also noted whether the teacher of the course was male or female. After each year was completed, totals for the history of Dickson County Senior High School were calculated. Based on the total DCHS enrollment of females and males each year, percentages of higher level mathematics enrollment were also obtained.

The second source of data was Tennessee Comprehensive Achievement Program test scores. Each Dickson County student takes the TCAP test in the eighth grade and again in the tenth grade. These scores are recorded on the students' permanent records. The scores on the mathematics portion of the TCAP test for each student enrolled in a higher level mathematics course during the 1994-95 school year were examined. Statistical analysis was conducted on both sets of scores for male and female students.

Limitations

A limiting factor exists when using teacher grades. No two teachers teach or evaluate performance in the exact same manner. Each teacher brings his or her own unique experiences and unique style to the classroom. A student may receive an "A" in one teacher's class, while he or she would have received a "B" in another teachers. The data collected cannot reflect teacher differences.

In regard to the information on standardized test scores, several limitations existed. First of all, only standardized scores for the 94-95 school year were readily available. Secondly, the TCAP scores may not accurately illustrate the achievement levels for males or females. The students who have taken the test may have known that a minimum score was not required. Since this test does not affect placement or delay graduation, it may not be seen as important. Therefore, full thought and attention may not have been given to this test; it carried no consequences.

CHAPTER 4

Results

Areas of Comparison

Two sources of data were used for this study. First of all, individual grades from teacher grade books for the years 1972 through 1995 were examined. Secondly, Tennessee Comprehensive assessment Program tests for students enrolled in higher level courses for the school year 1994-95 were compared.

Much information was obtained through the examination of teacher grade books. First of all, it was determined how many male and female students were enrolled in each higher level mathematics course. A grade distribution was made for male and female students in each of the five categories of mathematics courses. In addition, the percentages of males and females who were taking mathematics courses were obtained. Based on the obtained distribution, the percentages of male and female students receiving grades in divisions of 90 to 100, 80 to 89, 70 to 79, 60 to 69, and below 60 were also computed. Using the grade books as the source of information, the percentages of students taught by male and female teachers were also calculated.

As a final basis of comparison, TCAP test scores were used. The mathematics portion of this test was used to determine if Dickson County males outperformed females on standardized tests. The determination was made based on arithmetic means. Two means were calculated for males and females. One mean represented the eighth grade test scores and one represented tenth grade scores.

Research Questions

Do grades in mathematics courses of Dickson County Senior High School students indicate that males outperform females?

In order to answer this question, several distributions, percentages, and arithmetic means were obtained. First of all, information obtained from teacher grade book was organized. The mathematics courses were divided into five categories. Category 1 was Algebra II, Category 2 was Math IV, Category 3 was Probability and Statistics, Category 4 was Advanced Mathematics, Trigonometry and Space Geometry, Trigonometry and Analytic Geometry, and Trigonometry and Pre-Calculus, and Category 5 was Advanced Topics and Calculus. The grades for these courses were distributed into the five grade divisions. A summary of the information for female students can be found in Table 1, and the information for male students can be found in Table 2.

Through a comparison of the data in Table 1 and Table 2, it can be concluded that more females than males enrolled in higher level mathematics courses in fifteen out of the twenty-three years in which Dickson County Senior High School has existed. During the 1990-91 school year, an equal number of males and females were enrolled in the five categories of courses. For the remaining seven years, more males were enrolled. It can also be observed that a greater number of female students received an average of 80 or greater in each of the five course categories. Furthermore, a greater number of female

TABLE 1: COURSE ENROLLMENT OF FEMALE STUDENTS AT DCHS

YEAR	CATEGORY 1					CATEGORY 2					CATEGORY 3					CATEGORY 4					CATEGORY 5					TOTALS
	90-100	80-89	70-79	60-69	0-59	90-100	80-89	70-79	60-69	0-59	90-100	80-89	70-79	60-69	0-59	90-100	80-89	70-79	60-69	0-59	90-100	80-89	70-79	60-69	0-59	
72-73	20	9	3													12	4									48
73-74	11	13	2		1											11	6	5	1							50
74-75	22	28	3	1												6	5	3								68
75-76	24	16	10	4												11	17	5								87
76-77	9	17	12	4	1											15	9	6			7	7				87
77-78	29	16	7	5	2											6	11	5	1	1	3	5	2			93
78-79	12	22	13	4												10	12	6			5	4	2			90
79-80	12	23	15	8	3											4	8	5		1	4	7	2	1		93
80-81	10	13	12	3	1											5	10	9	1		4	3				71
81-82	7	20	12	3	2											6	10	8	3		4	5				80
82-83	11	11	11	4												4	5	10			5	4	1	1		67
83-84	1	8	14	1	4											4	9	16	1		5	8	1			72
84-85	8	14	16	6	2											7	15	15	1		3		5	1		93
85-86	16	30	30	12	5											4	8	10	1	2	2	2	1			123
86-87	15	24	18	7	11											3	7	9	3	1	8	4				110
87-88	10	19	24	20	6						5	6	1			7	7	3			3	4	4			119
88-89	13	23	25	15	26						1			1		4	5		2		4	3	3	1	2	128
89-90	12	17	6	4	3											8	8	2			5	1	1			67
90-91	4	1	8				5	2	1		1	4				11	9	3			4	4	1			58
91-92	6	7	5	1	2											5	10	5	1		6	3		1		52
92-93	14	21	11	4	4	6	7	6	1							8	3	2	2		1	5		2		97
93-94	14	17	16	9	8	2	7	10								10	13	8	3	1	5	2				125
94-95	11	10	12	1	1	13	19	11								13	13	3			4	4	1	1	1	120
TOTALS	291	379	285	116	82	21	38	29	2	0	7	10	1	1	0	174	204	138	20	6	82	75	26	8	3	1998

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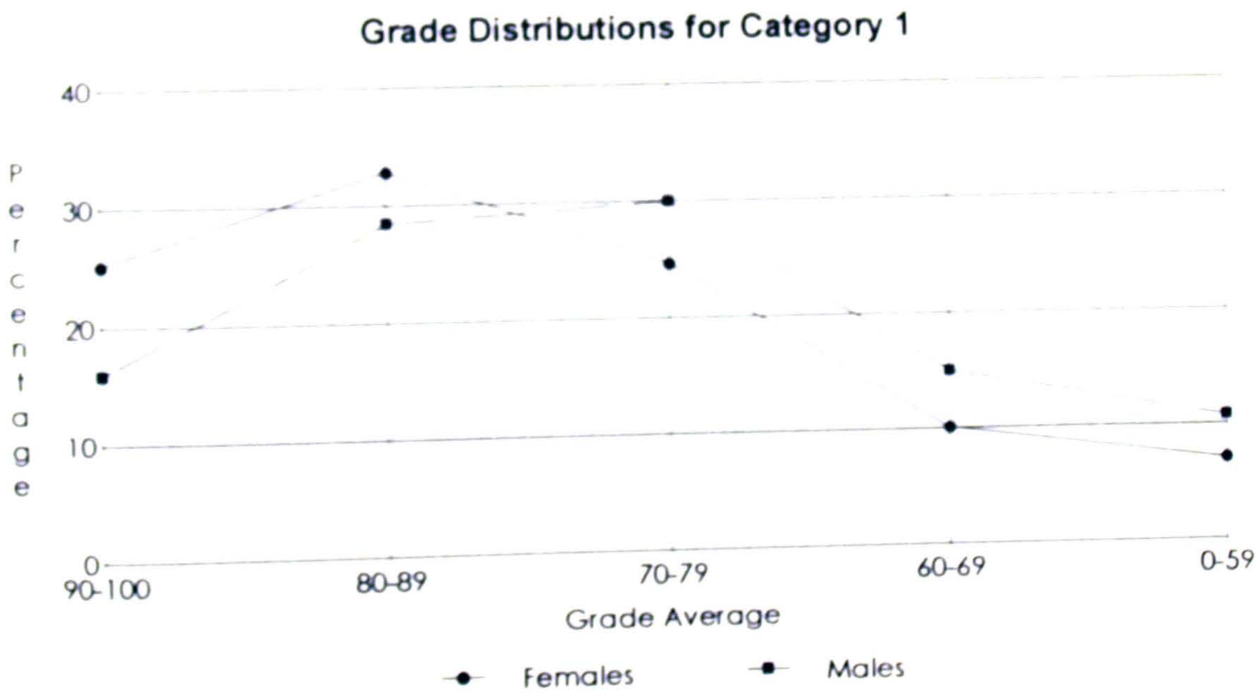
TABLE 2: COURSE ENROLLMENT OF MALE STUDENTS AT DCHS

YEAR	CATEGORY 1					CATEGORY 2					CATEGORY 3					CATEGORY 4					CATEGORY 5					TOTALS
	90-100	80-89	70-79	60-69	0-59	90-100	80-89	70-79	60-69	0-59	90-100	80-89	70-79	60-69	0-59	90-100	80-89	70-79	60-69	0-59	90-100	80-89	70-79	60-69	0-59	
72-73	11	9	5													12	9	1								47
73-74	11	17	8		2											5	13	10	1	1						68
74-75	8	16	8	5	3											5	13	4	2	1						65
75-76	11	22	13	5	4											10	15	4	1	1						86
76-77	6	13	15	6	3											9	8	14	2		4	5	1			86
77-78	11	19	16	7	2											6	9	4	1	2	6	2		1		88
78-79	3	21	14	11	2											6	8	8	2	2	5	4				86
79-80	3	10	16	13	12											4	10	14	6		4	4	2	1		99
80-81	6	8	12	5	2											3	9	6	1	2	3		4	1		62
81-82	11	16	24	6	3											3	7	7	3	1	2	4	6			93
82-83	4	12	8	4	4											7	9	9	4	2	2	2	4	1		72
83-84	1	1	9		2											3	8	5	9	3	1	3	1			46
84-85	3	9	15	6	3											1	7	12	6	2	4	4	1			73
85-86	9	21	31	12	11											3	2	5	4	3	2	5	2	1	1	112
86-87	14	28	18	14	4											6	10	10	1	1	3	2	2			113
87-88	12	11	19	14	8						6	4	5	5	1	9	9	5	1		6	5	2	1		123
88-89	7	13	18	16	21						1		1	2		1	3	8	1	2	4	3	9	2		112
89-90	6	6	9	2	2											2	7	4	1	1	1	1	4	1		47
90-91	1	6	5	1	1	1	4	5	2		2	1				6	8	5	1	3	1	3	1	1		58
91-92	7	5	6	3												12	7	5	5	1	3	2	1			57
92-93	6	9	9	3	5	1	7	6								7	5	4			2		1	1	1	67
93-94	4	3	4	7	9		6	9	1							2	8	11	1	3	2	2	4	1	1	78
94-95	11	5	9	7	3	3	17	15		2						7	2	2	1	1	2	1	3	2		93
TOTALS	166	280	291	147	106	5	34	35	3	2	9	5	6	7	1	129	186	159	54	32	57	52	48	14	3	1831

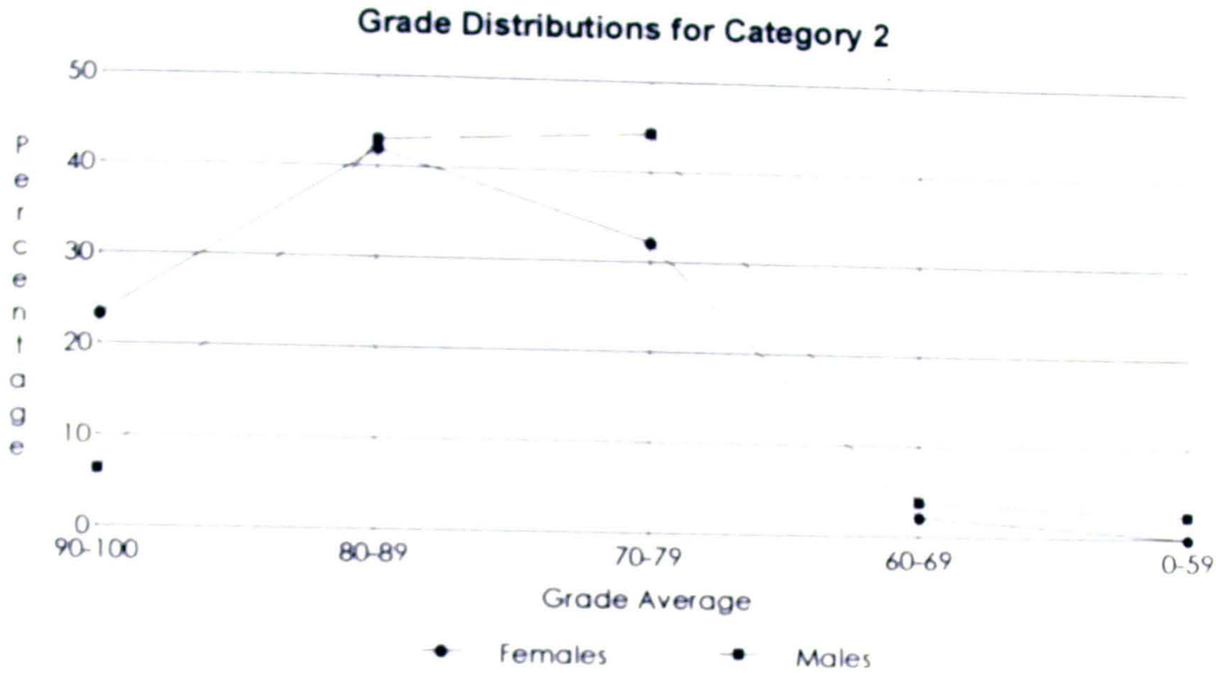
students received grades of 90 to 100 in every category except Category 3, a category with a very small number of entries. In this category, nine males received a grade of 90 to 100, while only seven females scored in this range. It can also be observed that more males received failing grades in every category except Category 5. In this category, the numbers of male and female failures were equal.

A second area of comparison involved grade distribution. Percentages of males and females receiving grades of 90 to 100, 80 to 89, 70 to 79, 60 to 69, and below 60 (0 to 59) for each of the five course categories were calculated. After the percentages were obtained, they were graphed and compared. The results of these comparisons were illustrated using line graphs (Figure 1 (a)-(e)).

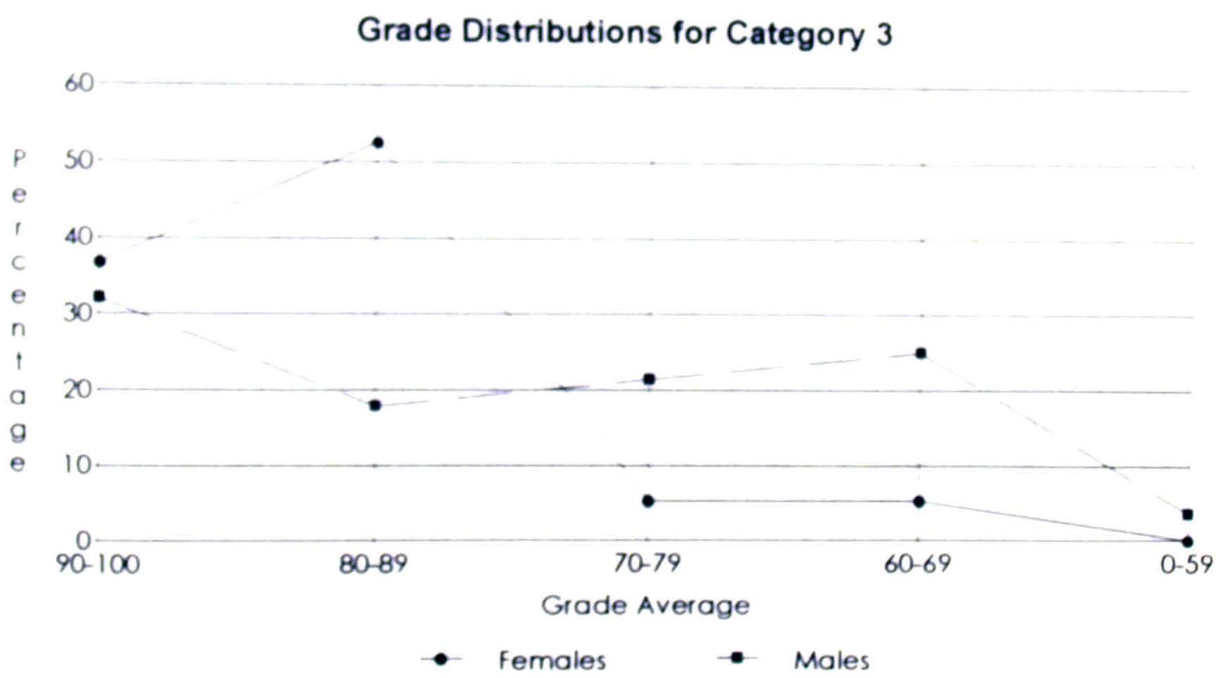


(a)

Figure1: GRADE DISTRIBUTIONS FOR COURSE CATEGORIES

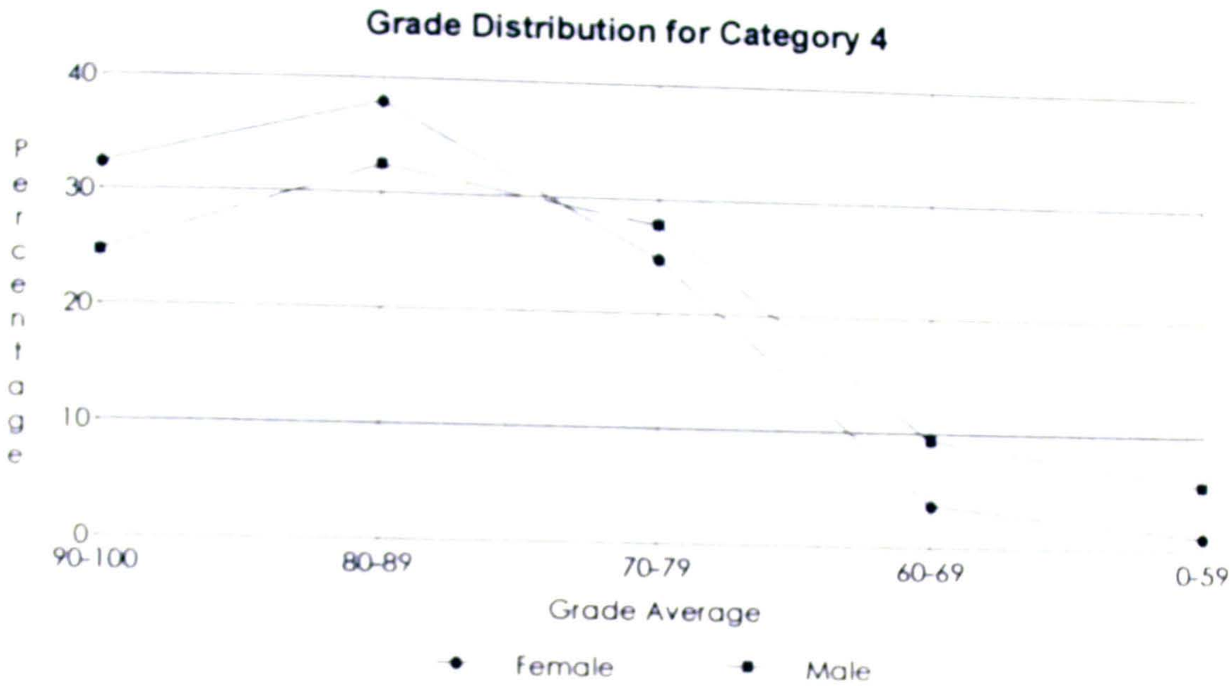


(b)

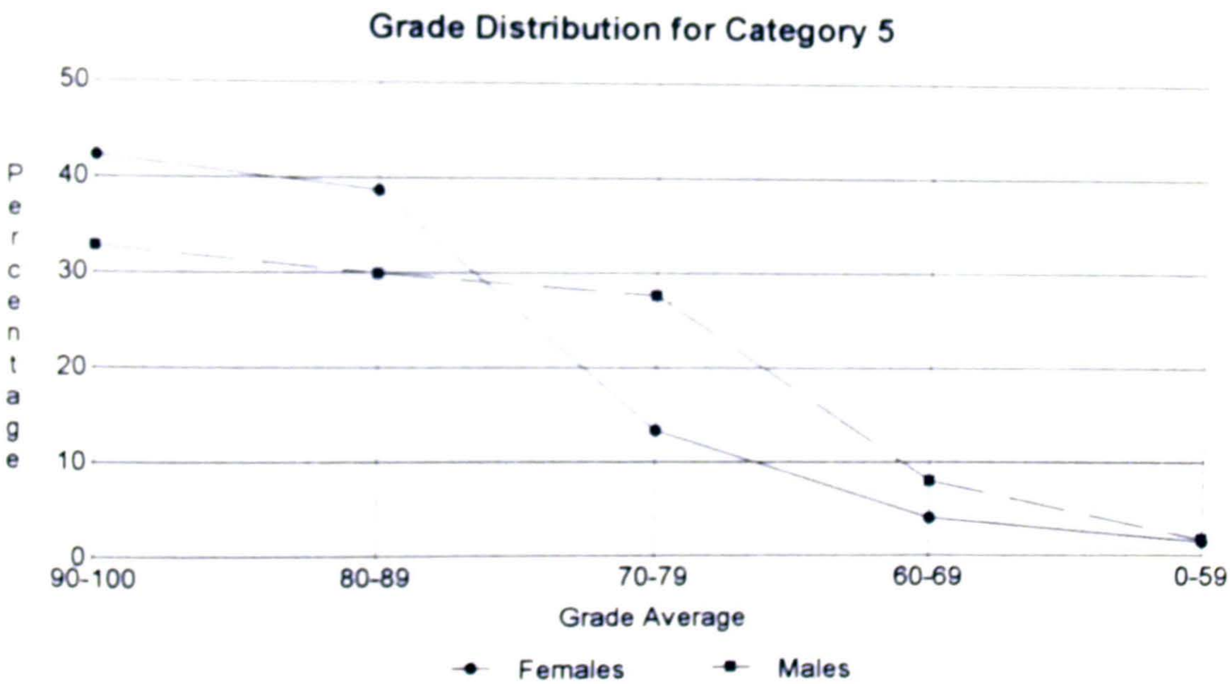


(c)

Figure 1: GRADE DISTRIBUTIONS FOR COURSE CATEGORIES (continued)



(d)



(e)

Figure 1: GRADE DISTRIBUTIONS FOR COURSE CATEGORIES (continued)

From Figure 1. (a)-(e), it is obvious that a greater percentage of girls received grades of 90 to 100 in every course category. A greater percentage of females also received grades of 80 to 89 in every category except Category 2 (Figure 1. (b)). In this category, the difference in the percentage of males and females was 0.8%. It was also observed that a greater percentage of male students received grades in the 0 to 59 range in every category.

In addition to examining grade distributions, the percentage of males and females enrolled in higher level mathematics courses was calculated each year. In order to do this, the total enrollment of male and female students for each year of the school's history was obtained. The results of these calculations were illustrated using a bar graph (Figure 2).

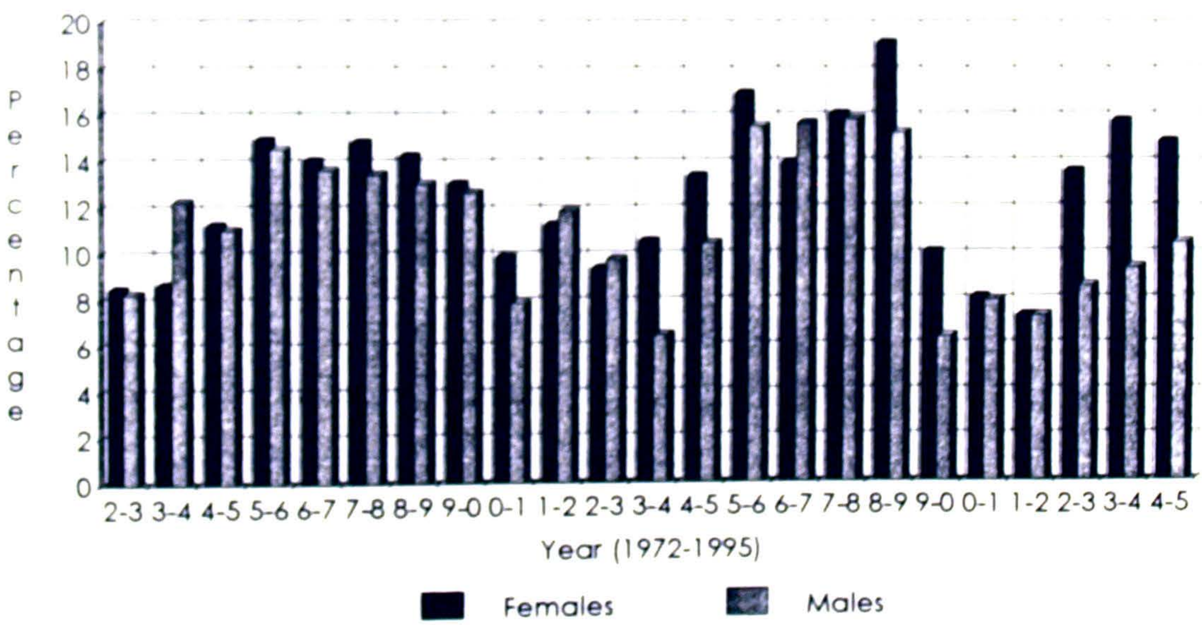


Figure 2: PERCENTAGE OF HIGHER LEVEL MATHEMATICS ENROLLMENT

From Figure 2, it can be observed that a considerable fluctuation occurred in the area of mathematics enrollment for both male and female students. It can also be observed that a greater percentage of female students were enrolled each year except 1973-74, 1981-82, 1982-83, 1986-87, and 1991-92. During the 1973-74 school year, the percentage of males enrolled in higher level mathematics courses was 12.3% while the percentage of females enrolled was only 8.7%. In 1981-82, the male percentage was 0.6% higher than the female percentage, and in 1982-83, the male percentage was 0.4% higher. In 1986-87, the male enrollment was 1.7% greater than the female enrollment, and in 1991-92, the percentage of males enrolled was equal to the percentage of females enrolled.

Through the examination of teacher grade books, it was also determined that most higher level mathematics students at Dickson County Senior High School are taught by female teachers. For the courses examined, 83.4% of the students were taught by female teachers, while only 16.6% were taught by male teachers.

From the information obtained from teacher grade books, it can be concluded that females outperform males at Dickson County Senior High School on grades given by the teachers. In every area of comparison, the results were the same.

Do standardized test scores of select Dickson County Senior High School students indicate that males outperform females?

The standardized test which was used in this study was the mathematics portion of the Tennessee Comprehensive Assessment Program test. The students whose scores were examined were those enrolled in a higher level mathematics course during the 1994-95 school year. An arithmetic mean test score was obtained for males and females for their eighth grade years and tenth grade years.

The number of female higher level mathematics students who took the test in the eighth grade was one hundred and ten. The mean percentage score on the mathematics portion of the TCAP test was 81.01.

The number of female higher level mathematics students who took the TCAP test in the tenth grade was one hundred and ten. The average percentage score on the mathematics portion of the test was 81.52.

The total number of male students who took the TCAP test in the eighth grade was eighty-six. Their average percentage score on the mathematics portion of the test for this year was 80.19.

The number of male students who took the TCAP test in the tenth grade was eighty-seven. Their average percentage score on the mathematics portion of the test was 79.44.

In both the eighth and tenth grade years, the female students outscored the male students. This contradicts the results of all examined studies which indicated that males score consistently higher on standardized mathematics tests.

It was also observed that the female students' percentage average increased slightly from the eighth grade to the tenth grade. On the other hand, the male students' average decreased from the eighth grade to the tenth grade by .75 percentage points.

CHAPTER 5

Summary, Discussion, and Recommendations

Summary

This study was conducted to determine the effects of gender on mathematics performance. In order to do this, two types of research techniques were used. First of all, professional literature was examined. Through this examination, it was determined that males outperform females on standardized mathematics tests. It was also revealed that males are more often encouraged to enroll in mathematics courses and that males have more confidence in their mathematical ability. As a second source of research, the mathematical performance of past Dickson County Senior High School students was determined. The results of this exploration conflicted with the conclusions drawn from the review of professional literature. When past DCHS records were compared, it was found that more females enrolled in higher level mathematics courses. It was also determined that the females outscored the male students on teacher-determined measuring instruments. Furthermore, when comparisons were made on a specific standardized test (the mathematics portion of the TCAP test), it was again determined that female students outperformed male students.

Discussion

The analyses within this study were for five main purposes. First, the researcher sought to determine if a difference in mathematical ability of males and females existed. Secondly, the researcher sought to establish comparisons in the attitudes and beliefs of female students with their male counterparts. Next, the researcher sought to determine if Dickson County Senior High School male students outperformed female students on grades given by the teacher. As a fourth purpose, the researcher sought to determine if Dickson County Senior High School male students outperformed female students on a selected standardized test. Finally, the researcher sought to determine methods of providing the best mathematics instruction to all students.

Through a review of professional literature, it was not definitely determined that a difference in mathematical ability of females and males existed; however, it was determined that there is a difference in the area of mathematical performance. In every previous study that was examined, males consistently outscored females on standardized tests. Several theories were presented to explain these results, but none were proven. Randhawa and Randhawa (1993) suggested that the difference in performance could be explained by underlying ability. They felt that males and females differ in the use of specific information processing components. Cherian (1993) theorized that performance discrepancies could be explained by biased teacher-student interactions. It was determined that females receive less attention and less praise in many mathematics classrooms. It was also stated by Steinback and Gwizdala (1995) that both male and female students reported that "teachers consider boys smarter." Harris and Pickle (1992) presented the theory that the standardized tests themselves are biased against females. They felt that the standardized test questions are derived from a male culture rather than a female one. Miller, Mitchell, and Van Ausdall (1994) theorized that the way in which standardized tests are administered is a source of bias. Finally, it has been theorized that parental encouragement can be a source of performance discrepancy. Society views mathematics as a male area rather than a female one. This idea is passed on by parents.

When results of studies related to attitude were examined, it was determined that males were more confident in their ability in doing well in mathematics related courses and in solving mathematics problems. It was also determined that males were more comfortable in applying their mathematical knowledge to daily tasks. Boys were determined to have lower mathematics anxiety. Males also seem to put higher value on the relevance of mathematics to society and have higher perceptions of their ability in mathematics than girls (Randhawa, 1994). It should be noted, however, that research involving attitudes can be questioned. Attitude is an unobservable trait. Only the effects of attitude can be measured.

When data was collected on students from Dickson County Senior High, many interesting conclusions were drawn. First of all, it was determined that a greater percentage of female students were enrolled in higher level mathematics courses. This did not support the belief that parents and society as a whole do not encourage females to pursue mathematics. Furthermore, a greater percentage of female mathematics students is not a recent trend at Dickson County Senior High. A greater percentage of females have been enrolled in higher level mathematics courses nearly every year since the school was built.

It was also determined that female DCHS students outscored male students in higher level mathematics courses. This outcome did not totally conflict with the results of available research. Many studies have shown that on teacher-made tests, there were no significant differences between the performance of males and females or the observed differences favored females (Randhawa, 1994).

In the area of standardized tests, the Tennessee Comprehensive Assessment Program (TCAP) test was used as a basis of comparison. The TCAP scores of students who were enrolled in higher level mathematics courses for the school year 1994-95 were the most readily available; therefore, they were used to establish the comparison. This test was administered during each student's eighth grade year and tenth grade year. For both of these years, the female students outscored the male students; however, the mean scores were very close. It was interesting to observe that the female students' scores increased slightly in the tenth grade from the eighth grade. It is often believed that females fall farther behind males mathematically as they age. The results of this comparison conflicted with this belief. The mean score of the male students decreased during their tenth grade year, thus, making the female gains appear even greater.

It can be argued that TCAP test scores are not the best measure of mathematical ability. First of all, the mathematics portion of the test is very basic. There are few or no problem-solving questions which require higher level thinking skills. Secondly, students face no consequences for poor performance on TCAP tests. For this reason, results may not be conclusive; students may not put forth their greatest effort.

It should be noted that results from DCHS students may be atypical because of the composition of the mathematics department faculty. During each year of the school's existence, the higher level mathematics courses have been taught predominately by female teachers. A total of 83.4% of the higher level mathematics students have been taught by females, while only 16.6% have been taught by male teachers. This indicates that most students at DCHS have a female as a "mathematical role model" rather than a male.

A final purpose of this study was to determine methods of providing the best mathematics instruction to all students. Many suggestions were provided in reviewed literature. First of all, it was stated that teachers should eliminate biases in their own behavior. Teacher should be aware of their questioning techniques and their use of praise. It was stated that teachers are willing to change their behavior when they see gender biases (Harris & Pickle, 1992). The most useful suggestion was to relate mathematics problems to practical situations. Every student, regardless of gender, is able to comprehend mathematics more easily when its relevance can be seen.

Recommendations

First, all educators should be aware of data related to their subject matter and their particular school. Even though published literature may suggest that males outperform females in a particular area, it is important to realize that every school is unique, and every student is unique. Educators should always beware of generalizations. A true knowledge of a school will allow the educators to see where strengths and weaknesses lie. When areas of need are identified, then methods for improving instruction can be developed.

As a second recommendation, teachers should be aware of their own practices. They should monitor their use of questioning and praise techniques. Teachers should always make an effort to call on all students equally.

Thirdly, when presenting a lesson, teachers should not focus on a particular sex. For example, if a teacher attempts to teach to females in order to alleviate gender differences, a bias towards males could be created. The teacher should attempt to provide the best possible education for all students regardless of gender.

Teachers of mathematics or any other subject should strive to make their subject relevant to all students. Students can learn more easily if they see a purpose for the learning. Problem-solving activities should be designed to be meaningful to males and females.

As a final recommendation, teachers should constantly review literature that pertains to their subject. Meaningful activities and improved methods of evaluation are constantly being developed. Teachers must continually improve to insure that each student is receiving the best education to prepare him or her to be productive citizens in our ever-changing society.

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VITA

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She is presently employed by the Dickson County Board of Education as a mathematics and art teacher.