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I am submitting herewith a dissertation written by Crystal Renee Rice entitled "Comparing Recent High School Graduates Placed in Developmental and College-Level Mathematics Courses." I have examined the final electronic copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in Education.

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COMPARING RECENT HIGH SCHOOL GRADUATES PLACED IN DEVELOPMENTAL AND COLLEGE-LEVEL MATHEMATICS COURSES

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ABSTRACT

The purpose of this study was to determine any significant differences among recent high school graduates placed in developmental and college-level mathematics courses. The focus of the investigation was on students' high school course-taking patterns in mathematics and their attitudes and beliefs towards mathematics. High school location was also considered.

The study was conducted at two community colleges in east Tennessee. Students placed in both developmental and college-level mathematics courses completed surveys at the beginning of the fall semester 2006. Four scales of the Fennema-Sherman Mathematics Attitudes Scales (1976), along with the Indiana Mathematics Belief Scales (Kloosterman & Stage, 1992), were used to assess students' attitudes and beliefs towards mathematics. Data analysis was limited to recent high school graduates (students who graduated from high school in the spring of 2006) who were taking a mathematics course for the first time in college.

No significant differences were found among rural and non-rural recent high school graduates with regard to mathematics course-taking patterns in high school and attitudes and beliefs towards mathematics. Furthermore, rural students were no more likely to be placed in developmental mathematics courses upon entering college than were non-rural students.

Significant differences were found among students placed in developmental and college-level mathematics courses. Students placed in developmental mathematics courses took significantly fewer mathematics courses in high school than did students placed in college-level mathematics courses. In addition, students placed in

developmental mathematics courses were less likely to have taken a course beyond Algebra II or Geometry in high school than were students placed in college-level mathematics courses. Students placed in developmental mathematics courses had significantly less confidence and effectance motivation in mathematics than did students placed in college-level mathematics courses. Also, students placed in developmental mathematics courses had a significantly lower belief in the usefulness of mathematics than did students placed in college-level mathematics courses. Finally, students placed in developmental mathematic courses had a significantly lower belief in their ability to solve time-consuming mathematics problems and in that it is not always possible to solve word problems using simple, step-by-step procedures than did students placed in college-level mathematics courses.

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CHAPTER I

INTRODUCTION

A study conducted through the U.S. Department of Education, National Center for Education Statistics (NCES), reports that 28% of entering college freshmen enrolled in at least one remedial reading, writing, or mathematics course in fall 2000 (Parsad & Lewis, 2003). Remedial courses were defined as "courses in reading, writing, or mathematics for college-level students lacking those skills necessary to perform college-level work at the level required by the institution" (Parsad & Lewis, 2003, p.3). According to NCES, more remedial courses were offered in mathematics than in reading or writing in fall 2000 (Parsad & Lewis, 2003). A larger proportion of institutions offered three or more courses in remedial mathematics (40%) as compared to reading (24%) and writing (23%). Likewise, NCES also reports that the proportion of freshmen enrolled in remedial coursework was larger for mathematics (22%) than for reading (11%) and writing (14%). Additionally, more freshmen enrolled in remedial mathematics at public 2-year colleges (35%) than at public 4-year colleges (16%). Community colleges tend to enroll large numbers of entering freshmen in remedial/developmental mathematics. For example, "at two-year colleges in SREB [Southern Regional Education Board] states, the percentage of students who take remedial math range from less than 30 percent to more than 75 percent" (Abraham & Creech, 2000, p. 12).

Many of the developmental mathematics students at community colleges are nontraditional aged (25 or older). Understandably, these students usually require a review of basic mathematical concepts and skills needed for college-level mathematics. In some cases, nontraditional aged students were not even exposed to algebra in high

school. Developmental mathematics courses are essential and difficult for this group of students. The majority of the developmental mathematics students at community colleges are traditional aged (24 or younger) however. Many of these students include recent high school graduates who have not demonstrated the algebraic skills needed for college-level mathematics.

The Problem

Haycock and Huang (2001) note that the average performance of 17-year-olds on the National Assessment of Educational Progress (NAEP) has gone up between 10 and 13 points in mathematics since the early 1980's. Although there have been gains in mathematics, "only about 1 in 12 of all 17 year-olds can comfortably do multi-step problem-solving and elementary algebra – a finding that may surprise those who know that 91% of those students took at least one algebra course" (Haycock & Huang, 2001, p. 5). Based on NAEP data, students seem to make more growth between grades 5 and 8 than they do during their high school years (Haycock & Huang, 2001). Haycock and Huang (2001) conclude, "Virtually all of the gains in mathematics…during the last decade can be attributed to increased learning prior to high school" (p. 5).

Too many recent high school graduates are unprepared for college-level mathematics (ACT, 2004a; SREB, 2000). Nationally, only 40% of the 1.2 million high school graduates who took the ACT Assessment in 2004 achieved scores that would deem them ready (indicating that they would earn a "C" or higher) for their first college algebra course (ACT, 2004a). In Tennessee, ACT (2004b) reports that only 32% of graduates were ready for their first college algebra course in 2004. ACT (2004a) also predicted that the high school graduates of 2006 and 2008 will be no better prepared.

Recently, Tennessee implemented the Gateway Tests "to raise the academic bar for all high school students and add accountability for students' academic performance" (Tennessee Department of Education, n.d.a, p.1). Beginning with the entering freshmen of 2001 (exiting graduates in 2005), students are required to pass three different Gateway Tests: English II, Biology, and Algebra I. The state maintains that "the examinations will help students to improve their performance and help prepare them for the ACT, SAT and Work Keys and successful entry into postsecondary educational programs" (Tennessee Department of Education, n.d.b, p. 1). Students must pass all three courses in addition to the corresponding Gateway Tests in order to receive a high school diploma.

Given the fact that all high school graduates are required to take Algebra I and pass the Algebra I Gateway Test in Tennessee, one might assume that this would lead to higher mathematics achievement, thus reducing the need for mathematics remediation in college. Yet, a significant number of recent high school graduates are still being placed in developmental mathematics courses upon entering college. Not all recent high school graduates have to take developmental mathematics courses; many are placed in college-level mathematics courses. So, what makes the difference between these two groups of students?

Students' course-taking patterns, along with their attitudes and beliefs towards mathematics, have been shown to have an effect on mathematics achievement. Differences in mathematics achievement have also been noted among rural and non-rural students. Hence, there may be a significant difference in the course-taking patterns, attitudes and beliefs towards mathematics, and school location among recent high school graduates placed in developmental and college-level mathematics courses. The following

sections provide further discussion of the relationships between course-taking patterns, attitudes and beliefs, school location, and mathematics achievement.

Course-Taking Patterns

Course-taking behavior of high school students has been a topic of educational research for several years, particularly in the area of mathematics (Trusty, 2002). "Most studies on course-taking have addressed its influences on high school achievement outcomes" (Trusty, 2002, p. 464). Research suggests that course-taking is a powerful indicator of mathematics achievement (Haycock & Huang, 2001). Several studies show a positive relationship between the quantity of mathematics courses taken in high school and mathematics achievement (e.g., Hoffer, Rasinski, & Moore, 1995). Other studies find advanced mathematics course-taking to be more predictive of achievement (e.g., Hoffer, 1997). SREB data also suggest that students who take a mathematics course during their senior year of high school have higher mathematics achievement upon graduation (Bottoms & Carpenter, 2003).

In regard to college readiness, studies show the level of mathematics preparation in high school to be predictive of remedial placement in college (e.g., Hoyt & Sorensen, 2001). ACT (2004b) data suggest that there is a strong positive relationship between mathematics course-taking and college readiness. ACT research also shows that students' academic preparedness for college depends upon both the amount and specific kinds of mathematics courses taken in high school, with Algebra I and higher-level courses making the most difference (Noble, 2004).

Research indicates that even advanced mathematics students are not always prepared for college-level mathematics (Boylan, 1999a). For example, in Maryland, 40%

of high school graduates who had completed a college preparatory mathematics courses needed remediation upon entering college (Oudenhoven, 2002). ACT research indicates that less than half of ACT-tested graduates who take a college preparatory curriculum are ready for college algebra (Noble, 2004).

Attitudes and Beliefs

Beliefs and attitudes have also been a topic of educational research in the area of mathematics. Attitudes have long been thought to affect performance in some way (Aiken, 1970). In particular, a strong relationship has been assumed between attitude and mathematics achievement; hence, most studies have primarily focused on examining this correlation (Ma & Kishor, 1997).

Although there have been numerous studies on attitude and mathematics achievement, little consensus exists in the research literature (Ma & Kishor, 1997). In a meta-analysis, Ma and Kishor (1997) found a weak, yet reliable positive relationship between attitude and mathematics achievement at the elementary and secondary school levels. This relationship was shown to be stronger and practically meaningful at the secondary school level. More recently, Schreiber (2002) also found a positive relationship between attitude and mathematics achievement with advanced mathematics students.

Epistemological beliefs have also been shown to have an effect on mathematics achievement (Schoenfeld, 1985; Schommer, 1993; Schommer, Calvert, Gariglietti, & Bajaj, 1997). Schoenfeld (1985) found that high school students who had low mathematics achievement tended to believe that if a mathematics problem is solvable, then it can be solved in less than ten minutes. Schommer (1993) and Schommer et al.

(1997) found that the more students believed in quick learning, the lower their mathematics grade point average.

Recent analysis of NAEP data indicates several relationships between mathematics attitudes, beliefs, and achievement (Braswell, Lutkus, Grigg, & Santapau, 2001). Based on the 2000 data, students who liked mathematics had higher test scores. Students who said that they would not study mathematics if given the choice had lower test scores. Students who believed that there is only one way to solve a problem had lower test scores. Students who believed that mathematics involved mostly memorizing facts also had lower test scores.

Attitudes/Beliefs and Course-Taking Interaction

Research shows that students' course-taking patterns are influenced by their attitudes toward mathematics (e.g., Thorndike-Christ, 1991). Thorndike-Christ (1991) found attitudes towards mathematics to be predictive of optional course-taking in mathematics for middle and high school students. In addition, students in more accelerated "tracks" had a more positive attitude and a greater intention of taking additional mathematics courses once they became optional (Thorndike-Christ, 1991).

School Location

Rural education is typically viewed as a deficit model of instruction (Lee & McIntire, 2000; Howley, 2002a). Rural schools are generally accepted as inferior to non-rural schools in many aspects, including achievement (Creech, 1992). Herzog and Pittman (1995) note the persistent problem of student achievement that has been documented in rural communities. Recent studies, however, have begun to show that

there are no significant differences in the performance of rural and non-rural students (e.g., Fan & Chen, 1999; Hopkins, 2004; Winters, 2003).

While rural issues have been a topic of educational research, the intersection between rural education research and mathematics education research is small (Howley, 2002a). Current studies have highlighted the differences in achievement among rural and non-rural students. Howley (2002b) found no national rural/non-rural achievement gap in mathematics. At the state level however, Lee and McIntire (2000) found that variability does exist among rural versus non-rural mathematics achievement, sometimes favoring rural students, sometimes favoring non-rural students.

Rural Education, Attitudes, and Course-Taking Interaction

Cobb, McIntire, and Pratt (1989) found that non-rural students place more importance on educational aspirations than do rural students. Gibbs (1998) suggests that rural students are less likely to pursue further higher education than are non-rural students. In fact, high school and college completion rates have been shown to be lower for rural students than for non-rural students (Herzog & Pittman, 1995).

Availability of resources has been an area of concern in rural education. Studies have investigated the differences in course offerings among rural and non-rural high schools (e.g., Finn, Gerber, & Wang, 2002). Several students have also examined course-taking among rural and non-rural high school students (Ballou & Podgursky, 1998; Haller, Monk, & Tien, 1993). It has been found that rural schools offer less advanced mathematics courses than do non-rural schools (Finn, Gerber, & Wang, 2002; Haller et al., 1993). Likewise, rural students take fewer courses in advanced mathematics than do non-rural students (Ballou & Podgursky, 1998; Haller, Monk, & Tien, 1993).

Purpose of the Study

The purpose of this study is to determine any significant differences among recent high school graduates placed in developmental and college-level mathematics courses. In particular, the study will focus on students' high school course-taking patterns in mathematics and their attitudes and beliefs towards mathematics. High school location (rural/non-rural) is also examined.

Research Questions

1. Are there any significant differences in the mathematics placement (developmental/college-level) among recent high school graduates with regard to high school location (rural/non-rural)?
2. Are there any significant differences in the mathematics course-taking patterns among recent high school graduates with regard to placement (developmental/college-level mathematics courses) and high school location (rural/non-rural)?
3. Are there any significant differences in the attitudes and beliefs towards mathematics among recent high school graduates with regard to placement (developmental/college-level mathematics courses) and high school location (rural/non-rural)?

Need for the Study

Recent high school graduates who are not ready for college find themselves placed in developmental coursework. These students are often shocked to learn that they are not prepared for college-level courses (Perin & Charron, 2003). Many are even resistant to taking developmental courses (Oudenhoven, 2002). Maxwell (1997) argues that developmental courses have "negative effects on students' attitudes and

expectations…lower their self-concepts, and make it more difficult for them to shed the image of being at risk students" (p. 8).

Hoyt and Sorensen (2001) note that college remediation yields greater costs to students and the public. Since many of the topics covered in developmental courses are a repeat of those previously presented in high school, taxpayers, colleges, and students themselves end up paying for the same education that should have been received prior to college. Tennessees' colleges and universities appropriations have continued to decrease through the years. The Tennessee Higher Education Commission (THEC) recognizes that this poor funding situation is exacerbated by the need for remediation in college (THEC, 2002b).

Boylan (1999b) observes that remediation extends a students' time in college by as much as a year. Many students are required to take developmental courses in more than one subject, further increasing their time and costs. Students who spend their first semester enrolled in remedial courses are generally unable to finish college in the typical four year period (Shaughnessy, Gaetke, Knoble, & Melancon, 1996). NCES reports that time spent in remediation is generally longer at 2-year colleges than all other types of institutions (Parsad & Lewis, 2003). In fall 2000, 53% of public 2-year colleges indicated that their students spent an average of one year on remediation courses compared to only 35% at public 4-year colleges (Parsad & Lewis, 2003). NCES data also suggests that the average time students spend in remedial courses increased between 1995 and 2000; the proportion of public 2-year colleges that reported an average of one year of remediation increased from 44% to 53% (Parsad & Lewis, 2003).

Research shows that students who need extensive remediation are less likely to be successful in college (Oudenhoven, 2002). Ignash (1997) suggests that there is a difference in the persistence and success rates of students who need only one remedial course as compared to three or four. In a study by Adelman (1998), a relationship was found between the need to take remedial education courses and the probability of achieving a degree. As the need for remediation increased, the degree completion rates fell. Only 35% of students who needed five or more developmental courses completed a degree, compared to 60% who needed no remediation.

THEC (2002b) presumes that the need for remedial/developmental coursework "affects the dismal persistence-to-graduation rates – 47% at public universities and 23% at public two-year institutions" in Tennessee (p. 2). In fall 2000, only 12.26% of first-time full-time freshmen requiring a mix of both remedial and developmental courses graduated within six years in Tennessee 2-year institutions (THEC, 2002a). The graduation rate for those requiring only developmental courses was 24.71%, while those students needing no remediation had a graduation rate of 38.97%.

Today, 60% of jobs require some education beyond high school (Bottoms & Feagin, 2003). This number is projected to reach 85% by the year 2020 (Bottoms & Feagin, 2003). "Improving college readiness is crucial to the development of a diverse and talented labor force that is able to maintain and increase U.S. economic competitiveness throughout the world" (ACT, 2004b). Employers expect students seeking technical or vocational degrees to have the academic knowledge and skills of a four-year college graduate (Bottoms & Feagin, 2003). Only 17.7% of Tennessee

residents have a bachelor degree or higher compared to the national average of 25.2% (THEC, 2002b).

THEC (2002b) and SREB (2000) affirm that "too many students enter college not prepared to do college level work" (THEC, 2002b, p. 1). A goal in *The Condition of Higher Education in Tennessee* report states, "the percentage of first-time freshmen 18 years or younger (2001 h.s. grads) taking developmental studies courses at the university level will be reduced by 20 percent" (THEC, n.d., p.6). The *Statewide Master Plan for Tennessee Higher Education 2000-2005* document identifies the need for P-16 (pre-school through college) reform as one of its current goals (THEC, 2000). P-16 education is focused on transitioning students from one level of education to the next, which includes the transition from 12th grade to college (THEC, 2002b). All graduates should be ready to pursue postsecondary education without remediation (Barth, 2001).

Hoyt and Sorensen (2001) recommend collaboration between colleges and high schools to help reduce the need for remediation among recent high school graduates. Creech (1992) and Ignash (1997) suggest that colleges make high schools aware of how prepared their students are for college-level work with college readiness reporting systems (Creech, 1992). Such systems could group students by their high school graduation date and include reports on the courses they completed in high school (Creech, 1992). SREB suggests that transcript studies, in addition to reports on how well high school experiences prepared students for postsecondary education, are needed to reduce remediation among recent high school graduates (SREB, 2000; Bottoms & Feagin, 2003).

This study will provide information about the differences in students' high school course-taking patterns in mathematics among recent high school graduates placed in developmental and college-level mathematics courses. In addition, differences in students' attitudes and beliefs towards mathematics, which may also have an affect on both achievement and course-taking patterns in mathematics, will also be reported. This study will also provide specific information concerning how these differences occur based on high school location (rural/non-rural). Hence, this study will add to the knowledge base of rural mathematics education, which is minimal.

The information provided in this study could be useful to both high schools and colleges. High schools could use this information to identify students that might be at-risk of placing in developmental mathematics courses upon entering college. With proper interventions in high school, the amount of mathematics remediation needed in college could be reduced. Rural high schools, in particular, might find this information useful.

Colleges could use this information to foster collaboration between themselves and area high schools. Developmental mathematics instructors might also find this information useful. Ignash (1997) suggests that educators inform themselves about the particular characteristics of developmental students in an effort to develop effective programs that address the students' needs and provide them with the tools necessary to succeed.

Assumptions

1. Students are placed at the appropriate mathematics level upon entering college.
2. Students will respond honestly to the instrument related to mathematics course-taking

patterns and high school location and the attitudes and belief instruments administered in the study.

3. Students' mathematical attitudes and beliefs can be measured.
4. The instruments selected to measure students' attitudes and beliefs are valid and reliable.
5. The researcher introduced no bias into the study.

Limitations

Student responses to the instrument related to mathematics course-taking patterns and high school location will be self-reported and may be inaccurate. Student responses to the mathematics attitudes and belief instruments only represent what students perceive and are willing to share about their actual attitudes and beliefs. In addition, due to the length of the survey, students may not give an appropriate amount of time and consideration to each item.

Delimitations

This study will be limited to mathematics students attending two community colleges in east Tennessee during the fall semester of 2006. Therefore, the results of the study will be limited in generalizability.

Survey analysis will be limited to students who graduated high school in the spring of 2006. They will also be enrolled in a mathematics course for the first time at either one of the participating community colleges. This will insure that the survey data reflects the students' attitudes and beliefs towards mathematics as perceived by them in high school. The survey will be completed at the beginning of the semester so that

students' attitudes and beliefs will not be affected by their current mathematics course in college.

Students who are not enrolled in lecture courses (face-to-face instruction) will be excluded from the study. This will preclude some students from participating; however this should not affect the results of the study since the majority of students at both community colleges are enrolled in lecture courses. Students under the age of 18 will also be excluded from the study. Again, this will preclude some students from participating in the study; however this should not affect the results since the majority of recent high school graduates are at least 18 years of age.

Definitions of Terms

1. Recent high school graduates: Students who graduated high school in the spring of 2006.
2. Developmental mathematics students: Students who indicate a lack in the ability to do algebraic computations (THEC, 2002a). In Tennessee Board of Regents (TBR) colleges, students with an ACT mathematics score less than 19 are placed in developmental mathematics courses.
3. College-level mathematics students: In TBR colleges, students with an ACT mathematics score of at least 19 are placed in college-level mathematics courses.
4. Non-rural high school: High school having a Locale code of 1 though 6, as defined by the NCES.
5. Rural high school: High school having a Locale code of 7 or 8, as defined by the NCES.
6. Locale codes: Also known as Johnson codes, a coding system that is based on

proximity to metropolitan areas and on population size and density. The codes are assigned based on the addresses of the individual schools and are assigned at the school level.

7. Attitude towards mathematics: A favorable or unfavorable response to mathematics.
8. Epistemological belief toward mathematics: Beliefs about the nature of knowledge and learning of mathematics (Schommer, Crouse, & Rhodes, 1992).

Organization of the Study

The study is composed of five major chapters. Chapter I includes an introduction to the study, a statement of the problem and purpose, need for the study, assumptions, limitations, delimitations, definitions of terms, and an organization of the study. In Chapter II, a literature review focuses on course-taking patterns in mathematics, attitudes and beliefs towards mathematics, and high school location, stressing each one's effect on mathematics achievement and preparedness for college. An explanation of the methodology and procedures used in the study is presented in Chapter III. The findings of the statistical analysis of the data are reported in Chapter IV. Chapter V summarizes the study and includes the findings, a discussion and conclusions, and recommendations for further research.

CHAPTER II

REVIEW OF THE LITERATURE

The purpose of this study is to determine any significant differences among recent high school graduates placed in developmental and college-level mathematics courses. In particular, the study will focus on students' high school course-taking patterns in mathematics and their attitudes and beliefs towards mathematics. In addition, the study will provide specific information concerning how these differences occur based on high school location (rural/non-rural).

This chapter summarizes the findings from a review of the literature addressing the three main areas related to the study. These areas include: high school course-taking patterns in mathematics, beliefs and attitudes towards mathematics, and high school location (rural/non-rural). More specifically, the literature review focuses on the influences of each these areas on mathematics achievement and preparedness for mathematics in college. Relationships among the different areas are also explored.

Course-Taking Patterns

During the 1960s and 1970s, American high schools began to offer more heterogeneous curricula, which allowed students to enroll in more nonacademic courses (Teitelbaum, 2003). As a result, there was an increase in the number of vocational courses taken by students, and in turn, there was a decrease in the number of academic courses taken (Teitelbaum, 2003). Furthermore, between 1972 and 1980, a lower percentage of students completed advanced courses in mathematics and science (Teitelbaum, 2003).

In regard to mathematics achievement, standardized test scores dropped and American students performed quite poorly on international comparisons of mathematics and science proficiency (National Commission on Excellence in Education, 1983). Most Asian and many European countries outperformed the United States, as documented by the First and Second International Mathematics Studies conducted in the early 1960s and early 1980s (Stigler & Hiebert, 1999). In response, the National Commission on Excellence in Education released a report entitled, *A Nation at Risk*, in 1983. Commission members offered several recommendations, including the strengthening of high school graduation requirements. Students were recommended to complete a minimum of three mathematics courses in high school (Teitelbaum, 2003).

Educators and policymakers supported the National Commission on Excellence in Education, placing "much of the blame on student course-taking patterns for America's poor performance on standardized and internationally administered tests" (Teitelbaum, 2003, p. 32). Several states and local districts responded by establishing or strengthening high school graduation mathematics course requirements (Hoffer, et al., 1995; Teitelbaum, 2003). Teitelbaum (2003) suggests that the adoption of increased high school graduation requirements, especially in mathematics and science, has been one of the most widely implemented educational reform efforts of the last two decades. "In 1990, more students were in the academic track than a decade before, and students were taking more math courses," indicating that the curriculum reforms of the 1980s did have some effect on course-taking (Lee, Croninger, & Smith, 1997, p. 108). The percentage of students who completed three years of high school mathematics increased greatly from 1982 to 1992 (Chaney, Burgdorf, & Atash, 1997).

There is a large amount of research supporting the notion that taking more mathematics courses in high school raises student proficiency in mathematics. Several studies have shown a positive relationship between the number of credits earned in mathematics and student achievement (Welch, Anderson, & Harris, 1982; Schmidt, 1983; Gamoran, 1987; Hoffer et al., 1995). These studies utilized data sets from nationally representative surveys of high school students taken over the past several decades.

Schmidt (1983) studied the effect of quantity of high school mathematics on achievement, while controlling for background characteristics. He analyzed data from the National Longitudinal Study of the High School Class of 1972 (NLS-72), a study designed and conducted by the NCES. Schmidt found a strong positive relationship between mathematics test scores and number of hours of mathematics instruction. The relationship remained substantially intact even after accounting for selected student background characteristics; "the largest effect on mathematics achievement is clearly and dramatically the quantity of schooling in mathematics" (p. 329). Schmidt replicated these results using ACT mathematics scores provided in the NLS-72 data.

Using 1977-1978 NAEP data (17-year olds), Welch et al. (1982) reached similar conclusions. Multiple regression analysis showed a .73 correlation between quantity of mathematics and mathematics achievement. Background variables such as home and community environment and previous mathematics learning accounted for only 24% of the variation in achievement scores, while amount of mathematics accounted for 34% of the total variance. Later studies have resulted in consistent findings (e.g., Jones, Burton, & Davenport, 1984).

In a more recent study, Hoffer et al. (1995) examined the relationship between the number of mathematics courses taken in high school and mathematics achievement using 1988 (8^{th} grade cohort) and 1992 (senior cohort) National Education Longitudinal Study (NELS) data. There was a strong positive correlation between student test score gains (from 8^{th} grade to 12^{th} grade) and the number of mathematics courses students completed in high school. Students who completed more mathematics courses showed greater achievement score gains during high school, regardless of social background.

Gamoran (1987) analyzed sophomore and senior cohort data from the High School and Beyond Longitudinal Study (HSBLS) conducted in 1980 and 1982. He found that taking additional mathematics courses in high school raised mathematics achievement. However, Gamoran also concluded that taking advanced mathematics courses had a more powerful effect on mathematics achievement. Other studies have produced similar results for the same data set (Jones, Davenport, Bryson, Bekhuis, & Zwick, 1986; Jones, 1987; Lee & Bryk, 1989). All of these studies found a strong relationship between mathematics test scores and number of years of advanced mathematics courses. Other studies based on NELS data also suggest enrollment in advanced mathematics courses to be a powerful determinant of mathematics proficiency (Rock, Ownings, & Lee, 1994; Rock and Pollack, 1995; Hoffer, 1997; Thomas, 2002; Teitelbaum, 2003).

Using the base year (1988) and first follow-up study (1990) data from NELS, Rock et al. (1994) determined that students who took higher levels of mathematics were more likely to be classified as proficient (at higher levels of mathematics) than students who took lower levels of mathematics. Students who did not take courses past Algebra I

showed little growth in understanding complex mathematical concepts and multi-step problem solving skills. Higher mathematics gains were associated with advanced course-taking. Rock et al. (1994) concluded, "Course-taking patterns in mathematics between 8th grade and 10th grade is an important factor in explaining increased mathematics proficiency at the 10th grade level," even after controlling for 8th grade math proficiency (p. 7). In a follow-up study, Rock and Pollack (1995) found that students who took more advanced courses (including pre-calculus and calculus) showed greater gains between 10th and 12th grades as well.

Hoffer (1997) studied the relationship between graduation requirements in mathematics and increases in student achievement in mathematics, as measured by 8th grade to 12th grade test score gains (NELS). Linear regression statistical techniques suggested that a three-course mathematics requirement was not associated with student achievement in mathematics. In other words, students who attended schools requiring three years of mathematics did not make significant mathematical gains compared with students who attended schools requiring less than three years of mathematics. Hoffer found the level of mathematics to be positively associated with mathematics achievement however. Mathematics course level had a very strong effect on mathematics achievement gains from 8th grade to 12th grade. Teitelbaum's (2003) study from the same data set yielded similar conclusions. He also found that a three-course requirement in mathematics did not improve achievement alone and that "students who take more and higher level math … courses achieve higher gains" (p. 43). Other large-scale studies based on 1990 NAEP data reveal similar findings (e.g., Chaney et al., 1997; Lee, Croninger & Smith; 1997).

SREB data suggest that students who take a mathematics course during their senior year of high school have higher mathematics achievement upon graduation (Bottoms & Carpenter, 2003). This may be due to the fact that these students are "more than twice as likely to complete Algebra III/trigonometry; three times more likely to complete pre-calculus, calculus, or advance placement mathematics; and three and one-half times more likely to take four mathematics credits" (Bottoms & Carpenter, 2003, p. 13). It should be noted however that students can earn three or four credits of mathematics without ever advancing past Algebra I (Creech, 1997).

Course-Taking Patterns and College Preparedness

Average ACT and SAT scores are below the national average in SREB states (Creech, 1997). Low ACT scores result in the need for mathematics remediation in college. According to SREB studies, fewer students who complete college preparatory courses require mathematics remediation upon entering college (Creech, 1997). SREB also notes that recent high school graduates who do not take a mathematics course during their senior year of high school are among remedial mathematics students in college (Creech, 1997).

In order to reduce mathematics remediation in college, Adelman (1998) recommends that high school educators work to intensify the curriculum, including the amount and kind of mathematics that is required. Supporting this notion, ACT (2004b) data suggest that there is a strong positive relationship between mathematics course-taking and college readiness. ACT research shows that students' academic preparedness for college, as reflected by their ACT scores, not only depends on the number of mathematics courses taken, but also on the specific courses taken (ACT 2004a; ACT

2005; Noble, 2004). Algebra I and higher-level mathematics courses seem to make the most difference in raising achievement (Bottoms & Feagin, 2003). Students who take more college preparatory mathematics courses (Algebra I and higher) score higher on the ACT mathematics test (McLure, 1998). Upper-level courses beyond Algebra II have a strong impact on ACT mathematics scores (ACT, 2004a; ACT, 2004b).

> Students taking Algebra 1, Algebra 2, and Geometry typically score 1.8 points higher on the ACT Mathematics test than students taking less than Algebra 1, Algebra 2, and Geometry. In comparison, students taking these three courses plus Trigonometry and Calculus, or Trigonometry, Calculus, and Other Advanced Math, typically score 5½ points higher on the ACT Mathematics test than students taking the three mathematics courses only (Noble, 2004, ¶ 6).

ACT maintains that taking upper-level mathematics courses is associated with significant increases in ACT Mathematics scores regardless of prior achievement and grade level at the time of testing (Noble, 2004). ACT recommends that high school students take at least three years of mathematics, including Algebra II and higher, to prepare themselves for college (ACT, 2003). SREB (2000) recommends four years of mathematics, including Algebra I, Algebra II, and higher.

Hoyt and Sorensen (2001) examined developmental mathematics placement by level of mathematics completed in high school among entering freshmen (from five high schools in two school districts) at Utah Valley State College (UVSC). They found a positive correlation between level of mathematics and ACT scores; completing higher levels of mathematics increased students' ACT test scores. Hoyt and Sorensen also found level of mathematics to be significantly predictive of placement in developmental mathematics. Taking higher levels of mathematics reduced developmental mathematics placement rates. Most of the students who did not take Algebra II were placed in

developmental mathematics, while over half of those who did take Algebra II were still placed in developmental mathematics. Only those students taking higher-level courses, such as trigonometry, precalculus and calculus were less likely to be placed in developmental mathematics.

Berry (2003) conducted a study at North Arkansas College (Northark) to determine whether high school students who took college preparatory mathematics placed into and succeeded in college-level mathematics courses. A three-year analysis of high school transcript data for entering freshmen at Northark examined both level of mathematics and presence of math during the senior year. Seventy-three percent of students who took a course higher than Algebra II placed in college-level mathematics courses as compared to only 29% of students whose highest course was Algebra II. Berry concluded that students taking a fourth year of mathematics (more advanced than Algebra II) had a better chance of placing in college-level mathematics courses.

Often times, students elect not to take a mathematics course during their senior year of high school (Rock & Pollack, 1995). Some students do not even take any mathematics during their last two years of high school (Perin & Charron, 2003). Even so, "there has been a trend toward more academically intensive course-taking" (Trusty, 2002, p. 464). Greater numbers of students are completing more advanced mathematics courses in high school according to NCES (2004). The percentage of high school graduates who had completed advanced mathematics courses (above algebra II and geometry I) increased from 26% in 1982 to 45% in 2000 (NCES, 2004).

Boylan (1999a) notes however that even advanced mathematics students are not always prepared for college-level mathematics. For example, Lappan and Phillips (1984)

found that nearly 70% of the students enrolled in Intermediate Algebra at one university had taken three to four years of mathematics (at the algebra I level and above) in high school. Hoyt and Sorensen (2001) found high developmental mathematics placement rates among students who had successfully completed college preparatory mathematics courses in high school. Similarly, a 1998 Maryland study found that 40% of high school graduates who had completed a college preparatory curriculum needed mathematics remediation in college (Oudenhoven, 2002). ACT research indicates that less than half of ACT-tested graduates who take college preparatory core coursework are ready for College Algebra (Noble, 2004).

Attitudes and Beliefs Towards Mathematics

In 1989, the National Research Council (NRC) released *Everybody Counts*: *A Report to the Nation on the Future of Mathematics Education*, which focused on the need for reform in U.S. mathematics education. *Everybody Counts* illuminated the fact that Americans tend to think that mathematical ability is innate rather than achievable by individual effort or opportunity to learn. Due to this, parents, students, teachers, and policy makers often accept or expect poor achievement in mathematics, which in turn lowers expectations (NRC, 1989). "Only in mathematics is poor school performance socially acceptable" (NRC, 1989, p. 74). *Everybody Counts* put considerable emphasis on the need to change the publics' beliefs and attitudes toward mathematics; "as attitudes about the importance of mathematics improve, so will expectations for mathematics education" (NCR, 1989, p. 82).

Stevenson and Stigler (1992) confirm the NCR, "the most self-defeating belief that has taken hold in the United States during recent decades concerns the relative

contributions of innate ability and effort to achievement" (p. 221). As already noted, U.S. students lag behind Chinese and Japanese students in mathematics achievement scores (Stigler & Heibert, 1999). In *The Learning Gap*, Stevenson and Stigler (1992) highlight an important attitudinal difference between Americans and Asians in this regard. The emphasis is on effort in Asian countries (Stevenson & Stigler, 1992). Therefore, lack of achievement is contributed to insufficient effort rather than innate ability (Stevenson & Stigler, 1992).

McLeod (1992) suggests that affective issues, such as attitudes and beliefs, play an important role in the teaching and learning of mathematics. McLeod (1992) reiterates the NCR, "The improvement of mathematics education will require changes in the affective responses of both children and adults" (p. 575). In addition to the NCR, other U.S. reform movements have called attention to affective issues in mathematics education (McLeod, 1992). In 1989, the National Council of Teachers of Mathematics (NCTM) released the *Curriculum and Evaluation Standards for School Mathematics*, which outlined major educational goals for students. Two of these goals included that students "learn to value mathematics" and "become confident in their ability to do mathematics" (NCTM, 1989, Introduction section). In NCTM's (2000) most recent document, *Principles and Standards for School Mathematics*, the teaching principle maintains that teachers are instrumental in shaping students' confidence in and disposition toward mathematics.

In the fall of 2005, 100,573 first-time college students at public and private, two- and four-year colleges and universities participated in the National Freshmen Attitudes Study (Noel-Levitz, 2006). This study disclosed students' lack in their mathematical

confidence as they transitioned from high school to college. Nearly 51% of first-time students at two-year colleges agreed with the statement, "I have a hard time understanding and solving complex math problems" (Noel-Levitz, 2006).

Attitudes

Attitude represents one component of the affective domain (McLeod, 1992). Aiken (1970) defined the term attitude as "a learned predisposition or tendency on the part of an individual to respond positively or negatively to some object, situation, concept, or another person" (p. 551). Neale (1969) referred to attitude toward mathematics as a "a liking or disliking of mathematics, a tendency to engage in or avoid mathematics activities, a belief that one is good or bad at mathematics, and a belief that mathematics is useful or useless" (p. 632).

Attitudes have long been thought to affect performance in some way (Aiken, 1970). In particular, a strong relationship between attitude and mathematics achievement has been assumed in both theory and practice (Ma & Kishor, 1997). Numerous studies have been reported on the relationship between attitude toward mathematics and achievement, however, little consensus exists in the research literature (Ma & Kishor, 1997).

Aiken (1970) presented a narrative review of the literature (for the years prior to 1970) pertaining to the effects of attitudes on achievement in mathematics. Aiken (1970) proposes, "The relationship of attitudes…to performance appears to be especially important in mathematics learning" (p. 559). In his review, Aiken reported small to moderate statistically significant correlations between attitude and achievement in mathematics for elementary, junior, and high school students. He noted that elementary

students tended to have a more positive than negative attitude toward mathematics. He also suggested that students' attitudes change over time; "A number of studies point to the persistence of negative attitudes toward mathematics as students ascend the academic ladder" (Aiken, 1970, p. 556). In other words, as students get older, their attitudes become more negative (Aiken, 1970).

More recently, Ma and Kishor (1997) conducted a meta-analysis to investigate the relationship between attitude toward mathematics (ATM) and achievement in mathematics (AIM) at the elementary and secondary levels. They explored both a general and causal relationship between ATM and AIM. Ma and Kishor (1997) extended Neale's (1969) definition of ATM to include "students' affective responses to the easy/difficult as well as the importance/unimportance of mathematics" (p. 27). A systematic search (computer-based and manual) resulted in a sample of 113 studies involving 82,941 students in 12 grade levels for the years 1966 to 1993. In their meta-analysis, Ma and Kishor found a positive and reliable general relationship between ATM and AIM. Although the effect size (.12) was statistically significant, the relationship was deemed too weak for educational use. A causal relationship of ATM on AIM was not found to be statistically significant, also due to a low effect size (.08). In regard to grade level, the relationship between ATM and AIM was determined to be statistically significant in each grade group. Ma and Kishor suggest, "The ATM-AIM relationship may not be strong at the elementary school level, but may be strong enough for practical considerations at the secondary school level" (p. 40).

Current research supports the notion that attitude is related to mathematics achievement among high school students. Several studies show a positive relationship

between attitude and achievement in mathematics (Braswell, Lutkus, Grigg, Santapau, Tay-Lim, & Johnson, 2001; Schreiber, 2002; Patterson, Emmett, Decker, Eckert, Klaus, Wendling, & Papanastasiou, 2003). These studies utilized data sets from nationally representative surveys of U.S. high school students in recent years.

Using 1995 Trends in International Mathematics and Science Study (TIMSS) data, Patterson et al. (2003) analyzed the effect of certain factors, including attitude toward mathematics, on student's advanced mathematics performance scores. U.S. students in their final year of high school were specifically studied. Of those students, more than 70% agreed that they liked mathematics and believed it was important. "Student math attitude accounted for 13.1% of the variance in mean advanced mathematics scores….in fact, it contributed more than the other factors combined" (pp. 102-103). Attitude toward mathematics had a significant effect on advanced mathematics achievement. This result supports the findings of Ma and Kishor (1997). Patterson et al. actually attained a greater effect size than Ma and Kishor (.11 as compared to .08).

Utilizing the same data set as Patterson et al. (2003), Schreiber (2002) reached similar conclusions. Using hierarchical linear modeling, he also found attitude to be a significant predictor of advanced mathematics achievement among high school students. Schreiber observed a significant negative relationship between attitude towards mathematics and advanced mathematics achievement; "Because this item was reverse coded, the interpretation was that students with poor attitudes toward mathematics tended to perform lower on the test" (pp. 279-280). Schreiber deemed this finding important because it illustrates that even advanced mathematics students' achievement is directly related to their attitude toward mathematics.

Analysis of 2000 NAEP mathematics data indicates that "the attitudes of students…relate rather strongly to performance" (Braswell et al., 2001, p. 178). Students at grades 4, 8, and 12 were asked to respond to statements such as, "I like math" and "Math is useful for solving problems." Braswell et al. (2001) found a positive relationship between students' attitudes towards mathematics and their performance on the mathematics assessment at all three grade levels. Students who agreed that they liked math and that math is useful for solving problems had the highest average scores. The NAEP data also shows that "students' attitudes towards mathematics have changed since the early 1990s…fewer eighth- and twelfth-grade students reported liking math" (p. 178). Additionally, the percentage of 12^{th} graders that agreed that math is useful for solving problems decreased from 73% in 1990 to 61% in 2000.

In the literature, the use of the term attitude often includes the term beliefs (e.g., Neale, 1969; Ma & Kishor, 1997). McLeod (1992) maintains, "It is difficult to separate research on attitudes from research on beliefs" (p. 582). Hence, research findings related to attitude often encompass students' beliefs as well.

Beliefs

Beliefs represent another component of the affective domain (McLeod, 1992). McLeod (1992) argues, "The role of beliefs is central in the development of students' emotional and attitudinal responses to mathematics" (p. 579). Bassarear (1991) suggests that the term beliefs "focuses on students' beliefs about the nature of mathematics, the nature of learning mathematics, and the nature of problem solving" (p. 44).

Garofalo (1989) proposes that beliefs influence how students' think about, approach, and carry out mathematical tasks. Beliefs are also thought to have an effect on

how students' learn and study mathematics (Garofalo, 1989; Mtetwa & Garofalo, 1989). Furthermore, evidence suggests that beliefs influence academic achievement among secondary students in mathematics (Schommer, Crouse, & Rhodes, 1992; Stage & Kloosterman, 1995; Braswell et al., 2001).

Schommer et al. (1992) examined the relationship between students' epistemological beliefs and mathematical text comprehension among college students. Epistemological beliefs are referred to as "beliefs about the nature of knowledge and learning" (Schommer et al., 1992, p. 435). Schommer, et al. (1992) focused on students' belief in simple knowledge, meaning that "knowledge is best characterized as isolated facts" (p. 435). Students who believe in simple knowledge are likely to concentrate on memorizing the facts, while failing to make connections between the facts, and then discontinuing study once the facts can be remembered (Schommer et al., 1992). Schommer et al. (1992) found belief in simple knowledge predicted both metacomprehension and comprehension of statistical text. Using path analysis, Schommer et al. (1992) established a link between students' belief in simple knowledge, their study strategies, and consequently their test performance. "Students who believed that knowing isolated facts was adequate to understand the material assumed that they had understood the text when their test performance indicated that they did not" (p. 441). Hence, "belief in simple knowledge predicted test performance;" the more a student believed in simple knowledge, the lower they scored on the statistical tests (Schommer et al., 1992, p. 441).

Recent analysis of mathematics NAEP data also provides insight on students' epistemological belief in simple knowledge (Braswell et al., 2001). In 2000, students at

grades 4, 8, and 12 were asked to respond to the statement, "Math is mostly memorizing facts." Students who agreed with this statement had the lowest average scores at all three grade levels. On a more positive note, "the percentage of students who disagreed that math was mostly memorizing facts increased at all three grade levels between 1992 and 2000" (Braswell et al., 2001, p. 178).

The 2000 mathematics NAEP data also provides information on students' beliefs about the nature of mathematics and problem solving (Braswell et al., 2001). For example, students were asked to respond to the statement, There is "only one way to solve a problem." Students who agreed with this statement had the lowest average scores at all three grade levels. Unfortunately, the percentage of 12^{th} grade students who disagreed with this statement decreased between 1996 and 2000 (Braswell et al., 2001).

McLeod (1992) suggests, "Research on beliefs has been highlighted by the results of research on problem solving….Schoenfeld's studies (1985) of the belief systems of problem solvers are important examples" (p. 579). Schoenfeld's studies primarily focused on college students solving problems individually or in pairs. Schoenfeld (1985) observed the following "typical" student belief: "Mathematics problems are always solved in less than 10 minutes, if they are solved at all" (p. 43). As a consequence of this belief, students may give up if not able to solve a problem quickly (Schoenfeld, 1985). In a later study, Schoenfeld (1989) noted this same belief among high school students. Schoenfeld (1989) also observed various other epistemological beliefs worth mentioning. For example, high school students believed: memorization is very important in learning mathematics; mathematics is rule bound; good grades in mathematics are due to hard

work rather than luck; and some people are good at mathematics while others aren't (Schoenfeld, 1989).

Kloosterman and Stage (1992) developed and validated an instrument to measure high school and college students' beliefs about the nature of mathematics and mathematics learning; special emphasis was placed on problem solving. The Indiana Mathematics Belief Scales consists of the following five scales: (1) Difficult Problems – I can solve time-consuming mathematics problems, (2) Steps – There are word problems that cannot be solved with simple step-by-step procedures, (3) Understanding – Understanding concepts is important in mathematics, (4) Word Problems – Word problems are important in mathematics, and (5) Effort – Effort can increase mathematical ability. Stage and Kloosterman (1995) used these scales to examine the relationship between gender, beliefs, and achievement in a college remedial algebra course. Student responses indicated the following:

> apprehension about doing time-consuming mathematics problems and uncertainty about the importance of understanding as opposed to getting the correct answer….slight disagreement with the notion that not all word problems can be solved simply by following a series of steps….uncertainty regarding the notion that word problems are an important part of mathematics….modest agreement with the notion that working harder could improve personal ability in mathematics. (pp. 301-302)

Stage and Kloosterman (1995) found both the Difficult Problems and Steps belief scale scores to be predictive of final grade for female students.

Attitudes/Beliefs and Course-taking Interaction

Only 37% of 17 year olds who took the 1996 NAEP mathematics assessment agreed with the statement, "I would like to take more mathematics" (Campbell, Voelkl, & Donahue, 2000). Additionally, 47% of 12th grade students reported that they "would not

study math if given the choice" (Braswell et al., 2001, p. 178). This percentage significantly decreased from 47% to 43% in 2000 (Braswell et al., 2001, p. 178). Walmsley (2000) suggests that American high school students exhibit negative mathematics attitudes in transition from high school to college.

The U.S. Department of Education advocates, "students' beliefs about the nature of mathematics may be key to their decisions to pursue mathematics" (Campbell, Voelkl, & Donahue, 2000, p. 91). Walmsley (2000) suggests that a students' decision to discontinue study in mathematics is often related to their attitude towards mathematics. Students' course-taking patterns are likely influenced by their attitudes toward mathematics (Thorndike-Christ, 1991). Thorndike-Christ (1991) examined the relationship between attitude and various other factors, including mathematics "track" and course-taking plans in mathematics. Subjects in the study included 1,516 male and female students enrolled in public middle and high schools. Thorndike-Christ found all of the attitudinal variables of the Fennema-Sherman Mathematics Scales (Fennema & Sherman, 1976) to be predictive of optional course-taking. The strongest relationships involved the following attitudinal variables:

> Perceived usefulness of mathematics ($\underline{r}$ = .41), those who felt that mathematics would be useful to them in their future lives expressed greater likelihood of enrolling in mathematics courses once such enrollment became optional; confidence in learning mathematics ($\underline{r}$ = .39), those with more confidence in their ability to learn mathematics were more likely to take mathematics once it was no longer required; and effectance motivation in mathematics ($\underline{r}$ = .37), the more fun an individual thought mathematics was, the more likely he or she was to express plans to continue to take mathematics courses once they became optional. (p. 31)

Thorndike-Christ also found significant positive relationships among attitude, level of mathematics course, and mathematics course-taking plans for middle and high school

students. Students in more advanced mathematics courses had more positive attitudes towards mathematics and a greater intention of taking optional mathematics courses. Ma and Willms (1999) also found attitude to have a significant effect on students' participation in advanced mathematics courses in the last two years of high school and particularly in the transition from 11th to 12th grade.

School Location

In 2003, approximately 51% of the public school districts in the United States were located in rural areas, according to the locale codes provided by the NCES. A student may be classified as having received either a rural or non-rural education depending on the location of the school. The general public typically views most aspects of rural communities, including education, negatively (Herzog & Pittman, 1995).

"Rural education has often been discussed as a deficit model of instruction" (Lee & McIntire, 2000, p. 1). This tends to support the notion that rural schools are inferior to their metropolitan counterparts (Greenberg & Teixeira, 1998; Fan & Chen, 1999). This also implies that significant differences in educational outcomes, such as academic performance, exist between rural and non-rural students (Creech, 1992; Greenberg & Teixeira, 1998; Fan & Chen, 1999). Herzog and Pittman (1995) note that a persistent problem of student achievement has been documented in rural communities.

Differences in educational outcomes among rural and non-rural students have been debated among researchers (Fan & Chen, 1999). Edington and Koehler (1987) suggest that an increasing number of studies have begun to examine the academic performance of rural students. In regard to mathematics, recent studies (Haller, Monk, & Tien, 1993; Greenberg & Teixeira, 1998; Fan & Chen, 1999; Howley, 2002b; Hopkins,

2004; Winters, 2003) fail to find any significant differences in the achievement of rural and non-rural students. Some studies (Lee & McIntire, 2000; Winters, 2003) have even found rural students to outperform non-rural students in mathematics.

Greenberg and Teixeira (1998) analyzed NAEP mathematics data (17 year-olds), beginning with 1975 and going through 1994. Although rural students' mathematics scores were slightly lower than non-rural students' mathematics scores, no significant differences in mathematics achievement were found among rural and non-rural students. In a similar, but more in-depth study, Howley (2002b) compared rural students' mathematics achievement to the national average. Analyzing NAEP mathematics scores for 4^{th}, 8^{th}, and 12^{th} graders, between 1978 and 2000, Howley (2002b) noticed the following two trends: "First, across 25 years of testing, there has been little change – increase or decrease – in the mathematics performance of rural students. Second, the performance of rural students differs not at all from the national average in all this time" (p. 9). Howley (2002b) notes that although the research literature is limited in this area, there are three recent empirical studies (Haller et al., 1993; Fan & Chen, 1999; Lee & McIntire, 2000) that provide a "comprehensive picture of mathematics achievement among rural students" (p. 9). These studies also utilized data sets from nationally representative surveys of middle and high school students.

Haller et al. (1993) studied the relationship between school location and students' higher-order thinking skills in science and mathematics. Data was analyzed from the Longitudinal Study of American Youth (LSAY), a study funded by the National Science Foundation. Using the base year sample (1987 for 10^{th} graders) and the first and second follow-up studies (1988 for 11^{th} graders and 1989 for 12^{th} graders), Haller et al. found no

effect of school size on students' higher-order thinking skills in mathematics. Likewise, no correlation was found between a school's location (rural/non-rural) and students' achievement on tests of higher-order thinking skills in mathematics.

Fan and Chen (1999) examined the academic achievement of rural, suburban, and urban high school students. Using the first three waves of data from the NELS (1988, 1990, and 1992 for 8th, 10th, and 12th graders), performance comparisons were made in reading, mathematics, science, and social studies. Multivariate analysis of variance revealed no systematic evidence that rural students performed worse than suburban or urban students in any subject, including mathematics. Fan and Chen concluded, "Students from rural schools perform as well as their peers in metropolitan areas" (p. 42).

Lee and McIntire (2000) conducted a systematic study of 1992 and 1996 NAEP national and state mathematics assessment data for 8th graders, selecting the 35 states that were common to both years. Lee and McIntire found no significant difference in the mathematics achievement of rural and non-rural students in 1992 at the national level. In 1996, however, rural students significantly outperformed non-rural students nationally. At the state-level, mathematics achievement among rural and non-rural students varied substantially. In the 14 (out of 35) states where significant mathematics achievement gaps were found between rural and non-rural students, seven states favored rural students, while the other seven states favored non-rural students. In order to understand these state-level variations in mathematics achievement, Lee and McIntire (2000) investigated six schooling conditions: instructional resources, professional training, algebra offering, progressive instruction, safe/orderly climate, and collective support. Multiple regression analysis indicated that the six schooling conditions accounted for 84% of the total

variance in rural mathematics achievement, where instructional resources, safe/orderly climate and collective support were found to be significant predictors. Lee and McIntire suggested, "Rural students in states where they have access to instructional resources, safe/orderly climate and collective support tend to perform better than their counterparts in states where they don't" (p. 171). Further analysis also indicated that the six schooling conditions accounted for 45% of the total variance in the state-level rural/non-rural mathematics achievement gap. "This implies that states which equalize schooling conditions across type of location, addressing school input, process and context variables together, would have relatively small achievement gap between rural and non-rural students" (Lee & McIntire, 2000, p. 173).

Based on these studies, Howley (2002b) makes some notable conclusions. These include: (a) there is no mathematics achievement gap among rural and non-rural students at the national level, (b) only 40% of states exhibit a mathematics achievement gap among rural and non-rural students at the state level, with 20% of these states favoring rural students, and (c) schooling conditions account for a large percentage of the state-level variation in the mathematics achievement gap among rural and non-rural students. Howley (2002b) suggests that such variability also exists at the district, school, and classroom level.

Rural Achievement in Tennessee

In Lee and McIntire's (2000) study of 1992 and 1996 mathematics NAEP data, no significant differences were reported in the mathematics achievement of 8th grade rural and non-rural students for the state of Tennessee. More recently, Winters (2003) examined the mathematics achievement of 8th and 12th grade students in the state of

Tennessee with regard to several variables, including school location. Based on the 2002 Tennessee Comprehensive Assessment Program (TCAP) scores, he found a significant difference in the mathematics achievement of 8th grade rural and non-rural students, where rural students outperformed non-rural students. At the high school level, no significant difference was found between 12th grade rural and non-rural students' 2002 ACT mathematics scores. Hopkins (2004) also examined the mathematics achievement of middle and high school students in the state of Tennessee with regard to school location. Excluding large city students, she found no significant difference between middle school rural and non-rural students' mathematics achievement on the 2003 TCAP; however, high school non-rural students scored significantly higher on the 2003 ACT mathematics assessment than did rural students. In an earlier study by Pinkerton (1996), non-rural students significantly outperformed rural students on the 1994 mathematics ACT assessment in the state of Tennessee.

Rural Education, Attitudes, and Course-taking Interaction

DeYoung (2003) notes that through the years, American education has evolved into "a context primarily for creating academic achievement and therefore for enabling upward social and economic ability" (p. 7). By 1950, more students were using their high school education as preparation for college rather than for vocational purposes (DeYoung, 2003). "In metropolitan and then suburban America, rising expectations of more schooling, and the consequent prolonging of entry into adult statuses, outpaced these developments in many rural communities" (DeYoung, 2003, p. 9).

Herzog & Pittman (1995) documented the differences in high school and college completion rates among rural and non-rural students. Although the completion rates have

increased for all students, non-rural students have always completed more schooling in both high school and college (Herzog & Pittman, 1995). From 1960 through 1980, rural students' high school completion rates remained around 10% lower than their metropolitan counterparts (Herzog & Pittman, 1995). By 1990, this gap had only been reduced to 7.8% (Herzog & Pittman, 1995). The gap in college completion rates among rural and non-rural students increased from 3.4% in 1960 to 9.5% in 1990 (Herzog & Pittman, 1995).

Parental and community involvement has been considered a possible contributor to rural/non-rural differences in educational outcomes (Fan & Chen, 1999). Edington and Koehler (1987) suggest that there is much support for the school in small communities. The school is often the center of activity (Edington & Koehler, 1987; DeYoung & Lawrence, 1995). Conversely, DeYoung and Lawrence (1995) propose that in poor rural communities, there is often less parental and community involvement in education. Additionally, rural communities often maintain lower expectations for students' educational and career aspirations than their non-rural counterparts (Edington & Koehler, 1987; Cobb et al., 1989; DeYoung & Lawrence, 1995). DeYoung (2003) hypothesizes:

> Many rural communities still resist the idea that their schools are primarily sites for teaching academic skills to students who will leave with them for elsewhere….At the same time, some rural high school students still resist the idea that they are to gain academic skills to leave home and their local economy to pursue college and jobs elsewhere in the country. (p. 13)

Using 1980 High School and Beyond data, Cobb et al. (1989) investigated educational and career aspirations among rural, urban, and suburban high school students. Rural students placed less value in academics than their urban and suburban counterparts (Cobb et al., 1989). Rural students expected to obtain jobs right after high school more

frequently than urban and suburban students (Cobb et al., 1989). Rural high school students did not aspire to attain as much higher education as their urban and suburban counterparts (Cobb et al., 1989). Rural high school students did not seem as confident in their abilities to complete a college education as did urban and suburban students (Cobb et al., 1989). Additionally, rural students perceived their parents to be "much less often supportive of full-time college…than their urban counterparts and more supportive of full-time jobs, trade schools, and the military" (Cobb et al., 1989, p. 13).

Rural high school graduates often "experience conflict between career aspirations and their preferences for a future residential location" (Silver & Castro, 2003, p. 8). Rural students are much less likely to live in a county that has a college, unlike urban students (Gibbs, 1998). Parents and children in rural areas recognize that a college education and future career choices often leads to temporary and in many cases permanent relocation from the community (Silver & Castro, 2003). Although "rural high school graduates are less likely than urban [high school graduates] to pursue further schooling" (Gibbs, 1998, p. 66), Cobb et al. (1989) found that rural students expressed more willingness to leave home for a job than did urban students.

As discussed, it is likely that some rural students may not be interested in academic pursuits such as post secondary education. Hence, many rural students choose to enroll in vocational courses rather than to participate in higher academic school offerings (DeYoung, 2003). On the other hand, some rural students may aspire to go to college and want to take challenging courses in high school. In either case, "all students have the right to take rigorous college preparatory courses; they should be offered in every high school in the country" (ACT, 2005). Unfortunately, this may not be the case

however. DeYoung (2002) suggests that some rural communities may lack the necessary resources to provide such academic possibilities.

Availability of resources has also been considered a possible contributor to rural/non-rural differences in educational outcomes (Fan & Chen, 1999). In rural schools, availability of resources is often related to limited curricula (Fan & Chen, 1999). Large high schools are usually able to offer more courses and more extensive programs of study than smaller high schools can (Haller et al., 1993). Large urban schools also tend to offer more advanced courses than smaller schools do (Barker, 1985; Haller et al., 1993). Rural schools are disadvantaged in that they may not be able to offer advanced or specialized courses, especially in critical areas such as mathematics and science (Herzog & Pittman, 1995; Ballou & Podgursky, 1998). Silver and Castro (2003) suggest that rural students' limited options in advanced course-taking also includes Advanced Placement (AP) courses.

There is a real concern that rural students are affected by limited curricula offered in public high schools (Jago, 2000). Several studies have examined the differences in course offerings and student enrollment in advanced courses among rural and non-rural schools (Haller et al., 1993; Ballou & Podgursky, 1998; Finn et al., 2002). These studies utilized data sets from nationally representative surveys of high schools.

Finn et al. (2002) investigated differences in mathematics course offerings in U.S. high schools in regard to several variables, including school location. Analyzing the 1994 High School Transcript Study, a NAEP component, Finn et al. also studied course-taking in mathematics among U.S. high school students. In "schools serving small, largely rural communities…both the number and proportion of advanced course offerings

were less than in more urbanized settings" (Finn et al., 2002, p. 356). In fact, there was a significant difference in the number of advanced mathematics courses offered among rural and urban/suburban schools. Additionally, rural schools offered significantly fewer semesters of calculus than did non-rural schools. With respect to students' course-taking, "urbanicity was significantly related to the years of mathematics taken, the highest level taken, and the ratio of advanced to basic coursework. The effect is attributable entirely to the disadvantage of students in rural schools" (Finn et al., 2002, p. 358).

Ballou & Podgursky (1998) compared advanced course-taking among rural and non-rural students. Based on data from the 1987-88 Schools and Staffing Survey, a study conducted by the NCES, Ballou & Podgursky found that rural students were less likely to participate in advanced mathematics courses than their suburban counterparts. Interestingly, however, students in non-metro towns spent more time in AP courses (Ballou & Podgursky, 1998).

Using LSAY data, Haller et al. (1993) reached similar conclusions as Coley (1999) and Ballou and Podgursky (1998). It was found that non-rural schools offered more advanced mathematics courses than rural schools did. Additionally, rural students took fewer advanced mathematics courses than did non-rural students. Haller et al. (1993) suggested that this was likely due to the difference in rural and non-rural mathematics course offerings. Even so, no relationship was found between a high school's advanced mathematics course offerings and its students' higher order-thinking skills in mathematics. Haller et al. concluded, "while large schools offered more advanced courses than do small ones, those offerings appear to have no influence on average levels of student achievement" (p. 71).

Summary

A literature review of mathematics course-taking patterns, beliefs and attitudes towards mathematics, and school location was done. Specifically, each topic was discussed in relation to mathematics achievement and college preparation. Interrelationships among the topics were also noted. Particular emphasis was placed on high school students.

Studies have shown that there is a positive relationship between the quantity of mathematics courses completed in high school and mathematics achievement. Other studies have found that the level of mathematics courses seems to be a more powerful predictor of mathematics achievement. Level of mathematics courses have also been shown to be predictive of college-level mathematics placement.

A general relationship, although sometimes weak, between attitude and mathematics achievement has been shown. The effect was found to be stronger in the secondary grades than in the elementary grades. Attitudinal studies have often included students' beliefs. A relationship between epistemological beliefs and mathematics performance has also been shown.

Although rural educational outcomes, such as achievement, have been viewed as inferior to metropolitan areas, recent studies have proven otherwise. It has been found that there are no significant differences in mathematics achievement between rural and non-rural students at the national level. State-level variations in the mathematics achievement gap between rural and non-rural students exist in 40% of the states, where 20% favor rural students. Schooling conditions have been shown to account for much of this variation.

It has been documented that rural students do not complete as much secondary and higher education as their non-rural counterparts do. Researchers have suggested that some rural students do not enroll in more academic courses. In any case, specialized and advanced courses in mathematics and science are shown to be limited in rural high schools. Significant differences in advanced mathematics course-taking among rural and non-rural high school students have been found.

CHAPTER III

METHODS AND PROCEDURES

In the fall of 2006, the researcher conducted a study at two community colleges in east Tennessee. Students placed in developmental and college-level mathematics courses completed surveys at the beginning of the semester. Data collected from recent high school graduates were analyzed using both descriptive and inferential statistical procedures. This chapter provides a description of the methodology employed in the study.

Research Questions

The purpose of this study is to compare recent high school graduates placed in developmental and college-level mathematics courses. The focus of the investigation is on students' high school course-taking patterns in mathematics and their attitudes and beliefs towards mathematics. High school location is also considered. The specific research questions are as follows:

1. Is there a significant difference in the mathematics placement (developmental/college-level) among recent high school graduates with regard to high school location (rural/non-rural)?
2. Are there any significant differences in the mathematics course-taking patterns among recent high school graduates with regard to placement (developmental/college-level mathematics courses) and high school location (rural/non-rural)?
3. Are there any significant differences in the attitudes and beliefs towards mathematics among recent high school graduates with regard to placement (developmental/college-level mathematics courses) and high school location

(rural/non-rural)?

Setting

Community Colleges

Two community colleges in the east Tennessee region participated in the study. Both of these colleges are TBR institutions that have an "open-door" admissions policy. Any student who has a high school diploma or a General Educational Development (GED) Certificate may be admitted.

Remedial/Developmental Mathematics

At TBR community colleges, a sequence of three remedial/developmental mathematics courses (DSPM 0700, DSPM 0800, and DSPM 0850) focusing on pre-algebra and algebra topics are offered. DSPM 0700 is a pre-algebra course that includes topics such as fractions, percents, decimals, and geometry. DSPM 0800 extends the topics of DSPM 0700 and includes content such as algebraic expressions, linear equations, inequalities, and functions. DSPM 0850 extends the topics of DSPM 0800 and includes content such as polynomial, quadratic, rational, and radical functions.

THEC specifies DSPM 0700 as a remedial course. Students in a remedial mathematics course lack the ability to do basic arithmetic (THEC, 2002a). DSPM 0800 and DSPM 0850 are specified as developmental courses. Students in a developmental mathematics course lack the ability to do algebraic computations (THEC, 2002a).

Mathematics Placement

Entering freshmen (under the age of 21) at TBR institutions are placed in mathematics courses (remedial, developmental or college-level) according to their ACT mathematics scores. Freshmen with an ACT mathematics score less than 19 are required

to enroll in one or more developmental mathematics course(s). If a student is placed in a developmental mathematics course, the student must complete that course and all subsequent courses in the sequence before enrolling in a college-level mathematics course.

Recent high school graduates comprise the bulk of the developmental mathematics students at the community colleges participating in the study. For example, in fall 2005, recent high school graduates (age 20 or younger) accounted for 68.73% of the total population of entering freshmen placed in developmental mathematics courses at one of the participating community colleges in this study. Of those, the majority were placed in DSPM 0800 or DSPM 0850.

Mathematics Background

In Tennessee, recent high school graduates were required to complete three units of mathematics in high school. Of the three units, one had to include Algebra I, Technical Algebra (formerly known as Mathematics for Technology II), or Integrated Mathematics I. In addition, students were only allowed to receive credit for one of those three courses. The two other units could include: Foundations I, Foundations II, Technical Mathematics (formerly known as Mathematics for Technology I), Geometry, Technical Geometry, Algebra II, Integrated Mathematics II, Integrated Mathematics III, Advanced Algebra and Trigonometry, Discrete Mathematics with Statistics and Probability, PreCalculus, Statistics, Calculus, Calculus AB (Advanced Placement), Calculus BC (Advanced Placement) and Statistics (Advanced Placement).

Participants

Data was collected from students enrolled in both developmental and college-level mathematics courses at two community colleges in east Tennessee. Developmental mathematics courses included DSPM 0800 and DSPM 0850; college-level mathematics courses included MATH 1010, MATH 1050, MATH 1130, MATH 1530, MATH 1630, MATH 1710, MATH 1720, MATH 1730, and MATH 1910. These college-level mathematics courses represent entry-level courses in which recent high school graduates are most likely to enroll in upon entering either community college. All lecture (face-to-face instruction) sections of the above listed courses were surveyed during the fall semester of 2006. Web based, interactive television (ITV), and regents online degree program (RODP) sections were excluded from the study. Students under the age of 18 were also excluded from the study. A total of 2,443 students participated in the study.

Instruments

Students in the above mentioned mathematics courses/sections were asked to complete a five page survey at the beginning of the fall semester 2006. The survey consisted of the Mathematics Education Experience instrument, the Indiana Mathematics Belief Scales instrument, and the Fennema-Sherman Mathematics Attitudes Scales instrument. Following, is a description of each instrument used in the study.

Mathematics Education Experience

This instrument is a one page survey (see Figure A-1[1]), consisting of seven questions, developed by the researcher to collect demographic data. The first three questions (multiple-choice) were used to sort the students according to: (a) high school

[1] All figures are in the Appendix.

graduation date (2006 or earlier), (b) current mathematics placement (developmental or college-level), and (c) college experience in mathematics (first time enrolled or previously enrolled). The last four questions (multiple choice and free response) pertain to students' high school location and mathematics course-taking.

Indiana Mathematics Belief Scales

This instrument is a two page survey (see Figure A-2) consisting of 30 Likert-type items. All five scales of the Indiana Mathematics Belief Scales (Kloosterman & Stage, 1992) were used to assess students' beliefs about the discipline of mathematics and how mathematics is learned. These scales include: (1) Difficult Problems – I can solve time-consuming mathematics problems, (2) Steps – There are word problems that cannot be solved with simple, step-by-step procedures, (3) Understanding – Understanding concepts is important in mathematics, (4) Word Problems – Word problems are important in mathematics, and (5) Effort – Effort can increase mathematical ability.

The Difficult Problems Scale measures "students' beliefs about their ability to solve problems which take more than a minute or two to complete" (Kloosterman & Stage, 1992, p. 109). The Steps Scale measures a student's "belief in the existence of rules" in mathematical problem solving (Kloosterman & Stage, 1992, p. 110). The Understanding Scale measures "students' beliefs about the importance of understanding in mathematics," versus memorization (Kloosterman & Stage, 1992, p. 110). The Word Problems Scale measures students' "perceptions of the importance of word problems as opposed to computational skills" (Kloosterman & Stage, 1992, p. 110). The Effort Scale measures "the extent to which students feel that effort and study will make them smarter in mathematics" (Kloosterman & Stage, 1992, p. 111).

The scales are described by the authors as follows:

> Statements were written so that students could respond to each statement using a Likert-type format of strongly agree, agree, uncertain, disagree, or strongly disagree…Individual items were scored by assigning the number 1 to the least positive response (strongly disagree if the item was positively worded and strongly agree if the item was negatively worded) and so on up to the number 5 for the most positive response (strongly agree if the item was positively worded and strongly disagree if the item was negatively worded). A total score for the six items on each scale was determined by adding the values reported for the six items on the scale. Using this scoring procedure, scores on each scale could range from 6 to 30. (p. 111)

To establish construct reliability, Kloosterman and Stage (1992) administered the five scales to 517 college students. The internal consistency reliability statistic (Cronbach's α) was computed and reported for each scale: Difficult Problems Scale (.77), Steps Scale (.67), Understanding Scale (.76), Word Problems Scale (.54), and Effort Scale (.84). To establish construct validity, correlations among each of the five scales were calculated and reported. Although significant correlations were found between several of the scales, inter-scale correlations were considered acceptably small.

The six items for each of the five scales used in this study were randomly distributed into one instrument. For data analysis, the five scales were separated and items were given a score of 1-5 depending on the response (positive or negative), and an average score for each scale was calculated for each person.

Fennema-Sherman Mathematics Attitudes Scales

This instrument is a two page survey (see Figure A-3) consisting of 48 Likert-type items. Four scales of the Fennema-Sherman Mathematics Attitudes Scales (Fennema & Sherman, 1976) were used to assess students' attitudes towards mathematics. These scales include: (1) Attitude Toward Success in Mathematics, (2) Confidence in Learning

Mathematics, (3) Effectance Motivation, and (4) Mathematics Usefulness. The Mathematics as a Male Domain Scale was not used since gender was not a variable in this study. The Mother Scale, Father Scale, and Teacher Scale were not used since the researcher was only concerned with student attitudes. The Anxiety Scale was not used since Fennema and Sherman (1976) found this scale to be highly correlated (.89) with the Confidence in Learning Mathematics Scale.

The four scales used in the study are defined by the authors as follows:

> The Attitude Toward Success in Mathematics Scale (AS) is designed to measure the degree to which students anticipate positive or negative consequences as a result of success in mathematics. They evidence this fear by anticipating negative consequences of success as well as by lack of acceptance or responsibility for the success, e.g., "It was just luck." (p. 2)
>
> The Confidence in Learning Mathematics Scale (C) is intended to measure confidence in one's ability to learn and to perform well on mathematical tasks. The dimension ranges from distinct lack of confidence to definite confidence. The scale is not intended to measure anxiety and/or mental confusion, interest, enjoyment or zest in problem solving. (p. 4)
>
> The Effectance Motivation Scale (E) is intended to measure effectance as applied to mathematics. The dimension ranges from lack of involvement in mathematics to active enjoyment and seeking of challenge. The scale is not intended to measure interest or enjoyment of mathematics. (p. 5)
>
> The Mathematics Usefulness Scale (U) is designed to measure students' beliefs about the usefulness of mathematics currently and in relationship to their future education, vocation, or other activities. (p. 5)

The scales are described by the authors as follows:

> Each scale consists of 6 positively stated and six negatively stated items with five response alternatives: strongly agree, agree, undecided, disagree, and strongly disagree. Each response is given a score of 1-5 and on each scale, except the Male Domain Scale, the weight of 5 is given to the response that is hypothesized to have a positive effect on the learning of mathematics. The person's total score on each of these scales is their cumulative total and the higher the score, the more positive their attitude. (p. 7)

To establish construct reliability, Fennema and Sherman (1976) administered the scales to 367 high school students. Split-half reliabilities were computed and reported for each scale: Attitude Towards Success in Mathematics Scale (.87), Confidence in Learning Mathematics Scale (.93), Effectance Motivation in Mathematics Scale (.87), and Usefulness of Mathematics Scale (.88). To establish construct validity, Fennema and Sherman (1976) administered the scales to 1,233 high school students. Correlations between scales were calculated and reported. Although the scales were found to be interrelated, each scale was deemed to measure a relatively different construct. Even though the scales were validated among high school students, it should be a satisfactory instrument to use among college students who just graduated from high school.

The 12 items for each of the four scales used in this study were randomly distributed into one instrument. For data analysis, the four scales were separated and items were given a score of 1-5 depending on the response (positive or negative), and an average score for each scale was calculated for each person.

Data Collection

Student packets, consisting of a Study Information Sheet (see Figure A-4), the survey, an entry form, and a return envelope, were bundled into classroom sets. Prior to the beginning of the fall semester 2006, the researcher attended a mathematics faculty meeting at each community college. During the meeting, the researcher explained the survey distribution/collection process and distributed the classroom sets to the mathematics instructors. An instruction sheet was also provided to each of the faculty members involved in the study.

Data collection occurred at the beginning of the semester so that the student's attitudes and beliefs would not be influenced by their current mathematics course in college. The instructors distributed the survey packets to the students within the first two weeks of the semester. The students were then given a maximum of two weeks in which to complete and return the survey to their instructor. For confidentiality, the students returned their survey using the envelope provided by the researcher. Survey responses were accepted during the first four weeks of the semester. The researcher gathered the surveys during the fifth week of the semester.

As stated in the Study Information Sheet, participation in the study was voluntary. In addition, the following statement was included on the Study Information Sheet: "Return of the completed survey (questionnaire) constitutes your consent to participate." Students did not have to sign an Informed Consent Statement and were instructed to keep the Study Information Sheet for their records.

To encourage student participation, cash awards were used as an incentive at both community colleges. To be eligible for the cash award drawing, students were required to: a) complete the entire survey, b) include their name and mailing address on the entry form, and c) return their completed survey and entry form to their instructor before the fifth week of the semester. Students were allowed to submit their survey responses anonymously; however, these were not included in the incentive award drawing. A drawing was held during the sixth week of the semester. Three students from each college were awarded $100 each. These students received a "Thank You" letter and their cash award by way of their mathematics instructor.

Data Analysis

There were approximately 3,012 surveys distributed, with a total of 2,443 surveys being returned. This represents an overall response rate of approximately 81.1%. Returned surveys were sorted and any identifying information was removed. Survey data was recorded into a spreadsheet using Microsoft Excel. The Statistical Package for the Social Sciences (SPSS) Version 14.0 was used to analyze the data. To ensure that the survey data reflected the students' attitudes and beliefs towards mathematics as perceived by them in high school, survey analysis was limited to recent high school graduates (students who graduated from high school in the spring of 2006) who were taking a mathematics course in college for the first time. Of the 2,443 students who participated in the study, 729 (approximately 30 %) belonged to this group. Data was classified according to mathematics placement (developmental/college-level) and high school location (rural/non-rural).

High School Location

The Locale codes, developed by the NCES, were used to categorize students' high schools as either rural or non-rural. NCES provides the following description of the Locale codes.

> This coding system is based on both the proximity to metropolitan areas and on population size and density. As a further aid to users, these codes are assigned based on the addresses of the individual schools and are assigned at the school level. Thus, it is possible to identify areas within school districts as being different types of localities.

Locale codes 1 – 6 are used to designate non-rural schools and codes 7 and 8 are used to designate rural schools (http://nces.ed.gov/surveys/RuralEd/definitions.asp).

Of the 729 students, 13 (less than 2%) were either homeschooled, attended a high school outside of the United States, or did not provide enough information to determine location. These students were not included in the analysis. Of the remaining 716 students, 426 (59.5 %) were placed in developmental mathematics courses, while 290 (40.5 %) were placed in college-level mathematics courses. Four hundred twenty-one students (58.8 %) attended high schools that are classified as non-rural, while 295 (41.2 %) attended high schools that are classified as rural.

Hypotheses Testing

To examine the question: Is there a significant difference in the mathematics placement (developmental/college-level) among recent high school graduates with regard to high school location (rural/non-rural)?, the following null hypothesis was tested.

H_1: The distribution of placement for rural recent high school graduates is not significantly different from the distribution of placement for non-rural recent high school graduates.

The Chi-Square (χ^2) test of independence, was used to examine Hypothesis 1.

To examine the question: Are there any significant differences in the mathematics course-taking patterns among recent high school graduates with regard to placement (developmental/college-level) and high school location (rural/non-rural)?, four separate null hypotheses were tested.

H_2: There is no significant difference in the number of mathematics courses taken in high school among recent high school graduates with regard to placement (developmental/college-level) and high school location (rural/non-rural).

H_3: There is no significant difference in the level of mathematics courses taken in high school among recent high school graduates with regard to placement (developmental/college-level) and high school location (rural/non-rural).

H_4: There is no significant difference in the proportion of recent high school graduates who took a mathematics course during their junior year of high school with regard to placement (developmental/college-level) and high school location (rural/non-rural).

H_5: There is no significant difference in the proportion of recent high school graduates who took a mathematics course during their senior year of high school with regard to placement (developmental/college-level) and high school location (rural/non-rural).

A two-way analysis of variance (ANOVA), with location and placement as factors and number of mathematics courses (excluding elective credit courses) as the dependent variable, was used to examine Hypothesis 2. To examine Hypothesis 3,

students were categorized according to their highest level of mathematics courses taken in high school. The Chi-Square test of independence was then used to test Hypothesis 3, as well as Hypothesis 4 and Hypothesis 5.

To examine the question: Are there any significant differences in the attitudes and beliefs towards mathematics among recent high school graduates with regard to placement (developmental/college-level mathematics courses) and high school location (rural/non-rural)?, two separate null hypotheses were tested.

H_6: There are no significant differences in the attitudes towards mathematics among recent high school graduates with regard to placement (developmental/college-level mathematics courses) and high school location (rural/non-rural).

H_7: There are no significant differences in the beliefs towards mathematics among recent high school graduates with regard to placement (developmental/college-level mathematics courses) and high school location (rural/non-rural).

Cronbach's α was computed for each of the attitudes and beliefs scales used in the study to examine the internal consistency reliability. A two-way multivariate analysis of variance (MANOVA), with location and placement as factors and four of the Fennema-Sherman Attitudes Scales as dependent variables, was used to examine Hypothesis 6. If significant factors were found, follow-up one-way ANOVAs were used to determine the

specific differences in attitudes towards mathematics. A two-way multivariate analysis of variance (MANOVA), with location and placement as factors and five of the Indiana Mathematics Belief Scales as dependent variables, was used to examine Hypothesis 7. If significant factors were found, follow-up one-way ANOVAs were used to determine the specific differences in beliefs towards mathematics.

CHAPTER IV

FINDINGS

Students enrolled in developmental and college-level mathematics courses were asked to complete a survey at the beginning of the fall semester 2006. Data were sorted according to mathematics placement, high school location and graduation date. SPSS was used to analyze the data and test the stated null hypotheses. All hypotheses were tested at the .05 level of significance.

A total of 716 students, who had graduated from a public/private high school in the spring of 2006 and were now taking a mathematics course for the first time at either one of the two community colleges, participated in the study. Seven of the students' data were automatically excluded from the analysis due to more than five survey items with no response. Of the remaining 709 students, 420 (59.2 %) were placed in developmental mathematics courses, while 289 (40.8 %) were placed in college-level mathematics courses. Four hundred seventeen students (58.8 %) attended high schools that are classified as non-rural and 292 students (41.2 %) attended high schools that are classified as rural. Table 4.1 displays this information.

School Location

To examine the question: Is there a significant difference in the mathematics placement (developmental/college-level) among recent high school graduates with regard to high school location (rural/non-rural)?, the following null hypothesis was tested.

Table 4.1: Number of Students by Placement and Location

			Placement		
			College-Level	Developmental	Total
Location	Non-rural	Count	170	247	417
		% within Location	40.8%	59.2%	100.0%
		% within Placement	58.8%	58.8%	58.8%
	Rural	Count	119	173	292
		% within Location	40.8%	59.2%	100.0%
		% within Placement	41.2%	41.2%	41.2%
Total		Count	289	420	709
		% within Location	40.8%	59.2%	100.0%
		% within Placement	100.0%	100.0%	100.0%

a. Chi-Square = .000, df = 1, p = .997

Hypothesis 1

H_1: The distribution of placement for rural recent high school graduates is not significantly different from the distribution of placement for non-rural recent high school graduates.

The Chi-Square test of independence was used to examine Hypothesis 1. The decision was made to fail to reject the null hypothesis with $\chi^2 = .000$, $df = 1$, $p = .997$. Therefore, the distribution of placement for rural recent high school graduates was not significantly different from the distribution of placement for non-rural recent high school graduates. In other words, the proportion of rural recent high school graduates placed in developmental mathematics courses was not significantly different from the proportion of non-rural recent high school graduates placed in developmental mathematics courses. Likewise, the proportion of rural recent high school graduates placed in college-level

mathematics courses was not significantly different from the proportion of non-rural recent high school graduates placed in college-level mathematics courses.

Course-Taking Patterns

To examine the question: Are there any significant differences in the mathematics course-taking patterns among recent high school graduates with regard to placement (developmental/college-level) and high school location (rural/non-rural)?, four separate null hypotheses were tested.

Hypothesis 2

H_2: There is no significant difference in the number of mathematics courses taken in high school among recent high school graduates with regard to placement (developmental/college-level) and high school location (rural/non-rural).

As can be seen in Table 4.2, less than 3% of the participating students reported taking fewer than three mathematics courses in high school. The majority of the students, 288 (40.6%), took four mathematics courses. There were 255 students (36.0%) who took only three mathematics courses, while 132 students (18.6%) took five mathematics courses.

A two-way analysis of variance (ANOVA) was used to examine Hypothesis 2. There was no evidence of any interaction between placement and high school location, $F(1, 705) = .299$, $p = .585$. No significant difference was found in the number of mathematics courses taken in high school with regard to location, $F(1, 705) = 3.323$,

Table 4.2: Number of Mathematics Courses

Number	Frequency	Percent	Cumulative Percent
1	2	.3	.3
2	12	1.7	2.0
3	255	36.0	37.9
4	288	40.6	78.6
5	132	18.6	97.2
6	18	2.5	99.7
7	2	.3	100.0
Total	709	100.0	

$p = .069$. However, a significant difference was found with regard to placement, $F(1, 705) = 4.549$, $p = .033$. More specifically, the means suggest that students placed in college-level mathematics courses ($M = 3.938$) took significantly more mathematics courses in high school than did students placed in developmental mathematics courses ($M = 3.796$).

Hypothesis 3

H_3: There is no significant difference in the level of mathematics courses taken in high school among recent high school graduates with regard to placement (developmental/college-level) and high school location (rural/non-rural).

As can be seen in Table 4.3, Algebra I, Algebra II, and Geometry was the most frequently taken sequence of mathematics courses in high school. Of the 709 students

Table 4.3: Number of Students by Mathematics Course

Course	Count	Percent
Foundations I	108	15.2
Foundations II	279	39.4
Algebra I	653	92.1
Geometry	665	93.8
Technical Geometry	2	.3
Algebra II	641	90.4
Integrated Mathematics I	4	.6
Integrated Mathematics II	3	.4
Integrated Mathematics III	2	.3
Advanced Algebra and Trigonometry	143	20.2
Discrete Mathematics with Statistics and Probability	18	2.5
PreCalculus	148	20.9
Statistics	28	3.9
Calculus	20	2.8
Technical Mathematics	7	1.0
Technical Algebra	11	1.6
Calculus AB (Advanced Placement)	22	3.1
Calculus BC (Advanced Placement)	1	.1
Statistics (Advanced Placement)	0	.0
Other	19	2.7

included in the analysis, 665 (93.8%) took Geometry. Similarly, 653 students (92.1%) took Algebra I, while 641 students (90.4%) took Algebra II.

Students were categorized according to their highest level of mathematics courses taken in high school. Students who took courses equivalent to, but not beyond Foundations I, Foundations II, or Technical Mathematics, were assigned to Level 0. Students who took courses equivalent to, but not beyond Algebra I, Integrated Mathematics I, or Technical Algebra, were assigned to Level 1. Students who took courses equivalent to, but not beyond Algebra II, Integrated Mathematics II, Geometry, Technical Geometry, or Integrated Mathematics III, were assigned to Level 2. Students who took courses equivalent to, but not beyond Advanced Algebra and Trigonometry, Discrete Mathematics with Statistics and Probability, Pre-Calculus, or Statistics, were assigned to Level 3. Students who took Calculus, AP Calculus, or AP Statistics were assigned to Level 4.

As can be seen in Table 4.4, the majority of the students, 428 (60.4%), took courses at, but not beyond Level 2; these students were reassigned to a category called

Table 4.4: Frequency of Students at Level of Mathematics

		Frequency	Percent	Cumulative Percent
Level	0	4	.6	.6
	1	19	2.7	3.2
	2	428	60.4	63.6
	3	225	31.7	95.3
	4	33	4.7	100.0
	Total	709	100.0	

ALG II/GEOM. Only 23 students (3.2%) took courses below Level 2; these students were excluded from the statistical analysis. There were 225 students (31.7%) who took courses at, but not beyond Level 3, while only 33 students (4.7%) took courses at Level 4; these students were grouped into a single category called BEYOND ALG II/GEOM.

Of the 289 students placed in college-level mathematics courses, 123 (42.6%) took courses at the ALG II/GEOM level, while 166 (57.4%) took courses at the BEYOND ALG II/GEOM level. Of the 397 students placed in developmental mathematics courses, 305 (76.8%) took courses at the ALG II/GEOM level, while 92 (23.2%) took courses at the BEYOND ALG II/GEOM level. Table 4.5 displays this information.

Disaggregated by location, negligible differences were found in the level of mathematics courses taken in high school among recent high school graduates placed in developmental and college-level mathematics courses (see Table 4.6). Therefore, to examine Hypothesis 3, only placement was considered. The Chi-Square test of independence was used to test the hypothesis. The decision was made to reject the null

Table 4.5: Number of Students by Level of Mathematics and Placement

			Math Level		
			ALG II/GEOM	BEYOND ALG II/GEOM	Total
Placement	College-Level	Count	123	166	289
		% within Placement	42.6%	57.4%	100.0%
	Developmental	Count	305	92	397
		% within Placement	76.8%	23.2%	100.0%
Total		Count	428	258	686
		% within Placement	62.4%	37.6%	100.0%

a. Chi-Square = 83.689, df = 1, $p < .001$

Table 4.6: Level of Mathematics by Location and Placement

Location				Math Level: ALG II/GEOM	Math Level: BEYOND ALG II/GEOM	Total
Non-rural	Placement	College-Level	Count	76	94	170
			% within Placement	44.7%	55.3%	100.0%
		Developmental	Count	180	51	231
			% within Placement	77.9%	22.1%	100.0%
	Total		Count	256	145	401
			% within Placement	63.8%	36.2%	100.0%
Rural	Placement	College-Level	Count	47	72	119
			% within Placement	39.5%	60.5%	100.0%
		Developmental	Count	125	41	166
			% within Placement	75.3%	24.7%	100.0%
	Total		Count	172	113	285
			% within Placement	60.4%	39.6%	100.0%

hypothesis with $\chi^2 = 83.689$, $df = 1$, $p < .001$. Therefore, the test found a significant difference in the level of mathematics courses taken by recent high school graduates with regard to placement. Students placed in developmental mathematics courses were more likely to have taken courses at the ALG II/GEOM level in high school than were students placed in college-level mathematics courses. Conversely, students placed in college-level mathematics courses were more likely to have taken courses at the BEYOND ALG II/GEOM level in high school than were students placed in developmental mathematics courses.

Hypothesis 4

H_4: There is no significant difference in the proportion of recent high school graduates who took a mathematics course during their junior year of high school with regard to placement (developmental/college-level) and high school location (rural/non-rural).

There were 708 students who responded to the item, "Did you take a mathematics course during your junior year of high school." There were 648 students (91.5%) who responded "Yes," while 60 students (8.5%) responded "No." Of the 289 students placed in college-level mathematics courses, 270 (93.4%) responded "Yes," while 19 (6.6%) responded "No." Of the 419 students placed in developmental mathematics courses, 378 (90.2%) responded "Yes," while 41 (9.8%) responded "No." Table 4.7 displays this information.

Disaggregated by location, negligible differences were found in the proportion of students who took a mathematics course during their junior year of high school among

Table 4.7: Mathematics During Junior Year by Placement

			Math Junior Year		Total
			No	Yes	
Placement	College-Level	Count	19	270	289
		% within Placement	6.6%	93.4%	100.0%
	Developmental	Count	41	378	419
		% within Placement	9.8%	90.2%	100.0%
Total		Count	60	648	708
		% within Placement	8.5%	91.5%	100.0%

a. Chi-Square = 2.273, df = 1, p = .132

recent high school graduates placed in developmental and college-level mathematics courses (see Table 4.8). Therefore, to examine Hypothesis 4, only placement was considered. The Chi-Square test of independence was used to test the hypothesis. The decision was made to fail to reject the null hypothesis with $\chi^2 = 2.273$, $df = 1$, $p = .123$. Therefore, the test found no significant difference in the proportion of recent high school graduates who took a mathematics course during their junior year of high school with regard to placement.

Hypothesis 5

H_5: There is no significant difference in the proportion of recent high school graduates who took a mathematics course during their senior year of high school with regard to placement (developmental/college-level) and high school location (rural/non-rural).

There were 709 students who responded to the item, "Did you take a mathematics course during your senior year of high school." There were 355 students (50.1%) who responded "Yes," while 354 students (49.9%) responded "No." Of the 289 students placed in college-level mathematics courses, 152 (52.6%) responded "Yes," while 137 (47.4%) responded "No." Of the 420 students placed in developmental mathematics courses, 203 (48.3%) responded "Yes," while 217 (51.7%) responded "No." Table 4.9 displays this information.

Disaggregated by location, negligible differences were found in the proportion of

Table 4.8: Mathematics During Junior Year by Location and Placement

				Math Junior Year		
Location				No	Yes	Total
Non-rural	Placement	College-Level	Count	11	159	170
			% within Placement	6.5%	93.5%	100.0%
		Developmental	Count	26	220	246
			% within Placement	10.6%	89.4%	100.0%
	Total		Count	37	379	416
			% within Placement	8.9%	91.1%	100.0%
Rural	Placement	College-Level	Count	8	111	119
			% within Placement	6.7%	93.3%	100.0%
		Developmental	Count	15	158	173
			% within Placement	8.7%	91.3%	100.0%
	Total		Count	23	269	292
			% within Placement	7.9%	92.1%	100.0%

Table 4.9: Mathematics During Senior Year by Placement

			Math Senior Year		Total
			No	Yes	
Placement	College-Level	Count	137	152	289
		% within Placement	47.4%	52.6%	100.0%
	Developmental	Count	217	203	420
		% within Placement	51.7%	48.3%	100.0%
Total		Count	354	355	709
		% within Placement	49.9%	50.1%	100.0%

a. Chi-Square = 1.244, df = 1, p = .265

students who took a mathematics course during their senior year of high school among recent high school graduates placed in developmental and college-level mathematics courses (see Table 4.10). Therefore, to examine Hypothesis 5, only placement was considered. The Chi-Square test of independence was used to test the hypothesis. The decision was made to fail to reject the null hypothesis with $\chi^2 = 1.244$, $df = 1$, $p = .265$. Therefore, the test found no significant difference in the proportion of recent high school graduates who took a mathematics course during their senior year of high school with regard to placement.

Attitudes and Beliefs Towards Mathematics

To examine the question: Are there any significant differences in the attitudes and beliefs towards mathematics among recent high school graduates with regard to

Table 4.10: Mathematics During Senior Year by Placement and Location

				Math Senior Year		
Location				No	Yes	Total
Non-rural	Placement	College-Level	Count	81	89	170
			% within Placement	47.6%	52.4%	100.0%
		Developmental	Count	119	128	247
			% within Placement	48.2%	51.8%	100.0%
	Total		Count	200	217	417
			% within Placement	48.0%	52.0%	100.0%
Rural	Placement	College-Level	Count	56	63	119
			% within Placement	47.1%	52.9%	100.0%
		Developmental	Count	98	75	173
			% within Placement	56.6%	43.4%	100.0%
	Total		Count	154	138	292
			% within Placement	52.7%	47.3%	100.0%

placement (developmental/college-level mathematics courses) and high school location (rural/non-rural)?, two separate null hypotheses were tested.

Hypothesis 6

H_6: There are no significant differences in the attitudes towards mathematics among recent high school graduates with regard to placement (developmental/college-level mathematics courses) and high school location (rural/non-rural).

To examine the reliability of the attitudes instrument, Cronbach's α was computed for each of the Fennema-Sherman Mathematics Attitudes Scales used in the study. As can be seen in Table 4.11, $\alpha > .70$ for all four scales. The Cronbach's α reliability estimates were similar to, but in all cases, slightly lower than the corresponding split- half reliability estimates computed by Fennema and Sherman (1976).

A two-way multivariate analysis of variance (MANOVA) was used to examine Hypothesis 6. Based on Wilks' Lambda statistics (see Table 4.12), there was no

Table 4.11: Reliability Statistics for Attitudes Scales

Scale	Cronbach's Alpha
Confidence	.920
Success	.832
Usefulness	.782
Effectance	.830

a. N of items in each scale: 12

Table 4.12: MANOVA Test Results for Hypothesis 6

Effect	Wilks' Lambda	F	Hypothesis df	Error df	Sig.
Intercept	.015	11270.257[a]	4.000	702.000	.000
PLACEMENT	.902	19.133[a]	4.000	702.000	.000
LOCATION	.997	.500[a]	4.000	702.000	.736
PLACEMENT*LOCATION	.999	.218[a]	4.000	702.000	.928

a. Exact statistic
b. Design: Intercept+PLACMENT+LOCATION+PLACEMENT * LOCATION

evidence of any interaction between placement and high school location, $F(4, 702) = .218$, $p = .928$. No significant differences were found in the attitudes towards mathematics with regard to high school location, $F(4, 702) = .500$, $p = .736$. However, significant differences were found with regard to placement, $F(4, 702) = 19.133$, $p < .001$.

Follow-up one-way ANOVAs were used to determine the specific differences in attitudes towards mathematics, as measured by the Fennema-Sherman Mathematics Attitudes Scales. No significant difference was found in the Success scale scores, $F(1, 705) = .091$, $p = .763$, among recent high school graduates placed in developmental and college-level mathematics courses. However, significant differences were found in the Confidence in Learning Mathematics Scale scores, $F(1, 705) = 61.841$, $p < .001$, Mathematics Usefulness Scale scores, $F(1, 705) = 17.007$, $p < .001$, and Effectance Motivation Scale scores, $F(1, 705) = 8.896$, $p = .003$. Based on the scale score means, Table 4.13 suggests that students placed in college-level mathematics courses had significantly more confidence in learning mathematics and effectance motivation in mathematics than did students placed in developmental mathematics courses.

Table 4.13: Mean Scale Scores in Attitudes Towards Mathematics

Dependent Variable	Placement	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
Confidence	College-Level	3.485	.047	3.394	3.577
	Developmental	3.009	.039	2.933	3.085
Success	College-Level	3.715	.034	3.648	3.781
	Developmental	3.701	.028	3.646	3.757
Usefulness	College-Level	3.645	.031	3.585	3.705
	Developmental	3.481	.025	3.431	3.530
Effectance	College-Level	3.199	.037	3.127	3.271
	Developmental	3.056	.030	2.997	3.116

Additionally, students placed in college-level mathematics courses had a significantly higher belief in the usefulness of mathematics than did students placed in developmental mathematics courses.

Hypothesis 7

H_7: There are no significant differences in the beliefs towards mathematics among recent high school graduates with regard to placement (developmental/college-level mathematics courses) and high school location (rural/non-rural).

To examine the reliability of the belief instrument, Cronbach's α was computed for each of the Indiana Mathematics Belief Scales used in the study. As can be seen in Table 4.14, $\alpha > .70$ for the Difficult Problems Scale and Effort Scale. Cronbach's

Table 4.14: Reliability Statistics for Belief Scales

Scale	Cronbach's Alpha
Difficult	.757
Steps	.555
Understanding	.673
Word Problems	.270
Effort	.816

a. N of items in each scale: 6

α was close to .70 for the Understanding Scale (.673). Kloosterman and Stage (1992) found a Cronbach's α estimate of .67 for the Steps Scale, which is reasonably higher than the reliability estimate found in this study (.555). Hence, caution should be taken when interpreting the hypothesis test for the Steps Scale. Kloosterman and Stage (1992) found a Cronbach's α estimate of .54 for the Word Problems Scale, which is noticeably higher than the reliability estimate found in this study (.270). Due to such a low reliability estimate, the decision was made to exclude the Word Problems Scale from the results.

A two-way multivariate analysis of variance (MANOVA) was used to examine Hypothesis 7. Based on Wilks' Lamba statistics (see Table 4.15), there was no evidence of any interaction between placement and high school location, $F(5, 701) = .914$, $p = .471$. No significant differences were found in the beliefs towards mathematics with regard to high school location, $F(5, 701) = .295$, $p = .916$. However, significant differences were found in the beliefs toward mathematics with regard to placement, $F(5, 701) = 5.615$, $p < .001$.

Table 4.15: MANOVA Test Results for Hypothesis 7

Effect	Wilks' Lambda	F	Hypothesis df	Error df	Sig.
Intercept	.006	23340.008[a]	5.000	701.000	.000
PLACEMENT	.961	5.615[a]	5.000	701.000	.000
LOCATION	.998	.295[a]	5.000	701.000	.916
PLACEMENT*LOCATION	.994	.914[a]	5.000	701.000	.471

a. Exact statistic
b. Design: Intercept+PLACMENT+LOCATION+PLACEMENT * LOCATION

Follow-up one-way ANOVAs were used to determine the specific differences in beliefs towards mathematics, as measured by the Indiana Mathematics Belief Scales. No significant differences were found in the Understanding Scale scores, $F(1, 705) = 1.270$, $p = .260$, and Effort Scale scores, $F(1, 705) = .139$, $p = .710$, among recent high school graduates placed in developmental and college-level mathematics courses. However, significant differences were found in the Difficult Scale scores, $F(1, 705) = 15.183$, $p < .001$, and Steps Scale scores, $F(1, 705) = 6.051$, $p = .014$. Based on the scale score means, Table 4.16 suggests that students placed in college-level mathematics courses had significantly higher beliefs in their ability to solve time-consuming mathematics problems than did students placed in developmental mathematics courses. Additionally, students placed in college-level mathematics courses had a significantly higher belief in that it is not always possible to follow simple, step-by-step procedures when solving word problems than did students placed in developmental mathematics courses.

Summary

A total of seven null hypotheses were tested within the study. Four of these hypotheses (Hypothesis 2, Hypothesis 3, Hypothesis 6, and Hypothesis 7) were rejected

Table 4.16: Mean Scale Scores in Beliefs Towards Mathematics

Dependent Variable	Placement	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
Difficult	College-Level	3.554	.040	3.475	3.633
	Developmental	3.350	.033	3.285	3.416
Steps	College-Level	2.523	.029	2.465	2.581
	Developmental	2.429	.024	2.381	2.477
Understanding	College-Level	3.863	.035	3.795	3.931
	Developmental	3.913	.029	3.857	3.970
Word Problems	College-Level	2.925	.025	2.875	2.974
	Developmental	2.917	.021	2.876	2.958
Effort	College-Level	3.978	.036	3.906	4.050
	Developmental	3.960	.030	3.901	4.020

as a result of the statistical analysis. Significant differences were found in both the number and level of mathematics courses taken in high school among recent high school graduates with regard to mathematics placement in college. Students placed in college-level mathematics courses took significantly more mathematics courses in high school than did students placed in developmental mathematics courses. Additionally, students placed in college-level mathematics courses were more likely to have taken courses at the BEYOND ALG II/GEOM level than were students placed in developmental mathematics courses.

Significant differences were also found in the attitudes and beliefs towards mathematics among recent high school graduates with regard to mathematics placement. Students placed in college-level mathematics courses had significantly more confidence in learning mathematics and effectance motivation in mathematics than did students placed in developmental mathematics courses. Additionally, students placed in college-

level mathematics courses had a significantly higher belief in the usefulness of mathematics than did students placed in developmental mathematics. In regard to beliefs, students placed in college-level mathematics courses had significantly higher beliefs in their ability to solve time-consuming mathematics problems than did students placed in developmental mathematics courses. Additionally, students placed in college-level mathematics courses had a significantly higher belief in that it is not always possible to follow simple, step-by-step procedures when solving word problems than did students placed in developmental mathematics courses.

Three of the null hypotheses (Hypothesis 1, Hypothesis 4, and Hypothesis 5) were not rejected as a result of the statistical analysis. No significant difference was found in the mathematics placement of recent high school graduates with regard to high school location. Additionally, no significant differences were found in the proportion of students who took a mathematics course during their junior or senior year of high school with regard to mathematics placement and high school location.

CHAPTER V

CONCLUSION

Due to an "open-door" admissions policy, many students who are admitted to the community college are unprepared to succeed in college-level mathematics courses. These students are properly placed in developmental mathematics courses upon entering college. For this reason, the developmental mathematics program has become an essential component at the community college level. Understandably, nontraditional aged (25 or older) students who have been out of high school for several years will likely need a review of algebra before enrolling in a college-level mathematics course. Even those students who have only waited a year or two after high school to attend college may need a refresher course in mathematics.

As an instructor of developmental mathematics courses at a community college, the researcher noticed that most of the developmental mathematics students appeared to be traditional aged (24 or younger) however. After some investigation, the researcher found that the majority of the entering freshmen placed in developmental mathematics at the community college are in fact students who are under the age of 21. This seems to be a common occurrence at community colleges.

So, why are so many recent high school graduates placed in developmental mathematics courses upon entering college? One would expect students who just graduated from high school to be prepared for college-level mathematics courses. Yet, a staggering number of them are not. At the same time, some recent high school graduates are prepared to enroll in college-level mathematics courses upon entering college. A main purpose of this study was to compare recent high school graduates placed in

developmental mathematics courses with recent high school graduates placed in college-level mathematics courses at the community college level. The focus of the investigation was on students' course-taking patterns in mathematics, their attitudes and beliefs towards mathematics, and high school location (rural/non-rural).

Rural education has long been considered inferior to non-rural education in many aspects. For example, rural students have been observed to place less value in academics than non-rural students (Cobb et al., 1989). In regard to mathematics, rural students have been shown to take fewer advanced courses than non-rural students (e.g., Ballou & Podgursky, 1998). Significant differences in mathematics achievement have also been found among rural and non-rural high school students (Pinkerton, 1996; Winters, 2003; Hopkins, 2004). Hence, a second main purpose of this study was to compare rural and non-rural recent high school graduates in regard to course-taking patterns in mathematics, attitudes and beliefs towards mathematics, and mathematics placement (developmental/college-level) in college.

Summary of the Study

A quantitative study was conducted to investigate any significant differences in students' course-taking patterns in mathematics and their attitudes and beliefs towards mathematics. Students enrolled in both developmental and college-level mathematics courses completed surveys at the beginning of the fall semester 2006. In an effort to include a wide range of students, two community colleges in east Tennessee participated in the study.

Students completed the Mathematics Education Experience (see Figure A-1) instrument, developed by the researcher to collect data on students' course-taking

patterns in mathematics. Students also completed four scales of the Fennema-Sherman Attitudes Scales (Fennema & Sherman, 1976) to measure students' attitudes towards mathematics. To gauge student's beliefs towards mathematics, students completed the Indiana Mathematics Belief Scales (Kloosterman & Stage, 1992) instrument.

The intent of the study was to measure recent high school students' attitudes and beliefs towards mathematics as perceived by them in high school. Hence, the decision was made to limit data analysis to only those students who had graduated from high school in the spring of 2006 and were now taking a mathematics course for the first time in college. This approach limited the time gap between high school and college and the students' exposure to mathematics courses beyond high school.

Data was sorted according to mathematics placement (developmental/college-level) and high school location (rural/non-rural). Locale codes, developed by the NCES, were used to determine whether a student had attended a rural or non-rural high school (http://nces.ed.gov/surveys/RuralEd/definitions.asp). Statistical techniques, including the chi-square test of independence, two-way analysis of variance, and two-way multivariate of analysis were used to test the null hypotheses of the study.

Findings

The first research question examined the mathematics placement of rural and non-rural recent high school graduates. No significant difference was found in the distribution of placement for rural and non-rural students. In other words, non-rural students were no more likely to be placed in college-level mathematics courses than were rural students. More importantly, rural students were no more likely to be placed in developmental mathematics courses than were non-rural students.

The second research question examined students' course-taking patterns in mathematics. With regard to the number of mathematics courses taken in high school, there was no interaction between mathematics placement and high school location. No significant difference was found among rural and non-rural students. This is in conflict with other studies which found that rural students took fewer mathematics courses in high school than did non-rural students (e.g., Finn et al., 2002). A significant difference was found among students placed in developmental and college-level mathematics courses. Students placed in developmental mathematics courses took significantly fewer mathematics courses in high school than did students placed in college-level mathematics courses.

With regard to the level of mathematics courses taken in high school, no significant difference was found among rural and non-rural students. In other words, non-rural students were no more likely to have taken advanced mathematics courses (beyond Algebra II and Geometry) in high school than were rural students. This is in conflict with other studies which found that rural students took fewer advanced mathematics courses in high school than did non-rural students (Finn et al., 2002; Ballou & Podgursky, 1998; Haller et al., 1993). A significant difference was found among students placed in developmental and college-level mathematics courses. Students placed in developmental mathematics courses were less likely to have taken courses beyond Algebra II and Geometry in high school than were students placed in college-level mathematics courses. This supports other studies which found level of mathematics in high school to be predictive of mathematics placement in college (Hoyt & Sorensen, 2001; Berry, 2003).

The proportions of students who took a mathematics course during their junior or senior year of high school were also examined. No significant difference was found among non-rural and rural students for either year. Additionally, no significant difference was found among students placed in developmental and college-level courses for either year. In other words, students placed in college-level mathematics courses were no more likely to have taken a mathematics course during their junior or senior year of high school than were students placed in developmental mathematics courses.

The third research question examined students' attitudes and beliefs towards mathematics. With regard to attitudes, there was no interaction between placement and high school location. No significant differences were found among rural and non-rural students. This indicates that non-rural students' attitudes towards mathematics were no more positive than were non-rural students' attitudes towards mathematics. Significant differences were found among students placed in developmental and college-level mathematics courses. Students placed in college-level mathematics courses had significantly more confidence in their abilities to learn and to perform well in mathematics than did students placed in developmental mathematics courses. Students placed in college-level mathematics courses had significantly more active involvement (enjoyment and seeking of challenge) in mathematics than did students placed in developmental mathematics courses. Finally, students placed in college-level mathematics courses had a significantly higher belief in the usefulness of mathematics than did students placed in developmental mathematics courses.

With regard to beliefs, there was no interaction between placement and high school location. No significant differences were found among rural and non-rural

students. This indicates that non-rural students' beliefs about mathematics were no more positive than were rural students' beliefs about mathematics. Significant differences were found among students placed in developmental and college-level mathematics courses. Students placed in college-level mathematics courses had significantly higher beliefs in their abilities to solve time-consuming mathematics problems than did students placed in developmental mathematics courses. Students placed in college-level mathematics courses also had a significantly higher belief in that it is not always possible to solve word problems using a simple, step-by-step procedure than did students placed in developmental mathematics courses.

Discussion

For one reason or another, recent high school graduates are often placed in developmental mathematics courses upon entering college. The researcher hoped to shed light on this situation by comparing students placed in developmental mathematics courses with students placed in college-level mathematics courses. Several significant differences were found between the two groups of students.

Course-Taking Patterns

As one might expect, students placed in developmental mathematics courses took significantly fewer mathematics courses in high school than did students placed in college-level mathematics courses. Even more predictable, students placed in developmental mathematics courses took lower levels of mathematics courses in high school than did students placed in college-level mathematics courses. Participation in courses beyond Algebra II or Geometry seemed to make the most difference in mathematics placement. More specifically, students placed in college-level mathematics

courses were more likely to have taken courses beyond Algebra II or Geometry in high school than were students placed in developmental mathematics courses. Therefore, the findings of this study suggest that both the quantity and level of mathematics courses taken in high school may have a direct impact on mathematics placement in college for recent high school graduates in east Tennessee.

Since the release of the report, *A Nation at Risk*, U.S. high schools have seen an increase in both the quantity and level of mathematics courses required for graduation (Teitelbaum, 2003). In Tennessee, all recent high school graduates (those who entered high school before 2005) were required to complete at least three units of mathematics, including Algebra I, Integrated Mathematics I, or Technical Algebra. University path students were required to complete the equivalent of Algebra I, Algebra II, and Geometry or another advanced mathematics course if Algebra I credit was received prior to high school and was not transferred to their high school transcript.

Fortunately, the graduation requirements in mathematics have been strengthened for future high school graduates (those who entered high school in 2005 or later) in the state of Tennessee. All students, regardless of path, will have to complete Algebra II, Geometry, Integrated Mathematics II, or Technical Geometry in order to graduate from high school. Although this appears to be a move in the right direction, it may not be enough to reduce the need for mathematics remediation in college. First of all, students will not be required to take additional units of mathematics. Secondly, the majority of all students, including university path students, will not be required to take a mathematics course beyond Algebra II or Geometry.

Based on the findings of this study, students should be encouraged to take more and higher levels of mathematics in high school. If possible, students should take a mathematics course beyond Algebra II and Geometry. This may increase their likelihood of being placed in a college-level mathematics course upon entering college. Since students at TBR institutions are placed in mathematics courses according to their ACT scores, students should carefully consider the mathematics courses they take in high school. After all, completing higher levels of mathematics courses in high school has been shown to significantly increase ACT Mathematics test scores (Noble, 2004). The results of this study suggest that students who took a mathematics course beyond Algebra II and Geometry in high school were more likely to have scored well enough on the ACT Mathematics test to avoid being placed in developmental mathematics courses.

Attitudes and Beliefs

Remedial mathematics students have been found to have significantly poorer attitudes towards mathematics than do college-level mathematics students (e.g., Buchanan, 1992). Hence, it came as no surprise to find that students placed in college-level mathematics courses had significantly better attitudes towards mathematics than did students placed in developmental mathematics courses. More specifically, students placed in college-level mathematics courses had more self-confidence and effectance motivation in mathematics, as well as a higher belief in the usefulness of mathematics, than did students placed in developmental mathematics courses.

Why are students' attitudes towards mathematics important? The mathematics courses that students choose to take in high school are likely influenced by their attitudes towards mathematics (Thorndike-Christ, 1991). Once course-taking becomes optional,

students who have poor attitudes towards mathematics may not continue to take more and higher levels of mathematics. As already discussed, students placed in developmental mathematics courses took significantly fewer and lower levels of mathematics courses in high school than did students placed in college-level mathematics courses. This finding may be contributed to the fact that developmental mathematics students had significantly poorer attitudes towards mathematics than did college-level mathematics students.

Developmental mathematics students' negative attitudes towards mathematics may have also affected their placement in mathematics. Research has shown there to be a positive relationship between attitude towards mathematics and mathematics achievement, especially among high school students (Braswell et al., 2001; Schreiber, 2002; Patterson et al., 2003). Students who had more negative attitudes towards mathematics, in this case, the developmental mathematics students, did not score well enough on the ACT mathematics test to achieve placement in college-level mathematics courses.

Therefore, the findings of this study suggest that attitudes towards mathematics may have an impact on mathematics placement in college for recent high school graduates in east Tennessee. Students who have a better attitude towards mathematics may decide to take more and higher levels of mathematics courses in high school, which in turn, may enhance their achievement on the ACT mathematics test, and thus, lead to placement in college-level mathematics courses upon entering college. Therefore, the improvement of students' attitudes towards mathematics is a critical issue in mathematics education.

Since the release of the report, *Everybody Counts* (1989), there has been an increased focus on attitudes and beliefs towards mathematics in the U.S. Educational reform groups have continued to emphasize the need to focus on students' affective responses in mathematics. For instance, the NCTM (1989, 2000) has urged teachers to take an active role in shaping their students' confidence in and dispositions towards mathematics. The results of this study substantiate this position.

Teachers have a direct effect on their students' cognitive and affective responses in mathematics. The NCTM (2000) suggests:

> Students learn mathematics through the experiences that teachers provide. Thus, students' understanding of mathematics, their ability to use it to solve problems, and their confidence in, and disposition toward, mathematics are all shaped by the teaching they encounter in school. (p. 16)

Not only are teachers responsible for the development of their students' understanding of mathematics, but they are also responsible for the enhancement of their students' attitudes and beliefs towards mathematics. Teachers can make a positive impact on their students' attitudes and beliefs towards mathematics by creating a supportive classroom environment and by choosing appropriate instructional tools and techniques.

There is indeed a need to build students' confidence in their abilities to learn and to do well in mathematics, especially at the high school level. Students should be given more opportunities to experience success in the mathematics classroom in order to develop their self-assurances in mathematics. There is also a need to build students' effectance motivation in mathematics. Students should be given more activities that encourage exploration and experimentation in the mathematics classroom. "Worthwhile tasks should be intriguing, with a level of challenge that invites speculation and hard

work…. Well-chosen tasks can pique students' curiosity and draw them into mathematics" (NCTM, 2000, p. 18). It also appears that the importance and usefulness of mathematics should be stressed at the high school level. This can be done by providing tasks that are "connected to the real-life experiences of students" (NCTM, 2000, p. 18).

The findings of this study suggest that beliefs about mathematics may also have an impact on mathematics placement in college for recent high school graduates in east Tennessee. Students placed in developmental mathematics courses had a significantly lower belief in their ability to solve time-consuming problems than did students placed in college-level mathematics courses. In addition, students placed in developmental mathematics courses had a significantly lower belief in that it is not always possible to solve word problems using simple, step-by-step procedures than did students placed in college-level mathematics courses.

Hence, there is a need to improve high school students' epistemological beliefs about mathematics. Not only do students lack confidence in their abilities to do mathematics, but they also lack confidence in their abilities to solve time-consuming problems. Students often give up when they are not able to solve a mathematics problem quickly (Schoenfeld, 1989). Students should be given more opportunities in the mathematics classroom to actively engage in problem solving. Tasks should encourage students to "formulate, grapple with, and solve complex problems that require a significant amount of effort" (NCTM, 2000, p. 18). The NCTM (2000) maintains:

> Teachers play an important role in the development of students' problem-solving dispositions by creating and maintaining classroom environments…in which students are encouraged to explore, take risks, share failures and successes, and question one another. In such supportive environments, students develop confidence in their abilities and a willingness to engage in and explore problems,

> and they will be more likely to pose problems and to persist with challenging problems. (p. 52)

Students also believe that most word problems can be solved by following a straightforward algorithm (Stage & Kloosterman, 1995). Ample instructional time should be devoted to the discussion of problem solving strategies in the mathematics classroom. The NCTM (2000) recommends:

> Students should have access to a wide range of strategies, be able to decide which one to use, and be able to adapt and invent strategies….Different strategies are necessary as students experience a wider variety of problems. Students must become aware of these strategies as the need for them arises, and as they are modeled during classroom activities, the teacher should encourage students to take note of them. (p.53)

Students should be given more activities that promote the use of multiple approaches. It would also benefit the students to discuss and compare their solution methods with each other.

High School Location

Students at Tennessee TBR institutions are placed in developmental and college-level mathematics courses according to their ACT mathematics score. Researchers have found non-rural students to significantly outperform rural students on the ACT mathematics assessment in the state of Tennessee (Pinkerton, 1996; Hopkins, 2004). For this reason, one might expect there to be a significant difference in the proportion of placement for rural and non-rural recent high school graduates, with more rural students being placed in developmental mathematics courses. However, there are no grounds for this argument based on the results of this study. It is important to note that rural students were no more likely to be placed in developmental mathematics courses than were non-rural students. At the same time, non-rural students were no more likely to be placed in

college-level mathematics courses than were rural students. This finding suggests that high school location has no impact on mathematics placement for recent high school graduates in east Tennessee. In other words, rural and non-rural students appear to be on equal footing with regard to mathematics placement in college. What may contribute to this?

As already discussed, both the number and level of mathematics courses taken in high school seem to be predictive of mathematics placement for recent high school graduates in east Tennessee. Despite the fact that rural high schools have been shown to offer fewer and less advanced courses in mathematics (e.g., Finn et al., 2002), no significant difference was found in the number of mathematics courses taken in high school among rural and non-rural students. Furthermore, the proportion of rural students who took advanced mathematics courses (beyond Algebra II or Geometry) was not significantly different from the proportion of non-rural students who took advanced mathematics courses in high school. In other words, rural students were just as likely as non-rural students to have taken advanced mathematics courses (beyond Algebra II or Geometry) in high school. These findings suggest that rural and non-rural students, who chose to go to college, have similar mathematical backgrounds.

In regard to attitudes and beliefs towards mathematics, this study failed to find any significant differences among rural and non-rural students. This is contrary to the perception that rural students tend to exhibit more negative attitudes toward academics than do non-rural students (Cobb et al., 1989). It should be emphasized that non-rural students' attitudes and beliefs towards mathematics were no more positive than were rural students' attitudes and beliefs towards mathematics. These findings suggest that

rural and non-rural students, who chose to go to college, have similar attitudes and beliefs towards mathematics. As already discussed, research has shown a positive relationship between attitude towards mathematics and course-taking patterns in mathematics (e.g., Thorndike-Christ, 1991). This may help to explain why no significant differences were found in the mathematics course-taking patterns among rural and non-rural students.

Conclusions

This study adds to the research base in developmental mathematics education. This study provides insight on the differences in high school course-taking patterns, attitudes and beliefs towards mathematics, and high school location (rural/non-rural) among students placed in developmental and college-level mathematics courses. In addition, this study focuses only on recent high school graduates, the majority of whom are placed in developmental mathematics courses upon entering college.

The findings of this study suggest that both course-taking in mathematics and attitudes and beliefs towards mathematics may have an impact on mathematics placement in college for recent high school graduates in east Tennessee. To reduce the need for mathematics remediation in college, students should take more and higher levels (beyond Algebra II or Geometry) of mathematics in high school. The study also supports the need to improve students' attitudes and beliefs towards mathematics. The improvement of students' attitudes towards mathematics may influence their course-taking patterns in mathematics, which may lead to placement in college-level mathematics courses.

In regard to attitudes and beliefs, numerous studies have examined the relationship between attitude towards mathematics and mathematics achievement. Fewer studies, however, have investigated the relationship between beliefs about mathematics

and mathematics achievement. Hence, this study adds to the research base in epistemological beliefs among high school students. In particular, this study finds significant differences in the beliefs about mathematics among recent high school students placed in developmental and college-level mathematics courses.

Based on the findings of this study, high school location appears to have no impact on mathematics placement in college for recent high school graduates in east Tennessee. Despite the negative connotation with rural education, students from rural high schools are no more likely to be placed in developmental mathematics courses than are non-rural students. In addition, the study finds no evidence to suggest that rural and non-rural students, who choose to enter college, differ in their course-taking patterns in mathematics and their attitudes and beliefs towards mathematics. Hence, this study adds to the research base in rural mathematics education, which is minimal.

As an instructor of developmental mathematics courses, the researcher is genuinely concerned with the mathematics preparation of students at both the high school and college level. Regardless of high school location, there is room for improvement in students' course-taking patterns in mathematics and their attitudes and beliefs towards mathematics in high school. High schools in east Tennessee might use the findings of this study to help identify and remediate students at risk of placing in developmental mathematics courses. Since a majority of recent high school graduates are placed in developmental mathematics courses, developmental mathematics instructors should also focus on improving students' attitudes and beliefs towards mathematics so that they may be more successful in their college-level mathematics courses.

Recommendations for Further Study

This study was conducted during the fall semester of 2006 at two community colleges in east Tennessee. Hence the results of the study are limited in generalizability. This study could be replicated at other community colleges to see how recent high school graduates compare in other parts of the state. In addition, this study could be replicated over several fall semesters. Are the findings similar for new groups of recent high school graduates each semester?

The study could be replicated with the inclusion of other variables of interest. For example, the data might be sorted according to the students' chosen path in high school (technical/university). Does path have an effect on students' course-taking patterns in mathematics and their attitudes and beliefs towards mathematics with regard to mathematics placement (developmental/college-level) and high school location (rural/non-rural)?

"The attitudes of significant others are doubtless important to the learning of mathematics," (Fennema & Sherman, 1976, p.3). Fennema and Sherman (1976) developed the Mother Scale, Father Scale, and Teacher Scale "to assess students' perceptions of these persons' attitudes toward them as learners of mathematics" (p. 3). This study could be replicated with the inclusion of these three scales. It might be interesting to determine whether there are any significant differences with regard to mathematics placement (developmental/college-level) and high school location (rural/non-rural).

The study could also be replicated with the inclusion of gender as a variable. A recent study found males to significantly outperform females on the ACT Mathematics

test in the state of Tennessee (Hopkins, 2004). In the same study, however, enrollment rates in Algebra II, Geometry, Advanced Algebra, and PreCalculus were higher for females than for males (Hopkins, 2004). Does gender have an effect on recent high school graduates' course-taking patterns in mathematics and their attitudes and beliefs towards mathematics with regard to mathematics placement (developmental/college-level) and high school location (rural/non-rural)?

Significant differences in student performance on the ACT Mathematics test have also been found with regard to high school location and Socioeconomic Status (SES) in the state of Tennessee (Hopkins, 2004). For the study at hand, only high school location was considered. Including other high school information, such as SES, might reveal significant differences in course-taking patterns in mathematics and attitudes and beliefs towards mathematics among rural and non-rural recent high school graduates.

With regard to high school location, it might be interesting to examine those high schools in which recent high school graduates were more likely to place in college-level mathematics courses. Qualitative studies could be conducted to provide more insight on students' course-taking patterns and attitudes and beliefs towards mathematics.

It should be noted that the results of this study are limited to only those recent high school graduates who chose to attend college. With regard to high school location, this study does not identify significant differences in students' course-taking patterns and attitudes and beliefs towards mathematics for rural and non-rural students in general. However, this study could be replicated with high school students at the end of their senior year, if so desired.

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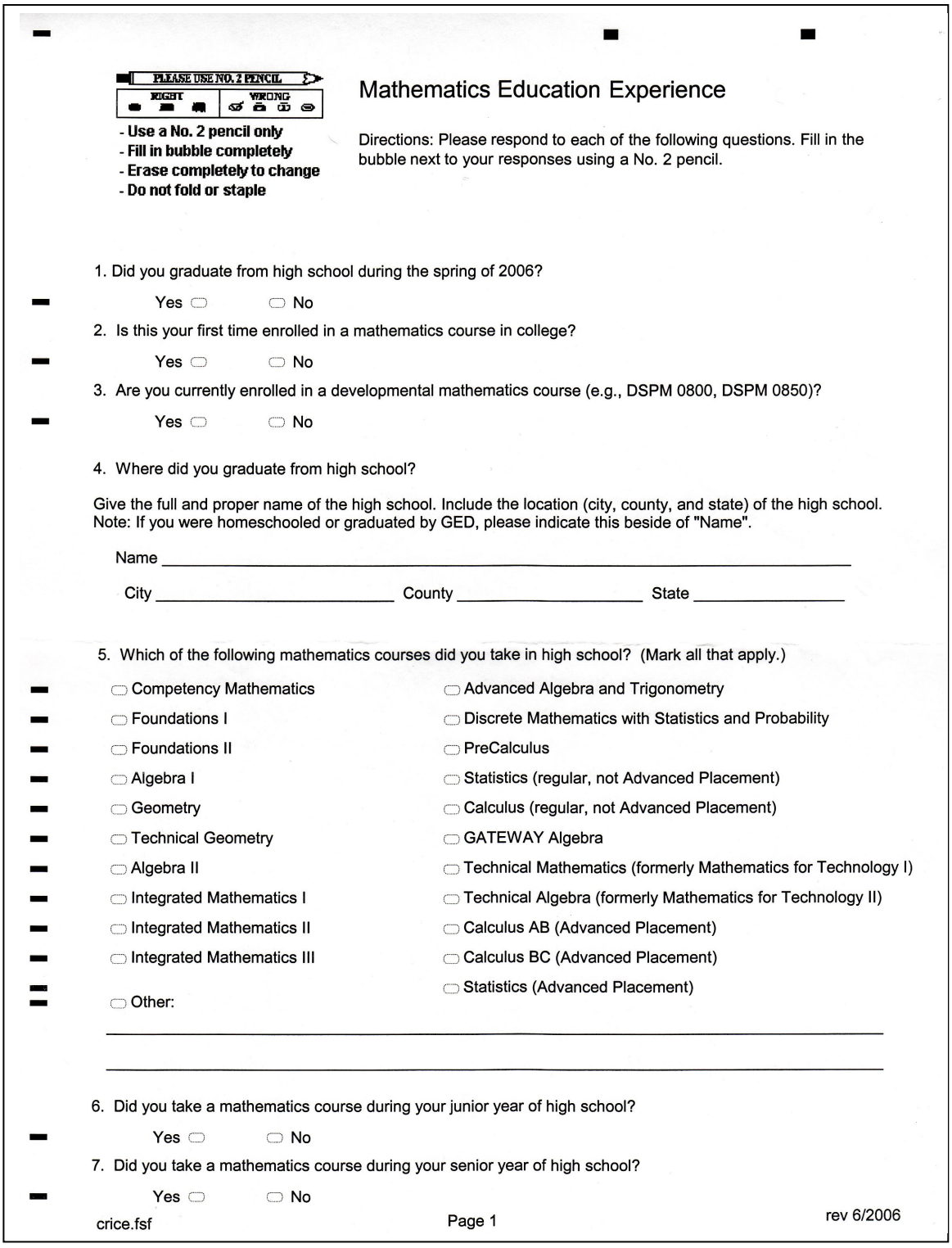
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APPENDIX



PLEASE USE NO. 2 PENCIL

RIGHT WRONG

- Use a No. 2 pencil only
- Fill in bubble completely
- Erase completely to change
- Do not fold or staple

Mathematics Education Experience

Directions: Please respond to each of the following questions. Fill in the bubble next to your responses using a No. 2 pencil.

1. Did you graduate from high school during the spring of 2006?

Yes ○ ○ No

2. Is this your first time enrolled in a mathematics course in college?

Yes ○ ○ No

3. Are you currently enrolled in a developmental mathematics course (e.g., DSPM 0800, DSPM 0850)?

Yes ○ ○ No

4. Where did you graduate from high school?

Give the full and proper name of the high school. Include the location (city, county, and state) of the high school. Note: If you were homeschooled or graduated by GED, please indicate this beside of "Name".

Name _____

City _____ County _____ State _____

5. Which of the following mathematics courses did you take in high school? (Mark all that apply.)

○ Competency Mathematics	○ Advanced Algebra and Trigonometry
○ Foundations I	○ Discrete Mathematics with Statistics and Probability
○ Foundations II	○ PreCalculus
○ Algebra I	○ Statistics (regular, not Advanced Placement)
○ Geometry	○ Calculus (regular, not Advanced Placement)
○ Technical Geometry	○ GATEWAY Algebra
○ Algebra II	○ Technical Mathematics (formerly Mathematics for Technology I)
○ Integrated Mathematics I	○ Technical Algebra (formerly Mathematics for Technology II)
○ Integrated Mathematics II	○ Calculus AB (Advanced Placement)
○ Integrated Mathematics III	○ Calculus BC (Advanced Placement)
	○ Statistics (Advanced Placement)
○ Other:	

_____

_____

6. Did you take a mathematics course during your junior year of high school?

Yes ○ ○ No

7. Did you take a mathematics course during your senior year of high school?

Yes ○ ○ No

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Figure A-1. Mathematics Education Experience Instrument.

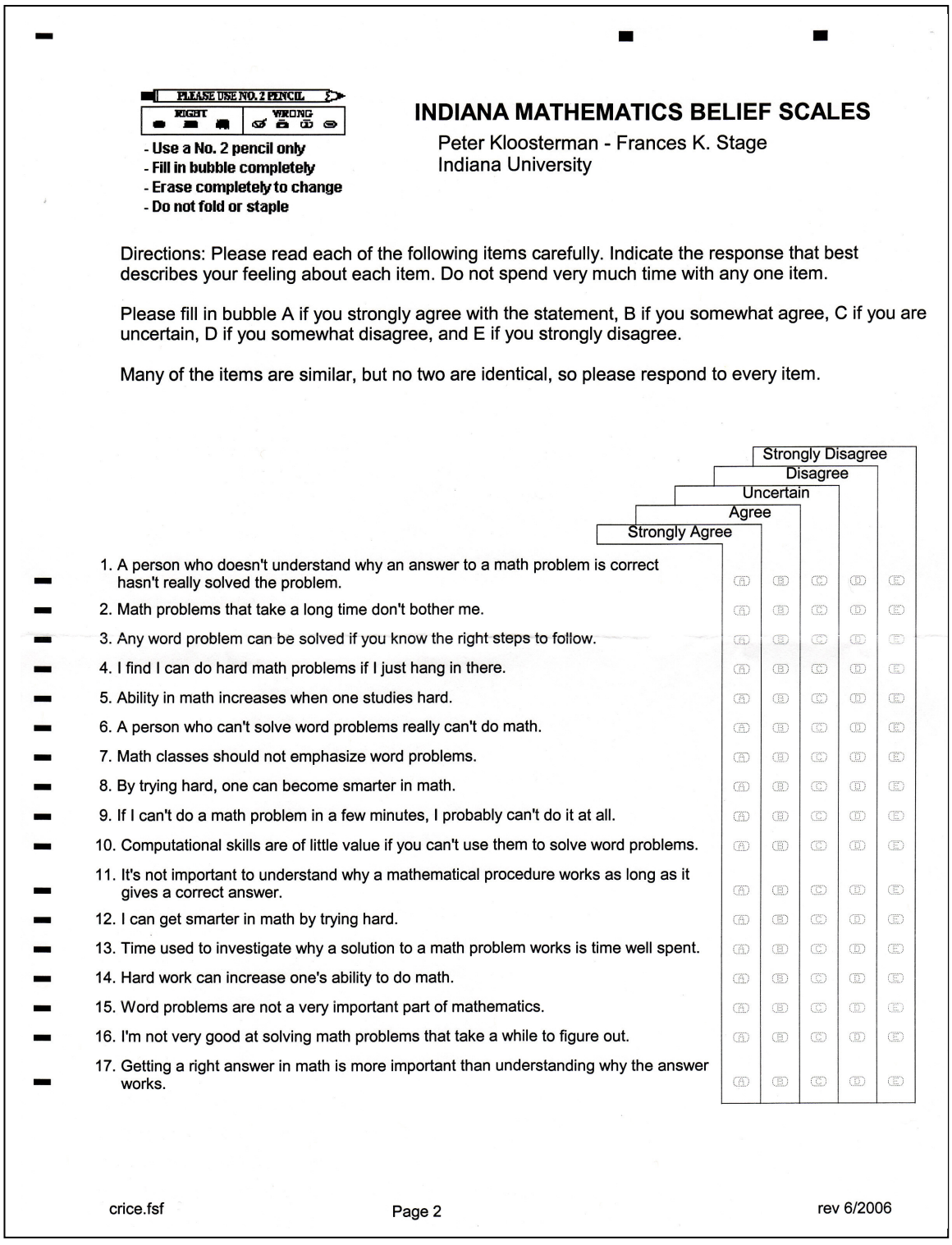


Figure A-2. Indiana Mathematics Belief Scales Instrument.

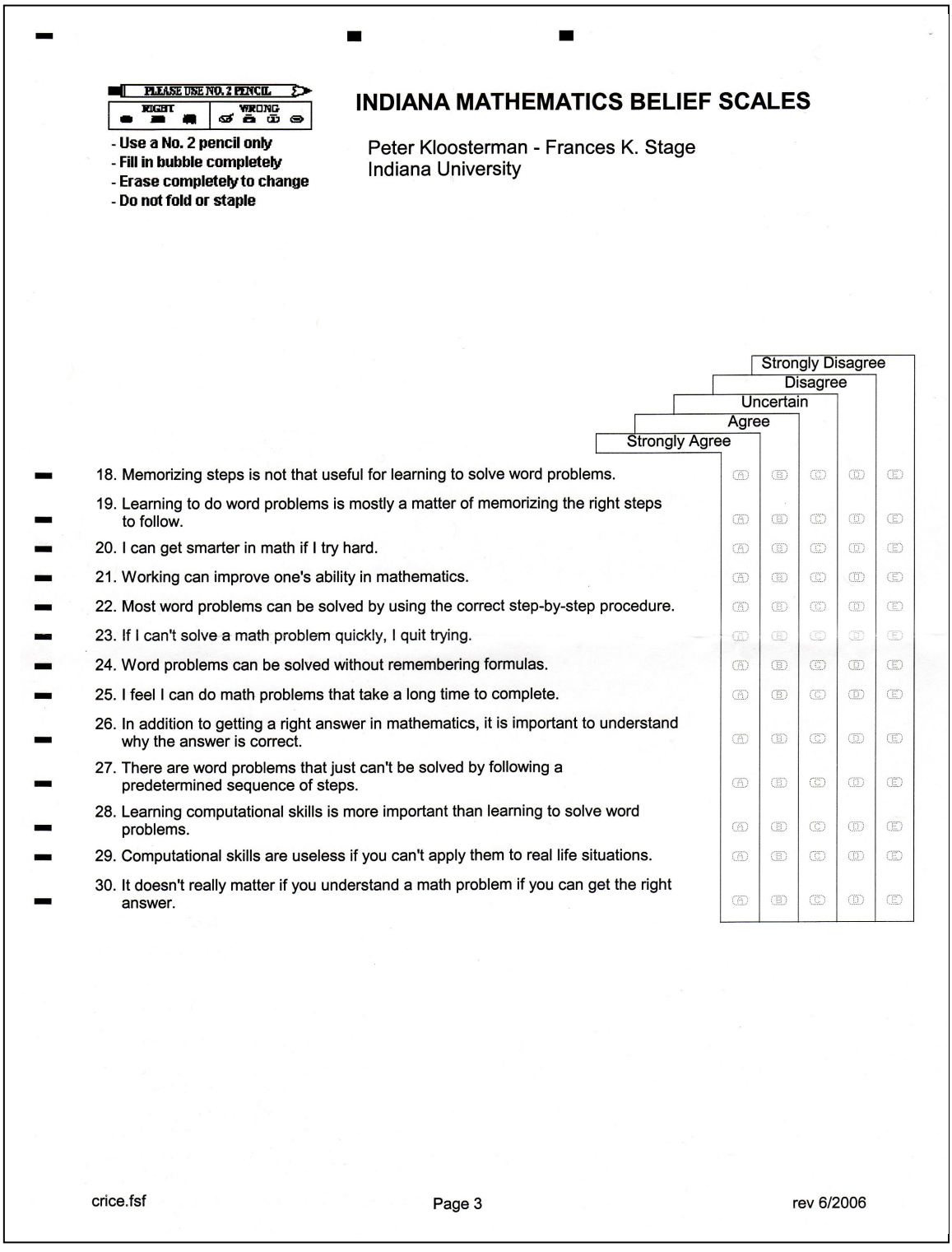
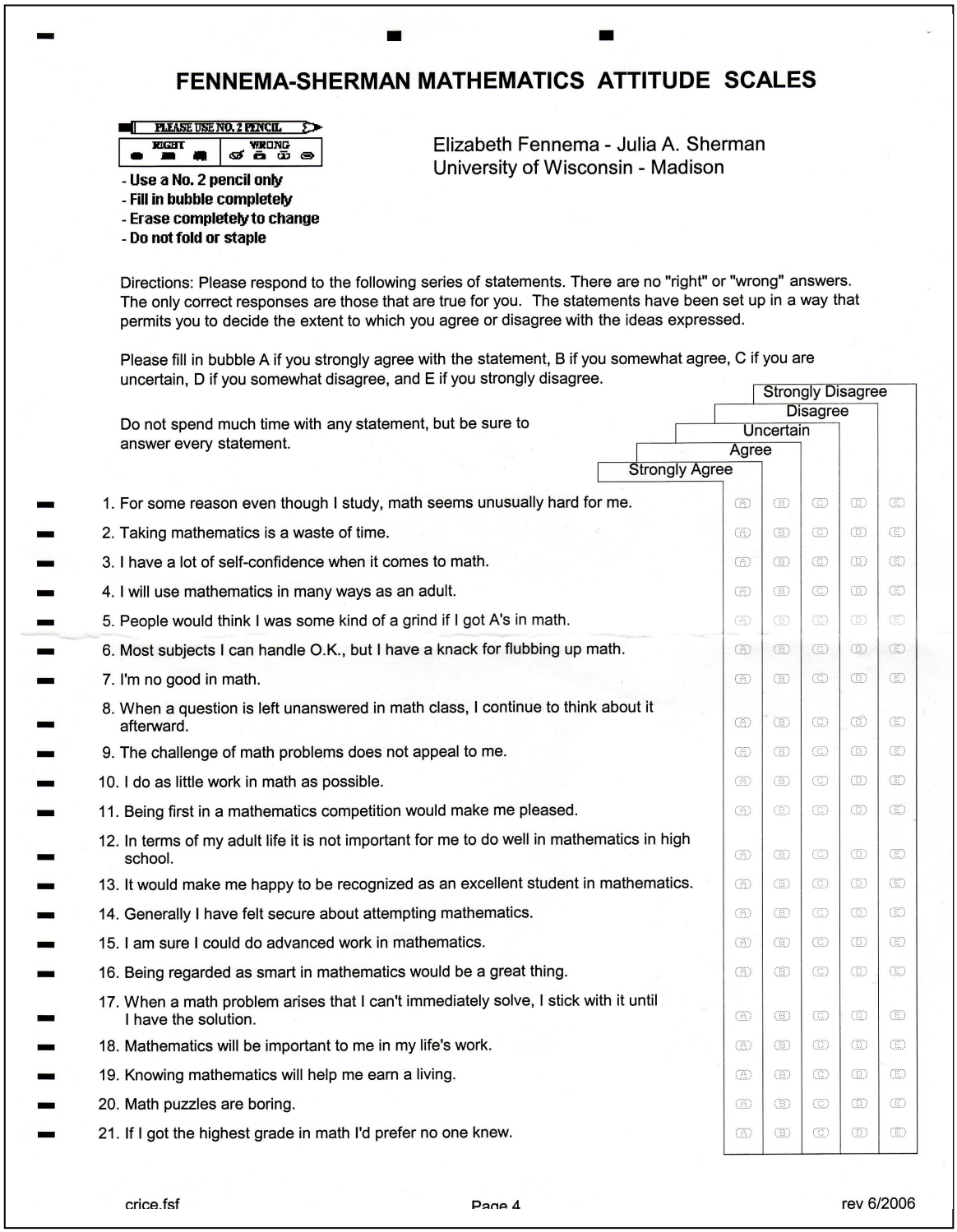


Figure A-2. Continued.



FENNEMA-SHERMAN MATHEMATICS ATTITUDE SCALES

PLEASE USE NO. 2 PENCIL

RIGHT | WRONG

- Use a No. 2 pencil only
- Fill in bubble completely
- Erase completely to change
- Do not fold or staple

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University of Wisconsin - Madison

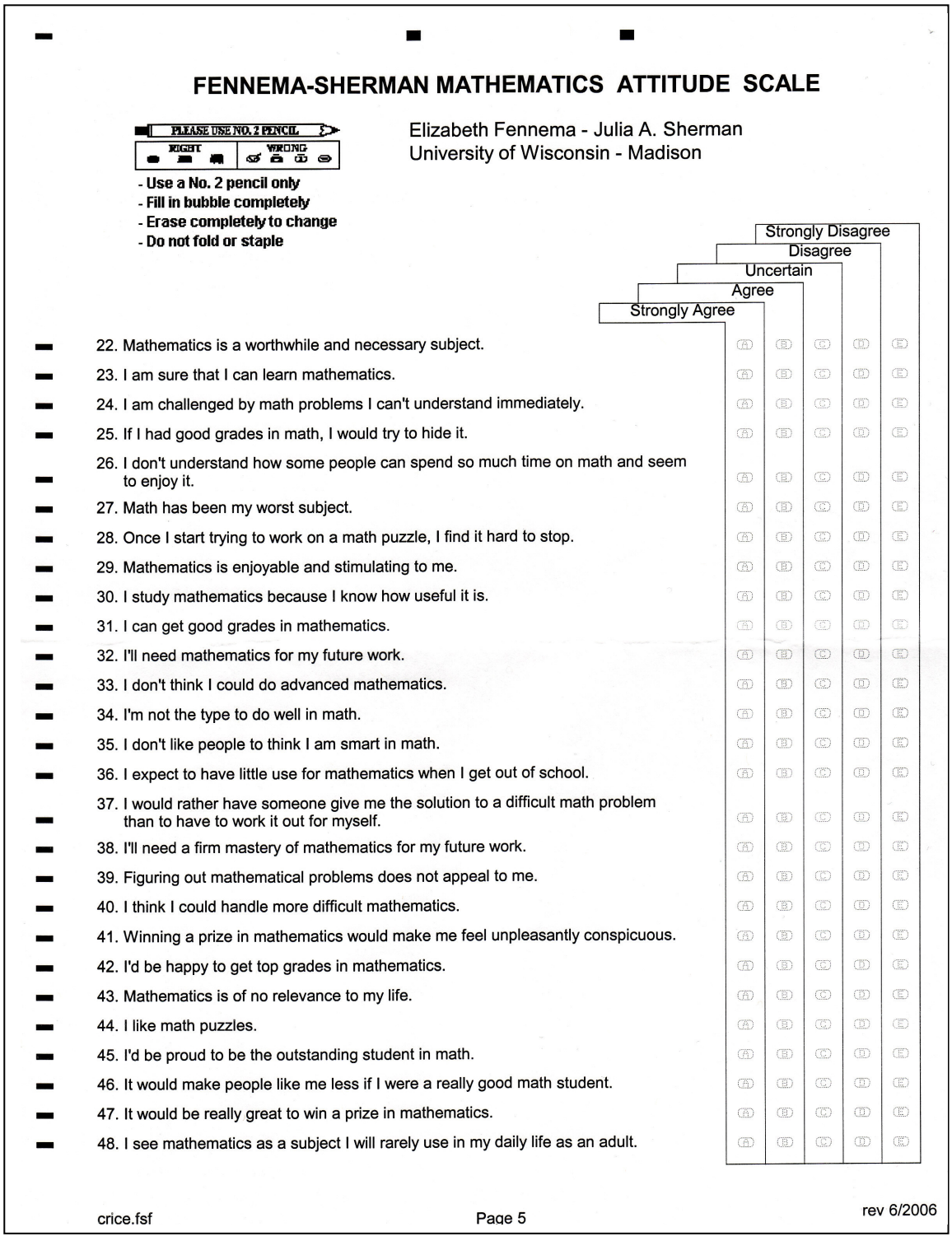
Directions: Please respond to the following series of statements. There are no "right" or "wrong" answers. The only correct responses are those that are true for you. The statements have been set up in a way that permits you to decide the extent to which you agree or disagree with the ideas expressed.

Please fill in bubble A if you strongly agree with the statement, B if you somewhat agree, C if you are uncertain, D if you somewhat disagree, and E if you strongly disagree.

Do not spend much time with any statement, but be sure to answer every statement.

	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
1. For some reason even though I study, math seems unusually hard for me.	A	B	C	D	E
2. Taking mathematics is a waste of time.	A	B	C	D	E
3. I have a lot of self-confidence when it comes to math.	A	B	C	D	E
4. I will use mathematics in many ways as an adult.	A	B	C	D	E
5. People would think I was some kind of a grind if I got A's in math.	A	B	C	D	E
6. Most subjects I can handle O.K., but I have a knack for flubbing up math.	A	B	C	D	E
7. I'm no good in math.	A	B	C	D	E
8. When a question is left unanswered in math class, I continue to think about it afterward.	A	B	C	D	E
9. The challenge of math problems does not appeal to me.	A	B	C	D	E
10. I do as little work in math as possible.	A	B	C	D	E
11. Being first in a mathematics competition would make me pleased.	A	B	C	D	E
12. In terms of my adult life it is not important for me to do well in mathematics in high school.	A	B	C	D	E
13. It would make me happy to be recognized as an excellent student in mathematics.	A	B	C	D	E
14. Generally I have felt secure about attempting mathematics.	A	B	C	D	E
15. I am sure I could do advanced work in mathematics.	A	B	C	D	E
16. Being regarded as smart in mathematics would be a great thing.	A	B	C	D	E
17. When a math problem arises that I can't immediately solve, I stick with it until I have the solution.	A	B	C	D	E
18. Mathematics will be important to me in my life's work.	A	B	C	D	E
19. Knowing mathematics will help me earn a living.	A	B	C	D	E
20. Math puzzles are boring.	A	B	C	D	E
21. If I got the highest grade in math I'd prefer no one knew.	A	B	C	D	E

Figure A-3. Fennema-Sherman Mathematics Attitudes Scales Instrument.



FENNEMA-SHERMAN MATHEMATICS ATTITUDE SCALE

PLEASE USE NO. 2 PENCIL

RIGHT WRONG

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- Erase completely to change
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University of Wisconsin - Madison

	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
22. Mathematics is a worthwhile and necessary subject.	A	B	C	D	E
23. I am sure that I can learn mathematics.	A	B	C	D	E
24. I am challenged by math problems I can't understand immediately.	A	B	C	D	E
25. If I had good grades in math, I would try to hide it.	A	B	C	D	E
26. I don't understand how some people can spend so much time on math and seem to enjoy it.	A	B	C	D	E
27. Math has been my worst subject.	A	B	C	D	E
28. Once I start trying to work on a math puzzle, I find it hard to stop.	A	B	C	D	E
29. Mathematics is enjoyable and stimulating to me.	A	B	C	D	E
30. I study mathematics because I know how useful it is.	A	B	C	D	E
31. I can get good grades in mathematics.	A	B	C	D	E
32. I'll need mathematics for my future work.	A	B	C	D	E
33. I don't think I could do advanced mathematics.	A	B	C	D	E
34. I'm not the type to do well in math.	A	B	C	D	E
35. I don't like people to think I am smart in math.	A	B	C	D	E
36. I expect to have little use for mathematics when I get out of school.	A	B	C	D	E
37. I would rather have someone give me the solution to a difficult math problem than to have to work it out for myself.	A	B	C	D	E
38. I'll need a firm mastery of mathematics for my future work.	A	B	C	D	E
39. Figuring out mathematical problems does not appeal to me.	A	B	C	D	E
40. I think I could handle more difficult mathematics.	A	B	C	D	E
41. Winning a prize in mathematics would make me feel unpleasantly conspicuous.	A	B	C	D	E
42. I'd be happy to get top grades in mathematics.	A	B	C	D	E
43. Mathematics is of no relevance to my life.	A	B	C	D	E
44. I like math puzzles.	A	B	C	D	E
45. I'd be proud to be the outstanding student in math.	A	B	C	D	E
46. It would make people like me less if I were a really good math student.	A	B	C	D	E
47. It would be really great to win a prize in mathematics.	A	B	C	D	E
48. I see mathematics as a subject I will rarely use in my daily life as an adult.	A	B	C	D	E

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Figure A-3. Continued.

Study Information Sheet

Comparing Recent High School Graduates Placed in Developmental and College-Level Mathematics Courses

INTRODUCTION
You are invited to participate in a research study. You must be at least 18 years of age and enrolled in a mathematics course in college. The purpose of this study is to determine any significant differences among recent high school graduates placed in developmental and college-level mathematics courses.

INFORMATION ABOUT PARTICIPANTS' INVOLVEMENT IN THE STUDY
Participants will complete a survey that includes:
A) the *Mathematics Education Experience* questionnaire, requiring approximately 5 minutes,
B) the *Indiana Mathematics Belief Scales*, requiring approximately 10 minutes, and
C) the *Fennema-Sherman Mathematics Attitude Scales*, requiring approximately 15 minutes.
Participants will return their completed survey to their instructor using the provided envelope.

RISKS
There are no foreseeable risks in the procedures used in this study.

BENEFITS
There will be no direct benefits to participants in this study. However, investigating the differences among recent high school graduates placed in developmental and college-level mathematics courses is a very relevant and useful study.

CONFIDENTIALITY
Information in the study records will be kept confidential. Data will be stored securely and made available only to persons conducting the study unless participants specifically give permission in writing to do otherwise. No reference will be made in oral or written reports that could link participants to the study.

COMPENSATION
All students who participate will be eligible for a **cash award of $100**. The following rules apply:
A) Participants must complete the **entire** survey (Respond to every question on all 5 pages of the survey.),
B) Participants must include their **name and mailing address** on the enclosed entry form, and
C) Participants must return their completed survey and entry form to their instructor **within two weeks**.
A drawing will be held six weeks into the semester. The winners (three per college) will be notified by mail. Surveys may be submitted anonymously; however these cannot be included in the award drawing.

CONTACT
If you have questions at any time about the study or the procedures, you may contact the researcher, Crystal Rice, at (423)585-6940 or Crystal.Rice@ws.edu. If you have questions about your rights as a participant, contact the Office of Research Compliance Officer at (865) 974-3466.

PARTICIPATION
Your participation in this study is voluntary; you may decline to participate without penalty. If you decide to participate, you may withdraw from the study at anytime without penalty and without loss of benefits to which you are otherwise entitled. If you withdraw from the study before data collection is completed, your data will be returned to you or destroyed. Return of the completed survey (questionnaire) constitutes your consent to participate.

****IMPORTANT****

KEEP this sheet for your records. DO NOT include this sheet with your survey responses.

Figure A-4. Study Information Sheet

VITA

Crystal Rice was born in Morristown, Tennessee. She attended school at Union Heights Elementary, East Ridge Middle School, and Morristown East High School in Morristown. Upon graduating high school in 1992, Crystal enrolled in Walters State Community College, also in Morristown.

Crystal received the Associate of Science degree in Pre-Engineering and Mathematics Education in 1995 from Walters State Community College (WSCC). She received the Bachelor of Science degree in Secondary Education in Mathematics from Tennessee Technological University (TTU) in Cookeville, Tennessee. Upon graduating TTU in 1997, Crystal was awarded a graduate assistantship in the Mathematics Department at the University of Tennessee, Knoxville (UTK). While in the graduate program, she assisted with and taught developmental and college-level mathematics courses. She received the Master of Science degree in Mathematics from UTK in 1999.

Crystal moved back to Morristown and began teaching mathematics courses at both WSCC and UTK as an adjunct instructor. She was hired in August of 2000 at WSCC where she is currently an Assistant Professor of Mathematics.

Crystal began the Appalachian Collaborative Center for Learning, Assessment, and Instruction in Mathematics (ACCLAIM) doctoral program in the summer of 2002. She received the Doctor of Philosophy degree with a concentration in mathematics, mathematics education, and rural education from the Theory and Practice in Teacher Education department at UTK.