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Title: AN ANALYSIS OF GENDER-RELATED, ATTITUDINAL FACTORS AFFECTING PARTICIPATION AND ACHIEVEMENT IN THE ESU MATH DAY COMPETITION

Abstract approval: Connie S. Schrock

The purpose of this thesis is to investigate the affect of student's attitudes on participation and achievement at an annual, university-sponsored, high school mathematics competition. The investigation focused mainly on how each gender's achievement correlated with these attitudinal factors. The affect of other significant factors, such as mathematical background, educational and occupational ambitions, and how school sponsors select the contestants, were also considered.

The mathematics competition used was the 1992 Emporia State University Donald L. Bruyr Math Day. The subjects of the study consisted of a nearly equal number of participants in ESU Math Day and non-participants from each cooperating high school. Both of these groups completed the Fennema-Sherman Mathematics Attitudes Scales (FSMAS) to determine their mathematical attitude. Each student who competed in an individual algebra or geometry test had their results analyzed with their FSMAS attitude score in each of nine categories using an analysis of variance. The following is a summary of the conclusions derived from the study: 1. Among both males and females, a more positive mathematics attitude enhances performance at math competitions; 2. Males who score well at math contests are more self-confident, believe they receive more support from teachers and parents, believe mathematics is more useful, rewarding, and challenging, and are much less anxious about tests than males who do not fare well; 3. Females who finish higher at math contests feel more encouraged by their mathematics teachers to succeed than females who do not fare well; 4. Males are much more comfortable if others know that they did well at mathematical endeavors than females; 5. Females of all mathematical abilities

and males of lower ability believe that mathematics is gender-neutral; however, high-achieving males feel that females are not as capable or as reliable and that mathematics is a male domain; 6. In general, the genders have little difference in overall mathematical attitudes; however, males that finish in the top 30% at math competitions have a significantly better mathematical attitude and have taken more mathematics classes than top 30% female finishers; and, 7. Females come to competitions with different priorities than males do, being motivated towards grades, not competition awards.

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DEDICATION

Many thanks to my loving parents, Dr. D. Kent Hurn and Janice M. Hurn, for encouraging me to succeed and to pursue my dreams. Also, in loving memory of my grandfather, Ernest L. Spencer, a wonderful man who inspired many things in the people his life touched.

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INTRODUCTION

During the late 1970's and early 1980's, a great deal was written and discussed about gender discrimination in mathematics. Recently, the topic has become widely discussed again in journals and books about mathematics education issues. A few possible explanations for the key differences in achievement between the sexes are discriminate attitude levels about mathematics and unequal participation in upper-level mathematics courses. Because mathematics is often the "gatekeeper" for emergence into a wide number of occupations in the 21st century, it is important to know as much as possible about the correlations between genders, participation, and achievement in mathematics. A common place to enhance and display newly acquired mathematical ability for high school students is at university-sponsored contests, where males have long enjoyed distinct advantages in final test score results.

It is widely believed that a student's attitude about learning a particular subject is a crucial aspect of obtaining and retaining that subject's key knowledge. Thus, attitudes largely affect both the learning of mathematics and its ultimate selection as a long-standing course of study. This research will attempt to measure the specific attitudinal categories that affect achievement at mathematical contests for each gender, along with attempting to discover the reasons for these dissimilarities by surveying the teachers and sponsors involved. Additional information collected in this study will include many of the other possible factors positively correlated to mathematics contest achievement, including the number of mathematics courses taken, post-secondary career plans and expected educational attainment level, and the methods teachers used to select the contest participants.

STATEMENT OF THE PROBLEM

The problem addressed in this study was to determine if the mathematical attitudes of males and females were a possible explanation for apparent male superiority at mathematics contests, or if other identifiable factors are more prevalent. Males participate more in university-sponsored mathematics competitions than females and also win a disproportionate share of the top prizes. Explanations about the dissimilarities that exist between top performers within each gender and for the various participation groupings have thus far been incomplete in arriving at acceptable answers for why this achievement problem is occuring. The factors of mathematical background advantages, educational goals as motivation, and the methods that teachers employ to select contestants have been hypothesized as potential contributors to the achievement differences, but never fully researched.

RATIONALE FOR THE STUDY

The need for research concerning the topic of how each gender's attitudes toward mathematics affect performance at contests during secondary school years was suggested by a review of related literature into gender differences and their causes. A majority of the literature available, however, deals only with investigations about gender differences and achievement or about mathematics contest performance, but not both. Because of this lack of specific investigation into the correlation between achievement and attitudes at mathematics contests, ESU's annual Donald L. Bruyr Math Day proved to be an appropriate vehicle for the necessary research, because it was easily accessible and the results of past years were available for comparisons.

The population for the research described above was high school students, at participating schools in ESU Math Day, in grades nine through twelve, who were currently enrolled in mathematics courses. A few eighth graders from large schools with advanced placement capabilities in the middle school mathematics curriculum were also included.

RESEARCH QUESTIONS AND NULL HYPOTHESES

The overall intention of this study was to examine the correlation between achievement and performance at mathematics contests in algebra and geometry against each gender's math-related positive attitudes and other factors, such as the number of mathematics courses a student has taken. This research was aimed at using comprehensive data from actual test results to determine if differences existed among the groups in the study, which included four separate headings when non-participating students were incorporated into the instrument. The research questions are presented here in the form of five null hypotheses that are stated as follows:

H_o (1) : That students of each gender finishing in the top 30% at ESU's 1992 Math Day individual competitions will not have a more positive attitude than those students who finish in the lower 70%, on each of the following parts of the Fennema-Sherman Mathematics Attitudes Scales:

a) Confidence in Learning Mathematics Scale (C);

b) Attitude Toward Success Scale (AS);

c) Mathematics as a Male Domain Scale (MD);

d) Effectance Motivation Scale (E);

e) Mathematics Usefulness Scale (U);

f) Mother Scale (M);

g) Father Scale (F);

h) Teacher Scale (T);

i) Mathematics Anxiety Scale (A);

j) Total of the nine scales together (TOTAL).

H_o (2) : That those females finishing in the top 30% at ESU's 1992 Math Day individual competitions will not show a statistically significant difference, in the ten Fennema-Sherman Mathematics Attitudes Scales listed in H_0 (1), to the males who finish in the top 30%.

H_0 (3) : That when considering how attitudes affect participation in ESU's 1992 Math Day contest, there is not a statistically significant difference among the positive attitudes scores of the possible combinations of the four different categories, participating males (PM), participating females (PF), non-participating males (NM), and non-participating females (NF), as found by the TOTAL from the Fennema-Sherman Mathematics Attitudes Scales.

H_0 (4) : That for each of the other two research variables that can affect performance, the courses - taken score (CTS) and the expected level of education score (ELS), a statistically significant difference cannot be found between the possible combinations of the four categories PM, PF, NM, and NF, as described in H_0 (3).

H_0 (5) : That those females finishing in the top 30% at ESU's 1992 Math Day individual competitions will not show a statistically significant difference to the males who score in the top 30% on the topic of the courses - taken score (CTS).

SAMPLE AND POPULATION

The sample for this study were male and female students from high schools across the state of Kansas. Every student who participated was currently enrolled in a mathematics course, although a substantial portion of them who were surveyed did not attend ESU's 1992 Donald L. Bruyr Math Day. The students were in grades eight through twelve and in mathematics courses ranging from General Math to Differential Equations I (through a neighboring college). A total of

600 students took part in this study, with the attitudes survey portion taking place at their school settings. Of these students, 310 were participants in ESU's Math Day activities (52%) and 290 were non-participants (48%). By design, these non-participant students were enrolled in classes where Math Day participants were found, but for whatever reason did not attend ESU's 1992 Math Day. Therefore, the students in the study have differing levels of mathematical background and usually participate at only a few mathematics contests each year, mainly because few university-sponsored mathematics contests are available to them. Everyone involved in the research took the same Fennema-Sherman Mathematics Attitudes Scales survey as part of their participation.

The population was every pupil at the high schools that contained students coming to ESU's Math Day who was enrolled in a mathematics class of any type. Any student in a class that contained students coming to ESU's Math Day were encouraged to complete a survey. Participation of each school and every student was voluntary.

CHAPTER TWO
REVIEW OF THE LITERATURE

CAREER ASPIRATIONS

In the studying of mathematics education issues, the need to better understand the relationship of gender-related differences is well-known. Although some research has been done on how genders and attitudes are related specifically to achievement and participation in math competitions, recent studies have added to our current knowledge of the gender issue. The following provides an overview of the important literature that has been published in this area.

First of all, a wide range of studies has focused on the role of mathematics in the career aspirations of women. In order for most students to study and pursue mathematics, they need to believe that it will provide them with occupational opportunities beyond high school. Pedro, et.al., in 1981, discovered perceived usefulness of mathematics to be a substantial predictor of plans of study for the males in high school, but not for the females. Sells (1980) found that knowledge of mathematics is largely responsible for "having created occupations that are segregated by sex." Thus, females who are not as mathematically prepared as much as males are effectively "filtered" out of the competition for those careers.

Females comprise forty-seven percent of the U. S. work force, but only sixteen percent of those women employed are in professions requiring a high degree of mathematical competence, while the percentages for men are nearly twice that much, at twenty-eight percent (Statistical Abstract of the U.S., 1989). These statistics involve nearly every scholastic category, for even females with high academic ability lag far behind high-ability males, as noted by Hollinger, who stated that, "high-achieving females ... avoid math/science careers because such careers are stereotypically masculine" (1983).

Other authors concur, such as Sherman, who stated that women avoid mathematical careers mainly because of gender-role orientation (1983).

It must be understood that these "women and career" studies are often controversial for a variety of reasons. Astin, in 1984, and Farmer, in 1985, both claim that most of the career development theories bantered about are appropriate for describing middle class males only. This makes defining women's career aspirations difficult, for it has been common to drop women from longitudinal studies because they get married (and often change names) or quit working (Wilson, 1981).

These rtesearch difficulties are most unfortunate, because the potential exists for young females to have an active interest in mathematically-connected fields. Actually, Farmer (1985) stated that young girls at or near junior high age actually have higher career motivation than boys. However, this higher motivation declines for most females in secondary school. This means a lower percentage of girls continue plans to pursue math-related occupations, with the girls citing math anxiety that resulted in a poor mathematics attitude as the primary reason (Kreger, 1988). An absence of math anxiety, according to Calvert, in 1981, seems to correlate strongly to the choice of mathematics as a career. Additionally, high mathematics anxiety exists much more frequently in females. Dew, et.al., concurred, finding that females in mathematics courses have a higher anxiety level than males, which did not affect their in-class performance much, but certainly adversely affected their attitude about mathematics (1983). However, it should be acknowledged that, according to Meece, et.al., in 1982, "males are less likely to report anxiety" than females. That fact notwithstanding, females confirm that the societal conception of mathematics being "masculine" was the most popular reason that they do not pursue careers in mathematics (Luchins and Luchins, 1986). This carries to adulthood, as noted in 1979 by Fennema, who documented that dramatically more males use mathematics daily, especially more advanced work (more complicated than simple arithmetic). To continue Fennema's research, in 1980, Brush found that the genders differ substantially in career interests and about the importance of mathematics in their own future. Explanations for this have ranged from differences in mathematics aptitude being slanted toward males, to more encouragement for boys from parents and teachers, to the higher mathematics confidence level of males. The bottom line, according to Fennema, is that "females, as compared to males ... underestimate their ability to solve mathematics," creating gender-related differences in career aspirations that need not exist (Fennema, 1981a).

ACHIEVEMENT MOTIVATION OF WOMEN FOR MATHEMATICS

Almost as a direct result of the increasing importance of women becoming involved in mathematics and related careers, the trend is for females to take more mathematics courses in high school in the 1980's (Smith and Walker, 1988). As a result, "more women are getting bachelor degrees in mathematics" (Nichols, 1991). This increased female participation is a welcome change, because a meta-analysis of 30 studies about gender differences in mathematics achievement and participation, comprised of studies completed from 1968 to 1988, showed that 61% of the studies favored superior male achievement (while 34% favored females) (Hines, 1989). Elizabeth Fennema, in her Fennema-Sherman Mathematics Attitudes Scales report, gave evidence in 1976 to support the idea that mathematics achievement has been correlated mostly to the following factors: level of parental support, attitudes toward math and the belief that mathematics is a male domain, level of teacher support, student confidence level and perceived usefulness of mathematics, and the controversial notions of innate ability and lack of test-taking skills. Also, interestingly, in a study by Peterson and Fennema in 1985, it was concluded that girl's mathematics achievement was correlated negatively to competition.

MATHEMATICS ATTITUDE RELATED TO ACHIEVEMENT / GENDER

The main intent of this research is to study how mathematics achievement correlates with students' attitudes; thus, it is pertinent to review the current literature on gender and attitudes. In the widely recognized instrument for assessing students' mathematics attitudes, the Fennema-Sherman Mathematics Attitudes Scales (FSMAS), it is stated that "an increasing number of students who are qualified intellectually are deciding not to study mathematics ... and that many more girls than boys make this decision. Attitudes affect both electing to study mathematics and its learning" (Fennema, 1976). Pedro, et.al. (1981), found conclusively that there is a strong positive correlation between a positive attitude and achieved mathematical success and between a negative attitude and math failure. Also, it was detected that attitude is the single largest influence on mathematics achievement, and that this more strongly affected males than females (Ethington and Wolfle, 1984). Davis and Rimm confirmed these findings in 1985, concluding that males are more interested in mathematics, thus scoring better when achievement is perceived to be crucial. Apparently, males are better able to transmit interest and positive attitudes in mathematics into higher results on standardized tests and mathematical competitions.

Where this problem of differential attitudes between the genders starts is a perplexing question. Overall, students in the United States have a positive attitude toward mathematics and do not perceive it to be a male domain (Travers and McKnight, 1985). Differences found in elementary grades in mathematical attitudes are also related to mathematics achievement. In fact, the less a girl perceives mathematics as a "male subject" in the important grades of fifth through eighth, the better her ability to problem solve in high school will be (Sherman, 1980). Sherman, a few years later in 1983, performed a longitudinal study about female's mathematics attitudes starting after two or three years of high school mathematics. The study was culminated mostly in the year following graduation, and Sherman found that as students take more mathematics courses, anxiety decreases and mathematical attitudes increase sharply. Normally, however, males take more mathematics and are "very single-minded in their pursuit of mathematics," while women are "more sensitive to social obligations and peer pressures" (Maines, 1982). This is important, because Chipman, et.al., showed in 1985 that students who enroll in optional mathematics courses achieve at a higher level than those who do not. Maines also found that " females ... seem less consumed by math, studied less, and rarely make math part of their leisure time activities like boys do " (1982). Ethington and Wolfle's 1986 attitudes surveys, using a very large sample (Men, N=7643; Women,N=8912), found that positiveness "leads to greater achievement for men than it does for women " (Ethington, 1986).

The research on this achievement / attitude relationship spans the spectrum of possibilities. Coutts, in a 1988 dissertation, related that high-ability males and high-ability females alike had a more positive mathematical attitude than lower-ability students. Additionally, low achievement, especially among older children, is positively correlated with the mathematical attitudes of self-confidence, usefulness, and how much they like mathematics (Weinstein, 1985). With our advancing technology, and ever-shrinking world, it is alarming that gender differences associated with secondary students and their positive mathematical attitudes now also correlate positively with proficiency in computers (Lockheed, et.al., 1985). Also, in 1990, in response to a growing concern, Bradford examined study characteristics about research on students' mathematical attitudes and found a lack of the Hawthorne effect, the notion of the study itself affecting or causing the results to happen because of the fact the subjects are being studied. An overview of the literature "substantiates a correlational relationship between student achievement and student attitudes" (Reyes, 1988). To summarize the findings, Hines states, "Males, in comparison to females, are typically less math anxious, have more positive attitudes about math, and exhibit expectations of success in mathematics" (1989).

To study these attitudes, the researcher selected the Fennema-Sherman Mathematics Attitudes Scales (FSMAS), a standard assessment for testing mathematics attitudes. Beginning in 1976, the FSMAS was tested on 1600 secondary students in two Madison, Wisconsin schools. Fennema and Sherman point out, as does Henerson, et.al., that attitudes are just "snapshots", portraits of what a person's attitude is at a particular moment in time (1978). Also, it is duly noted that attitudes are a constantly changing entity. The Fennema-Sherman scales are still considered to be the established standard in assessing these "snapshots", for in 1981, Broadbrooks, et.al., ran a "construct validity study" of the FSMAS and found evidence to support the theory behind the scales and that the scales were still current. They also speculated that the instrument would be valid for many years.

PARTICIPATION IN MATHEMATICS BY GENDER

Accordingly, one of the most definitive problems has been in recruiting women to participate in mathematics beyond the minimum requirements. In 1985, Armstrong identified three factors that affect participation of students, and four explanations for the existence of the problem. The affective factors were: (a) a positive attitude toward math; (b) perceived usefulness for math; and (c) the positive influence to continue mathematics by parents, teachers, and counselors. The four explanations included: (a) lack of ability; (b) negative mathematics attitudes; (c) perceived lack of usefulness for math; and (d) the discouraging social issues involved with being "mathematically gifted".

A case about participation in mathematics was made by Fennema, who said, "The one variable which can be positively identified as causing sex-related differences in mathematics learning is the differential number of years females and males spend formally studying and using mathematics" (1976). It is believed that the fact that women do not see the usefulness of mathematics is one of the reasons for this course-study difference. Females' fears and lack of self-confidence often inhibit performance in mathematics and deter them from taking more than the required number of courses (Fennema, 1983). Accordingly, roughly seven-eighths of the relationship between gender and twelfth-grade math achievement is attributed to the number of and quality of math courses taken (Wise, 1985). Wise claimed other important predictors of math achievement that show gender gaps included mathematical attitude and interest in the subject.

The statistical data backs these findings, for Elstrom, et.al. (1988), reported gains by females, but still substantial results slanted to males in grades 7-12: in 1972, males took 4.22 math courses on average, females 3.63; in 1982, males took 3.88 on average, females 3.52. While the gap between the genders narrowed and males' average courses taken suffered a greater drop, the fact remains that males take more mathematics courses in high school. In 1988, the College Entrance Examinations Board reported that 63% of college-bound males had taken four full years of high school math, while only 36% of college-bound females completed four years.

These figures indicate a lack of equal participation by the genders, not in the ability of females. In fact, despite their apparent high ability, females avoid upper-level high school mathematics courses (Vogel, 1990). Not only are females not taking the upper-level high school courses, but they are not completing math-related degrees in college either, for only 19% of those mathematicsdegrees conferred are awarded to women (Wise, et.al., 1979). Actually, as the material in mathematics courses becomes more difficult in upper-level courses, gender differences in achievement increase, prompting more females to discontinue mathematical study (Vogel, 1990).

The trend that mathematics becomes for males is one that begins at an early age. In elementary school, females start out ahead of or very close to males on achievement, especially in arithmetic, then decline steadily from eighth grade through high school (Marshall, 1983). One of the main causes for this appears to be the fact that mathematics becomes identified as a male domain. Lockheed, et.al., feel this gender-typing of mathematics as masculine directly leads to lower female participation in mathematics (1985). This is crucial, because "females who view mathematics as sex-appropriate outperform those who viewed mathematics as a male domain" (Vogel, 1990). Clearly, there is evidence that differential coursework accounts for a considerable amount of the gender difference in mathematics.

BASIC GENDER DIFFERENCES

Of course, the majority of the math education literature related to genders attempts to spell out the different ways males and females learn. Benbow and Stanley published in 1980 a finding that implied the existence of some important differences in the mathematical abilities of males and females. They had a firm conviction that middle school students have basically the same educational experiences, yet each succeeding year thereafter shows males scoring significantly higher than females on various mathematics examinations. Benbow's 1988 follow-up study showed that the results are current, claiming that numerous gender differences in mathematics achievement, particularly in high school, favor males. These achievement differences are minimal, it appears, in younger students, but a substantially larger proportion of eighth to twelfth grade males achieve higher than females, according to the results of the National Assessment of Educational Progress in 1986. Dorsey, et.al., found that in problem-solving, males had an advantage, while if well-known procedures can be followed to solve a problem (such as computational arithmetic), this gives females an edge (1988).

The well-publicized research has reported a wide gambit of characteristics that can be confusing because of the many inconsistencies. In elementary school, both boys and girls feel that their own gender is better at mathematics than the other gender (Ernest, 1976). Parsons believes these early years are important, stating in a report that rate of maturation, well-known to be more rapid in girls, leads to a more natural, progressive development of skills that might help the boys succeed more later (1980). As recently as 1989, it has been theorized that more fetal testosterone early-on in a pregnancy may be a key factor in the creation of more mathematically gifted males (Hensel). However, Benbow and Stanley, in 1988, studied these patterns during students formative years and found that the environmental explanations for better male achievement are remarkably familiar ones: female's negative attitude and anxiety towards mathematics, parents' and teachers' encouragement of males more than females, and the fact that females take fewer mathematics courses than males do. Additionally, females exhibit more "learned helplessness" characteristics in relation to their achievement in mathematics (Wolleat, et.al., 1980). These females attribute "effort" to explain their mathematical successes and (lack of) ability to explain their failures - both of which are considered to be "unstable-type" responses, because they do not give themselves enough credit for mathematical knowledge when they succeed and they blame themselves when they fail. Conversely, males attribute their success to ability and failures to task difficulty, both considered to be "stable-type" responses, because they accept credit for having the knowledge to succeed and look outward for blame when they fail (Fennema and Leder, 1990).

Other factors may also be contributing to the current gender differences. Armstrong's research found that while males have very clear problem-solving advantages by the time they reach secondary school, it might be the result of out-of-school learning, not differences in course-taking (1985). Also cited as possibilities for greater male performance were higher motivation, perseverance, and self-confidence. Some researchers, such as Marshall and Smith, believe girls are more receptive to and pick up quicker on routines, so they receive fewer detailed instructions and less attention from educators (1987). Fennema concluded that this does not just occur in mathematics courses, but that boys also acquire practice when they apply crucial mathematical concepts and problem-solving skills in science and computer classes, where boys outnumber girls also (Fennema, 1981b). Another possibility is that it is more acceptable for boys to challenge existing rules, and in doing so, they reach a better understanding of mathematics (Walden and Walkerdine, 1985). Gitelson, et.al. (1982), believe boys' achievement expectations are not usually affected by subsequent performance, while females are.

One of the primary concerns of some researchers is the notion that the way they evaluate achievement may inherently yield certain gender advantages or disadvantages. Marsh, et.al., in 1987, continued work first begun by Dwyer (1979) and developed a theory that males naturally do better on multiple choice tests in math, especially in problem-solving. They feel the main reason for this is because most distractors are common conceptual errors, not methods of problem-solving operations. As a result, boys can make computational errors as long as they select the correct operation (a strength of boys already), while girls more often will select incorrect choices despite good computation (a strength of girls). The theory continues that girls' errors are found among the distractors; boys' errors are not, so boys try again, usually with some success (possibly also because boys are more persistent on these tests). Another contributing factor may be that high school students, by gender, regardless of actual performance, perceive the level of difficulty for a test item differently; males think the problem is less-challenging than females do, which leads to more success (Sherman, 1980). Dwyer (1979) contends the gender of a character in a problem is irrelevant, for boys are nearly equally more likely than girls to solve a problem correctly if the character is male or female. Skolnick, et.al. (1982), however, did note a significant skewing factor in that girls leave answers blank far more often, being afraid to be wrong and feeling that guessing is not appropriate. Girls, however, generally do better when told it is okay to guess; boys do not, as they guess anyway.

Whatever the causes for these differences, some researchers believe these various test results help explain why high school students of both genders stereotype mathematics as being a subject primarily for males (Brush, 1980; Boswell, 1985). One likely by-product of this, claim Roberts, et.al. (1987), is a stronger relationship between self-image and mathematics achievement for boys. Another result is, "the public believes the differences in performance of mathematics is due primarily to innate ability", according to the National Research Council, in 1989. However, the public is apparently wrong, as Fennema and Leder (1990) assure educators that there is nothing inherent which keeps girls from dealing with mathematics as well as males.

CONFIDENCE IN MATHEMATICS

As self-image about mathematics decreases for females, so does confidence in the subject. Fennema and Sherman (1977) discovered males have significantly higher confidence in their abilities to do mathematics. Fox (1980) reported that when considering students who have low mathematics test scores, the females will score even lower on confidence scales than males - a key component, because with less confidence, a person naturally uses mathematics less later in life. Actually, middle school students are a good case study, for girls have lower confidence in their math skills during these years, even though the achievement scores are still comparable - yet soon, confidence accounts for a full one-fifth of the variance in the gender's mathematics achievement (Fennema and Sherman, 1978). A summary of key literature "points out that confidence is one of the more important affective factors relative to achievement" (Vogel, 1990).

INFLUENCE OF PARENTS

Students receive gender-type messages from their parents that may affect math achievement and attitudes as well. Eccles and Jacobs (1986) found that, next to students' attitudes about mathematics and its usefulness, students are most influenced by their parents' perceptions of how tough mathematics was for them. Eccles went on to write that, for females more than males, mothers' beliefs appear to be more crucial than fathers', and that these parents' attitudes together are more important than past mathematics grades in elementary school to the student, a finding seconded by separate research (Phillips, 1987). One study found that achievement-related attitudes of females are related to the perceptions of their cognitive abilities an appreciable amount more than males (Stevenson and Newman, 1986). Also, according to Parson and Ruble (1977), the influence of parents' performance expectations begins earlier and is stronger for boys than girls. Indeed, parental expectations have consistently been linked to students' eventual career aspirations (Armstrong, 1985). The evidence was definitive that parental influence affects students in several key ways, including role modeling, direct encouragement, and expression of positive attitudes toward mathematics.

It is possible that parents do certain specific things that help create "gender gaps" in mathematics achievement. These types of specific traits are usually transmitted unintentionally, for children use adults as role models, especially their parents, who often display math-related behaviors that children imitate (Macoby and Jacklin, 1974). Parents play an important role in female achievement when they expect less and accept poorer performance from their daughters (Hensel, 1989). Also, when compared to parents of boys, girls' parents are less likely to attribute good math performance to superior training and effort than to ability (Holloway and Hess, 1985). Additionally, in contrast, boys' parents view mathematics as the most important subject for their child, while the parents of girls many times do not (Parsons, Adler, et.al., 1982). Possibly to develop math skills, subconsciously, parents buy toys and games for boys that enhance thinking-type behaviors, while not doing likewise for girls (Hensel, 1989). In summary of the research available about the parents' role, Eccles, in 1986, concluded that parents think math is not as useful for girls and often more difficult for them. Teaming with Jacobs, Eccles stated an assurance that parents are affected by the research they read or hear about regarding their children, meaning educational literature may inadvertantly be a contributing factor (1986).

STANDARDIZED SCORES

In very real terms, often the disparate gender differences equate into superior scores for males on standardized tests. The causes are often elusive, but the recorded data concerning the actual scores is incontrovertible. A recent meta-analysis of mathematical ability as it relates to predicting college performance surmises that simple explanations about the superiority of either gender is impossible (Hyde, et.al., 1990). Bridgemen and Wendler (1991) claimed that on the Scholastic Aptitude Test - Mathematics (SAT-M), which ranges from 200 to 800 points, the gender difference is about 46 points, or .39 times the standard deviation, and on the American College Testing Programs' exam (ACT), which ranges from 1 to 39 points, the difference is about 2.6 points, or .33 times the standard deviation. These results demonstrate the continued pattern of slow but steady improvement in the variation between the genders. Ramist and Arbeiter (1986) report a male advantage of .40 to .47 SD (Standard Deviations) on the SAT-M math scores, and Burton (1987) tallied .30 to .45 SD on the ACT math scores. This gender discrepancy is especially strong where it matters most, at the top, for the College Entrance Examinations Board discloses that the ratio of males to females who score at the 90th percentile on the SAT-M was 13:5 (CEEB, 1988). Similar results occurred on the Preliminary Scholastic Aptitude Test/National Merit Scholarship Qualifying Test (PSAT / NMSQT) in 1988 (Feingold). On this test, it was interpreted that 96% of the scores in the top 10% are male (Dorans and Livingston, 1987). All of these findings become even more alarming because of studies like the one done by Michael (1983), who found that SAT-M scores negatively affect participation in mathematics of girls in science fairs, and apparently encourage boys to go to mathematics contests more. Michael's theory is that high-achieving females' relatively poor SAT-M scores, in relation to boys, discourages them from showing off their talents in contests and fairs. This might explain why some teachers claim that females do well grade-wise in mathematics class, but perform poorly (if they attend at all) at contests.

EVIDENCE ON CONTESTS, INCLUDING ESU'S DONALD L. BRUYR MATH DAY

There is a limited amount of published data specifically on mathematical competitions. It has been true for a number of years that very few females place (receive awards) in regional, state, or national math competitions (Galbraith, 1986). Maurer concurred in 1987, and stressed that this is also the case for international contests as well.

In Kansas, state-wide mathematics contests have been held since 1983, for students in the fourth through eighth grades. Although the format has evolved over the years, it has generally employed fourteen regional sites across the state of Kansas. Each school can send two students per grade to participate at the regional level in three categories: problem solving, mental math and estimation, and geometry. From there, top qualifiers move on to the state competition. In Kansas, there have always been more boys participating at regionals than girls, with girls' participation ranging from 46% to 49% (Nichols, 1991). However, in 1988 and 1989, 71% of those advancing to the state-wide level were males.

The results at the state-wide contest in Kansas are summarized, in Table 2.01, as tabulated using the KATM Bulletin, 1985-1991. There were a total of fifteen tests given each year, comprised of three contests for each the five grade levels, fourth through eighth. Overall, since 1985, participants are 52% male, yet 451 of the 541 total winners are male (83%).

TABLE 2.01

RESULTS OF THE KANSAS STATE-WIDE MATHEMATICS CONTEST

Year	% of males	% of females	# of male winners	# of female winners	# top 6 male	# top 6 female	% of top 6 females
1985	53	47	14	1	N/A	N/A	N/A
1986	51	49	14	1	74	16	18
1987	51	49	14	1	76	14	16
1988	52	48	12	3	80	11	12
1989	54	46	13	2	81	9	10
1990	53	47	14	1	75	15	17
1991	52	48	12	3	65	25	28

In Tables 2.02 and 2.03 are the results from the Emporia State University Donald L. Bruyr Math Day, from 1986 - 1991. Starting in 1989, each contest was split into two divisions, one for schools of size 4A-6A, and one for 1A-3A (note that 6A schools are the largest thirty-two schools in the state of Kansas) . Although these two divisions were created, note that the same test was given to each division. Table 2.02 shows the participation numbers in those years, in both the Algebra and Geometry

TABLE 2.02

ESU MATH DAY INDIVIDUAL CONTEST PARTICIPATION NUMBERS

	ALGEBRA INDIVIDUAL			GEOMETRY INDIVIDUAL		
Year	# of males	# of females	% of females	# of males	# of females	% of females
1986	87	44	34%	84	43	34%
1987	80	40	33%	80	33	29%
1988	81	41	34%	77	39	34%
1989	154	55	36%	147	47	32%
1990	138	51	37%	127	37	37%
1991	131	60	46%	125	53	42%

individual tests, given to high school students from 14 to 19 years old. To summarize these results, during the time period of 1986 to 1991, 1008 males and 543 females participated in either of ESU Math Day's individual tests, which is 35% female. At the same time, when considering the top 20 finishers in each contest, only 56 of the 320 top finishers, or 17.5%, were female.

Table 2.03 shows the contest results in each year for ESU'S Donald L. Bruyr Math Day, comparing the number of students of each gender who finished in the top 20 each year and where the top finishing female finished for each test, algebra and geometry.

TABLE 2.03

ESU MATH DAY INDIVIDUAL TEST CONTEST RESULTS

	ALGEBRA INDIVIDUAL		GEOMETRY INDIVIDUAL	
Year	# of top 20 females	Place of first female finish	# of top 20 females	Place of first female finish
1986	0	24th	4	8th
1987	1	20th	3	1st
1988	0	29th	3	8th
1989	4	6th	5	8th
1990 Div. 1	1	18th	1	5th
1990 Div. 2	9	1st	4	4th
1991 Div. 1	5	2nd	3	5th
1991 Div. 2	10	3rd	3	12th

NOTE : Two divisions in 1990-91; see explanation following Table 2.01

To summarize Table 2.03, it appears that males have performed consistently better in these individual contests than their participation percentages suggest they should. This means that while males approximately consist of 65% of the sample size participating in these type of individual mathematics contests, they consistently win between 80% and 85% of the top prizes. However, the trend is that females are doing better and gradually closing the gap on the males at ESU's Math Day.

The September 1992 NCTM NewsBulletin had a headline that read, "Girl Takes

Honor in MATHCOUNTS Competition." The article reported that a girl had placed, taking second, for the first time ever (in nine years). The boy who won, it seems, edged out his female opponent by answering a basketball playoff question, causing mild controversy, though the girl did not believe the question was necessarily sexist. Yet, it is interesting in this time of increased awareness about gender discrimination in mathematics, including contests, that a championship question concerning two all-male professional basketball teams was allowed and even posed to the female competitor.

In closing, it is noted that in the early part of the 1990's, interest has peaked again in the issue of gender difference in mathematics. While the differences between females and males are less than the difference in mathematics test scores of other significant groupings, such as between whites and blacks, research into gender dissimilarities may well be the most conclusive (Campbell, 1986). Females do not take upper-level mathematics courses as much as their male counterparts. Among the many consequences of this disparity in gender mathematics course study are that mathematical attitudes, achievement in contests, and long-term confidence in mathematics all may vary as a result. The available literature supports the fact that a gender problem exists even though mathematics is not inherently a male domain.

CHAPTER THREE
METHODOLOGY

DESCRIPTION OF ESU'S DONALD L. BRUYR MATH DAY

Every fall, usually in late October, Emporia State University hosts a mathematics contest for high school students from the state of Kansas. The contest is formally called the Donald L. Bruyr Mathematics Day, and in 1992 it was held on October 28 in the Memorial Union on Emporia State's campus. The Donald L. Bruyr Math Day is often informally refered to as simply "ESU Math Day." The university's Division of Mathematics and Computer Science serves as the host for the event.

The Math Day contest is held each year in memory of Dr. Donald L. Bruyr, a former Professor of Mathematics at Emporia State University. Dr. Bruyr is credited with inspiring the initial interest in holding the contest in the 1970's and for spearheading the development of the format currently being used for the competitions.

The invitations for school participation in ESU Math Day were mailed in September and each school interested in attending completed and returned a list of the students who would be coming to Math Day. This list included the students who would take each individual examination (see Appendix J). In 1992, over 100 schools that expressed prior interest were sent invitations, of which 45 accepted and attended. The participation level was affected in 1992 because Kansas University's mathematics contest was scheduled for the same day. However, nearly all of the schools who regularly attend ESU Math Day attended in 1992 also.

A participant in ESU's Math Day may be defined to be any student who attended Math Day in any capacity, whether they took an individual test, were in a team contest, or just participated as observers . These students who assume the key role of observers participate by attempting to answer mathematics questions informally in the back of the auditorium to gain valuable thematical experience. However, it should be noted that most of the students who attend Math Day participate in some form of actual competition, meaning that there are few observers. The other participants have several choices to pick from as part of the actual competition. Students may enter a computer programming team contest, or any of the following contests: 1. Team Algebra; 2. Team Geometry; 3. Team Math Scramble (over various disciplines); 4. Individual Geometry test; or , 5. Individual Algebra test.

An integral portion of ESU's Donald L. Bruyr Math Day are the team competitions. Each school who wishes to participate selects three students who answer, together as a team, a question about their topic (algebra, geometry, or a wide variety of mathematics in the Team Math Scramble). The questions are timed and points of various amounts based on content difficulty are awarded on an all-or-nothing basis. Since these competitions involve teams often consisting of contestants of each gender, and that establishing each person's role in overall team success is difficult, this research focuses on the two individual test competitions.

Each school that attends the Donald L. Bruyr Math Day is allowed to enter three students (or fewer, if desired) in each of the individual contests. It is noteworthy that the Individual Geometry contest is administered at the same time as the Team Algebra contest, meaning that participants must choose one or the other. Likewise, the Team Geometry and Individual Algebra contests are also held concurrently.

Each test is formulated and administered by faculty members of the Division of Mathematics and Computer Science at Emporia State University. The individual test is given in a large room with four to six students at each table. There is a 50 minute time limit for the exam. The Algebra test consists of 40 questions and the Geometry test consists of 20 questions, each of the same five-answer, multiple choice question format. Every student takes the same test, which is given on white paper on which the students are allowed to write. However, the students from the larger schools, in Division I (classes 4A-6A), transfer their multiple choice responses to a form of one color, while the smaller schools, from Division II (classes 1A-3A), have a different colored answer sheet. Yet, this is inconsequential, as this coloration disparity is merely to make separating and grading easier. A number of the questions offer "none of the above" type responses as choices and there was no penalty for guessing. Also, neither the Algebra nor the Geometry test have any questions which contain gender-biased language or topics, and names used are generically neutral. Each test also has an open-ended tie-breaker question to help eliminate the numerous ties that can occur. These tie-breakers are intended to reward solid mathematical content, not neatness or creativity. The individual algebra examination used in 1992 is presented as a representative of the format of the individual examinations and can be found in Appendix K.

The exams are graded and rankings are determined. The results are made available at an awards presentation several hours later to conclude Math Day. Normally, only the top 50% of the exam scores are available to the students and teachers, to protect those students who were not overly successful.

SUBJECTS

The subjects for the study included the participants of Emporia State University's annual, on-campus mathematics contest. Additionally, subjects from high school mathematics classes of participant schools, but who did not come with their school to the competition, were used. A total of 600 students made up this sample, comprised of 290 non-participants in ESU Math Day and 310 participants. These 600 subjects included 299 females and 301 males. Students of grades eight through twelve were represented by the sample. Overall, the subjects made up a heterogeneous, representative grouping of those students who take mathematics courses in secondary schools.

INSTRUMENTS

For the majority of this research, the instrument selected was the self-reporting measure known as the Fennema-Sherman Mathematics Attitudes Scales (FSMAS). In addition, on both a pre-survey given prior to ESU's 1992 Donald L. Bruyr Math Day, and on a post-survey given afterward, several questions of the investigator's choosing also were included. It is acceptable procedure to use any or all of the scales for attitudes research, according to the authors, Elizabeth Fennema and Julia A. Sherman, as well as to submit additional, self-made questions of special interest.

To construct the attitudes scales, during the early months of 1975, Fennema and Sherman constructed 173 questions in nine categories to assess the attitudes of high school mathematics students. Then, during March of 1975, they administered these questions to mathematics students at four high schools in Madison, Wisconsin, who were taking college preparatory classes. Data was collected and statistical analysis conducted to form "scales" for each item in the study. A booklet was created to aid others in using the Fennema-Sherman Mathematics Attitudes Scales also, for which Fennema and Sherman selected 108 questions that could be utilized. Of these 108 questions, the researcher carefully selected forty-three questions to use in the survey of contest participants of ESU Math Day and other classmates. At least three questions were selected from each of the nine categories to adequately cover the scales. However, no more than forty-three questions were used due to the concern about expecting high school teachers to complete the survey using valuable school time and because of the desire to limit the instrument to two pages of paper, front-and-back. The intent was to design a reliable, reasonably inexpensive, well-known instrument that required less than a ten minute commitment from each student.

Each of the nine scales used for the Fennema-Sherman Mathematics Attitudes Scales (FSMAS) have a special meaning and are inter-related in an interesting fashion. Since the questions selected for the survey, altogether, constituted a snapshot of a student's mathematical attitude, it was necessary to investigate the specific purpose of each scale to be sure that they were appropriate to the study.

The nine scale categories of the FSMAS are : Confidence in Learning Mathematics Scale (C), Mother Scale (M), Father Scale (F), Attitude Toward Success in Mathematics Scale (AS), cher Scale (T), Mathematics as a Male Domain Scale (MD), Usefulness of Mathematics Scale), Mathematics Anxiety Scale (A), and Effectance Motivation in Mathematics Scale (E). These e categories can be added into a tenth category that is referred to as the Total of the nine scales gether (TOTAL) in this research. First, the Confidence in Learning Scale is aimed at measuring f-assurance in one's ability to learn and perform mathematical tasks capably. The Mother and ther Scales, both, are designed to assess a pupil's perception of their parent's encouragement, erest, and confidence in the pupil's ability, in separate yet similar scales. Another very unique ale, the Attitude Toward Success in Mathematics Scale, measures the student's motive to avoid ticipated success in mathematics. This scale covers everything from considering negative nsequences of successful mathematical endeavors to the role of luck in being responsible for any ccess, from a student's point of view. The Teacher Scale was employed to ascertain the tudent's perception of their teacher's belief in them as a mathematics learner. A key scale to this esearch is the Mathematics as a Male Domain Scale, which assesses the amount to which each gender views mathematics as a male, female, or neutral subject. An essential component of this scale is it's desire to find out if females view mathematics as an acceptable area of study and occupational concentration. The Usefulness of Mathematics Scale helps discover a student's current belief in how essential to actual " real world " events mathematical skills will be in their lives. And finally, the Effectance Motivation Scale was developed to measure one's problem-solving attitude and drive to explore applied mathematics. Altogether, these nine scales help portray a student's overall feelings about mathematics and their role in dealing with it.

These domain-specific scales are utilized with statements posed to the student using a Likert-type style. Therefore, in questions that are either worded positively (such as "I like math") or negatively (such as "I hate math"), students select their degree of agreement or acceptability with the provided statement by choosing one of five responses - Strongly agree, agree, undecided, disagree, or strongly disagree. Point values are assigned to each response, ranging from one to five points, where five is the value given to the response believed to have the more positive effect mathematics learning. The questions are randomly distributed and the scale type is not ntified to the student in the questionnaire.

The scales are designed so that a high point total is conducive to a greater mathematics attitude each category. As a result, it should be noted that a high score in each scale has a different aning. A higher score on Confidence naturally means that a student has more confidence with thematics. However, a higher score on the Anxiety scale means that a student is less comfortable and less nervous working with mathematics than those who score lower. A high ore on either the Mother or Father scales means that the student feels encouraged greatly by that rent, and that they feel their parent has more confidence in them and shows more of an interest in at child's mathematical success than a child with a lower score does. A higher Teacher scale int total implies that a higher confidence from the teacher is perceived and that the teacher is nsidered to be a resource for concerns about mathematics by that student. High Usefulness scale ores demonstrate that mathematics is useful to that student, and higher Effectance Motivation cales imply that a student enjoys the challenge of mathematics more than lower scores do.

In addition to the forty-three questions selected from the Fennema-Sherman Mathematics Attitudes Scales for the pre-survey administered to students, two original questions were constructed, written by the investigator. These two questions were originated after considering the roles of each gender to "attributional styles". This trait centers on what a student identifies as the reasons for their own success or failure, be it ability, effort, task difficulty, or luck. The available research clearly shows that males attribute success mostly to ability, while females attribute their success to effort and their failure to ability (Fennema and Leder, 1990). Occasionally, males must be pressed for reasons for their own failure. However, once a choice is made, the overwhelming belief is that they failed because of task difficulty, simply believing that the question was obviously too difficult for them and their skill level at that time. These two questions complemented nicely the data collected as a result of the FSMAS.

To accompany the FSMAS information, a course-taking questionnaire was used as an egral part of the instrument (see Appendix A). Students were asked for their name, gender, ade in school, and school name, all of which enabled the student to be placed in the various ographical categories appropriate to them without guessing or errors. The questionnaire then quired about which mathematics courses the student had taken or was currently taking, to attempt discern how much mathematical background each student possessed and how it affected their hievement and attitudes.

ROCEDURE

To make the comparisons discussed in the hypotheses, it was necessary to administer athematics attitudes surveys to the participants of ESU's 1992 Donald L. Bruyr Math Day, well as to non-participant peers of these participants. The goal was to have as close to an qual number of participant and non-participant surveys as possible to assist with statistical eliability.

To begin the process, every school that sent written notice to Emporia State University that they would attend Math Day was sent a packet of materials that would enable them to partcicpate in this research. The packet included an estimated number of copies of the attitudes pre-survey (see Appendix A), several copies of the teacher's instructions sheet (see Appendix B), a copy of the letter to the principal / director of secondary education (see Appendix C), three copies of the teacher's survey (see Appendix D), and an abundant number of informed consent documents. Each sponsor was encouraged to copy additional attitude pre-surveys as needed for themselves. Sponsors were requested to bring the completed materials to ESU's Math Day on the morning of October 28, 1992.

Most of the materials in the packet were constructed originally by the researcher, based on consultations with several related dissertations, such as Hines (1989) and Nichols (1991). However, for the attitudes pre-survey, the Fennema-Sherman Mathematics Attitudes Survey (FSMAS) was used, in order to utilize a well-established, standard instrument that had a word of its own. Along with the three questions from each of the nine scales, additional questions were selected without regard to category. Two questions about attributional styles was also included to complement the study.

The Rights of Human Subjects policies from Emporia State University, concerning the use of high school students for this research, were followed closely to allow students to participate in this study. Accordingly, attention was given to selecting questions from the FSMAS and writing instructions that gave the participants no attendant discomforts or other forma of risks. Each student was supplied with a signature form that allowed their data to be used and confirmed their understanding of the research in which they were taking part (see Appendix E). To accompany this form, each school was also sent a detailed letter for the signature of the school's principal or director of secondary education, making them the authorized representative and giving the permission necessary to proceed (see Appendix C). Several schools requested special parental consent forms in addition to student signature forms, to address school policies, and these forma were provided (see Appendix E).

The teacher's survey (see Appendix D) was constructed to provide information for a determination of how students of each gender became enrolled in the individual tests. Teachers were also asked to share how their students prepared for the contest and for an assessment of why girls are not more successful at mathematics competitons.

Each student who filled out an attitudes pre-survey also completed a permission form. These signature forms were checked to make sure that every student had allowed the use of the results and was aware of their participation in this research study. Each school's principal / director of secondary education form was also cross-referenced at this time. Several sponsors also included requests that research conclusions be returned to them.

Several schools who wanted to lend assistance to the research, but who had misplaced their packet or otherwise were inadvertently unable to participate prior to Math Day, were afforded a chance to participate. However, this opportunity was limited and all students who filled out tudes pre-surveys did so before competing.

The post-survey (see Appendix I) was available for each school's sponsor to pick up at U's 1992 Math Day. The intent of the post-survey was to discern whether the iversity-sponsored mathematics' contest experience was a positive one to each gender's athematics attitude or not. As such, it was only necessary to survey the participants of ESU's 92 Math Day. The teachers sent the material back to Emporia State University in pre-addressed, mped envelopes. The teachers were instructed to wait a few days after Math Day to give the rveys to their students so that the students could reflect a bit on their experience. However, to sure that the attitudes expressed truly were as a result of the contest, only those surveys returned ithin two weeks after Math Day were used.

Following Math Day, the pre-surveys were hand-tabulated by the researcher. To id in identifying each school's name in a concise way, each school was assigned a two-letter code that corresponded to the school's initials whenever possible. The surveys were numbered and sorted by school. When totaled, there were 601 surveys and 36 schools who participated out of the 45 who attended ESU's 1992 Math Day (80%). Both of these totals were deemed suitable to continue, as the targeted goal for each was four to five hundred surveys and 75% school participation. After close scrutiny of these surveys, one survey was disqualified from use due to comical responses given throughout. Thus, the tabulation phase was begun with 600 valid surveys. Having exactly 600 surveys was purely coincidental and was not selected because it was statistically convenient.

The first part of the attitudes pre-survey included the course-taken score section (CTS) and an expected level of education score section (ELS) (see Appendix A). Before any attitude responses were recorded, these two sections were transformed into a numerical variable using the system outlined in Tables 3.01 and 3.02. Since no established, numerical procedure was found for using the information obtained from the Course-Taking Questionnaire, the values for these tables were formulated by the researcher.

irst, to figure a student's course - taken score (CTS), every course's point value that had taken or was currently being taken by the student was added together. A few students vertently neglected to note some prerequisite mathematics courses, such as Algebra I, but did cate having taken the later courses that would require such prior knowledge. In these rare

BLE 3.01

URSE - TAKEN SCORE (CTS) POINT VALUES .

NTS	COURSE NAME
5	GENERAL MATH
75	CONSUMER MATH
1	PRE-ALGEBRA
[illegible]	ALGEBRA I
2	GEOMETRY
[illegible]	ALGEBRA II
2	TRIGONOMETRY
2.25	MATH ANALYSIS / SENIOR MATH
2.25	PRE-CALCULUS
2.25	COLLEGE PREP. MATH
2	PROBABILITY & STATISTICS
5.5	CALCULUS I
6	CALCULUS II
7	CALCULUS III
4	DIFFERENTIAL EQUATIONS I
.5	OTHER LOWER-LEVEL COURSES NOT MENTIONED ABOVE

cases, the prerequisite mathematics course was assumed and credited to the student. Otherwise, the information obtained was accepted without corrections. Thus, the CTS is a sum of all mathematics courses a student has taken.

Secondly, to figure the Expected Level of Education Score (ELS), the student simply received the point total associated with their response, outlined in Table 3.02. Several students checked more than one level, in which case they received the highest level checked.

The students were also asked what they planned to study at a two-year or four-year college and their future occupational plans, as part of the Course - Taking Questionnaire on the attitudes pre-survey (see Appendix A). These results were tabulated separately.

TABLE 3.02

EXPECTED LEVEL OF EDUCATION SCORE (ELS) POINT VALUES

POINTS	HIGHEST LEVEL OF EDUCATION EXPECTED TO COMPLETE
4	HIGH SCHOOL
8	FOUR-YEAR COLLEGE OR UNIVERSITY
6	TWO-YEAR COMMUNITY COLLEGE
5	VOCATIONAL OR BUSINESS SCHOOL
10	GRADUATE OR PROFESSIONAL SCHOOL AFTER COLLEGE

At this point, the surveys were prepared for each of the forty-five responses and seven special categories. On specially-lined paper prepared to record the scores, the following subheadings were employed: NAME AND ID (Identification Number), SI (School Identification Initials), M/F (Male or Female), CTS (Course - Taken Score), ELS (Expected Level of Education Score), AT (for those who participated in the Algebra Test and the order of their finish), GT (for those who participated in the Geometry Test and the order of their finish), PART (marked X for participant; NO for non-participant), the numbers 1 through 45 for each of the forty-five questions on the survey, and TOTAL for the computed score of each individual. To further assist with the task of discerning the gender differences, the male's scores were recorded in black ink, while the female's scores were written in red ink.

Each student's survey was then transferred from the Likert-style responses to points by the following system: a) the most positive attitude response, five points; b) the second most positive response, four points; c) undecided, three points; d) the second most negative response, two points; and, e) the most negative attitude response, one point. Because some questions used by the Fennema-Sherman Mathematics Attitudes Scales (FSMAS) questions are worded positively and some negatively, this determination of which response, strongly agree or strongly disagree, is the most positive, must be made on a question-by-question basis. On this instrument, 27 were positively worded questions and 16 were negatively worded questions.

As stated earlier, a student was classified to be a participant if they attended ESU's 1992 Math Day in any capacity. The students who actually take an individual test or take part in any of the team contests have clearly participated. The other students gained contest experience through observing and attempting mathematical problems during the team contests informally in the back of the room, and thus have also participated. Only those students who did not attend ESU's 1992 Math Day in any meaningful capacity were considered to be non-participants.

Naturally, a vital component of the research process was the collection of the test result data from each individual test. For both algebra and geometry, a complete listing of results was compiled, from first to last place, for each of the two Divisions (I for the large schools, II for the small schools). The tie-breaker question was used to break any ties that occured for those who finished in the top five places; the other scores that were the same were left as ties. The tests were graded by faculty members of the Division of Mathematics and Computer Science at Emporia State University.

Those students who finished in the top 30% of each test were deemed to be successful. This year, 121 students took the Individual Algebra test in Division I, which means the top 23 were classified "T30", meaning "Top 30%". The rest of the students who took the Individual Algebra test but finished in the lower 70% were classified "L70", which indicated that they took the test but were not in the top 30%. The rest of the students who did not take the test at all were classified with an "N". Other results were as follows: 1) Geometry, Division I - 103 students took the test, meaning the top 21 students were classified T30; 2) Algebra, Division II - 121 students took the test, meaning the top 14 students were classified T30; and, 3) Geometry, Division II - 107 students took the test, meaning the top 11 students were classified T30. Since some students participated in both tests, it should be noted that a few students were found to be in the top 30% both times, while still others were in the top 30% on one test but not on the other test. For the purposes of this research, any student was classified as T30 who finished in the top 30% on either test, meaning that these students mentioned above were all classified as T30.

After the 600 surveys were recorded as the corresponding numbers one through five, the [illegible]estion of human error was addressed. To check the values for accuracy, every fourth survey [illegible]s coded a second time, this time looking for mistakes. Of this 25% of the surveys that were [illegible]uble-checked, no errors were discovered.

To scale and total the data, the Fennema-Sherman Mathematics Attitudes Scales were utilized. [illegible]ales include the male and female means from the original research done by Fennema and [illegible]erman with 1600 high school mathematics. These values were used to establish the mean score [illegible]r both genders using the same procedure utilized to figure each student's total attitude score. [illegible]hus, each gender's TOTAL was calculated by adding each individual question's mean and scaling [illegible]ch category to an equal weight, as was done before for every student. For the study done by [illegible]ennema and Sherman, with just the questions used in this study factored in, the mean for the [illegible]ales was calculated by this researcher to be 391.75, while the mean for the females was 395.42. These calculations, which represents a weighted mean, are exhibited in Table 3.03, under each of the FSMAS categories. This information is cited only for the purpose of noting that the genders

TABLE 3.03

FENNEMA-SHERMAN AVERAGE SCORES FOR EACH GENDER ON THE FORTY-THREE FSMAS QUESTIONS UTILIZED.

CATEGORY	MALE SCORE	FEMALE SCORE
CONFIDENCE	45.15	42.51
MOTHER	44.34	43.53
FATHER	45.87	43.86
ATTITUDE TOWARD SUCCESS	47.40	47.04
TEACHER	43.65	44.43
MALE DOMAIN	39.33	53.16
USEFULNESS	47.25	45.69
ANXIETY	39.44	35.88
EFFECTANCE MOTIVATION	39.32	39.32
TOTAL	391.75	395.42

SOURCE: FENNEMA-SHERMAN MATHEMATICS ATTITUDES SCALES AND SURVEY DATA.

ve no inherent statistically significant differences on these FSMAS questions; in fact, males and males score remarkably closely on the scales for a random sampling.

Notice that the procedure for figuring the total score was dependent on the number of questions om each scale type used for the pre-survey. Of the forty-three FSMAS questions on the survey, e breakdown of the number of questions of each type is found in Table 3.04. The specific estions from the survey that fit each category are found at the end of Appendix A; this formation was not available to the subjects who filled out the survey. This data is significant ecause of the fact that, even though there are an uneven number of questions from each category, ere still needs to be an equal affect of each category on the total score so that they can fit the cales. For their attitudes scales, Fennema and Sherman selected twelve questions from all nine ategories. Therefore, each number of questions must be "scaled" to twelve before being used, o each multiplier is found simply by dividing by twelve. In Table 3.04, it can be seen how this "multiplier" of each category is found.

Using the information from Table 3.04, the total score was tabulated for each student. To

TABLE 3.04

ESTABLISHMENT OF MULTIPLIERS FOR THE FSMAS SCALES

SCALE	# OF QUESTIONS USED	MULTIPLIER
CONFIDENCE	8	1.5
MOTHER	4	3
FATHER	4	3
ATTITUDE TOWARD SUCCESS	3	4
TEACHER	4	3
MALE DOMAIN	7	1.71 *
USEFULNESS	4	3
ANXIETY	6	2
EFFECTANCE MOTIVATION	3	4

NOTE: * THE MALE DOMAIN MULTIPLIER IS APPROXIMATE AND REQUIRED SOME OCCASIONAL ROUNDING OF THE FINAL DATA.

efly describe this process : 1) For each of the nine scales, the questions from that category re added together; 2) Each sum was multiplied by it's corresponding "multiplier", to achieve a btotal of between 12 and 60; and, 3) The nine subtotals were added together to yield the dent's Total for the Nine Scales Together (TOTAL). This total score should be representative of ch student's mathematics attitude, with all of the factors figured in, just before ESU's Math Day n October 28, 1992.

Because of the size and nature of the data collected from the surveys, a computer-generated nalysis of variance procedure was employed. The information was systematically entered into a omputer. Then, to ensure accuracy, the data was checked using roughly the same procedure as efore, but this time by checking 50% of the entries for errors. At this point, the research data were prepared for analysis and the data collection phase was complete.

TEST STATISTICS

After each student's scores were recorded and scaled using the FSMAS, the appropriate test statistics to help interpret the data were employed. First, the data were processed by computer, using the Statistical Analysis System (SAS) computer system, to figure the weighted means for each of the ten variables of the FSMAS. These weighted means were formulated for each of the possible participation categories for each gender, specifically T30 (Top 30% finishers on the individual test), L70 (Lower 70% finishers), N (for participants of ESU Math Day who did not take either the Algebra or Geometry test), or NO (for non-participants). The Type III sums of squares and its corresponding F value and significance probability were used to indicate potential preliminary conclusions about each of the five null hypotheses.

Since the data collected from each of these categories resulted in sample sizes that were unequal, this represented a risk to the validity of the study if only weighted means were used. While some of the sample sizes were remarkably close in magnitude (such as 299 females to 301 males and 290 non-participants to 310 participants), other significant sample sizes varied greatly in ys that had to be addressed. As a consequence, the data was processed by computer again, this e to figure the unweighted (also known as least squares or adjusted) means.

Using these unweighted means, an analysis of variance (ANOVA) was completed for each pothesis using a general linear model. The null hypothesis is rejected if the significance bability (labeled PR>T) is less than .05, the alpha value used for this study, for each mponent of the hypothesis. Hypotheses 1 and 2 contain ten elements each, for the nine separate itudes scales and the total. These hypotheses were considered in parts, because of the mplicated nature of the data set and FSMAS. Hypothesis 4 has two parts to it, and it also is lowed to be partially accepted or rejected. The other two hypotheses, numbers 3 and 5, assess ly one notion apiece.

Additionally, because of the highly correlated nature of the nine scales of the FSMAS, it hould be noted that each variable is not truly independent of the others. In fact, attitude testing of ach individual scale independently to ensure complete statistical certainty would be impractical. As a result, this arrangement of data and analysis should be acceptable in determining a reasonable interpretation of the role of each gender's attitudes and other factors to enhanced mathematics competition performance and participation.

CHAPTER FOUR
RESULTS AND ANALYSIS

TRODUCTION

In order to investigate the relationship between each gender's various mathematical attitudes d achievement level on individual tests at mathematics competitions, the following five null potheses were established. The pertinent statistics for each hypothesis will be reported in tables t include the following information: the number of students in each category (N), the weighted ean, the unweighted mean (UM), the degrees of freedom (DF), the standard error of the weighted mean, and the significance probability (labeled PR>T, or p). An analysis of variance NOVA) was used to assess each hypothesis, along with an unweighted mean, being utilized cause of the unequal sample sizes involved within each category in the study. In the main text of e table, note that T30 stands for "Top 30% finishers on individual exams" and that L70 stands or "Lower 70% finishers on individual exams". The statistical significance for each analysis of riance table is provided with one star (*) if $p < .05$ and two (**) if $p < .01$.

First, however, in order to provide some introduction to the main context of the research data collected from the pre-surveys, Table 4.01 contains the descriptive statistics for the FSMAS attitudes TOTAL, Courses - Taken Score (CTS) and Expected Level of Education score (ELS) for each definitive category used in the study. Although these statistics are taken from weighted means, it is interesting to note the obvious comparisons between related categories and the range differences among the respondents. Table 4.01 is structured to range from the more general categories at the top to the more specific at the bottom. Those tables are labeled as follows: by gender (MALE or FEM.); by participation (PART for "participation", NN-PT for "non-participation"); and by achievement on the individual Algebra or Geometry tests, if taken (T30 for "finished in the top 30%", L70 for "finished in the lower 70%").

The important things to note in Table 4.01 include: 1) The relative closeness of the means for the males and females (Males, 427.93 - Females, 423.84); 2) The extreme closeness of both the rticipating and non-participating male / female groups (Participating Males, 449.18 - rticipating Females, 447.86 ; Non-Participating Females, 402.69 - Non-Participating Males, 0.37).; 3) The relative closeness between the genders in the lower 70% on achievement levels r both the attitude total and the CTS (Females L70, 437.43 - Males L70, 428.38 ; Males L70 a TS of 10.43 - Females L70 a CTS of 10.06).; and, 4) Conversely, the wide disparity between e genders in the top 30% on achievement levels for both the attitude total and the CTS (Males 30, 497.31 - Females T30, 466.46 ; Males T30 a CTS of 17.93 - Females T30 a CTS of 12.00). ll of this data suggests that each gender is inherently equal (females are even slightly higher), but at a significant correlation between attitude and the highest achievement at mathematics contests ccurs, favoring males.

TABLE 4.01

DESCRIPTIVE STATISTICS FOR THE ATTITUDES PRE-SURVEY BY CATEGORY

GROUP	SAMPLE SIZE	TOTAL'S MEAN	TOTAL'S STD DEV	TOTAL'S VAR.	RANGE	CTS MEAN	ELS MEAN .
FEMALES	299	423.84	47.64	2269.43	252.5 - 535.5	9.24	8.56
MALES	301	427.93	50.51	2551.43	283.3 - 537.0	10.62	8.63
NN-PT	290	401.64	43.22	1867.98	252.5 - 500.0	9.02	8.33
PART	310	448.58	43.11	1858.24	324.1 - 537.0	10.78	8.84
T30	48	488.31	29.21	853.29	399.0 - 537.0	16.20	9.00
L70	89	433.06	42.54	1809.29	324.1 - 521.1	10.24	8.74
NN-PT FEM.	159	402.69	42.84	1835.42	252.5 - 492.0	8.97	8.35
PART FEM.	140	447.86	41.06	1686.12	324.1 - 535.5	9.54	8.79
NN-PT MALE	131	400.37	43.81	1918.94	283.3 - 500.0	9.08	8.31
PART MALE	170	449.18	44.83	2010.00	332.3 - 537.0	11.80	8.89
FEM. - L70	46	437.43	46.79	2189.58	324.1 - 521.0	10.06	8.61
MALE - L70	43	428.38	37.44	1401.65	342.1 - 502.1	10.43	8.88
FEM. - T30	14	466.46	33.31	1109.24	399.0 - 507.5	12.00	8.71
MALE - T30	34	497.31	22.19	492.47	417.5 - 537.0	17.93	9.11

Table 4.02 shows the range of these weighted means within each category and also what specific attitude categories were more positive (represented by a higher score) and which were

more negative (lower scores), for each group. It becomes apparent from the table that males possess a more confident attitude (category C) when using mathematics than their female counterparts in each participation category, that they are less anxious about it (category A), and less

TABLE 4.02

RANGE OF ATTITUDE SCORES FOR FSMAS SCALES BY HIGH / LOW CATEGORIES

GROUP	HIGHEST TWO ATTITUDE CATEGORIES (WITH MEANS)		LOWEST TWO ATTITUDE CATEGORIES (WITH MEANS)	
FEMALES	1) MD - 55.43	2) U - 50.20	8) E - 42.43	9) A - 41.06
MALES	1) U - 51.20	2) C- 50.60	8) E - 45.27	9) A - 44.87
NN-PT	1) MD - 50.98	2) U - 48.64	8) E - 39.92	9) A - 38.17
PART	1) C - 53.33	2) U - 53.63	8) E - 47.54	9) A - 47.46
T30	1) C - 56.53	2) U - 56.00	8) M - 51.96	9) MD - 51.74
L70	1) C - 52.18	2) MD - 50.82	8) E - 46.07	9) A - 44.76
NN-PT FEM.	1) MD - 54.32	2) U - 48.57	8) E - 39.19	9) A - 37.72
PART FEM.	1) MD - 56.70	2) C - 52.41	8) E - 46.11	9) A - 44.85
NN-PT MALE	1) U - 48.73	2) F - 46.99	8) E - 40.79	9) A - 38.72
PART MALE	1) C - 54.10	2) U - 53.10	8) MD - 47.97	9) AS - 47.54
FEM. L70	1) MD - 55.03	2) C - 51.65	8) M - 45.65	9) A - 42.83
MALE L70	1) C - 52.74	2) U - 50.79	8) T - 46.05	9) AS - 43.63
FEM. T30	1) MD - 58.82	2) C - 54.43	8) A - 49.43	9) M - 46.50
MALE T30	1) A - 57.53	2) C - 57.40	8) M - 54.21	9) MD - 48.82

THIS PART IS LABELLED AS : 1) M / F ; 2) PART (P) / NN-PT (N) ; 3) 'NO' FOR DID NOT TAKE ANY TEST / T30 / L70

F-N-NO	1) MD - 54.32	2) U - 48.57	8) E - 39.19	9) A - 37.72
F-P-NO	1) MD - 57.28	2) U - 52.50 ; C - 52.50	8) E - 45.30	9) A - 45.21
F-P-T30	1) MD - 58.82	2) C - 54.43	8) A - 49.43	9) M - 46.50
F-P-L70	1) MD - 55.03	2) C - 51.65	8) E - 46.17	9) A - 42.83
M-N-NO	1) U - 48.73	2) F - 46.99	8) E - 40.79	9) A - 38.72
M-P-NO	1) C - 53.52	2) U - 52.77	8) M - 47.10	9) AS - 46.24
M-P-T30	1) A - 57.53	2) C - 57.40	8) E - 55.10	9) MD - 48.82
M-P-L70	1) C - 52.74	2) U - 50.79	8) T - 46.05	9) AS - 43.63

PLEASE NOTE : FOR THE FENNEMA-SHERMAN MATHEMATICS ATTITUDES SCALES (FSMAS) USED ABOVE, THE FOLLOWING ABBREVIATIONS ARE UTILIZED :

C - CONFIDENCE IN LEARNING MATHEMATICS　　M - MOTHER SCALE
F - FATHER SCALE　　AS - ATTITUDE TOWARD SUCCESS IN MATHEMATICS SCALE
T - TEACHER SCALE　　MD - MATHEMATICS AS A MALE DOMAIN
U - USEFULNESS OF MATHEMATICS SCALE　　A - MATHEMATICS ANXIETY SCALE
E - EFFECTANCE MOTIVATION IN MATHEMATICS SCALE

orried about success being made public (category E). In fact, the males in the top 30% on hievement report less anxiety (it is their #1 positive category) than females in the top 30% (the xt-to-last category for them). Interestingly, the FEM. T30 category ranks Male Domain (MD) as eir highest positive scale, while MALE T30 ranks MD as last for them.

YPOTHESIS 1

H_0 (1) : That students of each gender finishing in the top 30% (labeled T30) at ESU's 1992 Math Day individual competitions will not have a more positive attitude than those students who finish in the lower 70% (L70), on each of the following parts of the Fennema-Sherman Mathematics Attitudes Scales : a) Confidence in Learning Mathematics Scale (C); b) Attitude Toward Success Scale (AS); c) Mathematics as a Male Domain Scale (MD); d) Effectance Motivation Scale (E); e) Mathematics Usefulness Scale (U); f) Mother Scale (M); g) Father Scale (F); h) Teacher Scale (T); i) Mathematics Anxiety Scale (A); and, j) Total of the nine scales together (TOTAL).

The statistical data for the Confidence in Learning Mathematics Scale (C) are provided in Table 4.03. While each gender's top 30% grouping had the higher mean, this difference was only significant for the males (with p = .0043). For each group, achievement may be somewhat

TABLE 4.03

ANALYSIS OF VARIANCE : CONFIDENCE - H_0 (1)

	N	WEIGHTED MEAN	UNWEIGHTED MEAN (UM)	DF	STD. ERR. OF UM	SIGNIF. PROB. FOR T30 vs. L70
FEM. - T30	14	54.43	50.08	2	1.95	.1985
FEM. - L70	46	51.65	47.31	2	1.15	
MALE - T30	34	57.40	53.67	2	1.30	.0043 **
MALE - L70	43	52.74	49.02	2	1.18	

rrelated to confidence in one's own ability, but the null hypothesis can only be rejected for the les. For males, it appears to be highly significant ($p < .01$).

For the variable of Attitude Toward Success (AS), a strong statistical difference was dicated for the MALE - T30 category. These results are located in Table 4.04. While females

ABLE 4.04

NALYSIS OF VARIANCE : ATTITUDE TOWARD SUCCESS - H_0 (1)

	N	WEIGHTED MEAN	UNWEIGHTED MEAN (UM)	DF	STD. ERR. OF UM	SIGNIF. PROB. FOR T30 vs. L70
EM. - T30	14	50.00	48.86	2	2.34	.6140
EM. - L70	46	48.70	47.56	2	1.38	
MALE - T30	34	56.03	55.20	2	1.56	.0001 **
MALE - L70	43	43.63	42.80	2	1.41	

howed relatively little difference, males in the top 30% rated a mean over 12 points higher than their lower 70% counterparts. The significance probability ($p = .0001$) was sufficient to reject the null hypothesis for the males, but not the females.

The Male Domain variable data can be found in Table 4.05. In both gender categories, the

TABLE 4.05

ANALYSIS OF VARIANCE : MALE DOMAIN - H_0 (1)

	N	WEIGHTED MEAN	UNWEIGHTED MEAN (UM)	DF	STD. ERR. OF UM	SIGNIF. PROB. FOR T30 vs. L70
FEM. - T30	14	58.82	57.34	2	2.05	.0952
FEM. - L70	46	55.03	53.55	2	1.21	
MALE - T30	34	48.82	48.07	2	1.37	.1417
MALE - L70	43	46.31	45.56	2	1.24	

BLE 4.06

ALYSIS OF VARIANCE : EFFECTANCE MOTIVATION - H_0 (1)

	N	WEIGHTED MEAN	UNWEIGHTED MEAN (UM)	DF	STD. ERR. OF UM	SIGNIF. PROB. FOR T30 vs. L70
M. - T30	14	50.57	47.52	2	2.15	.0651
M. - L70	46	46.17	43.12	2	1.27	
ALE - T30	34	55.09	51.66	2	1.44	.0001 **
ALE - L70	43	45.95	42.52	2	1.30	

p 30% achievers scored higher means than the lower 70% students did, but neither significance obability was small enough to constitute a null hypothesis rejection. The most notable difference ere was between genders, not within each gender.

For the variable of Effectance Motivation (E), Table 4.06 contains the results. Again each ender's higher mean can be found in the T30 category. Yet, only the male significance probabilty of .0003 was found to be significant enough to reject the null hypothesis in this case.

The Usefulness (U) variable's results can be found in Table 4.07. While both genders' lower 70% population had an unweighted mean lower than the T30 students of each grouping, only the MALE T30 group's strong belief that mathematics is a useful subject resulted in a rejection

TABLE 4.07

ANALYSIS OF VARIANCE : USEFULNESS - H_0 (1)

	N	WEIGHTED MEAN	UNWEIGHTED MEAN (UM)	DF	STD. ERR. OF UM	SIGNIF. PROB. FOR T30 vs. L70
FEM. - T30	14	53.79	51.82	2	2.00	.1687
FEM. - L70	46	50.74	48.77	2	1.18	
MALE - T30	34	56.91	54.89	2	1.34	.0003 **
MALE - L70	43	50.79	48.77	2	1.21	

BLE 4.08

ALYSIS OF VARIANCE : MOTHER - H_0 (1)

	N	WEIGHTED MEAN	UNWEIGHTED MEAN (UM)	DF	STD. ERR. OF UM	SIGNIF. PROB. FOR T30 vs. L70
M. - T30	14	46.50	44.27	2	2.18	.7255
M. - L70	46	45.65	43.43	2	1.29	
ALE - T30	34	54.21	52.85	2	1.46	.0001 **
ALE - L70	43	47.02	45.67	2	1.32	

the null hypothesis. The male significance probability was .0003 and indicated a strong orrelation to achievement, while the female's value (p = .1687) was above the acceptable lpha level of .05. Consistent with most of the other categories, the males reject the null ypothesis, while the females do not reject.

For the variable of Mother (M), the results of the analysis of variance is located in Table 4.08. The female comparison showed virtually no significant result, although the FEM. T30 group was slightly higher on its unweighted mean. By sharp contrast, males in the top 30% show a clear statistical edge (p = .0001) over those in the lower 70%. These results lead us to reject the null hypothesis for the males, but do not allow us to do so for the females.

TABLE 4.09

ANALYSIS OF VARIANCE : FATHER - H_0 (1)

	N	WEIGHTED MEAN	UNWEIGHTED MEAN (UM)	DF	STD. ERR. OF UM	SIGNIF. PROB. FOR T30 vs. L70
FEM. - T30	14	50.79	48.47	2	2.30	.4937
FEM. - L70	46	49.04	46.73	2	1.36	
MALE - T30	34	55.47	53.74	2	1.54	.0008 **
MALE - L70	43	49.05	47.32	2	1.39	

The results of the analysis done on the Father (F) variable are found in Table 4.09. The MALE T30 grouping is able to reject the null hypothesis based on its very low significance probability (p = .0008) and clear edge in means. While females in the top 30% also have a higher mean value than the L70 finishers, their results cannot reject the null hypothesis (p = .4937).

For the variable of the perceptions of the Teacher (T), the results are summarized in Table 4.10. Both T30 categories display sizeable advantages in terms of unweighted means for this variable. As a result, with a significance probability small enough for both the females (p = .0347) and the males (p = .0001), this part of the null hypothesis is rejected wholly. Notice that the MALE T30 significance probability indicates a particularly strong correlation.

TABLE 4.10

ANALYSIS OF VARIANCE : TEACHER - H_0 (1)

	N	WEIGHTED MEAN	UNWEIGHTED MEAN (UM)	DF	STD. ERR. OF UM	SIGNIF. PROB. FOR T30 vs. L70
FEM. - T30	14	52.14	49.40	2	1.94	.0347 *
FEM. - L70	46	47.61	44.87	2	1.14	
MALE - T30	34	55.59	53.67	2	1.29	.0001 **
MALE - L70	43	46.05	44.13	2	1.17	

The data about the variable of Anxiety (A) are situated in Table 4.11. As has occurred in several other segments of the Fennema-Sherman scales, the males had a significant difference, while the females did not. Anxiety is apparently a fairly important deciding factor for each gender, because close scrutiny shows that both genders in the T30 category enjoy a wide advantage in the unweighted means. Yet, the female difference is not nearly enough to reject the null hypothesis (p = .2264) for this sample size. By comparison, the male significance probability (p = .0093) is sufficient to support the rejection of the hypothesis.

TABLE 4.11

ANALYSIS OF VARIANCE : ANXIETY - H_O (1)

	N	WEIGHTED MEAN	UNWEIGHTED MEAN (UM)	DF	STD. ERR. OF UM	SIGNIF. PROB. FOR T30 vs. L70
FEM. - T30	14	49.43	45.68	2	4.93	.2264
FEM. - L70	46	42.83	39.08	2	2.90	
MALE - T30	34	57.53	52.89	2	3.29	.0093 **
MALE - L70	43	46.84	42.20	2	2.98	

For the variable that sums of the other nine scales together, the TOTAL, the results are found in Table 4.12 and supported by Figure 1. While a great number of the female categories have not had sufficient evidence to reject the null hypothesis, the cumulative affect of all nine segments is enough to be significant. The top 30% of each gender display a substantial difference in means, with FEM. T30 over FEM. L70 by 442.51 to 413.47 and MALE T30 over MALE L70, by 476.89 to 407.97. The male's disparity of nearly 70 points is especially indicative of the role of attitudinal factors on achievement. For both genders, the significance probability is

TABLE 4.12

ANALYSIS OF VARIANCE : TOTAL - H_O (1)

	N	WEIGHTED MEAN	UNWEIGHTED MEAN (UM)	DF	STD. ERR. OF UM	SIGNIF. PROB. FOR T30 vs. L70
FEM. - T30	14	466.46	442.51	2	11.39	.0210 *
FEM. - L70	46	437.43	413.47	2	6.68	
MALE - T30	34	497.31	476.89	2	7.58	.0001 **
MALE - L70	43	428.38	407.97	2	6.86	

low enough to reject the null hypothesis (females, p = .0210 and males, p = .0001). Figure 1 on the next page complements these findings by showing the difference in slopes of the groups volved. In addition to the table information used for T30 and L70, the unweighted means for all students who did not take an individual test were used (FEM. NO - 403.6, MALE NO - 414.8).

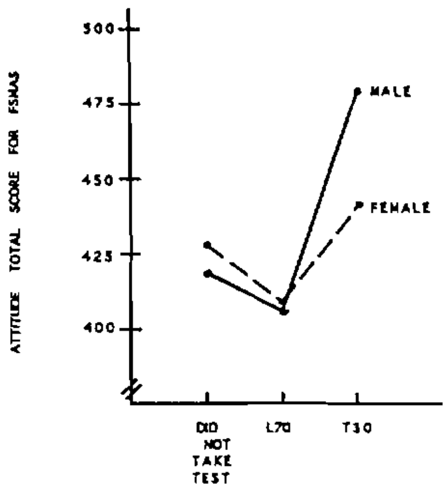

FIGURE 1

INTERACTION BETWEEN EACH GENDER'S ACHIEVEMENT LEVEL AND TOTAL ATTITUDE SCORE

HYPOTHESIS 2

Null hypothesis two directly challenges the top 30% of achievers on either the algebra or geometry test given at ESU Math Day of each gender:

H_O (2) : That those females finishing in the top 30% at ESU's 1992 Math Day individual competitions will not show a statistically significant difference, in the ten Fennema-Sherman Mathematics Attitudes Scales listed in H_O (1), to the males who finish in the top 30%.

The first variable of the FSMAS to be discussed is the Confidence scale, for which the results are located in Table 4.13. Top achievers of both categories recorded an unweighted mean of over 50 in confidence, so the significance probability (p = .1266) was not enough to reject the ll hypothesis. Yet, the difference of over 3.5 points on this variable does show a slight vantage for males in this category.

ABLE 4.13

NALYSIS OF VARIANCE : CONFIDENCE - H_0 (2)

	N	WEIGHTED MEAN	UNWEIGHTED MEAN (UM)	DF	STD. ERR. OF UM	SIGNIF. PROB. FOR MALE T30 vs. FEM. T30
ALE - T30	34	57.40	53.67	2	1.30	.1266
EM. - T30	14	54.43	50.08	2	1.95	

TABLE 4.14

ANALYSIS OF VARIANCE : ATTITUDE TOWARD SUCCESS - H_0 (2)

	N	WEIGHTED MEAN	UNWEIGHTED MEAN (UM)	DF	STD. ERR. OF UM	SIGNIF. PROB. FOR MALE T30 vs. FEM. T30
MALE - T30	34	56.03	55.20	2	1.56	.0245 *
FEM. - T30	14	50.00	48.86	2	2.34	

For the variable of Attitude Toward Success, the outcome is found in Table 4.14 above. Males displayed a decisive advantage in means, over six points, which resulted in a significance probability small enough ($p = .0245$) to reject the hypothesis in this case.

Male Domain represents the only variable where females in the top 30% finished with a higher mean than their male counterparts, and these results are found in Table 4.15. The females were a full ten points higher on the weighted means and over nine points higher on the unweighted means. As a consequence, the results easily support rejecting the hypothesis, with the difference here being that the FEMALE T30 grouping has a significantly higher mean. The fact that T30 females perceive mathematics as a gender-neutral domain, while T30 males do not nearly as much, pears to be one of the alarming outcomes of this research.

ABLE 4.15

NALYSIS OF VARIANCE : MALE DOMAIN - H_0 (2)

	N	WEIGHTED MEAN	UNWEIGHTED MEAN (UM)	DF	STD. ERR. OF UM	SIGNIF. PROB. FOR MALE T30 vs. FEM. T30
MALE - T30	34	48.82	48.07	2	1.37	.0002 **
FEM. - T30	14	58.82	57.34	2	2.05	

TABLE 4.16

ANALYSIS OF VARIANCE : EFFECTANCE MOTIVATION - H_0 (2)

	N	WEIGHTED MEAN	UNWEIGHTED MEAN (UM)	DF	STD. ERR. OF UM	SIGNIF. PROB. FOR MALE T30 vs. FEM. T30
MALE - T30	34	55.09	51.66	2	1.44	.1103
FEM. - T30	14	50.57	47.52	2	2.15	

The variable of Effectance Motivation has its results situated in Table 4.16. The ANOVA for this variable showed that males were a few points higher than the females on overall means, but that this difference was not significant. In fact, the two genders both place less importance on this category than others, and the significance probability ($p = .1103$) does not suggest the rejection of the hypothesis.

Table 4.17 contains the analysis of variance data for the Usefulness variable. Males possess a small advantage in means score for usefulness of mathematics, but not one of any major consequence. This variable does not experience enough gender deviation to reject the hypothesis, since $p = .2017$.

BLE 4.17

ALYSIS OF VARIANCE : USEFULNESS - H_0 (2)

	N	WEIGHTED MEAN	UNWEIGHTED MEAN (UM)	DF	STD. ERR. OF UM	SIGNIF. PROB. FOR MALE T30 vs. FEM. T30
ALE - T30	34	56.91	54.89	2	1.34	.2017
M. - T30	14	53.79	51.82	2	2.00	

ABLE 4.18

NALYSIS OF VARIANCE : MOTHER - H_0 (2)

	N	WEIGHTED MEAN	UNWEIGHTED MEAN (UM)	DF	STD. ERR. OF UM	SIGNIF. PROB. FOR MALE T30 vs. FEM. T30
MALE - T30	34	54.21	52.85	2	1.46	.0011 **
FEM. - T30	14	46.50	44.27	2	2.18	

For the variable of the role of the Mother as it corresponds to null hypothesis number two, the results are located in Table 4.18. Males in the top 30% share a fairly large advantage in means, highlighted by the very low relative score recorded by females. The hypothesis here is rejected, based on the merits of the very small significance probability ($p = .0011$).

TABLE 4.19

ANALYSIS OF VARIANCE : FATHER - H_0 (2)

	N	WEIGHTED MEAN	UNWEIGHTED MEAN (UM)	DF	STD. ERR. OF UM	SIGNIF. PROB. FOR MALE T30 vs. FEM. T30
MALE - T30	34	55.47	53.74	2	1.54	.0574
FEM. - T30	14	50.79	48.47	2	2.30	

The key information from the analysis of variance for the Father variable is found in Table 19. The high-achieving males have a higher mean than the high-achieving females by over five ints. Yet, notice that the significance probability (p = .0574) is slightly greater than the ceptable alpha value of .05. As a result, this portion of the hypothesis cannot be rejected.

Below, the findings for the variable of the perceptions of the Teacher are provided in ble 4.20. The weighted and unweighted means both show a small difference leaning wards the males. However, just as in the Father scale, the significance probability of p = 0671 is too much to allow rejection of null hypothesis number two for the Teacher scale.

TABLE 4.20

ANALYSIS OF VARIANCE : TEACHER - H_O (2)

	N	WEIGHTED MEAN	UNWEIGHTED MEAN (UM)	DF	STD. ERR. OF UM	SIGNIF. PROB. FOR MALE T30 vs. FEM. T30
MALE - T30	34	55.59	53.67	2	1.29	.0671
FEM. - T30	14	52.14	49.40	2	1.94	

For the variable of Anxiety, the results of the ANOVA are found in Table 4.21. Even though males have a sizeable advantage in anxiety mean scores, over seven points, this was not sufficient to create a meaningful statistical significance, due in part to the relatively large standard error of the unweighted means for each gender. Accordingly, because p = .2247, it follows that

TABLE 4.21

ANALYSIS OF VARIANCE : ANXIETY - H_O (2)

	N	WEIGHTED MEAN	UNWEIGHTED MEAN (UM)	DF	STD. ERR. OF UM	SIGNIF. PROB. FOR MALE T30 vs. FEM. T30
MALE - T30	34	57.53	52.89	2	3.29	.2247
FEM. - T30	14	49.43	45.68	2	4.93	

he null hypothesis is unable to be rejected in this case.

In Table 4.22, the results of the analysis of variance carried out on the variable of the TOTAL is found. A statistical significance was indicated, in both the amount of the difference between the means and with the statistical significance probability. A rather sizeable gap of more than thirty-four points developed over the course of the nine Fennema-Sherman scales, favoring the high-achieving males. This resulted in p = .0120, well below the established alpha level.

TABLE 4.22

ANALYSIS OF VARIANCE : TOTAL - H_0 (2)

	N	WEIGHTED MEAN	UNWEIGHTED MEAN (UM)	DF	STD. ERR. OF UM	SIGNIF. PROB. FOR MALE T30 vs. FEM. T30
MALE - T30	34	497.31	476.89	2	7.58	.0120 *
FEM. - T30	14	466.46	442.51	2	11.39	

For additional evidence, Figure 2 is provided below, to establish the dramatically different slope

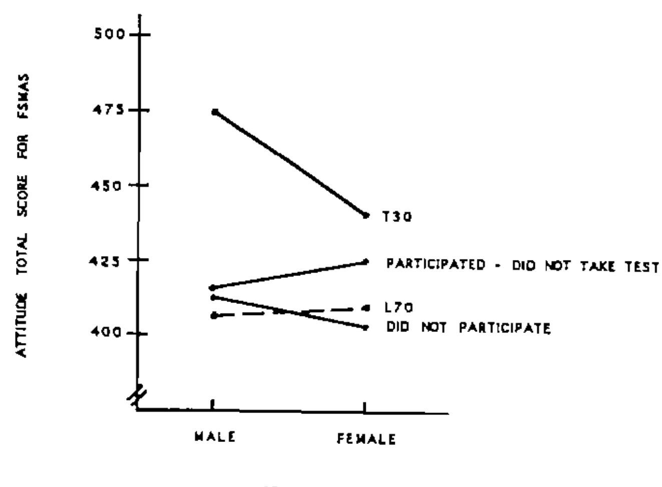

FIGURE 2

INTERACTION BETWEEN TOP 30% STUDENTS AND OTHER ACHIEVEMENT CATEGORIES ON TOTAL ATTITUDE SCORE the T30 scores set against the other three categorical possibilities (L70, participated but did not the test, and non-participant). Data used for the table that is not found in Table 4.22 includes : 1) L70 - Male 408.0, Female 413.5; 2) Participants who did not test - Male 420.8, Female 426.6; and, 3) Non-participants - Male 414.8, Female 403.6. Altogether, these results allowed for the null hypothesis to be rejected for the TOTAL.

HYPOTHESIS 3

H_O (3) : That when considering how attitudes affect participation in ESU's 1992 Math Day contest, there is not a statistically significant difference among the positive scores of the possible combinations of the four different categories, participating males (PM), participating females (PF), non-participating males (NM), and non-participating females (NF), as found by the TOTAL from the Fennema-Sherman Mathematics Attitudes Scales.

TABLE 4.23

ANALYSIS OF VARIANCE : TOTAL - H_O (3)

	N	WEIGHTED MEAN	UNWEIGHTED MEAN (UM)	DF	STD. ERR. OF UM
NN-PT FEM.	159	402.69	403.58	1	6.12
PART FEM.	140	447.86	451.50	1	4.45
NN-PT MALE	131	400.37	414.80	1	5.55
PART MALE	170	449.18	455.63	1	3.45

NN-PT FEM. vs. PART FEM. - PR>T : .0001 **
NN-PT MALE vs. PART MALE - PR>T : .0001 **
PART FEM. vs. PART MALE - PR>T : .4636
NN-PT FEM. vs. NN-PT MALE - PR>T : .1753
NN-PT FEM. vs. PART MALE - PR>T : .0001 **
NN-PT MALE vs. PART FEM. - PR>T : .0001 **

For this null hypothesis, the specific dependent variable of TOTAL was all that was gated. The appropriate statistics are presented in Table 4.23. Both genders are further orized as being either participants or non-participants, which resulted in six different pairings is hypothesis. Although four of the six aspects turned out to be statistically significant, ith p = .0001, the two that directly tested participating males versus participating females h p = .4636) and non-participating males versus non-participating females (with p = .1753) e not significant enough to reject the hypothesis. As for the unweighted means, males have a ht edge in both categories, according to Table 4.23, but notice that these are less than twelve nts in each case.

POTHESIS 4

H_0 (4) : That for each of the other two research variables that can affect performance, the courses - taken score (CTS) and the expected level of education score (ELS), a statistically significant difference cannot be found between the possible combinations of the four categories PM, PF, NM, and NF, as described in H_0 (3).

Null hypothesis four does not use the Fennema-Sherman Mathematics Attitudes Scales at all. Instead, the Course - Taken Score (CTS) and Expected Level of Education Score (ELS), from the first page of the Attitudes Pre-Survey instrument (see Appendix A), are the basis for this research question.

For the variable of the CTS, the results are found in Table 4.24. Two of the category pairings did not have a sufficiently small significance probability to enable the researcher to reject the null hypothesis : non-participating females (NN-PT FEM.) versus participating females (PART FEM.) and non-participating females (NN-PT FEM.) versus non-participating males (NN-PT MALE). Of these two groupings, NN-PT FEM. vs. PART FEM. was not close to being significant, with p = .7612, and since the weighted means and unweighted means disagree on which group had the er mean, seem to indicate that the difference is probably negligible. The other pairing, NN-PT M. vs. NN-PT MALE , was much closer with p = .0901 (yet, still over the established .05 a value). It is evident, however, that non-participating males have a slight advantage in CTS n over the non-participating females.

BLE 4.24

NALYSIS OF VARIANCE : COURSES - TAKEN SCORE - H_0 (4)

	N	WEIGHTED MEAN	UNWEIGHTED MEAN (UM)	DF	STD. ERR. OF UM
N-PT MALE	131	9.08	11.74	1	0.51
ART MALE	170	11.80	12.85	1	0.32
N-PT FEM.	159	8.97	10.45	1	0.56
ART FEM.	140	9.54	10.29	1	0.41

NN-PT FEM. vs. PART FEM. - PR>T : .7612
NN-PT MALE vs. PART MALE - PR>T : .0304 *
PART FEM. vs. PART MALE - PR>T : .0001 **
NN-PT FEM. vs. NN-PT MALE - PR>T : .0901
NN-PT FEM. vs. PART MALE - PR>T : .0002 **
NN-PT MALE vs. PART FEM. - PR>T : .0274 *

The other four category pairings all had sufficient statistical support to enable the researcher to reject the null hypothesis. Table 4.24 shows that all four had a PR>T value well below .05, with NN-PT MALE vs. PART MALE (p = .0304) and NN-PT MALE vs. PART FEM. (.0274) being less significant than the other two pairings. For males, participants have a higher unweighted mean than the non-participants, as expected. However, the non-participant males have an even greater edge (than NN-PT MALE vs. PART MALE) over participating females, 11.74 to 10.29. Additionally, participating males have a distinct statistical advantage over both PART. FEM. and NN-PT FEM. categories, with p = .0001 and p = .0002, respectively.

The statistical information for the variable of the Expected Level of Education Score (ELS) is found in Table 4.25. Little variance can be found in the unweighted means between any of these ups. At any rate, three pairings had differences of a magnitude that resulted in a significance bability well below the acceptable alpha value of .05. These were non-participating females N-PT FEM.) versus participating females (PART FEM.), with p = .0022, non-participating les (NN-PT FEM.) versus non-participating males (NN-PT MALE), with p = .0046, and non-ticipating females (NN-PT FEM.) versus participating males (PART MALE), with p = .0009. ch of these three significance probabilities would result in the null hypothesis being rejected. e other three pairings were substantially higher than the selected alpha level and were bsequently unable to reject hypothesis four.

ABLE 4.25

NALYSIS OF VARIANCE : EXPECTED LEVEL OF EDUCATION SCORE - H_0 (4)

	N	WEIGHTED MEAN	UNWEIGHTED MEAN (UM)	DF	STD. ERR. OF UM
NN-PT MALE	131	8.31	8.43	1	0.18
PART MALE	170	8.89	8.94	1	0.11
NN-PT FEM	159	8.35	8.19	1	0.19
PART FEM	140	8.79	8.74	1	0.14

NN-PT FEM. vs. PART FEM. - PR>T : .0022 **
NN-PT MALE vs. PART MALE - PR>T : .0046 **
PART FEM. vs. PART MALE - PR>T : .2742
NN-PT FEM. vs. NN-PT MALE - PR>T : .3556
NN-PT FEM. vs. PART MALE - PR>T : .0009 **
NN-PT MALE vs. PART FEM. - PR>T : .1743

Notice, in Table 4.25, contrary to the courses - taken score's unweighted means for this hypothesis, that the non-participating females had a lower ELS unweighted mean than the participating females. In fact, the .55 point differential was slightly greater than the .51 disparity enjoyed by participating males over non-participating males.

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BLE 4.25

ALYSIS OF VARIANCE : EXPECTED LEVEL OF EDUCATION SCORE - H_0 (4)

	N	WEIGHTED MEAN	UNWEIGHTED MEAN (UM)	DF	STD. ERR. OF UM
PT MALE	131	8.31	8.43	1	0.18
T MALE	170	8.89	8.94	1	0.11
PT FEM	159	8.35	8.19	1	0.19
T FEM	140	8.79	8.74	1	0.14

NN-PT FEM. vs. PART FEM. - PR>T : .0022 **
NN-PT MALE vs. PART MALE - PR>T : .0046 **
PART FEM. vs. PART MALE - PR>T : .2742
NN-PT FEM. vs. NN-PT MALE - PR>T : .3556
NN-PT FEM. vs. PART MALE - PR>T : .0009 **
NN-PT MALE vs. PART FEM. - PR>T : .1743

Notice, in Table 4.25, contrary to the courses - taken score's unweighted means for this othesis, that the non-participating females had a lower ELS unweighted mean than the icipating females. In fact, the .55 point differential was slightly greater than the .51 disparity oyed by participating males over non-participating males.

POTHESIS 5

H_O (5) : That those females finishing in the top 30% at ESU's 1992 Math Day individual competitions will not show a statistically significant difference to the males who score in the top 30% on the topic of the courses - taken score (CTS).

For the specific pairing of the two genders' top 30% (T30) achieving students, Table 4.26 ntains the results of the ANOVA for the dependent variable CTS. A clear statistical significance indicated that rejects null hypothesis five. The courses - taken score shows an over five point dvantage for the T30 males on the unweighted means, which is a large amount for a tatistic with relatively small numbers like this. The resultant significance probability of p = .0001 emonstrates the magnitude of this key difference. Figure 3 is also provided to further emphasize he significance of the T30 gender gap on CTS versus the other two categorical possibilites.

TABLE 4.26

ANALYSIS OF VARIANCE : COURSES - TAKEN SCORE - H_O (5)

	N	WEIGHTED MEAN	UNWEIGHTED MEAN (UM)	DF	STD. ERR. OF UM	SIGNIF. PROB. FOR FEM. T30 vs. MALE T30
FEM - T30	14	12.00	12.08	1	1.04	.0001 **
MALE - T30	34	17.93	17.38	1	0.70	

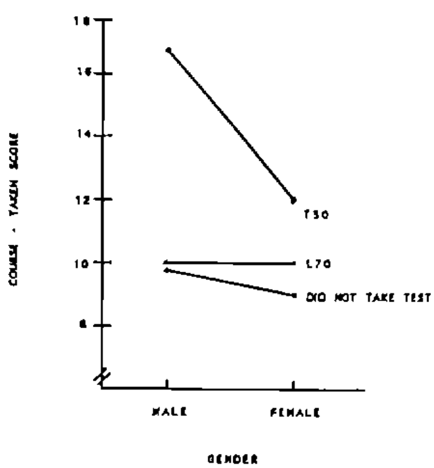

FIGURE 3

INTERACTION BETWEEN GENDER AND ACHIEVEMENT CATEGORIES ON CTS

CHER'S SURVEY DATA COLLECTED

The ESU Math Day Teacher's Survey was distributed to teachers in the original packet of

erials that were sent to each participating school. See Appendix D for a copy of the Teacher's

BLE 4.27

SULTS OF ESU'S MATH DAY 1992 TEACHER'S SURVEY

QUESTION # 1 : " HOW DO YOUR STUDENTS PREPARE FOR THE CONTEST? "

RESPONSES :	
Don't formally prepare	17
Study old tests / Class tests	15
Work very hard at it	2
Don't know	1

QUESTION # 2 : " HOW ARE STUDENTS SELECTED TO PARTICIPATE IN THE ESU'S MATH DAY? "

RESPONSES :	
Teacher's recommendations	12
Students volunteer	6
Good-test taker / Past course successes	6
Math club members	4
Selected by teachers from volunteers	4
Calculus students (or top class) are utilized	3

QUESTION # 3 : " HOW ARE THE THREE STUDENTS SELECTED THAT TAKE THE INDIVIDUAL ALGEBRA AND GEOMETRY TESTS AT MATH DAY? "

RESPONSES :	
Success in that course / Best test-takers	13
Selected by teacher	12
Student preference	8
Classification (Seniors picked)	1
Same students used as selected for team contest	1

QUESTION # 4 : " HOW OFTEN DO YOU DISCUSS MATH-RELATED CAREERS WITH YOUR STUDENTS? "

RESPONSES :	
Very seldomly	10
Informally in class occasionally	9
Two / three times a semester	7
Once weekly	7
Daily	2

QUESTION # 5 : " PRESENTLY, VERY FEW GIRLS ARE HIGHLY SUCCESSFUL AT MATHEMATICS COMPETITIONS. WHY DO YOU FEEL THIS IS THE CASE? "

RESPONSES :	
Priorities / Motivation / Girls are not as competitive	13
Teacher surveyed disputes the statement made before the question	6
Stereotypes / Myths	4
No response to question / Uncertain	4
Boys take more mathematics classes	2
Girl's lack of self-confidence in mathematics	2
Lack of hand-speed at an early level	1
Cycles	1
The quality math girls are not asked to attend	1
Girls need well-defined procedures not offered in mathematics	1

survey. While each school was sent enough copies that several teachers could participate, only the sponsor who would be bringing the students to Math Day was strongly encouraged to fill out the survey. A total of 35 teachers, most of them the sponsors, participated in the survey. A summary of the results are presented on the page 59, in Table 4.27, paraphrased and categorized together to assist the reader.

OTHER PRE-SURVEY DATA COLLECTED

Students who took the pre-survey were asked about what they planned to study in college and what their career plans were as a part of the Course - Taking Questionnaire on the first page (see Appendix A). Students were asked to identify their anticipated highest level of completed

TABLE 4.28

STUDENT'S RESPONSES TO CHOICE OF GENERAL ACADEMIC FIELD

QUESTION: " DO YOU HAVE IN MIND A GENERAL ACADEMIC FIELD OF CONCENTRATION? IF YES, PLEASE SPECIFY. "

RESPONSES:

AREA OF ACADEMIC CONCENTRATION	# OF MALES	# OF FEMALES	PERCENTAGE1 OF MALES	PERCENTAGE2 OF FEMALES
UNDECIDED	39	60	13.0%	20.1%
NO RESPONSE	25	12	8.3%	4.0%
SCIENCE	53	63	17.6%	21.1%
SCIENCE & MATH	27	18	9.0%	6.0%
BUSINESS	24	26	8.0%	8.7%
MATHEMATICS	35	22	11.6%	7.4%
ENGINEERING	40	4	13.3%	1.3%
EDUCATION	5	27	1.7%	9.0%
MEDICINE	16	14	5.3%	4.7%
ART / MUSIC / THEATER	7	12	2.3%	4.0%
COMPUTERS	12	4	4.0%	1.3%
PSYCHOLOGIST	5	8	1.7%	2.7%
ENGLISH	6	6	2.0%	2.0%
SOCIAL SCIENCE	0	6	-----	2.0%
LAW	3	4	1.0%	1.3%
NURSING	1	4	0.3%	1.3%
JOURNALISM	2	3	0.7%	1.0%
LIBERAL ARTS & SCIENCES	0	3	-----	1.0%
FOREIGN LANGUAGES	0	3	-----	1.0%
LAW ENFORCEMENT	1	0	0.3%	-----

NOTE : 1 - THERE WERE 301 MALE STUDENT SURVEYS
2 - THERE WERE 299 FEMALE STUDENT SURVEYS

BLE 4.29

UDENT'S RESPONSES TO CAREER GOALS

ESTION : " DO YOU HAVE A CAREER GOAL? IF YES, PLEASE SPECIFY. "

SPONSES :

REER GOALS	# OF MALES	# OF FEMALES	PERCENTAGE 1 OF MALES	PERCENTAGE 2 OF FEMALES
IDECIDED	50	65	16.6%	21.7%
O RESPONSE	17	18	5.6%	6.0%
IGINEER	75	12	24.9%	4.0%
OCTOR	29	42	9.6%	14.1%
DUCATION	9	46	3.0%	15.4%
CCOUNTANT	12	14	4.0%	4.7%
USINESS	9	11	3.0%	3.7%
OMP. PROGRAMMER	14	4	4.7%	1.3%
AWYER	5	12	1.7%	4.0%
SYCHOLOGIST	5	12	1.7%	4.0%
RTS/MUSIC/ENTERT.	5	8	1.7%	2.7%
URSING	1	11	0.3%	3.7%
IOLOGIST	5	7	1.7%	2.3%
PHYSICAL THERAPY	1	9	0.3%	3.0%
VETERINARIAN	7	3	2.3%	1.0%
SCIENTIST	7	3	2.3%	1.0%
JOURNALIST	5	3	1.7%	1.0%
ARCHITECT	7	1	2.3%	0.3%
MEDICAL TECHNOL.	4	4	1.3%	1.3%
FARMER	7	0	2.3%	-----
MATH PROFESSORS	2	0	0.7%	-----
MATHEMATICIANS	5	1	1.7%	0.3%
PHYSICIST	5	1	1.7%	0.3%
OTHERS 3	14	12	4.7%	4.0%

NOTE : 1 - THERE WERE 301 MALE STUDENT SURVEYS
2 - THERE WERE 299 FEMALE STUDENT SURVEYS
3 - ' OTHERS ' FOR MALES INCLUDED ONE OR TWO RESPONSES IN EACH OF THE FOLLOWING CATEGORIES : STOCK BROKER, PROFESSIONAL ATHLETE, PILOT, MILITARY, FORESTRY, PARAMEDIC, FIRE FIGHTER, POLICE OFFICER, DETECTIVE; ' OTHERS ' FOR FEMALES INCLUDED ONE OR TWO RESPONSES IN EACH OF THE FOLLOWING CATEGORIES : LEGAL ASSISTANT, COMMERCIAL DESIGN, MIDWIFE, FLORIST, METEROLOGIST, TRAVEL AGENT, INTERNATIONAL RELATIONS, SECRETARY, INTERIOR DECORATOR.

education. Then, those who responded that they intended to pursue a two-year or four-year college were asked to answer two additional questions about their plans, the data from which are represented in Tables 4.28 and 4.29. The questions were open-ended, so the answers were paraphrased and grouped together to assist the reader.

Notice that both Table 4.28 and Table 4.29 demonstrate similar career goals and ambitions nt for the career "Engineering". By a 10:1 ratio, 40 males to 4 females, engineering, long wved to be a highly technical and mathematical field, is preferred by males as a career choice.

As a part of the FSMAS's questions on the pre-survey, of which there were forty-three, e were two additional questions designed to address the concept of student's attributional es. These two questions appeared as questions number 40 and 45 (see Appendix A). The ilts were counted separately from the rest of the questions and the data appear below in Table 0. The results are given both for each gender and for each of the following categories : all ticipants, all non-participants, male participants, female participants, male non-participants, and nale non-participants.

ABLE 4.30

UDENT'S RESPONSES ON THE PRE-SURVEY ATTRIBUTIONAL STYLE QUESTIONS

NOTE : THERE WERE 301 MALES (170 PARTICIPANTS; 131 NON-PARTICIPANTS) AND 299 FEMALES (140 PARTICIPANTS; 159 NON-PARTICIPANTS) IN THIS SURVEY. OVERALL, THERE WERE 310 PARTICIPANTS AND 290 NON-PARTICIPANTS.

E-SURVEY
UESTION #40 " WHEN I SUCCEED ON A DIFFICULT MATH PROBLEM, IT IS MAINLY BECAUSE OF EFFORT, NOT MY ABILITY. "

ALES	SA - 12	A - 72	U - 111	D - 82	SD - 24
EMALES	SA - 29	A - 60	U - 108	D - 87	SD - 15
ARTICIPANTS	SA - 15	A - 59	U - 112	D - 96	SD - 28
ON-PARTICIPANTS	SA - 26	A - 73	U - 107	D - 73	SD - 11
ALE PART.	SA - 1	A - 34	U - 63	D - 53	SD - 19
EMALE PART.	SA - 14	A - 25	U - 49	D - 43	SD - 9
MALE NON-PART.	SA - 11	A - 38	U - 48	D - 29	SD - 5
EMALE NON-PART.	SA - 15	A - 35	U - 59	D - 44	SD - 6

PRE-SURVEY
QUESTION #45 " WHEN I FAIL ON A MATH PROBLEM, IT IS USUALLY BECAUSE I DID NOT TRY HARD ENOUGH. "

MALES	SA - 30	A - 100	U - 60	D - 91	SD - 20
FEMALES	SA - 46	A - 97	U - 62	D - 82	SD - 12
PARTICIPANTS	SA - 36	A - 98	U - 63	D - 91	SD - 22
NON-PARTICIPANTS	SA - 40	A - 99	U - 59	D - 82	SD - 10
MALE PART.	SA - 6	A - 43	U - 38	D - 65	SD - 18
FEMALE PART.	SA - 30	A - 55	U - 25	D - 26	SD - 4
MALE NON-PART.	SA - 24	A - 57	U - 22	D - 26	SD - 18
FEMALE NON-PART.	SA - 16	A - 42	U - 37	D - 56	SD - 8

ST-SURVEY DATA COLLECTED

When schools turned in their attitudes completed pre-surveys at ESU's 1992 Math Day, they eived an envelope with enough post-surveys to administer them to all of their Math Day ticipants. As instructed, each teacher waited several days before giving out the survey, and then urned them within two weeks. Several schools returned surveys after the final return date; these rveys were not used. See the last page of Appendix I for a complete listing of the specific estion numbers that were repeated from usage on the attitudes pre-survey to the post-survey.

In all, fourteen schools completed the surveys and returned them in time to be utilized. There re 131 post-surveys, filled out by 63 males and 68 females.

The data were separated into two components : 1) The questions that were repeated from e pre-surveys for comparison with the prior results; and, 2) The new, original questions that ere written due to the interest of the investigator.

Twenty questions from the attitudes pre-survey were repeated on the post-survey, with the purpose being to see if the mathematical competition (and achievement accomplished there) enhances or hinders a student's mathematical attitude. All twenty of these questions are from the Fennema-Sherman Mathematics Attitudes Scales (FSMAS), as described before.

The results of these repeated questions as described above are found in Table 4.31. Because each student had responded to the exact same questions roughly just three weeks earlier, the data was tabulated as "over and under" what they had previously answered. "Over" means that their attitudinal response is more positive on the post-survey than it was before. Conversely, "Under" means that they have responded in a more negative way than they had previously. "Even" means that the student answered the question the same way as before. The table only has a range from over by two to under by two; although a response of over or under by three or four was technically possible, no such responses were detected. Due to the fact that a few of the discrepancies that did occur are possibly attributable to simple response error on the part of the students, this results are not considered scientific nor statistically prevalent; it is put forth only interesting piece of information that was collected for which a few preliminary conclusions be appropriate.

LE 4.31

H GENDER'S VARIABILITY OF STUDENT'S RESPONSES ON THE POST-SURVEY MPARED TO THE PRE-SURVEY ___ SEE NOTE BELOW

STION ON /POST	NUMBER OVER BY 2 M	NUMBER OVER BY 2 F	NUMBER OVER BY 1 M	NUMBER OVER BY 1 F	NUMBER EVEN M	NUMBER EVEN F	NUMBER UNDER BY 1 M	NUMBER UNDER BY 1 F	NUMBER UNDER BY 2 M	NUMBER UNDER BY 2 F
1 / # 1	0	3	11	9	51	37	1	15	0	4
2 / # 2	1	2	9	8	48	30	5	18	0	10
3 / # 3	2	2	21	7	39	24	1	24	0	8
5 / # 4	0	1	2	1	57	55	4	8	0	0
7 / # 5	1	0	10	3	49	43	3	20	0	2
8 / # 6	0	0	10	2	48	44	5	19	0	3
11 / # 7	0	0	1	6	59	61	2	1	1	0
12 / # 8	2	2	6	11	53	43	2	10	0	0
13 / # 9	1	0	6	1	55	38	1	27	1	2
14 / #10	2	3	6	9	50	46	5	8	0	2
15 / #11	3	2	10	12	48	43	2	9	0	2
# 17 / #12	2	4	10	14	49	44	1	6	1	0
# 20 / #13	1	0	2	6	56	59	4	3	0	0
# 22 / #14	8	0	12	3	41	48	2	14	0	3
# 23 / #15	7	0	15	4	39	46	2	15	0	3
# 26 / #16	0	0	2	11	55	56	6	1	0	0
# 27 / #17	2	0	16	8	42	49	3	3	0	3
# 28 / #18	1	0	10	1	51	61	6	0	0	0
# 32 / #19	1	0	9	5	49	53	4	8	0	2
# 41 / #21	0	0	10	6	51	60	1	2	1	0
TOTALS	34	19	178	127	990	940	60	211	4	44

NOTE : OF THE 131 WHO PARTICIPATED IN THE POST-SURVEY, 63 WERE MALES AND 68 WERE FEMALES.

Notice, in Table 4.31, that while most student's attitudes have not altered as a result of the university-sponsored experience, far more of the responses that resulted in drops of one or two points occurred from female students, suggesting that the experience may not have been as positive for them as it was for the males.

Table 4.32 summarizes students' responses to the eight original questions that were asked as a part of the attitudes post-survey instrument, which were questions 23 through 30 (see ndix I). This time, the actual response given by the students of each gender is presented, with the corresponding instrument statement. Notice that since these questions were nated by the investigator, the Fennema-Sherman scales do not apply to them. Thus, these data pen to interpretation and speculation as to the nature of its importance to gender differences at ests. It is presented, therefore, merely as a matter of interest for which a few reasonable lusions may be appropriate.

BLE 4.32

UDENT'S RESPONSES TO QUESTIONS # 23 - 30 ON THE ATTITUDES POST-SURVEY

NOTE : THERE WERE 131 TOTAL STUDENTS - 63 MALES, 68 FEMALES.

3 "I THINK OFTEN ABOUT HOW MUCH MATH MEANS IN MY LIFE"					
MALES:	SA - 4	A - 14	U - 18	D - 20	SD - 7
FEMALES:	SA - 6	A - 17	U - 17	D - 19	SD - 8
4 "I THINK MATH IS BORING"					
MALES:	SA - 2	A - 5	U - 15	D - 24	SD - 17
FEMALES:	SA - 14	A - 6	U - 3	D - 31	SD - 13
5 "ESU MATH DAY HELPED ME SEE SOME OF THE USES OF MATHEMATICS"					
MALES:	SA - 6	A - 24	U - 14	D - 17	SD - 2
FEMALES:	SA - 6	A - 23	U - 15	D - 10	SD - 11
#26 "PARTICIPATING IN MATH COMPETITIONS ENHANCES MY MATHEMATICS ABILITY"					
MALES:	SA - 10	A - 34	U - 11	D - 7	SD - 1
FEMALES:	SA - 6	A - 23	U - 6	D - 13	SD - 19
#27 "MY ATTITUDE ABOUT MATHEMATICS IS GOOD"					
MALES:	SA - 19	A - 35	U - 8	D - 0	SD - 1
FEMALES:	SA - 15	A - 40	U - 6	D - 5	SD - 6
#28 "MATH IS A VERY DRY, DULL SUBJECT"					
MALES:	SA - 1	A - 2	U - 8	D - 35	SD - 18
FEMALES:	SA - 12	A - 9	U - 3	D - 25	SD - 19
#29 "I CAN BE VERY CREATIVE IN MY MATHEMATICS WORK"					
MALES:	SA - 10	A - 32	U - 17	D - 4	SD - 1
FEMALES:	SA - 8	A - 31	U - 16	D - 12	SD - 0
#30 "I CAME TO ESU MATH DAY JUST TO GET OUT OF A DAY OF SCHOOL"					
MALES:	SA - 0	A - 3	U - 7	D - 37	SD - 17
FEMALES:	SA - 17	A - 19	U - 3	D - 22	SD - 7

Notice on Table 4.32 the following comparisons: 1) Questions number 23, 27, and 29 appear have very similar results between the genders; 2) Questions 24 and 28, both pertaining to thematics as boring or dull, elicit far more affirmative responses from females than from males; Question 25 suggests that more females than males (by 11 - 2) strongly disagree that ESU Math y helps them see mathematics usefulness more clearly; 4) Question 26 shows that more males ree that mathematics competitions enhance their abilities, while females strongly disagree more 9 to 1); and ,5) Question number 30 indicates that more females come to ESU Math Day just to t out of school (as indicated by Strongly Agree - Females 17, Males 0; Agree - Females 19, ales 3; and Strongly Disagree - Males 17, Females 7).

CHAPTER FIVE
CONCLUSIONS AND RECOMMENDATIONS

SUMMARY

The purpose of this study was to investigate whether or not a significant gender difference exists in mathematics attitude that affects each gender's performance at university-sponsored mathematics contests. Other factors that could affect the outcome of mathematics contests, including the amount and content of mathematics courses taken, career goals, educational plans, method of selection of contest participants by schools sponsors, and methods of preparation for the contest by the schools were also considered. The subjects were students in grades eight through twelve who were enrolled in high school mathematics courses, at schools that planned to attend Emporia State University's annual mathematics contest. The contest utilized was the ESU Donald L. Bruyr Math Day, on October 28, 1992. The schools were asked to secure an equal number of contest participants and non-participants, so some of the subjects actually participated in ESU's 1992 Math Day and some did not. However, all of the subjects completed an attitudes pre-survey comprised of forty-three questions from the Fennema-Sherman Mathematics Attitudes Scales (FSMAS), and some additional questions about the courses the subjects had taken and about their career / educational goals. An attitudes post-survey was also administered to those students who participated in Math Day to discern to what extent the competition altered mathematical attitudes.

For each FSMAS survey, there were ten different components of a subject's mathematics attitude considered separately, these being : a) Confidence in Learning Mathematics Scale (C); b) Attitude Toward Success Scale (AS); c) Mathematics as a Male Domain Scale (MD); d) Effectance Motivation Scale (E); e) Mathematics Usefulness Scale (U); f) Mother Scale (M); g) Father Scale (F); h) Teacher Scale (T); i) Mathematics Anxiety Scale (A); and, j) Total of the nine scales together (TOTAL). Using information gathered from these attitudes surveys, ported by the initial research done by Elizabeth Fennema, it was determined that there is no rent difference between the genders in overall mathematics attitudes. Thus, with no evidence ng found to suggest that males should do much better at mathematics contests than females ause of mathematical attitudes, the subjects who participated in Math Day's individual petition had their attitudes scores considered with the results of a written, multiple choice, ividual algebra or geometry test given at Math Day. Each school was only allowed to enter ee students in this written test competition, so this sample was limited.

The results of the 1992 ESU Math Day individual tests were basically the same as other years, th males finishing in the top spots on each test and having a significantly higher number of top irty percent finishers. An analysis of variance, using unweighted means, was employed with the ta to find any pertinent correlations between attitude, achievement, and gender.

The Hawthorne Effect is a potential concern to a study of this type that appears in this case not have played a role. The Hawthorne Effect is the theory that subjects who have an active role in n experiment will sometimes perform better just to meet expectations. While this possibility cannot be totally dismissed, there are several conditions of this study that reduce the chances of the Hawthorne Effect : 1) Students had no prior knowledge of specifically which achievement group was expected to do better or was being studied; and, 2) The ESU Math Day competition already had an outstanding tradition as being a good place to showcase mathematical talents, meaning that the motivation was already present to perform well.

FINDINGS

Hypothesis one stated the following : "That students of each gender finishing in the top 30% (labeled T30) at ESU's 1992 Math Day individual competitions will not have a more positive attitude than those students who finish in the lower 70% (L70), on each of the following parts of the FSMAS : a) Confidence in Learning Mathematics Scale (C); b) Attitude Toward Success Scale (AS); c) Mathematics as a Male Domain Scale (MD); d) Effectance Motivation Scale (E);

Mathematics Usefulness Scale (U); f) Mother Scale (M); g) Father Scale (F); h) Teacher Scale (T); i) Mathematics Anxiety Scale (A); and, j) Total of the nine scales together (TOTAL)." Males who finished in the top 30% on the individual tests scored significantly higher than males who finished in the lower 70% on every component of the FSMAS except for Male Domain. This suggests that a difference in attitude towards mathematics does seem to enhance achievement at contests for males. These males who score well at contests are more confident, less anxious, expect to be more successful, are less concerned about others finding out about their success, perceive themselves to receive more support from parents and teachers, and find mathematics more useful and challenging than males who do not enjoy high achievement at these contests.

Conversely, females in the top 30% of achievement on the individual tests displayed a statistically significantly higher attitude score on just two categories, the Teacher scale and the Total. This implies that females who perform well at contests feel more encouraged by their mathematics teachers to succeed than lower achieving females do. Overall, top 30% females have a more positive attitude about mathematics and their role in it than lower 70% females, reflected in their total attitude score.

Hypothesis two stated the following : "That those females finishing in the top 30% at ESU's 1992 Math Day individual competitions will not show a statistically significant difference, in the ten FSMAS listed in H_0 (1), to the males who finish in the top 30% ." In this hypothesis that considered just the top 30% achievers at the contest, males had the higher unweighted mean than females in every category except for Male Domain, where females had a sizeable advantage. Yet, males were found to be significantly higher than females in only three scales: Attitude Toward Success, Mother, and Total. Thus, the males were found to be more comfortable about their own success and also about who found out that they were successful. Additionally, the mothers of these successful males were perceived to be more interested and appreciative of peak mathematics performance. The difference in the total attitude scores was great, favoring the males, suggesting that males see the many benefits of mathematics and of being successful at university-sponsored tests more than females do, which in turn aids in higher achievement.

Females in the top 30%, however, have a great statistical advantage on the question of Male Domain. Females feel very strongly that they are as capable at mathematics as males are. Also, females feel that mathematics is every bit as much for them as it is for males. Males who score well at contests do not share that view, however. This disagreement is the key difference between the genders in this category. In fact, if this view that mathematics is a gender-neutral discipline was not scored more favorably by the FSMAS, then the difference in the total attitudes scores would be even greater than it is already.

Hypothesis three stated the following : "That when considering how attitudes affect participation in ESU's 1992 Math Day contest, there is not a statistically significant difference among the positive scores of the possible combinations of the four different categories, participating males (PM), participating females (PF), non-participating males (NM), and non-participating females (NF), as found by the TOTAL from the FSMAS." Of the six possible combinations, four proved to have a strongly statistically significant correlation. These were the ones matching non-participants with participants of each gender (non-participant females versus participant females & non-participant males versus participant males) and non-participants versus participants cross-gendered (non-participant females versus participant males & non-participant males versus participant females). However, these were the four parts of the hypothesis that were fully expected to be significant. The two pairings that provided the stimulus to formulate the hypothesis, participant males versus participant females and non-participant males versus non-participant females, did not enable the researcher to reject the null hypothesis and were not considered significant. It is evident that male and female participants do not have any differences in total attitude score of consequence, which supports the notion that it is only the high-achieving students who possess the noteworthy differences that translate into mathematics contest achievement.

The last two hypotheses considered how much the amount of mathematics a student has taken how far they expect to go educationally can affect performance at ESU Math Day. This data was collected to complement the FSMAS survey information in an effort to discover if non-attitudinal factors might instead be the important components of gender differences in mathematics contest performance.

Hypothesis four stated the following : "That for each of the other two research variables that can affect performance, the courses - taken score (CTS) and the expected level of education score (ELS), a statistically significant difference cannot be found between the possible combinations of the four categories PM, PF, NM, and NF, as described in H_0 (3)." For the CTS, just two of the six combinations were not statistically significant. Non-participant females were not statistically significant to either the participant females nor to the non-participant males. Interestingly, the non-participant females had a higher CTS unweighted mean than the participant females did, lending key support to some teacher's expressed beliefs that often the most qualified females academically are not brought to mathematics competitions in the first place. Clearly, some of the females who are competing have not only had fewer mathematics courses than the males who are beating them at these contests, but they have not even had as much mathematics as other girls in their own classes who did not come to the competition. Apparently, these girls are good test takers, which was a high criteria cited by the school sponsors as a way these students are selected to attend contests, but do not have the mathematical background to be more successful.

The other four combinations all rejected null hypothesis number four. Among these, the highest statistically significant advantage was participant males versus participant females. Males in this category had a score that was over two-and-a-half points higher, which can mean an entire semester of mathematics or more. Participant males also had a higher CTS than non-participant males and non-participant females that was found to be significant. Altogether, males who attend Math Day have been exposed to enough mathematics courses that the other categories have not that their success is not so surprising.

The expected level of education score (ELS) had very different results on hypothesis four, as osed to the CTS. Three of the six combinations contained significance probabilities that orized the researcher to reject the null hypothesis, these being : 1) non-participant females us participant females; 2) non-participant males versus participant males; and, 3) non-icipant females versus participant males. The lack of similarity to the CTS results of null othesis four is noteworthy. Participating females had a lower CTS mean than non-participating ales, yet they possess a sizeable advantage in ELS. This is interesting because some teachers eyed for this study expressed a concern that while females with more mathematical ability, are getting the highest grades in their classes, often do not attend the competition, it can be that the girls with more ambitious career goals do attend. These data seem to confirm that ion that the girls who attend mathematical competitions expect to go farther in post-secondary ool than some of the girls who have taken more mathematics and do not attend. Notice that for boys, these two groups, those who take more mathematics and those who are educationally bitious, are largely one and the same group.

Another interesting aspect of the ELS is found in the comparison between participant males and ticipant females. Where participant males had a sizeable advantage over participant females in TS, notice that the very small edge males have for ELS is really not close to being statistically gnificant. This relatively small difference indicates that the expected level of education a student lans to attain is most likely not the overriding factor in enhanced mathematics contest erformance. Most likely, this leads back to CTS and attitudes as being more prevalent factors.

Hypothesis five stated the following : "That those females finishing in the top 30% at ESU's 1992 Math Day individual competitions will not show a statistically significant difference to the males who score in the top 30% on the topic of the courses - taken score (CTS)." Males were found to have a significantly higher CTS than females, by over five and a quarter points on the average. This differential translates into two full courses of high school mathematics (or a full year) or over one semester of college-level mathematics study (probably Calculus). While it is true that several males had taken Calculus 3 or beyond and probably skewed the results some, it should oted that nearly all of the males in the top 30% had taken more mathematics than their female petitors. In actuality, the girls probably are better test-takers than the males, but the males have eat deal more mathematical background to rely on.

From the Teachers' Surveys, it was learned that most schools, if they prepare at all, mainly dy old tests to get ready for the mathematical competition. Students are selected to attend ESU th Day usually through teachers' recommendations or student volunteers. Teachers believe that ls are not as successful at mathematics competitions mainly because their priorities are set ward other types of achievement or because they are just not as competitive as boys are toward n-graded activities.

The subjects, as part of the Courses-Taking Questionnaire, expressed career goals that were emarkably similar, except that females are far less interested in engineering as a career.

ONCLUSIONS

The following conclusions are direct outcomes derived from the findings outlined in the preceding pages. Specific conclusions from this study include the following :

1. Among both males and females, a more positive attitude toward mathematics enhances performance at mathematics competitions.
2. Males who score well at mathematics contests are more self-confident and expect to be more successful than males who do not fare well.
3. Males who finish higher at mathematics contests than other males are much less anxious about the testing situation.
4. Males who finish higher at mathematics contests believe that they receive more support from teachers, and their own parents than, do males who do not score as well.
5. Males who score well at mathematics contests believe mathematics is more useful, rewarding, and challenging than males who are less successful do.
6. Females who finish higher at mathematics contests feel more encouraged by their mathematics teachers to succeed than females who do not fare well.

7. Males are much more comfortable if others know that they did well at mathematical endeavors than females do.

8. While there is no perceivable difference in how fathers feelings are interpreted, the mothers of high-achieving males at mathematics competitions are believed to be more interested and appreciative of top performance for them than high-achieving female's mothers are.

9. Females of all mathematical abilities believe very strongly that mathematics is gender-neutral. Males of lower abilities agree that mathematics is gender-neutral, though not as strongly as females do. However, high-achieving males seem to feel that females are not as capable or as reliable in mathematics as males. Some of these males even cite the poor performance of females at mathematics competitions as part of their reasoning.

10. In general, males and females that attend mathematics competitions have little if any discernable differences in overall mathematical attitudes. However, males that finish in the top 30% at these competitions have a significantly better mathematical attitude than females that finish in the top 30%.

11. Females that do not participate in mathematics competitions have taken a slightly greater number of mathematics courses than females that do participate. However, these non-participant females do not expect to go as far educationally as the female participants.

12. Males that participate in mathematics competitions have taken a great deal more mathematics and expect to go farther educationally than males or females who do not participate. These participating males have also taken considerably more mathematics than participating females, but there is not a sizeable disparity in expected educational level between these groups.

13. Females come to mathematics competitions with different priorities than males do. Teachers stated in their survey that they felt girls do not do better at competitions because girls lack the motivation and competitiveness to succeed more. Girls are motivated towards grades, not trophies. The attitudes post-survey confirmed this, as girls stated that they came to Math Day to get out of school, while males did not.

[cut off]TATIONS AND PROBLEMS

[cut off]he following is a listing of the limitations and problems encountered during the completion of [cut off]research :

1. Not every participant at ESU's 1992 Donald L. Bruyr Math Day took an attitudes pre-survey (that is, a survey filled out before Math Day). While 36 out of the 45 attending schools participated, this means that nine schools chose not to assist with this research. As a result, some students at Math Day were not represented in the study.

2. Not every student who took an individual examination (algebra or geometry) filled out a survey. This means that some students who finished in the top 30% in test achievement, and some who did not, were unfortunately excluded from the study.

3. This study was limited to a population primarily of ninth through twelfth graders, as opposed to including the younger students, such as fourth through eighth graders, like the Kansas Association of the Teachers of Mathematics (KATM) statewide mathematics contest does.

4. This study was limited to only those students who are taking mathematics courses in Kansas secondary schools. This means that students who are listed as "Non-participants" actually did not participate in ESU's 1992 Math Day, but all students who took surveys for this research took mathematics courses during the Fall 1992 and, thus, participated in that sense. It might be significant to include eleventh and twelfth graders who chose not to take mathematics courses at all (after completing requirements), students not included in this research.

5. For the attitudes pre-survey instrument, the information obtained on the Course - Taking Questionnaire might be questioned about validity of responses. Specifically, the student-reported information on the courses they have taken (or are taking) might be suspect. It is possible that more accurate information could have been obtained from a search of the permanent school records of each student, or by talking to the appropriate

school counselors. Such information was not available, however.

6. All attitude survey data (both on the pre-survey and the post-survey) was self-reported by students with no interview-type follow-up, which could introduce insincere response data to the research. Cooperating teachers observed students filling out the surveys to try to minimize this concern, but some insincere answers are possible.

7. The study outcomes are subject to the obvious possibility of computational or clerical errors originating with the relatively massive amount of data collected.

8. This study is limited to Emporia State University's Donald L. Bruyr Math Day. The question of whether or not other similar-style, university-sponsored mathematics contests around the state of Kansas and the Midwest (such as Kansas University and Washburn University), have similar results, was not addressed.

9. The fact that a different number of items from each of the nine scales of the Fennema-Sherman Mathematics Attitudes Scales (FSMAS) were utilized in the pre-survey used before ESU Math Day caused a few problems. The results of each scale category had to be "scaled" to equal amounts so that the tenth category, total, made coherent sense. Hopefully, any minor confusion that this causes is offset by the parity of the total category's results and the magnitude of the conclusions it made possible.

10. Although two scales were utilized that involved parents, the Mother scale and the Father scale, it was impractical to contact any of the parents of the students in the study. A parent's survey to find out some of their views would have added considerably to the data.

11. A very small percentage of schools, fourteen out of 45, completed and returned the attitude post-survey in time to be used, causing limitations in the valid conclusions that were possible from this data. Perhaps allowing more than two weeks to return them would be more successful, yet still yield reliable data.

12. Limitations had to be put on the number of the FSMAS questions utilized in the attitudes pre-survey to limit the amount of classtime required by each student to participate.

It would have been nice to include every question found in the FSMAS.

13. Limitations had to be put on the number of the FSMAS questions utilized in the attitudes post-survey to limit the paper usage (which had been a great deal at that point) to one page, front-and-back. It would have been nice to include every FSMAS question used in the attitudes pre-survey to completely cross-check the data.

14. The nine scales of the FSMAS were not assessed independently of each other, limiting the scope of the interpretation of this data. Technically, in order to assess them independently, a separate survey about each scale would have to be given to a random, representative sample from the population. This was not feasible in this case. While this does temper the results somewhat, this is not considered to be a significant problem because of the design of the FSMAS.

RECOMMENDATIONS

The following recommendations are presented as ideas for future research and some possible changes that could be made to improve the design model of the study. The recommendations offered here are predicated on the conclusions and limitations cited throughout this research.

The recommendations for future research include the following:

1. Future studies on this topic could include every participant at a particular university-sponsored mathematics competition. In this manner, all of the students who make up the final rankings will be accounted for in the data collected. If possible, a contest where every student who attends takes an examination would be helpful.

2. Future studies on this topic could depend on students from a wider grade range than just ninth through twelfth. Including students of grades four through twelve, for instance, would include more students who are in the formative years of their mathematical learning.

3. Future studies on this topic could include all of the students enrolled at a particular secondary school (or several schools in a larger city or district). This approach would allow for students continuing towards a high school diploma, but not enrolled in mathematics, to be involved in the study. Also, all self-reported data about courses taken and current mathematical progress would be easily verifiable by school personnel.

4. Future studies on this topic could include a face-to-face interview to accompany (or instead of) the attitudes survey given using paper and pencil. These data could either help cross reference and verify the survey results, or it could complement them substantially.

5. Future studies on this topic could include a parental interview or survey for each subject, to accompany the attitudes survey given. These data could be used to assess what mathematical attitudes are being learned in the home versus the school setting.

6. Future research that includes an attitude survey could employ cards or computer-assisted answer sheets. This would enable participants to transfer responses to a sheet of paper that could be fed directly into a computer for tabulation. Besides the obvious benefits of less chance for human error, this procedure would be less time consuming as well.

7. Future research could incorporate more than one university-sponsored mathematics contest into the data set. Using, for instance, all of the mathematics contests that occur in an entire state or region of the country in one year could yield interesting results. This could allow the determination of whether all mathematics contests have an achievement-attitude correlation that slants toward high-achieving males or not.

8. Future studies could include a longitudinal study to chart the participant's progress from one university-sponsored contest through college or beyond.

9. Future studies on this topic that utilize the Fennema-Sherman Mathematics Attitudes Scales (FSMAS) could consist of all 108 questions to see if using all of the questions yields similar results to this study or not.

10. Future studies could assess each scale of the FSMAS independently of the others. This would enable them to be expressed separately, instead of as a unit.

11. Future research could assess what the role of computer-assisted learning to mathematics coursework has on achievement at mathematics contests. The possibility that computers help improve overall attitudes that assist in achievement could be questioned.

12. Future research could deal exclusively with the research variables of the courses taken score and expected level of education score. These variables, if designed into a study without regard to mathematical attitudes, but instead as a part of a larger analysis into how these components affect contest performance, could yield interesting results.

13. Future research probably should limit the courses-taken score. The CTS could have been scored differently, to include an upper limit for the highest possible score obtainable. A suggested upper limit could be 30, for at that level, the advantage of more mathematical maturity is clearly established.

CONCLUDING REMARKS

It should be apparent from this study that a gender problem does exist that suggests males do perform appreciably better at mathematics contests year-after-year. More than a just coincidence, in fact, the attitudinal factors of fidence in one's own ability, mathematical anxiety, support from teachers and parents, ognizing the usefulness of mathematics, and a genuine enjoyment of the challenge and rigor of thematics may play a part in distinguishing one gender from another. Other factors may also lude the number and content of courses each gender takes in secondary school, the educational d career goals one sets for oneself, and possessing the motivation to make an otherwise aningless competition a true priority. Whatever factor is most prevalent, it is probable that it is a mbination of several of these factors that creates a situation where females will usually not win many mathematical "medals" as their participation percentages suggest they should. The uation appears to be improving, and probably not without some help from educators who want see females prosper in the world of mathematics. The researcher became interested in studying is subject because of a firm belief that females are every bit as capable of fine, top-quality athematics performance as males are, and also that all educators can do something to level the laying field. The Constitution of the United States implies that America is the land where all eople are created equally; it is time mathematics becomes the discipline where students of each ender are achieving equally as well.

APPENDIX A

ESU Math Day 1992 Attitudes Pre-Survey

EMPORIA STATE UNIVERSITY'S DONALD L. BRUYR MATH DAY 1992
ATTITUDES SURVEY

ART 1: COURSE-TAKING QUESTIONNAIRE

Male/Female________
(JUST PUT M OR F)

NAME____________________ **GRADE**________
LAST FIRST 7,8,9,10,11,12

SCHOOL NAME____________________

A. Check the courses you have taken, and are currently taking. Indicate your grade level when the course was taken (or is being taken) as well.

COURSE TITLE	CHECK IF TAKEN	GRADE LEVEL (7TH,8TH, ETC.)
General Math	----------	------------
Algebra I	----------	------------
Geometry	----------	------------
Algebra II	----------	------------
Trigonometry	----------	------------
Math Anlys/Sr.Math	----------	------------
Calculus	----------	------------
Others	----------	------------
------------ (PLEASE SPECIFY)	----------	------------

B. Have you participated before this year in ESU Math Day? YES____ NO____
(CHECK ONE)

If YES, what year(s)? ________________

C. Check the highest level of education you expect to complete (CHECK ONLY ONE)

High School ____
Four-year College or University ____
Two-year Community College ____
Vocational or Business School ____
Graduate or Professional School after College ____

D. If you plan to attend a two-year or four-year college or university, answer these questions:

a) Do you have in mind a general academic field of concentration? (For example: English, art, science, math, etc.)
If you respond YES, please specify:

\-

b) Do you have a career goal? (Example: engineer, teacher, lawyer, scientist, medical doctor, etc.) If YES, please specify:

\-

DIRECTIONS

FENNEMA-SHERMAN MATHEMATICS ATTITUDES SCALES (IN PART)

CREDIT TO: Elizabeth Fennema - Julia A. Sherman (Univ. of Wisconsin - Madison)

On the following pages is a series of statements. There are no incorrect answers for these statements. They have been set up in a way which permits you to indicate the extent to which you agree or disagree with the ideas expressed. Suppose the statement is:

EXAMPLE 1: I like mathematics.

As you read the statement, you will know whether you agree or disagree. If you strongly agree, circle SA next to that number on your paper. If you agree but with reservations, that is, you do not fully agree, circle A. If you disagree with the idea, indicate the extent to which you disagree by circling D for disagree or SD for strongly disagree. But if you neither agree nor disagree, circle U for undecided. Also, if you cannot answer a question, feel free to circle U.

IT IS IMPORTANT THAT YOU DO NOT SPEND MUCH TIME WITH ANY STATEMENT, BUT BE SURE TO ANSWER EVERY STATEMENT. Work fast but carefully.

There are no right or wrong responses. The only correct responses are those that are true for you. Whenever possible, let the things that have happened to you help you make a choice.

THIS INVENTORY IS BEING USED FOR RESEARCH PURPOSES ONLY AND NO ONE WILL KNOW WHAT YOUR RESPONSES ARE.

SA = STRONGLY AGREE   A = AGREE
U = UNDECIDED   D = DISAGREE   SD = STRONGLY DISAGREE

1. SA A U D SD — GENERALLY, I HAVE FELT SECURE ABOUT ATTEMPTING MATHEMATICS.

2. *SA A U D SD — MOST SUBJECTS I CAN HANDLE OKAY, BUT I HAVE A KNACK FOR FLUBBING UP MATH.*

3. SA A U D SD — MY MOTHER THINKS I COULD BE GOOD IN MATH.

4. *SA A U D SD — MY MOTHER HATES TO DO MATH.*

5. SA A U D SD — MY FATHER THINKS I'LL NEED MATHEMATICS FOR WHAT I WANT TO DO AFTER I GRADUATE.

6. *SA A U D SD — MY FATHER THINKS I'M THE KIND OF PERSON WHO COULD DO WELL IN MATHEMATICS.*

7. SA A U D SD — I DON'T LIKE PEOPLE TO THINK I'M SMART IN MATH.

SA = STRONGLY AGREE A = AGREE
U = UNDECIDED D = DISAGREE SD = STRONGLY DISAGREE

SA A U D SD — *IF I GOT THE HIGHEST GRADE IN MATH, I'D PREFER NO ONE KNEW.*

SA A U D SD — WHEN IT COMES TO ANYTHING SERIOUS, I HAVE FELT IGNORED WHEN TALKING TO MATH TEACHERS.

SA A U D SD — *I WOULD TALK TO MY MATH TEACHERS ABOUT A CAREER WHICH USES MATH.*

SA A U D SD — GIRLS CAN DO JUST AS WELL AS BOYS IN MATHEMATICS

SA A U D SD — *I'M NO GOOD IN MATH.*

SA A U D SD — IN TERMS OF MY ADULT LIFE, IT IS NOT IMPORTANT FOR ME TO DO WELL IN MATH IN HIGH SCHOOL.

SA A U D SD — *I ALMOST NEVER HAVE GOTTEN SHAKEN UP DURING A MATH TEST.*

SA A U D SD — MATHEMATICS USUALLY MAKES ME FEEL UNCOMFORTABLE AND NERVOUS.

SA A U D SD — *I WOULD RATHER HAVE SOMEONE GIVE ME THE SOLUTION TO A DIFFICULT MATH PROBLEM THAN TO HAVE TO WORK IT OUT FOR MYSELF.*

17. SA A U D SD — MATH DOES NOT SCARE ME AT ALL.

18. *SA A U D SD* — *I'LL NEED MATHEMATICS FOR MY FUTURE WORK.*

19. SA A U D SD — FEMALES ARE AS GOOD AS MALES ARE IN GEOMETRY.

20. *SA A U D SD* — *MY TEACHERS HAVE ENCOURAGED ME TO STUDY MORE MATH.*

21. SA A U D SD — IT WOULD MAKE ME HAPPY TO BE RECOGNIZED AS AN EXCELLENT STUDENT IN MATHEMATICS.

22. *SA A U D SD* — *I AM SURE I COULD DO ADVANCED WORK IN MATHEMATICS LATER, AFTER HIGH SCHOOL.*

23. SA A U D SD — I THINK I COULD HANDLE MORE DIFFICULT MATHEMATICS NOW, IN HIGH SCHOOL.

24. *SA A U D SD* — *MY MOTHER HAS SHOWN NO INTEREST IN WHETHER OR NOT I TAKE MORE MATH COURSES.*

25. SA A U D SD — MY FATHER HAS SHOWN NO INTEREST IN WHETHER OR NOT I TAKE MORE MATH COURSES.

26. *SA A U D SD* — *STUDYING MATHEMATICS IS JUST AS APPROPRIATE FOR WOMEN AS IT IS FOR MEN.*

27. SA A U D SD — MY MIND GOES BLANK AND I AM UNABLE TO THINK CLEARLY WHEN WORKING MATHEMATICS.

28. *SA A U D SD* — *I STUDY MATHEMATICS BECAUSE I KNOW HOW USEFUL IT IS.*

SA = STRONGLY AGREE A = AGREE
U = UNDECIDED D = DISAGREE SD = STRONGLY DISAGREE

29. SA A U D SD MATHEMATICS IS ENJOYABLE AND EXCITING TO ME.

30. *SA A U D SD GIRLS WHO ENJOY STUDYING MATH ARE A BIT PECULIAR.*

31. SA A U D SD I WOULD TRUST A WOMAN JUST AS MUCH AS I WOULD TRUST A MAN TO FIGURE OUT IMPORTANT CALCULATIONS.

32. *SA A U D SD I AM SURE THAT I CAN LEARN MATHEMATICS.*

33. SA A U D SD MATH HAS BEEN MY WORST SUBJECT.

34. *SA A U D SD MATH TEACHERS HAVE MADE ME FEEL I HAVE THE ABILITY TO GO ON IN MATHEMATICS.*

35. SA A U D SD MY MOTHER THINKS I'LL NEED MATHEMATICS FOR WHAT I WANT TO DO AFTER I GRADUATE FROM HIGH SCHOOL.

36. *SA A U D SD MY FATHER WOULDN'T ENCOURAGE ME TO PLAN A CAREER WHICH INVOLVES MATH.*

37. SA A U D SD I WOULD HAVE MORE FAITH IN THE ANSWER FOR A MATH PROBLEM SOLVED BY A MAN THAN BY A WOMAN.

38. *SA A U D SD I CAN GET GOOD GRADES IN MATHEMATICS.*

39. SA A U D SD I HAVEN'T USUALLY WORRIED ABOUT BEING ABLE TO SOLVE MATH PROBLEMS.

40. *SA A U D SD WHEN I SUCCEED ON A DIFFICULT MATH PROBLEM, IT IS MAINLY BECAUSE OF EFFORT, NOT MY ABILITY.*

41. SA A U D SD MALES ARE NOT NATURALLY BETTER THAN FEMALES IN MATH.

42. *SA A U D SD I USUALLY HAVE BEEN AT EASE DURING MATH TESTS.*

43. SA A U D SD I AM CHALLENGED BY MATH PROBLEMS I CAN'T UNDERSTAND IMMEDIATELY.

44. *SA A U D SD MATHEMATICS IS A WORTHWHILE AND NECESSARY SUBJECT.*

45. SA A U D SD WHEN I FAIL ON A MATH PROBLEM, IT IS USUALLY BECAUSE I DID NOT TRY HARD ENOUGH.

AT THIS TIME, BE SURE THAT YOU HAVE ANSWERED EVERY QUESTION AND HAVE MARKED THEM ALL CLEARLY.

NOTE: Your participation and accompanying signature merely allows Emporia State University to use your survey results. Please understand that your responses will be kept strictly confidential at all times.

THANK YOU FOR PARTICIPATING IN THIS SURVEY!

Have a super day at ESU MATH DAY!!

BLE

U'S MATH DAY 1992 ATTITUDES PRE-SURVEY - QUESTIONS BY CATEGORY

CATEGORY	QUESTION NUMBERS ON PRE-SURVEY OF THIS TYPE
ONFIDENCE	1, 2, 12, 22, 23, 32, 33, 38
OTHER	3, 4, 24, 35
ATHER	5, 6, 25, 36
TTITUDE TOWARD SUCCESS	7, 8, 21
EACHER	9, 10, 20, 34
ALE DOMAIN	11, 19, 26, 30, 31, 37, 41
SEFULNESS	13, 18, 28, 44
NXIETY	14, 15, 17, 27, 39, 42
FFECTANCE MOTIVATION	16, 29, 43
RITTEN BY RESEARCHER	40, 45

OURCE: FENNEMA-SHERMAN MATHEMATICS ATTITUDES SCALES

APPENDIX B

Instructions for Teachers (for Attitudes Pre-Survey)

ESU MATH DAY 1992 ATTITUDES SURVEY

INSTRUCTIONS FOR TEACHERS

To begin with, thanks to you and your students for helping us with this survey.

In order for this survey to foster meaningful results, please observe students as they take the survey. Stress that students who attend ESU's Donald L. Bruyr Math Day do not have to complete a survey to do so, but that it will be appreciated if they do. However, any school or student can choose not to participate if they wish.

Please administer this instrument to all classes who contain students that plan to attend Math Day on October 28th this year. It is the hope of the researchers that you will survey *all* students who end up attending Math Day and roughly the same number who do not attend. *HOWEVER, IT IS IMPORTANT YOU AT LEAST TRY TO GET YOUR THREE STUDENTS TAKING THE ALGEBRA AND GEOMETRY INDIVIDUAL TESTS TO TAKE THE SURVEY.* If you or any member of your staff would like to have the results of this research, you may make a written request and we will be happy to share them with you.

Read the directions carefully with or to the students. You have been sent __ surveys to employ. If your school would like to use more of them, feel free to remove the staples from one and create more of them to use. If your school would rather Emporia State University incur the costs of these surveys, please make a phone call to one of the numbers below and we will be happy to send you as many copies as you need. Send all of the completed surveys back to:

EMPORIA STATE UNIVERSITY, DR. CONNIE S. SCHROCK/JEFF HURN, BOX NO. 27, 1200 COMMERCIAL, EMPORIA KANSAS 66801, *or you can bring them with you to ESU's Donald L. Bruyr Math Day if you wish* (look for details there for where to leave them). I suggest that if you mail them you attempt to use the envelope they came in.*The post-survey should be mailed back to the same address above.*

A copy of the informed consent document for your principal or director of secondary education to sign is enclosed - please forward it to them for their signature. It is also important that each student who participates sign the pink form enclosed.

****If you have any questions at all, please call 316-341-5451 and ask for Jeff Hurn OR contact Dr. Connie S. Schrock at 316-341-5631...we would be happy to assist you in any way we can*****Thank you for all of your help!***

APPENDIX C

Letter of Authorized Consent to Principal or Director of Secondary Education

Jeffrey L. Hurn
1201 Triplett Dr., Apt. #D-37
Emporia, Kansas 66801
Home Ph# 316-343-6532
Work Ph# 316-341-5451

Dear Principal or Director of Secondary Education,

I am delighted to see that your school has decided to participate in the 1992 Donald L. Bruyr Math Day on October 28. Additionally, it is my hope that you and your mathematics staff will lend your support to my interest in studying how student's attitudes affect their achievement in math competitions.

I am a second-year graduate student at Emporia State University about to begin my Master's Thesis in Mathematics. I would like to have each of your students who plan to attend ESU's Math Day, and some who do not (if that is possible), fill out two attitudes surveys, a pre-survey and a post-survey. The statements will deal with the student's experiences and attitudes about mathematics. In addition, I will correlate these surveys with the student's individual results in the algebra and geometry tests given at Math Day, for the student is involved in those exams.

For this research, there are no attendant discomforts or any other forms of risk involved for any subject participating in this survey (or to your school). The expected benefits include an increased knowledge in the relationship between math attitudes and enhanced learning and performance. If you have any questions, now or in the future, please feel free to inquire about them by written correspondence, or by phone to Jeff Hurn, 316-341-5451, or Dr. Connie S. Schrock (Faculty Advisor), 341-341-5631. All of your student's responses will be reported under strict confidentiality or as grouped data, so complete privacy will be guaranteed. You, as your school's authorized representative, or any member of your math faculty or the students who participate, may request by written correspondence a report of the results of this study at any time (make requests to the address written above).

If you allow your school to take part, you and your school's participants are free to withdraw their consent and discontinue participation at any time. In addition to your consent, we are also securing signatures from each of the participants in the study. If you consent to have your school participate, please sign this form, make a copy for your own records, and return the original to me in the enclosed envelope, preferably no later than October 28, 1992, please.

Thank you.

Jeffrey L. Hurn

INFORMED CONSENT DOCUMENT

____________________________ has my permission to participate in the
(YOUR SCHOOL'S NAME)
research project outlined in this letter.

____________________________ Date________________
(SIGNATURE OF AUTHORIZED REPRESENTATIVE)

APPENDIX D

ESU Math Day 1992 Teacher's Survey

EMPORIA STATE UNIVERSITY'S DONALD L. BRUYR MATH DAY 1992
TEACHER'S SURVEY

NAME______________________________

SCHOOL NAME______________________________

TITLE/POSITION______________________________
(CHAIR, MATH CLUB SPONSOR, ETC.)

I am assessing the attitudes of students in your math classes and how that relates to achievement at math competitions. I would appreciate your assistance in responding to a few questions which will add to my understanding of their preparation for going to ESU's Donald L. Bruyr Math Day, or why they are not attending.

By cooperating, you will help us find answers to important educational questions; however, your participation is strictly voluntary. Confidentiality is guaranteed; your name will not be associated with your answers in public or private reports of the results. Please omit any questions which you feel invade your privacy or are otherwise offensive to you. *Please return this with your student's surveys. USE THE BACK IF NECESSARY!* Thank you for your cooperation.

1. How do your students prepare for the contest? (Please explain)

2. How are students selected to participate in the ESU's Math Day?

3. How are the *three* students selected that take the individual algebra and geometry tests at Math Day?

4. How often do you discuss math-related careers with your students?

5. Presently, very few girls are highly successful at mathematics competitions. Why do you feel this is the case?

TEACHER'S SIGNATURE______________________________
YOUR SIGNATURE MERELY ALLOWS US TO USE THIS SURVEY - CONFIDENTIALITY IS EXPRESSLY GUARANTEED

APPENDIX E

Student / Parent's Informed Consent Document

STUDENT/PARENT'S INFORMED CONSENT DOCUMENT

STUDENT: Your signature below signifies that you are a willing participant in this research; that you allow Emporia State University to use the data collected from this survey; that you recognize that there are absolutely no discomforts or risks involved to you; that strict confidentiality is guaranteed in this study; and that you may withdraw your participation at any time at your request.

Student's Signature_________________________________ DATE___________

PARENT: The research for Emporia State University that your student is being asked to participate in is to find if there is a correlation between their mathematics attitude and their achievement in mathematics competitions. The results will never be associated with their name or school, and there are no attendant discomforts involved and complete confidentiality is guaranteed. Your signature below signifies that you are willing to let your student participate in this survey; that you allow Emporia State University to use the data collected about your student from this survey; and that you may withdraw your participation at any time at your request.

Your permission is greatly appreciated.

Parent's Signature_____________________________________DATE_____________

APPENDIX F

Post - Survey Teacher's Instruction Sheet

ESU MATH DAY 1992 ATTITUDES POST-SURVEY

INSTRUCTIONS FOR TEACHERS

Many thanks to you and your students for helping us with these surveys.

As before, in order for this survey to foster meaningful results, *please observe students* as they take the survey. Students do not have to participate, of course, but it will be greatly appreciated if they do. Please administer this instrument only to students who attended Math Day on October 28th this year. The researchers plan to see whether or not attending ESU's Donald L. Bruyr Math Day improves their mathematics attitude or has a different affect. Thus, it's important that you give the survey at least to the students who took the individual algebra and geometry tests at Math Day. The other students who attended Math Day should also be given the survey. Since we are studying the affects of participating in mathematics competitions, *please wait to give the post-survey until the time period of November 4-12 - this is very important.* This will give students a little time to reflect on their experience (roughly a week). However, do not wait beyond Nov. 12, as that could involve other factors influencing their attitude changes. Again, if you or any member of your staff would like to have the results of this research, you may make a written request and we will be happy to share them with you.

The directions are the same as before, so please be sure everyone is familiar with them. Send all of the completed surveys back to: EMPORIA STATE UNIVERSITY, DR. CONNIE S. SCHROCK/JEFF HURN, BOX NO. 27, 1200 COMMERCIAL, EMPORIA, KANSAS 66801, in the envelope provided.

It has been written as part of the research document that the informed consent forms signed for the first attitudes survey is sufficient to allow ESU to use this survey as well. As a consequence, another consent form is not required. Anyone who wants to can withdraw their participation at any time.

If you have any questions or concerns, please call 316-341-5451 and ask for Jeff Hurn OR contact Dr. Connie Schrock at 316-341-5631...we would be happy to assist you in any way we can

THANK YOU FOR ALL OF YOUR HELP!!

APPENDIX G

Attitudes Survey Reminder Sheet to Teachers

Oct. 23, 1992

FROM: Jeff Hurn - Emporia State University

CONCERNING: Attitudes Surveys for ESU Donald L. Bruyr Math Day, Oct. 28, 1992

Recently, Emporia State University sent you a number of attitudes surveys for you to administer to your mathematics students who are attending ESU Math Day and a similar number who are not. We appreciate any effort you make to have your school participate. I hope that you also have decided to participate by filling out the green teacher's survey that accompanied the material. So far, participation has been strong and enthusiastic, and ESU hopes you too are employing the surveys, which will help foster more meaningful results.

If you have any questions or concerns, please call 316-341-5631 (ask for Dr. Connie Schrock) or 316-341-5451 (ask for Jeff Hurn). After you have completed the surveys, please get from your principal the signed consent form for your school. Bring with you to ESU Math Day the completed surveys, the pink student consent forms, the green teacher's surveys, and the signed principal's consent form on Wednesday October 28, 1992. There will be a table or booth set up in the lobby adjacent to Webb Lecture Hall all Wednesday morning so you can drop off your survey packet. When you do so, please pick up the envelope containing your school's "post-attitudes surveys". These should be filled out between Nov. 4th and Nov. 12th, then mailed back in the envelope. Postage and addressing is provided to minimize your hassles. I do realize, however, and appreciate greatly, the 'hassles' that you have already endured for this research endeavor. Please accept my sincere thanks.

Sincerely,

Jeff Hurn

APPENDIX H

Introductory Sheet about Research to Teachers

Oct. 23, 1992

To: Accompanying Teacher to Math Day

From: Jeff Hurn - Emporia State University

Concerning: ESU's Donald L. Bruyr Math Day

I am pleased to see that your school has decided to come the 1992 ESU Math Day. As part of our Math Day this year, we are having each school's participants (and some students who are not able to attend) fill out an attitudes survey, to aid in research about how a student's mathematics attitude affects their achievement at competitions. Because of the relatively short time period between now and Oct. 28, it would be unwise for us to send your school these surveys, as you would not have time to complete them and bring them with you to ESU Math Day. Thus, we would appreciate it greatly if you would pick up your surveys (look for directions there), fill them out, and return them that day. We are also doing a post-survey that you can participate in. It is our hope that you do not miss out on this opportunity.

I look forward to seeing you on Oct. 28.

Sincerely,

Jeff Hurn

APPENDIX I

ESU Math Day 1992 Attitudes Post-Survey

EMPORIA STATE UNIVERSITY'S DONALD L. BRUYR MATH DAY 1992
ATTITUDES POST-SURVEY

Male/Female_______
(JUST PUT M OR F)

NAME_____________________________ GRADE________
LAST FIRST 7,8,9,10,11,12

SCHOOL NAME_____________________________

DIRECTIONS

Following is a series of statements, in an attitudes survey similar to the one you may have already participated in - this survey is being repeated to insure the validity of your responses. There are no incorrect answers for these statements. They have been set up in a way which permits you to indicate the extent to which you agree or disagree with the ideas expressed.

As you read each statement, you will know whether you agree or disagree. If you strongly agree, circle SA next to that number on your paper. If you agree but with reservations, that is, you do not fully agree, circle A. If you disagree with the idea, indicate the extent to which you disagree by circling D for disagree or SD for strongly disagree. But if you neither agree nor disagree, circle U for undecided. Also, if you cannot answer a question, feel free to circle U.

IT IS IMPORTANT THAT YOU DO NOT SPEND MUCH TIME WITH ANY STATEMENT, BUT BE SURE TO ANSWER EVERY STATEMENT. Work fast but carefully.

There are no right or wrong responses. The only correct responses are those that are true for you. Whenever possible, let the things that have happened to you help you make a choice.

THIS INVENTORY IS BEING USED FOR RESEARCH PURPOSES ONLY AND NO ONE WILL KNOW WHAT YOUR RESPONSES ARE.

SA = STRONGLY AGREE A = AGREE
U = UNDECIDED D = DISAGREE SD = STRONGLY DISAGREE

1. SA A U D SD GENERALLY, I HAVE FELT SECURE ABOUT ATTEMPTING MATHEMATICS.
2. *SA A U D SD MOST SUBJECTS I CAN HANDLE OKAY, BUT I HAVE A KNACK FOR FLUBBING UP MATH.*
3. SA A U D SD MY MOTHER THINKS I COULD BE GOOD IN MATH.
4. *SA A U D SD MY FATHER THINKS I'LL NEED MATHEMATICS FOR WHAT I WANT TO DO AFTER I GRADUATE.*
5. SA A U D SD I DON'T LIKE PEOPLE TO THINK I'M SMART IN MATH.
6. *SA A U D SD IF I GOT THE HIGHEST GRADE IN MATH, I'D PREFER NO ONE KNEW.*

SA = STRONGLY AGREE A = AGREE
U = UNDECIDED D = DISAGREE SD = STRONGLY DISAGREE

7. SA A U D SD GIRLS CAN DO JUST AS WELL AS BOYS IN MATHEMATICS

8. *SA A U D SD* *I'M NO GOOD IN MATH.*

9. SA A U D SD IN TERMS OF MY ADULT LIFE, IT IS NOT IMPORTANT FOR ME TO DO WELL IN MATH IN HIGH SCHOOL.

10. *SA A U D SD* *I ALMOST NEVER HAVE GOTTEN SHAKEN UP DURING A MATH TEST.*

11. SA A U D SD MATHEMATICS USUALLY MAKES ME FEEL UNCOMFORTABLE AND NERVOUS.

12. *SA A U D SD* *MATH DOES NOT SCARE ME AT ALL.*

13. SA A U D SD MY TEACHERS HAVE ENCOURAGED ME TO STUDY MORE MATH.

14. *SA A U D SD* *I AM SURE I COULD DO ADVANCED WORK IN MATHEMATICS LATER, AFTER HIGH SCHOOL.*

15. SA A U D SD I THINK I COULD HANDLE MORE DIFFICULT MATHEMATICS NOW, IN HIGH SCHOOL.

16. *SA A U D SD* *STUDYING MATHEMATICS IS JUST AS APPROPRIATE FOR WOMEN AS IT IS FOR MEN.*

17. SA A U D SD MY MIND GOES BLANK AND I AM UNABLE TO THINK CLEARLY WHEN WORKING MATHEMATICS.

18. *SA A U D SD* *I STUDY MATHEMATICS BECAUSE I KNOW HOW USEFUL IT IS.*

19. SA A U D SD I AM SURE THAT I CAN LEARN MATHEMATICS.

20. *SA A U D SD* *WHEN I SUCCEED ON A DIFFICULT MATH PROBLEM, IT IS MAINLY BECAUSE OF EFFORT, NOT MY ABILITY.*

21. SA A U D SD MALES ARE NOT NATURALLY BETTER THAN FEMALES IN MATH.

22. *SA A U D SD* *WHEN I FAIL ON A MATH PROBLEM, IT IS USUALLY BECAUSE I DID NOT TRY HARD ENOUGH.*

23. SA A U D SD I THINK OFTEN ABOUT HOW MUCH MATH MEANS IN MY LIFE.

24. *SA A U D SD* *I THINK MATH IS BORING.*

25. SA A U D SD ESU MATH DAY HELPED ME SEE SOME OF THE USES OF MATHEMATICS.

26. *SA A U D SD* *PARTICIPATING IN MATH COMPETITIONS ENHANCES MY MATHEMATICS ABILITY.*

27. SA A U D SD MY ATTITUDE ABOUT MATHEMATICS IS GOOD.

28. *SA A U D SD* *MATH IS A VERY DRY, DULL SUBJECT.*

29. SA A U D SD I CAN BE VERY CREATIVE IN MY MATHEMATICS WORK.

30. *SA A U D SD* *I CAME TO ESU MATH DAY JUST TO GET OUT OF A DAY OF SCHOOL.*

** PLEASE BE SURE THAT YOU HAVE ANSWERED EVERY QUESTION **

NOTE: Your participation merely allows Emporia State University to use your survey results. Please understand that your responses will be kept strictly confidential at all times. THANK YOU FOR PARTICIPATING!

TABLE

ESU'S MATH DAY 1992 ATTITUDES POST-SURVEY - QUESTIONS BY CATEGORY

CATEGORY	QUESTION NUMBERS ON POST-SURVEY OF THIS TYPE
CONFIDENCE	1, 2, 8, 14, 15
MOTHER	3
FATHER	4
ATTITUDE TOWARD SUCCESS	5, 6
TEACHER	13
MALE DOMAIN	7, 16, 21
USEFULNESS	9, 18
ANXIETY	10, 11, 12, 17
EFFECTANCE MOTIVATION	None
WRITTEN BY RESEARCHER	20, 22, 23, 24, 25, 26, 27, 28, 29, 30

SOURCE: FENNEMA-SHERMAN MATHEMATICS ATTITUDES SCALES.

APPENDIX J

General Correspondence for ESU Math Day

EMPORIA STATE UNIVERSITY
1200 COMMERCIAL EMPORIA, KANSAS 66801-5087 316/341-1200

September 14, 1992

Dear Colleague,

This letter is your invitation to attend the Donald L. Bruyr Mathematics Day sponsored by the Division of Mathematics and Computer Science on Wednesday, October 28, 1992. Your group should report to the Webb Lecture Hall in the Memorial Union between 8:30 a.m. and 9:30 a.m. for registration. At 9:30, the opening session will be held, and this will be followed by the day's contests commencing at 10:00 a.m. Awards will be presented at the final session from 1:30 to 1:50 p.m. in Webb Lecture Hall. Your students will have approximately one hour for lunch.

As in the past, participating schools will be classed as DIVISION I (4A, 5A, 6A) and DIVISION II (1A, 2A, 3A), for all contests with the exception of the computer programming contest. All students in a given contest will take the same test, but trophies and medals will be awarded on a DIVISION basis. Thus, there will be assured winners in each of the divisions.

The significant features of the day will be the individual and team contests. Students not competing in contests during a given hour may do any of the following: (1) Cheer their favorite math team; (2) Attend planetarium lectures; (3) Participate in campus tours; (4) Participate in tours of the Physics, Chemistry and Earth Science laboratories; (5) Visit the Schmidt Natural History Museum; or (6) Visit the Geology Museum.

Please remember that your team members for the MATH SCRAMBLE contest should be capable of fielding questions from the areas of Algebra, Geometry, Trigonometry, Computer Science, Probability, Logic, and Functions. Calculators may be used for certain designated questions in this contest.

Enclosed with this letter, you will find general and specific information relating to the team and the individual contests. The PINK sheet provides instructions relating to the computer programming contest. Also, you will find two application forms--one for the computer contest and the other for the remaining contests. If you want to enter a team in the computer contest, you should submit that application along with the regular application sheet. Please mail your application or applications to me as soon as possible. No application can be accepted after October 19, 1992. I will confirm your school's visit by return mail. In the confirmation letter, you will find information relating to the parking of buses and cars. In addition, information will be provided regarding where to bring your computer equipment if you have a team participating in this contest.

If you have questions relating to the computer contest, you may call Dr. Bill Simpson. Questions regarding other parts of the day's events may be directed to me. Call (316) 341-5281 to reach either Dr. Simpson or me. We are looking forward to having you and your students visit us on Mathematics Day--Wednesday, October 28, 1992.

Sincerely,

George L. Downing

George L. Downing

GLD/jm
Enclosure

GENERAL INFORMATION FOR ESU MATHEMATICS DAY CONTESTS

1. There will be contests for individual competitions and for team competitions.

2. A student, by participating in any contest, agrees that his or her scores and/or standing becomes public information.

3. Each school accepting the invitation to ESU Mathematics Day is expected to have at least one student participate in some contest. Students may come, however, who will not be participating in any contest. They should have, at least, some interest in mathematics.

GENERAL INFORMATION FOR TEAM COMPETITIONS

1. There will be four team competitions--three math and one computer programming contest.

Algebra Team Contest	10:00-10:50
Geometry Team Contest	11:00-11:50
Math Scramble Team Contest	12:00-12:50
Computer Programming Contest	10:00-11:30

2. Calculators may be used for certain designated problems during the Math Scramble.
3. The team contests will be held in a large lecture hall and the public is invited to observe. Non-participating students may also attend and cheer their favorite teams.
4. Each MATH TEAM for the team contests will consist of exactly three members.
5. No school can have more than one team for each MATH TEAM contest.
6. No student can be a member of more than one MATH TEAM. However, a student can compete in one team contest and one or both individual contests as accommodates his or her schedule.
7. A Student may be on a Computer Programming Team and participate in the Math Scramble contest at 12 noon.

GENERAL INFORMATION FOR INDIVIDUAL COMPETITIONS

1. There will be two individual competitions:

Geometry Contest	10:00-10:50
Algebra Contest	11:00-11:50

2. No school can have more than three students competing in any one of the individual contests. However, any one student can compete in both individual contests if desired.
3. The Algebra Contest will cover both Algebra I and Algebra II content. You may assign any student to take this test--even one who has not yet taken Algebra II, but such a student should be aware that some of the content may be beyond him or her at the time of the test.

SPECIFIC PROCEDURES FOR THE ALGEBRA, GEOMETRY AND MATH SCRAMBLE TEAM COMPETITIONS

1. Each competition will last approximately 50 minutes.

2. Each problem will be projected on a screen with a specific time allowed for each problem and with the point value of the problem.

3. Each three member team will be seated together with an assigned monitor. (Monitors will be provided). An agreed upon answer to each problem must be written on a provided answer sheet and passed to the monitor for that team during the allotted time.

4. The team competition for each problem will stop after the allotted time expires.

5. An answer is either correct or incorrect. No partial credit is awarded.

6. Each team submitting a correct answer within the allotted time will be awarded the indicated point value for the problem.

7. Several times during the contest, team scores will be totaled and revealed in order that the teams and observers can evaluate their progress in the contest.

8. At the conclusion of each contest, the scores of each school team will be totaled and awards given for 1st and 2nd place winners in each division. Ties will be eliminated by further competition.

SPECIFIC PROCEDURES FOR INDIVIDUAL COMPETITIONS

1. The individual competitions will be 40 to 50 minutes in duration. The test will be a comprehensive one over the subject.

2. Each answer is either correct or incorrect with no partial credit awarded.

3. Only students competing in the individual competition will be allowed in the room of the contest.

4. 1st, 2nd, 3rd, 4th, and 5th place medals will be awarded for each of the two individual competitions in each division.

5. There will be questions on each test to be used only if breaking a tie is necessary.

EMPORIA STATE UNIVERSITY APPLICATION FOR MATHEMATICS DAY--1992

School Name____________________________ Phone No.____________

School Classification (circle one) 1A 2A 3A 4A 5A 6A
(Please ensure that your classification is correct for this year.)

School Address____________________________________

Accompanying Teacher's Name____________________________

Check One:

___ YES, I plan on sponsoring a group from my school to participate in the ESU Mathematics Day, October 28, 1992.

___ NO, I cannot attend this year.

___ YES, I want to enter a team in the Computer Programming Contest (IF YES, COMPLETE SPECIAL COMPUTER APPLICATION FORM).

_______ Number of buses you will use for transporting students to Math Day.

List below the names of the students you wish to enter in each of the categories:

<u>INDIVIDUAL CONTESTS</u>

One school can have at most three students in an individual contest.

ALGEBRA INDIVIDUAL CONTEST

1.____________________

2.____________________

3.____________________

GEOMETRY INDIVIDUAL CONTEST

1.____________________

2.____________________

3.____________________

ON THE BACK OF THIS SHEET, PLEASE LIST THE NAMES OF ALL OTHER STUDENTS WHO WILL BE ATTENDING MATHEMATICS DAY.

<u>TEAM CONTESTS</u>

1. Designate a team only for those team contests your school desires to participate in.
2. A team must have exactly three members.
3. No student can be on more than one team.

ALGEBRA TEAM CONTEST

1.____________________

2.____________________

3.____________________

GEOMETRY TEAM CONTEST

1.____________________

2.____________________

3.____________________

MATH SCRAMBLE

1.____________________

2.____________________

3.____________________

Please print below in alphabetical order the names of the other students who will attend Mathematics Day. Do not list names of students already listed on the front side.

LAST NAME FIRST GRADE	LAST NAME FIRST GRADE
1. ______	25. ______
2. ______	26. ______
3. ______	27. ______
4. ______	28. ______
5. ______	29. ______
6. ______	30. ______
7. ______	31. ______
8. ______	32. ______
9. ______	33. ______
10. ______	34. ______
11. ______	35. ______
12. ______	36. ______
13. ______	37. ______
14. ______	38. ______
15. ______	39. ______
16. ______	40. ______
17. ______	41. ______
18. ______	42. ______
19. ______	43. ______
20. ______	44. ______
21. ______	45. ______
22. ______	
23. ______	
24. ______	

Mail to:

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APPENDIX K

ESU Math Day 1992 Individual Algebra Test

with Answer Sheet

Co-authored by Assistant Professors Dr. Linda Fosnaugh and Timothy Fosnaugh,

Division of Mathematics and Computer Science, Emporia State University

MATH DAY
1992

ALGEBRA TEST

SCHOOL LOCATION__________

NAME__________

SCHOOL__________

Directions: Determine the best answer and indicate your choice on the answer sheet.

---

1. Evaluate: $-5 - (-3) =$

a) -8 b) -2 c) 8

d) 2 e) none of these

2. Evaluate: $-2(-6 + 3) - 5 =$

a) -17 b) -1 c) 1

d) 7 e) none of these

3. Evaluate: $7x + 5(x-y) + 2y =$

a) $12x + 7y$ b) $2x - 3y$ c) $12x + 3y$

d) $12x - 3y$ e) none of these

4. If $\frac{8}{x} = \frac{9}{5}$, then $x =$

a) $\frac{40}{9}$ b) $\frac{9}{40}$ c) $\frac{45}{8}$

d) $\frac{8}{45}$ e) none of these

5. If $6x - 3 = 9 - 3x$, then $x =$

a) 1 b) $\frac{3}{2}$ c) $-\frac{2}{3}$

d) -1 e) none of these

6. Evaluate: $-(3c)^2 =$

a) $9c^2$ b) $6c^2$ c) $-9c^2$

d) $-6c^2$ e) none of these

7. Evaluate: $\frac{2}{x} - \frac{1}{y} =$

a) $\frac{2}{x-y}$ b) $\frac{2y-x}{x-y}$ c) $\frac{2y-x}{xy}$

d) $\frac{2}{xy}$ e) $\frac{xy}{2}$

8. $(3xy^6)(-2x^4y^2) =$

a) $-6x^5y^8$ b) $-5x^5y^8$ c) $-6x^4y^{12}$

d) x^5y^8 e) none of these

9. $(x^{-1} + y^{-1})^{-1} =$

a) $x + y$ b) $\frac{x+y}{xy}$ c) $\frac{xy}{x+y}$

d) $\frac{1}{x+y}$ e) none of these

10. If $x+y=1$ and $x-y=3$, then $x=$

a) 2 b) 0 c) 1

d) -1 e) none of these

11. The graph of $x - 3y + 6 = 0$ crosses the y-axis at $y=$

a) -6 b) 2 c) -2

d) 0 e) none of these

12. For all $x \neq 3$ or -3, $\frac{x^2 + 5x + 6}{x^2 - 9} =$

a) $\frac{x+2}{x-3}$ b) $\frac{x+2}{x+3}$ c) $\frac{x+1}{x-3}$

d) $-\frac{6}{9}$ e) none of these

13. If $x^2 - 12x + 35 = 0$, then x=

a) 5 only   b) -7 only   c) 7 or 5

d) -7 or -5   e) 7 or -5

14. In the arithmetic progression 5, 1, -3, -7, . . . what is the 15th term?

a) -47   b) -55   c) -43

d) -51   e) none of these

15. If $y = \sqrt{2 - 8x^2}$, what is the minimum value of y?

a) $\frac{1}{2}$ b) $\frac{1}{4}$ c) 0

d) $-\infty$ e) none of these

16. $\log_3 27 =$

a) $\frac{1}{9}$ b) 3   c) 9

d) $\frac{1}{3}$ e) none of these

17. What are the real numbers x for which $(x+2)(x-3) < 0$?

a) $-2 < x < 3$ b) $2 < x < -3$ c) $x < -2$ or $x > 3$

d) $x < -3$ or $x > 2$ e) none of these

18. If $27^x = 3$ and $4^{x+y} = 64$, then y =

a) $\frac{2}{3}$ b) 2   c) 0

d) -1   e) none of these

19. $$\begin{vmatrix} 0 & 4 & 0 \\ 2 & 1 & -1 \\ 3 & 0 & 1 \end{vmatrix} =$$

a) -4   b) 3   c) 20

d) 0   e) none of these

20. If $|3 - x| > 4$, then

a) x < -1 or x > 7
b) x < -1 and x > 7
c) x > -1 or x < 7
d) x > -1 and x < 7
e) none of these

21. Suppose x > 0. Then 78.32% of x is

a) greater than x
b) equal to x
c) less than x
d) impossible to compare with x
e) none of these

22. Suppose x < 0. Then 78.32% of x is

a) greater than x
b) equal to x
c) less than x
d) impossible to comare with x
e) none of these

23. $\pi =$

a) 3.14 b) $\frac{22}{7}$ c) $\sqrt{10}$
d) all of the above e) none of these

24. If $x^3 - 1 = 0$, then

a) x = 1 b) $x = 1, -\frac{1}{2} \pm \frac{\sqrt{3}}{2}i$ c) $x = \pm 1$
d) $x = \frac{1}{3}$ e) none of these

25. Which of the following is a geometric sequence with common ratio $r = \frac{1}{3}$?

a) 81, 27, 9, 3, 1, ...
b) $\frac{1}{3}, \frac{2}{3}, 1, \frac{4}{3}$.....
c) 1,3,9,27,81, ...
d) all of the above
e) none of these

26. Which of the following numbers are irrational?

a) $2+\sqrt{3}$ b) $\sqrt{12}\sqrt{27}$ c) 2π
d) all of the above e) a and c

27. If f(x) $= \frac{x^2}{x+3}$ and g(x) $= x^{1/3}$, then f(g(x)) =

a) $\frac{x^{2/3}}{x^{1/3}+3}$ b) $\left(\frac{x^2}{x+3}\right)^{1/3}$ c) $\frac{x^{2/3}}{x^{1/3}+3^{1/3}}$

d) $x^{1/3}+\frac{x^{2/3}}{3}$ e) none of these

28. Find functions f(x) and g(x) so that f(g(x)) $= \sqrt{x^2+1}+2$

a) f(x) $= \sqrt{x^2+1}$, $g(x)=2$
b) f(x) $= \sqrt{x+1}+2$, $g(x)=x^2$
c) $f(x)=x^2+1$, $g(x)=\sqrt{x}+2$
d) $f(x)=\sqrt{x^2+1}+2$, $g(x)=x^2$
e) none of these

29. The repeating decimal $2.1\overline{33}$ is equal to

a) $\frac{213}{100}$ b) $\frac{32}{15}$ c) $\frac{2133}{1000}$

d) $\frac{64}{25}$ e) none of these

30. Find the range of f(x) $= x^2-5x-3$.

a) all real numbers b) $\left[\frac{5}{2},\infty\right)$ c) $[0,\infty)$

d) $\left[-\frac{37}{4},\infty\right)$ e) none of these

31. If $\frac{1}{x-3}+2=\frac{x}{x-3}$, then x =

a) 3 b) -5 c) 5
d) 1 e) none of these

32. If $x - 6 = \sqrt{x}$, then x =

a) 3 b) 4 and 9 c) 4
d) 9 e) none of these

33. If $\log_2 x + \log_2(x - 2) = 3$, then x =

a) 5 b) $\frac{5}{2}$ c) 4

d) -2, 4 e) None of these

34. Find the point(s) of intersection of $y = (x - 1)^2$ and $x^2 + y^2 = 1$.

a) (1,0) b) (0,1) c) (1,1)
d) (0,0), (0,1) e) (0,1), (1,0)

35. What are the possible number of ways that a parabola can intersect a circle?

a) 3 b) 1 or 2 c) 0, 1 or 2
d) 2 e) 0, 1, 2, 3 or 4

36. $\dfrac{x^{-1} + y^{-1}}{(xy)^{-1}} =$

a) $\dfrac{xy}{x + y}$ b) $\dfrac{x + y}{xy}$ c) x + y
d) 2 e) None of these

37. If $y = \dfrac{x + 3}{x - 1} + 2$, then x =

a) $\dfrac{y + 5}{y - 1}$ b) $\dfrac{y + 1}{y - 3}$ c) $\dfrac{y - 1}{y + 3}$
d) $\dfrac{y - 1}{y + 3} + 2$ e) None of these

38. If the quotient of two numbers x and y is 12 and the difference of x and y is 66, then x =

a) 2 b) 60 c) 11
d) 6 e) None of these

39. Rosie drove to the store. Her average speed going to the store was 30 mph. On the return trip, she traveled the same route. Her average speed was 40 mph. Rosie's average speed for the entire trip was

a) 35 mph.
b) less than 35 mph.
c) greater than 35 mph.
d) impossible to tell from the given information.
e) none of these.

40. Rosie's Restaurant is located in a town which charges a 5% sales tax. The restaurant's receipts for last week totaled $2100. How much of this money does Rosie owe the government?

a) $100
b) $105
c) $10.50
d) $150
e) None of these

ALGEBRA TEST

NAME: ____________________

SCHOOL: ____________________

Tie-breaker: This problem will be graded to break ties, should they occur, for any of the first five places. Work on this page and give a neat precise solution to the following:

Rosie wants to open a vending stand at the park where she will sell hot dogs and hamburgers. She can sell up to 100 items per day. The freezer at her stand holds 410 cubic inches. Each hot dog contains 5 cubic inches, while each hamburger contains 3 cubic inches. Each hot dog sold yields a profit of 75 cents, while each hamburger sold yields a profit of 50 cents. How should Rosie plan her daily inventory in order to maximize profits?

Let x =

Let y =

MATH DAY

ALGEBRA TEST

NAME ______________________

SCHOOL ______________________

SCHOOL LOCATION ______________________

School Classification (circle one) 1A 2A 3A 4A 5A 6A

Please blacken your selected answer.

1. ⓐ ⓑ ⓒ ⓓ ⓔ
2. ⓐ ⓑ ⓒ ⓓ ⓔ
3. ⓐ ⓑ ⓒ ⓓ ⓔ
4. ⓐ ⓑ ⓒ ⓓ ⓔ
5. ⓐ ⓑ ⓒ ⓓ ⓔ
6. ⓐ ⓑ ⓒ ⓓ ⓔ
7. ⓐ ⓑ ⓒ ⓓ ⓔ
8. ⓐ ⓑ ⓒ ⓓ ⓔ
9. ⓐ ⓑ ⓒ ⓓ ⓔ
10. ⓐ ⓑ ⓒ ⓓ ⓔ
11. ⓐ ⓑ ⓒ ⓓ ⓔ
12. ⓐ ⓑ ⓒ ⓓ ⓔ
13. ⓐ ⓑ ⓒ ⓓ ⓔ
14. ⓐ ⓑ ⓒ ⓓ ⓔ
15. ⓐ ⓑ ⓒ ⓓ ⓔ
16. ⓐ ⓑ ⓒ ⓓ ⓔ
17. ⓐ ⓑ ⓒ ⓓ ⓔ
18. ⓐ ⓑ ⓒ ⓓ ⓔ
19. ⓐ ⓑ ⓒ ⓓ ⓔ
20. ⓐ ⓑ ⓒ ⓓ ⓔ
21. ⓐ ⓑ ⓒ ⓓ ⓔ
22. ⓐ ⓑ ⓒ ⓓ ⓔ
23. ⓐ ⓑ ⓒ ⓓ ⓔ
24. ⓐ ⓑ ⓒ ⓓ ⓔ
25. ⓐ ⓑ ⓒ ⓓ ⓔ
26. ⓐ ⓑ ⓒ ⓓ ⓔ
27. ⓐ ⓑ ⓒ ⓓ ⓔ
28. ⓐ ⓑ ⓒ ⓓ ⓔ
29. ⓐ ⓑ ⓒ ⓓ ⓔ
30. ⓐ ⓑ ⓒ ⓓ ⓔ
31. ⓐ ⓑ ⓒ ⓓ ⓔ
32. ⓐ ⓑ ⓒ ⓓ ⓔ
33. ⓐ ⓑ ⓒ ⓓ ⓔ
34. ⓐ ⓑ ⓒ ⓓ ⓔ
35. ⓐ ⓑ ⓒ ⓓ ⓔ
36. ⓐ ⓑ ⓒ ⓓ ⓔ
37. ⓐ ⓑ ⓒ ⓓ ⓔ
38. ⓐ ⓑ ⓒ ⓓ ⓔ
39. ⓐ ⓑ ⓒ ⓓ ⓔ
40. ⓐ ⓑ ⓒ ⓓ ⓔ

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FROM: Emporia State University Graduate School

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Jeffrey L. Hurn
Signature of Author

April 29, 1993
Date

AN ANALYSIS OF GENDER-RELATED, ATTITUDINAL FACTORS AFFECTING PARTICIPATION AND ACHIEVEMENT IN THE ESU MATH DAY COMPETITION
Title of Thesis/Research Project

Doug Cooper
Signature of Graduate Office Staff Member

April 29, 1993
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