To the Graduate Council:

I am submitting herewith a dissertation written by Julianna Gregory entitled “Presentation Software and its Affects on Developmental Students’ Mathematics Attitudes.” 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.

Vena Long

Major Professor

We have read this dissertation
and recommend its acceptance:

JoAnn Cady

P. Mark Taylor

Carl Wagner

Accepted for the Council:

Carolyn R. Hodges

Vice Provost and
Dean of the Graduate School

(Original signatures are on file with official student records.)

Presentation Software and its Effects on Developmental Students' Mathematics Attitudes

A Dissertation

Presented for the

Doctor of Philosophy Degree

The University of Tennessee, Knoxville

Julianna Gregory

May, 2007

ACKNOWLEDGEMENTS

I would like to acknowledge all of those whose support and encouragement made it possible for me to complete this journey. First, I would like to thank God for giving me the patience and endurance necessary to complete all of my degree requirements. Second, I would like to thank my friends and family for their encouragement and putting up with my absence during the past four years.

Thank you to Dr. Vena Long for providing guidance and advice throughout the dissertation process. I would also like to acknowledge the other members of my committee, Dr. Carl Wagner, Dr. Mark Taylor, and Dr. JoAnn Cady, for their contributions to my knowledge and experience with this dissertation.

I would like to thank the National Science Foundation for bringing the ACCLAIM program (Appalachian Collaborative Center for Learning, Assessment, and Instruction in Mathematics) into existence and believing in the management team. Thank you to all of those involved in the ACCLAIM program for making this the most rich, eye-opening experience of my life – from the thought-provoking classes to the rich professional development experiences. Thank you ACCLAIM for forming our cohort, without whom I could not have finished this program. Finally, I thank my fellow cohort members for their constant support and encouragement: Caroline, Brian, Barbie, Frank, Craig, Debbie, Brenda, Bill, Sue, Judy, Christie, Crystal, and Karla.

ABSTRACT

This study investigated whether the use of presentation software as the primary delivery system would affect developmental mathematics students' attitudes toward mathematics and investigated the differential impact presentation software might have on mathematical attitudes of students with respect to their gender, locale (rural vs. non-rural), or age (traditional vs. non-traditional). The student's locale was determined by the Johnson code assigned to the high school he or she graduated from by the National Center for Education Statistics. A student was classified as traditional (under 21 years of age) or non-traditional (21 years of age or older).

An experimental study was conducted with four community college instructors each teaching two sections of elementary algebra, one with a traditional delivery system and one with presentation software as the primary delivery system. The students were given four subscales of the Fennema-Sherman Mathematics Attitude Scales (1976) to detect changes in their attitudes toward mathematics during the first week of classes (pre-test), at week nine (mid-test), and during the last week of classes (post-test). The four subscales used were Attitude Toward Success in Mathematics, Confidence in Learning Mathematics, Mathematics Anxiety Scale, and the Mathematics Usefulness Scale.

A Multivariate Analysis of Variance with repeated measures was run using the Wilk's Lambda as an indicator for significance. At the time of the mid-test,

the control group was found to have significantly higher scores on confidence in learning mathematics. Furthermore, across classes, student attitudes toward mathematical usefulness significantly declined over time. In addition, across classes, student mathematics anxiety levels significantly increased over time.

Finally, when examining gender, locale, and age, a significant difference was found for rural students between the mathematics anxiety scores of students in the control group versus the mathematics anxiety scores of rural students in the experimental group, with the experimental group reporting significantly higher scores on mathematics anxiety. Furthermore, males reported higher confidence in learning mathematics levels than females at the pre-test and mid-test. However, at the post-test, no significant differences were found between males and females with respect to their confidence in learning mathematics.

TABLE OF CONTENTS

CHAPTER I ntroduction 1
Statement of Problem 6
Research Questions 7
Significance of the Study 7
Limitations of the Study 8
Delimitations of the Study 8
Assumptions 8
Definitions 9
Organization of the Study 12
Summary 12
CHAPTER II Review of the Literature 13
Attitude 13
Attitude and Achievement 14
Self-Efficacy as a Component of Attitude 16
Instruments 17
Confidence in Learning Mathematics 19
Attitude Toward Success in Mathematics 21
Usefulness of Mathematics 21
Mathematics Anxiety 23
Student Age 26
Locale 27
Developmental Students 29
Learning Styles 32
Instructional Preferences: Color 33
Instructional Preference: Organization 36
Presentation Software 37
Benefits of Presentation Software 38
Software Presentations and Student Perception 39

Presentation Software and Achievement 41
Summary 45
CHAPTER III Research Methodology 46
Research Questions 46
Subjects 46
Design 47
Instructors 48
Classroom Conditions 48
Measures 49
Data Analysis 50
Summary 51
CHAPTER IV Results 53
Introduction 53
Reliability of Instrument Between Administrations 53
Confidence, Usefulness, Success, and Anxiety 55
Gender, Locale, and Age 59
Summary 63
CHAPTER V Conclusions 65
Summary of the Study 66
Findings 67
Confidence, Usefulness, Success, and Anxiety 68
Gender, Locale, and Age 68
Discussion 70
Conclusions 78
Implications for Further Research 79
Mathematics Attitude Research 80
Rural and Mathematics Education Research 81
REFERENCES 82
APPENDICES 93
Appendix A Teacher Vitas 94

Teacher A Vita 94
Teacher B Vita 96
Teacher C Vita 98
Teacher D Vita 99
Appendix B Sample PowerPoint® Lessons 101
Teacher A.....101
Teacher B.....104
Teacher C 110
Teacher D 113
Appendix C Fennema-Sherman Mathematics Attitude Scale 115
Vita…. 117

LIST OF TABLES

Table 4.1 Reliability for Subscales and Overall Instrument.....54
Table 4.2 Pre-test Correlations.....56
Table 4.3 Mid-test Correlations.....56
Table 4.4 Post-test Correlations.....57
Table 4.5 Independent Sample t-tests for Confidence.....58
Table 4.6 Usefulness Means Over Time.....60
Table 4.7 Anxiety Means Over Time.....60

LIST OF FIGURES

Figure 4.1 Confidence Means 58
Figure 4.2 Confidence Means by Gender Over Time 62
Figure 4.3 Anxiety Means by Locale 62

CHAPTER I

Introduction

The concept of developmental education – helping students to bridge the gap between what they should know and what they do know when they enter college – is not new in the United States. According to Casazza (1999), "Institutions of higher learning have been accepting students who may not have met their standards for almost 200 years and, at the same time, have also been developing ways to meet the needs of these diverse learners" (p. 3).

For a multitude of reasons, students who find themselves in developmental mathematics courses did not master mathematical skills, specifically algebra, in high school or have forgotten them during the time they have been out of school. The traditional pedagogy of lecturing, with an emphasis on skill and drill and whole group instruction, has been largely ineffective with these students (Boylan & Saxon, 1999). One contributing factor to weak mathematical skills may be that many students tend to take only the minimum amount of mathematics required for high school graduation. In the state of Tennessee, three high school mathematics courses are required for graduation, one of which is Algebra I. Admission requirements to most colleges in Tennessee also include three high school mathematics courses: Algebra I or Math for Technology II, Algebra II, and Geometry. Since in many schools Algebra I is offered during the eighth grade, it is possible for students to have completed their high school mathematics requirements by the end of their

sophomore year. Even good mathematics students often forget skills by the time they get to college when they have not studied mathematics in over two years.

With the advances in technology over the last thirty years (i.e. computers, software, and graphing calculators), many questions have been raised about their possible efficacy in assisting developmental mathematics students. Several studies have examined the effects of using graphing calculators, computer software, and Internet resources in mathematics classes (Shore, 1999; Cassity, 1997; Dunham & Dick, 1994; Ysseldyke, et al, 2003; DeVaney, 1996). One of the more recent technological advances is presentation software which allows instruction to be projected in a classroom setting as an alternate delivery of instruction. Little research has been conducted concerning the use of presentation software in a mathematics class versus chalk, white boards, and overhead delivery of instruction.

Presentation software can tap into students' learning styles by utilizing color and organization. Daniels (1999) points out that PowerPoint® presentations can assist students with visual differentiation through the use of multiple colors. In addition, "in a more traditional setting, students may be unsure when a professor has finished with an anecdote or side issue and returned to the main points of the lecture" (Daniels, 1999, p. 45). Presentation software slides may remove this confusion. Furthermore, PowerPoint® presentations are able to assist the teacher in providing structure to the lesson (Susskind, 2005). In student surveys conducted in classes that used PowerPoint® presentations,

students rated the presentations as making the instruction and material more organized than traditional methods of instruction (Susskind, 2005; Cassady, 1998). Finally, students reported greater positive attitudes and self-efficacy beliefs when PowerPoint® presentations were used (Susskind, 2005).

Organization and color have been established as an important factor in student learning by the works of Pascarella et al. (1996), Moore and Dwyer (1998), and Lamberski and Dwyer (1983). Pascarella et al. (1996) found that teacher organization is more of an influence than other teacher behaviors on general cognitive skills. Moore and Dwyer found "students who received . . . color coded instructional treatment achieved significantly higher scores on the identification, drawing, and total criterion test than did those students who received the black and white" (1998, p. 295) instruction. Furthermore, color enables greater concept acquisition, retrieval, and retention than black and white instruction (Lamberski & Dwyer, 1983).

Students placed in developmental mathematics may never have had a positive experience in a mathematics course. They often exhibit high anxiety levels (Hembree, 1990), are more likely to be visual and hands-on learners (Boylan & Saxon, 1999), and have poor organizational skills (Cross, 1976).

Research shows that attitudes toward mathematics also play a part in achievement with varying degrees of confirmation (Aiken, 1972; Neale, 1969; Singh, Granville, & Dika, 2002; De Corte & Op't Eynde, 2003; Shashaani, 1995). Fortunately, research has shown that negative attitudes toward mathematics anxiety can be modified (Hembree, 1990; Tobias & Weissbrod, 1980). When

considering attitudes with respect to gender, the results are mixed. De Corte and Op't Eynde (2003) have found a gender difference between Flemish junior high students with boys tending to value mathematics more than girls, given an equal achievement level. However, Ma and Kishor (1997) conclude gender does not have a significant effect on the relationship between a student's attitude toward mathematics and the student's achievement in mathematics. Furthermore, Aiken (1976) has shown that "girls' mathematics marks are more predictable from their attitudes than boys' marks" (p. 296) since the correlation between attitude in mathematics and achievement in mathematics is usually a bit higher for girls. However, the work of Ai (2002) reveals that "the effect of mathematics attitude on math scores seemed to be stronger for boys than for girls" (p. 13) with a statistically significant difference favoring high achieving males.

The concept of self-efficacy helps enlarge upon this research. Young and Ley (2002) define self-efficacy as involving a "judgment of one's capabilities" (p. 22). Researchers have established that a student's self-efficacy influences cognitive functions (Bandura, 1993) and performance (Pajares, 1996). The influence of self-efficacy on performance has been shown to be stronger in lower achieving mathematics students than in higher achieving students at the same grade level (Multon et al., 1991). However, Young and Ley (2002) found no significant differences between the self-efficacy of students in regular college classes and students in developmental mathematics classes. This finding is explained by observing that many developmental mathematics students have an

"inflated sense of what he or she is capable of doing" and that these beliefs are incongruent with their achievement in mathematics (Young & Ley, 2002, p. 26).

Most of these studies examined the relationship between attitude and achievement of students in middle or high school. Very few examined college students, with even fewer looking at developmental mathematics students. Furthermore, most of these studies were conducted in urban or suburban areas. None of these college level mathematics studies examined the relationship between attitude and achievement in terms of traditional vs. non-traditional students or rural vs. non-rural students. Few of the studies looked at the effects of delivery instruction via technology on attitude and achievement.

Therefore, an examination of the effects of presentation software on developmental students is needed, specifically, whether or not the use of presentation software interacts with student attitudes toward mathematics. Furthermore, an examination of whether a students' gender, locale, or age interacts with the use of presentation software and attitudes should be conducted. Community colleges provide the majority of developmental education in the state of Tennessee (Golfin et al., 2005); thus this examination should take place at the community college level.

Appleton Community College (a pseudonym) is located in upper East Tennessee, with ten counties in its service area. Of the twenty-four high schools within these ten counties, thirteen high schools are in districts classified as rural, according the locale codes provided by the National Center for Education Statistics (http://nces.ed.gov/ccd/schoolsearch/). Thus, this community college

serves students from both rural and non-rural areas. For this study, "traditional" will refer to students who are under 21 years of age while "non-traditional" will refer to students who are 21 years of age and older. In the fall of 2004, 98.3% of the first-time, degree-seeking non-traditional freshmen and 56.2% of the first-time, degree-seeking traditional freshmen enrolled were placed in one of the three developmental mathematics classes at Appleton Community College (Appleton Community College, First-Time Freshmen Data Base Retention Report, 2005). The largest percentage of the students in developmental mathematics education at Appleton Community College enters the developmental program at the elementary mathematics level (45.3% in the fall of 2004).

Statement of Problem

Too many students arrive at college unprepared for college-level coursework. As a result, the student is placed in developmental education to teach, refresh, or re-teach skills that were supposed to be acquired in high school; these students often come with poor attitudes toward mathematics and a sense of failure. Stress levels of these students are high and success rates low. The following study examined the impact of presentation software in developmental mathematics classrooms upon student attitudes toward mathematics.

Research Questions

This study will address the following research questions:

1. Does the use of presentation software affect elementary algebra students' attitudes toward mathematics?
2. Does the use of presentation software affect the attitudes of any subgroup more than others, specifically gender, locale, and age?

Significance of the Study

This study will offer insight into whether presentation software is an effective tool to improve attitudes and assist in the remediation of developmental mathematics students. Improved attitudes toward mathematics may result in improved learning in developmental mathematics students. Students who are attending college now have been immersed in a visually rich society. Using a visually stimulating environment in the mathematics classroom may impact the students' attitude, achievement, performance, or interact with demographic characteristics such as gender, locale, and age. If the value of this pedagogical technique can be shown, teachers will be guided to the use of a readily available tool.

Limitations of the Study

This study will explore whether the use of presentation software affects the attitudes of students toward elementary algebra mathematics class. The study will *not* delve into the why or how the presentation software affects the student attitudes. Neither will this study examine the experiences of those who arrive at college with the appropriate level of mathematics. Nor will this study examine the achievement level of students in mathematics. Therefore, it will not be known if the same results would apply to college level classes.

Delimitations of the Study

This study does not deal with all forms of presentation software, nor will its findings be generalizable beyond the specific type of institution (community college), type of students (previously unsuccessful in mathematics), and content (elementary algebra) targeted. Other types of instruction via technology may be equally effective or ineffective with other students and within other disciplines.

Assumptions

This study assumes that choosing instructors from one community college who use the same text will result in instructors who are equally qualified and teach the same content in a similar manner. Furthermore, it is assumed the college scheduling procedure in signing up for mathematics classes without

knowing who will be teaching what section results in a random assignment of students to sections. Finally, it is assumed the Hawthorne Effect will not be significant because of the video-saturated society from which the students come.

Definitions

1. Developmental courses: Developmental courses are courses designated with a number from 0800 to 0899 and are "designed to assist students in developing proficiency in the basic academic competencies defined by the College Board in its EQ [Educational Quality] Project" (Appleton Community College, First-Time Freshmen Data Base Retention Report, p. 3).

2. Developmental students: A degree-seeking student who is under 21 years of age is placed in developmental education courses if he or she has an ACT score under 19. A degree-seeking student who is 21 years of age or over is placed in developmental education courses if he or she does not meet the minimum cutoff score on the COMPASS test, the placement exam used by the Tennessee Board of Regents schools. These cutoff scores are set by the Tennessee Board of Regents (Academic Enrichment, 2005).

3. Traditional lectures: Szabo and Hastings (2000) defined traditional lecture as "[l]ectures delivered without the significant use of IT [instructional technology] equipment other than overhead projectors and possibly the occasional use of an audio-visual (VHS and audio playback) apparatus" (2000, p. 177).

4. Presentation software: Parsons & Oja (2004) state that presentation software is “software that provides tools to combine text, graphics, graphs, animation, and sound into a series of electronic slides that can be output on a projector” or television (p. 234). Szabo and Hastings further comment that presentation software lectures are:

> Lectures in which the content, and complementary diagrams or pictures, is [sic] presented electronically with the aid of the PowerPoint software. This is done with little or no reliance (unless it is necessary for the sake of the clarification of students’ questions) on overhead projection or blackboard usage. (2000, p. 177)

The presentations may be linear, augmented linear, or mixed (both linear and hierarchical) in structure and may contain hyperlinks to applets/software that allow for student interaction. A linear structure is one in which each “page is linked to the next and to previous pages, in an ordered chain of pages” (Carey & Kemper, 2003, pg. 2.12). An augmented linear structure is one in which each page includes a link that “jumps directly back to the first page, while keeping the links that allow . . . [movement] to the next and previous pages” (Carey & Kemper, 2003, pg. 2.12). A “hierarchical structure starts with a general topic that includes links to more specific topics” and back but not links from specific topic to specific topic (Carey & Kemper, 2003, pg. 2.12). The Microsoft® product PowerPoint® will be used as the presentation software in this study.

5. Traditional and Non-traditional student: "Traditional" will refer to students who are under 21 years of age. "Non-traditional" will refer to students who are 21 years of age and older.

6. Locale – rural and non-rural: Johnson codes were developed in the early 1980s and are revised with each census by the United States Bureau of the Census based on the proximity to metropolitan areas and based on population size and density. Each school is assigned a Locale Code based on the mailing address of the school (National Center for Education Statistics, Urban/Rural Classification Systems). In the Johnson coding schema, a locale code of 7 indicates a mailing address not within a Consolidated Metropolitan Statistical Area (CMSA) or Metropolitan Statistical Area (MSA) and designated as rural (National Center for Education Statistics, Urban/Rural Classification Systems). In the Johnson coding schema, a locale code of 8 indicates a mailing address within a CMSA or MSA designated as rural (National Center for Education Statistics, Urban/Rural Classification Systems). Students in this study will be labeled as rural if the high school from which they graduated lies within a Johnson locale code of 7 or 8. Students will be labeled as non-rural if the high school from which they graduated lies within a Johnson locale code of 1, 2, 3, 4, 5, or 6.

Organization of the Study

This study is organized into five chapters. Chapter 1 introduces the study and explains the framework of the study. Chapter 2 contains a literature review organized by the key concepts related to the study. Chapter 3 consists of an explanation of the methodology used to test the hypotheses. Chapter 4 includes the quantitative results of the study. Chapter 5 consists of the conclusions, implications, and a discussion of further necessary research.

Summary

Students in developmental mathematics classes enter college already behind their counterparts enrolled in college level mathematics courses. Presentation software may enhance student learning and attitudes through the use of color and eye-catching transitions and may allow instructors to tap into learning styles that have previously been hard to access in a conventional classroom setting. This study is designed to investigate these possibilities.

CHAPTER II

Review of the Literature

The purpose of this study is to investigate whether the use of presentation software as a means of instruction might influence attitudes of elementary algebra students toward mathematics. A survey of literature relating to the aspects of student attitudes toward mathematics was conducted via a computerized ERIC (Education Resource Information Clearinghouse) search for ERIC documents and journal articles, a search of Dissertation Abstracts International, and a survey of the World Wide Web. Important aspects of research into student achievement in elementary algebra include students' attitude toward mathematics, student age, student locale, learning style, and the use of technology in instruction.

Attitude

Aiken (1970) defines 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) narrows this definition in relation to mathematics by defining attitude toward mathematics as a measure of "a liking or disliking of mathematics, a tendency to engage in or avoid mathematical activity, a belief that one is good or bad at mathematics, and a belief that mathematics is useful or useless" (p. 632). Finally, Mager (1968) adds that favorable attitudes toward school subjects will maximize the likelihood that

students will remember what they have learned, willingly learn more about the subject, and use what they have learned.

Attitude and Achievement

Research shows attitudes toward mathematics do influence achievement with varying degrees of confirmation (Aiken, 1972; Braswell et al., 2001; De Corte & Op't Eynde, 2003; Gallagher and De Lisi, 1994; Singh et al., 2002; Neale, 1969; Shashaani, 1995; Thorndike-Christ, 1991; Ma & Kishor, 1997). In addition, the "correlation between attitudes and achievement is frequently higher for mathematics than for school subjects with more verbal content" (Aiken, 1972, p. 231). A meta-analysis by Ma and Kishor (1997) of the relationship between students' attitudes toward mathematics and their achievement in mathematics reveals the correlation is significant but not strong; from 1981 to 1993 the relationship between the two has remained almost constant in the literature reviewed by Ma and Kishor. Gallagher and De Lisi (1994) found a positive relationship between a student's SAT-M scores and their confidence and persistence scores as measured by the Fennema-Sherman Mathematics Attitudes Scales (Fennema & Sherman, 1976). An analysis of the 2000 National Assessment of Educational Progress (NAEP) reveals that in all three grade bands tested (grades four, eight, and twelve) there is a positive relationship between student attitudes toward mathematics and performance on the NAEP test (Braswell et al., 2001). Finally, Singh, Granville, and Dika (2002) found that

in eighth graders, “attitudinal and motivational variables are influential in explaining the variability in mathematics achievement” (p. 329).

A study of Flemish junior high students reveals that high achieving students have more positive beliefs concerning the relevance of and their ability in mathematics than low achieving students (De Corte & Op’t Eynde, 2003). Thorndike-Christ (1991) affirmed De Corte and Op’t Eynde’s results with United States’ middle school and high school students. In the Thorndike-Christ (1991) study, students in advanced classes held significantly more positive attitudes toward mathematics as measured by the Fennema-Sherman Mathematics Attitudes Scales (Fennema & Sherman, 1976) than students in regular and remedial classes.

The research regarding attitude and achievement by gender varies. When significant differences are found between attitude, achievement, and gender in studies of mathematics instruction, it is more frequently in favor of the males. The work of Ai (2002) reveals “the effect of mathematics attitude on math scores seemed to be stronger for boys than for girls” with a statistically significant difference favoring males for the high-achievement group (p. 13); thus, for males the more positive the mathematics attitude, the higher the mathematics achievement. Conversely, Aiken (1976) states that “girls’ mathematics marks are more predictable from their attitudes than boys’ marks” since the correlation between attitude in mathematics and achievement in mathematics is generally higher for girls (p. 296). However, Ma and Kishor (1997) conclude gender does

not have a significant effect on the relationship between a student's attitude toward mathematics and the student's achievement in mathematics.

Self-Efficacy as a Component of Attitude

The concept of self-efficacy helps further refine the research in attitude and achievement in mathematics instruction. Young and Ley (2002) define self-efficacy as involving a "judgment of one's capabilities" (p. 22). Self-efficacy, specifically mathematics self-efficacy, "can be distinguished from other measures of attitudes toward mathematics in that mathematics self-efficacy is a situational or problem-specific assessment of an individual's confidence in her or his ability to successfully perform or accomplish a particular task or problem" whereas "attitude" is a more global or generalizable view of mathematics (Hacknett & Betz, 1989, p. 262). Some researchers have established that a student's self-efficacy influences his or her cognitive functions (Bandura, 1993) and performance (Pajares, 1996). As Pajares (2002) explains:

> Self-efficacy beliefs also help determine how much effort students will expend on an activity, how long they will persevere when confronting obstacles, and how resilient they will be in the face of adverse situations. The higher the sense of efficacy, the greater the effort, persistence, and resilience. Self-efficacy beliefs also influence the amount of stress and anxiety students experience as they engage a task. (p. 117)

The influence of self-efficacy on achievement in mathematics has been shown to be stronger in lower achieving students than in higher achieving students at the same grade level (Multon et al., 1991). However, Young and Ley (2002) found no significant differences between the self-efficacy of students in regular college classes and students in developmental mathematics classes. This finding is explained by observing that many developmental mathematics students have an "inflated sense of what he or she is capable of doing" and that these beliefs are incongruent with their skill ability (Young & Ley, 2002, p. 26); thus, for developmental mathematics students' efficacy measure may conflate rather than help in the study of attitudes toward mathematics in developmental mathematics students.

Instruments

Elizabeth Fennema and Julia Sherman established the following affective domains in the Fennema-Sherman Mathematics Attitudes Scales (Fennema & Sherman, 1976): Confidence in Learning Mathematics Scale, Attitude Toward Success in Mathematics Scale, Usefulness of Mathematics Scale, and Mathematics Anxiety Scale. Each scale consists of twelve questions, half of which are positively phrased and half of which are negatively phrased.

The Fennema-Sherman Mathematics Attitudes Scales (1976) will be used as the instrument in this study. These scales have been widely used and their reliability and validity have been well established. Fennema and Sherman developed the Confidence in Learning Mathematics scale 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" (Fennema & Sherman, 1976, p. 4). The authors noted that this scale "is not intended to measure anxiety and/or mental confusion, interest, enjoyment or zest in problem solving" (Fennema & Sherman, 1976, p. 4). Items on this scale include "1) I am sure that I can learn mathematics. [and] 2) I'm not the type to do well in mathematics" (Fennema & Sherman, 1976, p. 21). The term self-efficacy came into use after Fennema and Sherman (1976) developed these scales; however, the Confidence in Learning Mathematics scale is designed to measure ideas that closely match the concept of self-efficacy as defined by Hacknett and Betz (1989).

The Attitude Toward Success in Mathematics scale was developed to "measure the degree to which students anticipate positive or negative consequences as a result of success in mathematics" (Fennema & Sherman, 1976, p. 2). Students show evidence of this "fear by anticipating negative consequences of success as well as by lack of acceptance or responsibility for the success" (Fennema & Sherman, 1976, p. 2). Examples of items on this scale include "1) Being regarded as smart in mathematics would be a great thing. [and] 2) If I had good grades in math, I would try to hide it" (Fennema & Sherman, 1976, p. 24).

The Usefulness of Mathematics scale was developed to "measure students' beliefs about the usefulness of mathematics currently and in relationship to their future education, vocation, or other activities" (Fennema &

Sherman, 1976, p. 5). Statements included on this scale are "1) Knowing mathematics will help me earn a living. [and] 2) I see mathematics as a subject I will rarely use in my daily life as an adult" (Fennema & Sherman, 1976, p. 27).

Fennema and Sherman developed the Mathematics Anxiety scale to "measure feelings of anxiety, dread, nervousness and associated bodily symptoms related to doing mathematics. The dimension ranges from feelings at ease to those of distinct anxiety" (Fennema & Sherman, 1976, p. 4). The authors note that this scale "is not intended to measure confidence in or enjoyment of mathematics" (Fennema & Sherman, 1976, p. 4). Items on this scale include "1) I almost never have gotten shook up during a math test. [and] 2) Mathematics makes me feel uncomfortable, restless, irritable, and impatient" (Fennema & Sherman, 1976, p. 28).

Confidence in Learning Mathematics

Research using Fennema and Sherman's (1976) Confidence in Learning Mathematics scale shows that, in general, males express more confidence in their ability to learn mathematics than females as seen in Fennema and Sherman's (1978) study with students in grades six through twelve. Similar results have been found using instruments other than the Fennema-Sherman Mathematics Attitude Scales (1976) (i.e. Math Anxiety Rating Scale, Kulm Math Self-Concept Test, and Mathematics-Related Beliefs Questionnaire) as seen in Eccles's (1984) study with students in grades five through twelve, Shashaani's (1995) study with students in grades nine through twelve, and in Sax's (1992)

study with undergraduate college students. In addition, Sax (1992) found while both men and women's confidence toward mathematics fell during college, the decline was greater for women.

Furthermore, Goolsby (1988), using the Fennema-Sherman Mathematics Attitude Scales (1976), has found "confidence in one's ability to learn mathematics is the only affective variable … which contributes significantly to prediction of performance in a first … developmental mathematics course" (p. 24). Other factors examined in this college level study include mathematics anxiety, attitude toward success, perception of teacher's attitude toward the student as a learner of mathematics, and locus of control. Thorndike-Christ (1991), also using the Fennema-Sherman Mathematics Attitude Scales (1976), found similar results with middle school and high school students where "those who expressed more confidence in their ability to learn mathematics received higher final grades" (p. 29). However, as cautioned by Fennema (2000), it should be noted that the exact relationship between confidence and performance and influences of confidence on learning is not precisely known. These findings of a relationship between confidence and performance agree with the self-efficacy research, which has been linked to performance by Pajares (1996) as the Confidence in Learning Mathematics scale measures concepts of self-efficacy.

Attitude Toward Success in Mathematics

Mixed results have been found in the area of students' attitude toward success in mathematics as it relates to the focus of Fennema and Sherman's (1976) Attitude Toward Success in Mathematics scale. In Eccles' (1984) study with students in grades five through twelve, males held higher expectations for future success in mathematics than girls. Furthermore, the study revealed females' self-concept of their ability in mathematics declined with age from grade five up through grade twelve (Eccles, 1984). However, Thorndike-Christ (1991) found in a study of middle school and high school students that females held more positive attitudes toward success in mathematics than did boys. However, a study by Fennema and Sherman (1978) of students in grades six through twelve found no gender differences in students' attitude toward success in mathematics.

Usefulness of Mathematics

Research relating to Fennema and Sherman's (1976) Usefulness of Mathematics scale reveals that males tend to value mathematics as being more useful than females for high school students (Fennema & Sherman, 1978) and college students (Benton, 1979). Similar results were found with other instruments for both middle and high school students (Eccles, 1984; Perl, 1982). Furthermore, both males and females view mathematics as being more useful for males than for females (Eccles, 1984). De Corte and Op't Eynde (2003), using the Mathematics-Related Beliefs Questionnaire developed by De Corte and Op't

Eynde, found similar results with Flemish junior high students, with males tending to value mathematics more than females, given an equal achievement level. In addition, the research of Pederson et al. (1985), using the Fennema-Sherman Mathematics Attitude Scales (1976), found females' attitude toward the usefulness of mathematics decreasing from seventh to the eighth grade while males' attitude toward the usefulness of mathematics increased over the same time period.

Furthermore, students involved in a small study in New Jersey by Gallagher and De Lisi (1994), using the Fennema-Sherman Mathematics Attitude Scales (1976), from grades eleven and twelve who tend to use algorithms to solve problems view mathematics as not having much relevance to their lives. However, middle school and high school males and females in Thorndike-Christ's (1991) study, also using the Fennema-Sherman Mathematics Attitude Scales (1976), valued the usefulness of mathematics equally. Finally, according to the National Assessment of Educational Progress (NAEP) test data from 2000, the percentage of "fourth-grade students who agreed that math was useful for solving everyday problems increased from 63 percent in 1990 to 71 percent in 2000;" however, the percentage of "twelfth-grade students who responded similarly decreased from 73 percent in 1990 to 61 percent in 2000" (Braswell et al., 2001, p. 196).

Mathematics Anxiety

Richardson and Suinn (1972) define mathematics anxiety as “feelings of tension and anxiety that interfere with the manipulation of numbers and the solving of mathematical problems in a wide variety of ordinary life and academic situations” (p. 551). A meta-analysis conducted by Hembree (1990) reveals several interesting characteristics concerning mathematics anxiety as it relates to the focus of Fennema and Sherman’s Mathematics Anxiety scale (1976). The meta-analysis includes 151 studies involving students across grade one through twelve and post-secondary education (Hembree, 1990). Hembree found “higher mathematics anxiety consistently related to lower mathematics performance” (p. 38) with similar results being found in Thorndike-Christ’s (1991) study, using the Fennema-Sherman Mathematics Attitude Scales (1976), with 1,516 middle school and high school students and in Austin-Martin et al.’s (1980) study, also using the Fennema-Sherman Mathematics Attitude Scales (1976), with 377 female college freshmen. This relationship was found to be stronger for males in grades five through twelve than for females while no significant difference in gender appeared in college students (Hembree, 1990). Furthermore, research has shown that “positive attitudes toward mathematics consistently [relate] to lower mathematics anxiety” (Hembree, 1990, p. 38), specifically, one’s level of mathematics anxiety appears to affect one’s “attitudes toward confidence in one’s ability to learn mathematics and toward the usefulness of mathematics” (Austin-Martin et al., 1980, p. 5).

Females report higher levels of anxiety than males on the Fennema-Sherman Mathematics Attitude Scales (1976) (Thorndike-Christ, 1991; Betz, 1978; Benton, 1979) and other instruments measuring mathematics anxiety (Hembree, 1990; Eccles & Jacobs, 1986; Perl, 1982) with this difference being more prominent in college students (Hembree, 1990). Furthermore, older college females report higher levels of math anxiety than younger women (Betz, 1978). However, when only age is considered, Woodard (2002), using the Math Anxiety Rating Scale, found in a study of developmental mathematics students at a Virginia community college no significant difference in the mathematics anxiety levels of traditional and nontraditional students. Likewise, Bitner, Austin, and Wadlington (1994), using the Math Anxiety Rating Scale, found no significant difference between the mathematics anxiety levels of traditional and nontraditional students enrolled in developmental mathematics courses at the university level.

High levels of mathematics anxiety appear in remedial mathematics college students while the level of mathematics anxiety declines in college students in courses of more advanced study (Hembree, 1990). Furthermore, in a study of 129 nontraditional community college students, Gonske (2002), using his own instrument, found that the greatest contributing factor to nontraditional students' mathematics anxiety is a lack of confidence in their ability to solve problems. In addition, mathematics anxiety seems to be a learned condition (Hembree, 1990). Therefore, it makes sense that "treatment can restore the

performance of formerly high-anxious students to the performance level associated with low mathematics anxiety" (Hembree, 1990, p. 44).

According to Tobias (1981), there are four major sources of anxiety for students: time pressure, humiliation, emphasis on one right answer, and working in isolation. Tobias and her colleagues, working with students at a "Math Clinic" at Wesleyan University, developed several techniques to assist students in dealing with their mathematics anxiety. The desired effect was that eventually students would realize that it is permissible to be confused, see triggers and patterns of their anxiety, and realize that a certain level of anxiety in the mathematics class is "normal" and expected of engaged learners.

Additional research has shown negative attitudes toward mathematics anxiety can be modified (Hembree, 1990; Tobias & Weissbrod, 1980). Furthermore, the values students have toward various school subjects can be modified (Eccles, 1984). Singh, Granville, and Dika (2002) found that in middle school students "attitudes toward mathematics and other school-related behaviors are flexible and can be changed through policy and changes in instructional practices" (p. 329).

While there is considerable research concerning gender differences relating to these four variables, there is substantially less research concerning the differences for traditional and non-traditional students. Furthermore, there has been no research concerning mathematical attitudes as measured by these four scales for rural and non-rural students.

Student Age

For the present study, the term “traditional students” refers to students who are under 21 years of age while “non-traditional students” refers to students who are 21 years of age and older. However, it should be noted that a standard definition of a non-traditional student is not agreed upon in the literature of mathematics instruction. Generally, non-traditional students are more likely to be female (King & Bauer, 1988; Limbert, 1991) and often have poor or rusty study skills and lack confidence in their abilities (King & Bauer, 1988; Limber, 1991). In addition, in “contrast to adolescents who tend to take college for granted, adults place more value on going to college because they have waited longer to attend – and usually attend at greater personal and economic sacrifice” (Nordstrom, 1989, p. 11). According to Cross (1980), adult learners tend to be achievement oriented, independent, and their “primary educational needs are for schedules, curricula, and instruction appropriate to their maturity and adult responsibilities” (p. 627). However, as of 1993, non-traditional students are less likely to earn a degree within 5 years of beginning their postsecondary education, and far more likely to leave school without returning than traditional students (National Center for Education Statistics, Nontraditional Undergraduates: Highlights). Finally, the likelihood that a non-traditional student will leave after his or her first year of school is twice that of traditional students (National Center for Education Statistics, Nontraditional Undergraduates: Highlights).

With regard to student attitudes, there is inconsistency within the research concerning traditional and non-traditional students and attitude toward

mathematics. According to Elliot (1990), "There is not a great deal of difference between the nontraditional and traditional students for most cognitive and affective variables" (p. 164). However, Brown (1991) in her dissertation study found significant differences between the attitudes of young, traditional students and the attitudes of older, non-traditional students. Furthermore, in a study of 100 adult learners Lehmann (1987) concluded that there is no significant difference between men and women with regard to those who reported they did or did not like mathematics and found no significant difference between the age of a respondent and the expressed liking for mathematics.

Locale

The body of research concerning mathematics instruction and rural versus non-rural students is small. The research concerning rural students' attitudes toward mathematics is nonexistent. However, a few studies and documents can add some insight into the nature and characteristics of rural students and their educational experiences.

The Rural School and Community Trust has conducted a series of three reports analyzing the status of rural education in the United States as a whole and each state individually. *Why Rural Matters* (The Rural School and Community Trust, 2005) is the third report in the series and contains the most up-to-date statistics concerning rural education. This report discusses schools at the district level in order to analyze financial variables, using the Johnson codes

of 7 and 8 to define a district as rural. According to the report, at the national level 30.3% of all public schools are located in rural areas with 19.1% of all public school students being enrolled in rural schools (Rural School and Community Trust, 2005). The national median number of students enrolled in rural schools is 148,579 students. However, in the state of Tennessee, these numbers are somewhat higher. In Tennessee, 36.0% of all public schools are located in rural areas with 30.7% of all public school students being enrolled in rural schools, which corresponds to 276,920 rural Tennessee students (Rural School and Community Trust, 2005). While these numbers may be expected when one examines the geography and demographics of Tennessee, what is not expected is the great gap in rural four-year graduation rates between the national level and the state level. At the national level, the rural four-year graduation rate is 70.5% while in the state of Tennessee the rural four-year graduation rate is 59.6% (Rural School and Community Trust, 2005).

Potential reasons for these differences are hard to discern. Cobb, McIntire, and Pratt (1989) analyzed data collected from the longitudinal study "High School and Beyond" in order to "determine if aspiration levels of rural students nationwide differ from those of students in urban and suburban settings," (p. 11). The researchers found that rural students "value their jobs more and their academics less than urban and suburban youth" (p. 12). Furthermore, rural students perceived their parents as being "much less often supportive of full-time college . . . than their urban counterparts and more supportive of full-time jobs, trade schools, and the military" (p. 13). In addition,

rural high school graduates are less likely to enroll in post-secondary education than urban or suburban graduates (Cobb et al., 1989; Gibbs et al., 1998). Finally, “rural students are not as confident as urban and suburban students in their abilities to complete a college education” (Cobb et al., 1989, p. 13).

According to DeYoung (2002), many rural areas are “unlikely to have the resources (human or economic) to provide livelihood or academic possibilities” for students (p. 9). Furthermore, DeYoung (2003) conjectures that many rural high school students define “successful living in ways that do not assume obtaining college degrees and leaving home” (p. 1). As a result, Tennessee has many students who potentially do not have the support system, resources, confidence, or drive to be successful in post-secondary education.

Developmental Students

The research of Roueche and Roueche (1999) indicate that there are several characteristics that can cause a student to be at risk and in need of developmental education. Roueche and Roueche (1999) state that students at risk may be one or a combination of the following:

- is a first-generation learner,
- has a poor self-image,
- has not left his/her neighborhood,
- works 30 hours per week,
- is an average age of 28,

- is a returning woman,
- is economically insecure,
- is economically driven,
- is academically weak,
- has poor or low test scores,
- or has a GED instead of a regular high school diploma.

Abraham and Creech (2000) go on to classify four major categories of students who enroll in developmental education. The first category is the returning adult. These students are usually in their mid-twenties and are returning to school in order to attain a new job. The second category is the recent high school graduate who took the college preparatory curriculum and earned high grades, but the school did not maintain a vigorous curriculum. Thus, the student is unprepared for college level courses. The third category is the recent high school graduate who took the college preparatory curriculum, but earned low grades. The fourth category is the recent high school graduate who did not take the college preparatory curriculum. These categories and characteristics compound the fact that a wide variety of students enroll in a developmental course together with varied needs and background knowledge.

Regardless of the reason for being placed in developmental education, community colleges are the largest source of developmental instruction (Golfin et al., 2005). In 2000, only 38.94% of the 2000 Tennessee high school graduating class did not need any developmental coursework (English, mathematics, or reading) in Tennessee's two-year institutions (Tennessee Higher Education

Commission, 2001). Furthermore, 72.1% of Tennessee's first-time freshmen from fall 1998 through fall 2000 needed at least one developmental course in English, mathematics, or reading at the two-year college level (Tennessee Higher Education Commission, 2001). According to Abraham and Creech (2000) in a Southern Regional Education Board report, in Tennessee over the past ten years:

> Nearly two-thirds of high school graduates who entered two-year colleges within one year needed at least one [developmental] . . . course. Eighty percent of those who graduated from high school more than a year before entering college needed academic refresher courses. (pg. 6)

Furthermore, as of 1997, at Tennessee's two-year colleges two-thirds of those students taking developmental courses were returning adults, or non-traditional students (Creech, 1997). Finally, at the national level in 2000, 35% of freshmen at two-year colleges enrolled in developmental mathematics courses (National Center for Education Statistics, 2003).

Research suggests that developmental students do not possess the organization schema necessary to be successful in many academic areas (Cross, 1976) and these weak students would benefit from "highly structured learning experiences" in order to help them compensate for their lack of organizational schema (Boylan & Saxon, 1999, p. 3; Cronbach & Snow, 1977; Kulik & Kulik, 1991). Furthermore, Boylan and Saxon conclude that students "in remedial courses have been lectured to in the past without much effect" (1999, p. 3). Boylan and Saxon argued for "the use of a wide variety of teaching

techniques" since "the body of research [suggests] that [developmental] students learn in ways not accommodated by traditional instruction" (1999, p. 3). As a result, developmental students may represent an even more broad range of learning styles than non-developmental students.

Learning Styles

Learning styles can be defined simply as the "way in which individuals learn information" (Atkinson & Longman, 1995, p. 307). Price (2004) refines this definition to explain:

> Learning style is often used as a metaphor for considering the range of individual differences in learning. The term 'learning style' when used in this way is considered to include a range of constructs describing variations in the manner in which individuals learn. (p. 681)

Curry (1983) posits three categories or layers to learning style: instructional preference, information processing style, and cognitive personality style. The cognitive style layer is the inner-most layer "defined as the individual's approach to adapting and assimilating information" that is less likely to be modified by instruction (p. 3). The information processing style layer, refers to how an individual prefers to process information obtained from external stimuli. This layer is relatively stable, but modifiable and is influenced by cognitive personality style. The outer layer, instructional preference, refers to environmental

characteristics under which a student prefers to learn. According to Curry, a student's instructional preferences are the most likely to be modified by instruction and influenced by his or her information processing style and cognitive personality style. Two important components of a student's instructional preferences are color and organization.

Instructional Preferences: Color

Much research has been conducted concerning the effects of color on student learning. Francis Dwyer, David Moore, and Richard Lamberski conducted a series of studies exploring the use of color in anatomy and physiology instruction; their study used the anatomy and functions of the human heart during diastolic and systolic heartbeat to explore the effects of color on achievement in an anatomy and physiology course (Dwyer & Moore, 1999; Moore & Dwyer, 1998; Lamberski & Dwyer, 1983). The students received instructional booklets containing "one page of directions and twenty pages of concepts and functions of the heart integrated by prose text with accompanying visualization" (Moore & Dwyer, 1998, p. 292). Half the booklets were color coded with six colors and the other half of the booklets were all black text and black and white visuals. Color was used to "1) emphasize the central concepts being presented; 2) . . . structure a large number of heart concepts into smaller category groups; 3) . . . differentiate dissimilar concepts; and 4) . . . contextually (physical form) and semantically (associative value) relate similar concepts or functions" (Moore & Dwyer, 1998, p. 292). Dwyer and Moore found "students

who received the color coded instructional treatment achieved significantly higher scores on the identification, drawing, and total criterion test than did those students who received the black and white" (1998, p. 295). This "indicates that color remains to be an important instructional variable in improving student achievement" (Moore & Dwyer, 1998, p. 295), which re-affirmed similar results found by Lamberski and Dwyer (1983) in an earlier study. Furthermore, "the more visual color code in instructional materials enabled greater concept acquisition, greater availability at retrieval, and a memory decline rate similar to that of the black/white instructional treatments." (Lamberski & Dwyer, 1983, p. 19).

Berry (1991) summarizes the results of fifteen years of color studies conducted at the University of Pittsburgh as having two conclusions relevant to this study. First, "all forms of color facilitate the recognition of visual material equally well. Both realistic and nonrealistic color materials are superior to monochrome materials in terms of their utility as cueing devices" (p. 7). Second, "in recall memory tasks, realistic color cueing is most effective, followed by black & white and line drawing formats" (Berry, 1991, p. 7).

Pruisner (1993; 1995) conducted a series of studies to determine the impact of color on learning. Students were exposed to one of two types of presentation summarizing a Norse myth. One was a color-cued presentation while the other was a black and white presentation, followed by either a color-cued or black and white assessment for a total of four treatment groups. One of the studies was conducted with middle school students in grades seven through

nine (Pruisner, 1993). As a result of this study, one major finding came to light: "the important factor in enhancing performance appeared to be the presence of a systematic color cue" in the graphic presentation (Pruisner, 1993, p. 31). However, this finding was not supported when the same study was conducted with college students (Pruisner, 1995). The use of color did not have a significant impact on the recall and retention of verbal information presented in graphic form. However, some of the students who received the color-cued graphic presentation and took the black and white assessment wrote the correct color names used in the color-cued graphic beside the black and white questions. As a result, Pruisner concluded "the notation of the color names on three of the black/white graphic assessments clearly indicates that some students use a color strategy to facilitate recall and retention" (Pruisner, 1995, p. 6), thus underscoring the role of the relation of color to instructional preferences for some students.

Longo (2001) used Visual Thinking Networks (VTNs) to explore how color impacted student learning in a high school freshmen level earth science class. Longo defines a VTN in the context of an earth science class as "a tool for the learner to organize, represent, and revise her/his meaning making of science knowledge by chunking and linking conceptual labels with colored symbolic visualizations of scientific concepts, processes, and experiences into a coherent whole" (p. 3). Students in two experimental classes were allowed to construct their own VTNs in color or black and white and with or without symbolic images. Students in the control class were given instructions on how to use writing

strategies to express their understanding of the material. All students then received the same assessment. Results of the assessment revealed "learning was most improved in the area of problem solving achievement for those students who used color VTNs" (p. 9). Longo also found females used more color VTNs than boys. Furthermore, the females who used color VTNs displayed a knowledge that became more interrelated in that they were able to "generate more accurate connections in their ability to solve problems" (p. 13).

Finally, research supports the fact that color does assist students to categorize and organize material into meaningful patterns, enabling students to interpret and adjust to their environment (Dwyer & Lamberski, 1982-83; Longo, 2001). Furthermore, color acts as an attention-getting device (Lamberski & Dwyer, 1983, p. 18; Longo, 2001) during learning and instruction. These two traits together aid in "enhancing conceptual recall and in the reconstruction of memory" (Longo, 2001, p. 13). In addition, Dwyer and Lamberski (1982-83) found "color coded materials were preferred by learners over other coding systems and, furthermore, learning rates and learner performance improved with the color coded materials" (p. 314) but caution that the value of color is highly dependent upon the complexity of the task.

Instructional Preference: Organization

The works of Pascarella et al. (1996) and Pittman (1985) have established the importance of organization in student learning. Pascarella et al. (1996) conducted a nation-wide study of first-year college students to determine the

factors that influence learning and cognitive development. The study reveals "teacher organization/preparation is a more salient influence than other dimensions of teacher behavior even when the outcome is general cognitive skills rather than course-level achievement" (Pascarella et al., 1996, p. 17). Pittman (1985) reached a similar conclusion when he investigated "which teacher instructional characteristics (creativity, organization, understanding) are most highly related to the criterion variables – motivation, performance, and perceived instructor effectiveness" (p. 38). Pittman's results indicate "the organizational element in teaching was the most highly related to each of the outcome areas" (Pittman, 1985, p. 38).

Presentation Software

Little research has been conducted in the realm of presentations software with virtually no studies examining the effectiveness of mathematics instruction with presentation software or its effects on students' mathematics attitudes. However, literature does exist discussing the benefits to the student that features of presentation software can provide and the effects on student achievement in non-mathematics courses. This literature review examining presentation software focuses on the benefits of presentation software, student perceptions of presentation software, and the results of studies on presentation software and student achievement.

Benefits of Presentation Software

Daniels (1999) points out that PowerPoint® presentations can assist students with visual differentiation, which agrees with the literature concerning the benefits of color previously discussed. For example, multiple colors can be used "for the text, graphics, and background of the slides, which make the slides easier to understand than when read on a chalkboard" (p. 44). Furthermore, "in a more traditional setting, students may be unsure when a professor has finished with an anecdote or side issue and returned to the main points of the lecture" (Daniels, 1999, p. 45). With PowerPoint® slides, students are more aware of when the instructor has returned to the focus of the lecture.

PowerPoint® presentations are able to assist the teacher in providing organized notes for the students (Daniels, 1999) and structure to the lesson (Susskind, 2005), which, as Pascarella et al. (1996) and Pittman (1985) have noted, are important for student learning. In student surveys conducted in classes that used PowerPoint® presentations, students rated the presentations as improving their note taking (Susskind, 2005) and making the instruction and material more organized than traditional methods of instruction (Susskind, 2005; Cassady, 1998). Instructors have indicated that the presentations increase the flow of the lesson by eliminating the need to hunt for and change transparencies (Lowry, 1999) and worry about transparencies getting lost or out of order (Cassady, 1998).

Software Presentations and Student Perception

Surveys from an international relations course at the University of Cincinnati in which the instructor utilized PowerPoint® presentations in place of traditional overhead projections reveal that over 80% of the students felt the presentations were beneficial (Harknett & Cobane, 1997). Similar results were found with a Russian fairy tales course at the University of Pittsburgh in which PowerPoint® presentations were used during the lectures (Frey & Birnbaum, 2002). The majority of the Russian fairy tales students reported having a positive perception about the use of the presentations in lectures, feeling the presentations emphasized key points, believing that the visual images in the presentations helped them to recall information for tests, and feeling the presentations held their attention.

Cassady (1998) examined the views of students enrolled in an educational psychology course toward the use of computer-aided presentations. Five sections with four different instructors participated in the study with one section serving as the control group. The students rated the presentation of one lesson with a survey at the conclusion of the lesson. The results indicate that "undergraduate students perceive computer-aided lectures making use of multimedia features as more effective than traditional lectures" in the following areas: " 1) ability to hold the attention of the class, 2) interesting nature of material, 3) organization of the material, 4) instructor preparedness, 5) ease in following the presentation, 6) clarity of information, and 7) flow of the information in the presentation" (Cassady, 1998, p. 185).

In a college-level, semester-long study Nowaczyk, Santos, and Patton (1998) presented lecture material on computer slides through text, static graphics, and limited-animation graphics in a behavioral statistics course; in the study students were given a copy of the computer slides in advance. An analysis of student responses indicated students significantly preferred the multimedia presentation method to traditional lecture methods.

Results from a survey given to students enrolled in a freshman level fundamentals of public speaking course at Del Mar College, a community college in Texas, which used PowerPoint® presentations, produced findings similar to those found at the university level (Atkins-Sayre, et al, 1998). The majority of the public speaking students reported that the presentations helped them maintain interest in the lecture, enhanced their understanding of the material, and helped them to retain material. Furthermore, these "students perceived themselves to have a higher self-efficacy when exposed to PowerPoint" presentations than when exposed to traditional lectures (Atkins-Sayre et al., 1998, p. 9).

Austin-Wells, Zimmerman, and McDougall (2003) found senior citizens preferred PowerPoint® presentations to flip charts or overhead projections. The study presented three topics to the senior citizens in different presentation styles: 1) "Buying Drugs in Foreign Countries" with PowerPoint® presentation, 2) "Consumer Fraud and Crimes Against Elderly" with a flip chart, and 3) "Drug Interactions" with overhead projections (p. 494). The subjects were then interviewed in groups concerning their thoughts on the presentation styles. Participants preferred PowerPoint® presentations because of the emphasis on

"brighter colors, larger text, simplicity of format, and high novelty, all of which reduced boredom and fatigue" (p. 499). This study supports the idea that students who did not grow up during the graphics- and technology-saturated era find the software presentations appealing.

Presentation Software and Achievement

Numerous studies have been conducted concerning whether or not the use of presentation software affects student achievement with mixed results. Rankin (2001) found PowerPoint® presentations to have "no significant effect in terms of student performance" (p. 113) in an experimental study with students enrolled in four sections of introductory economics in which two sections were taught with the aid of PowerPoint® presentations. Rankin calls for further research to examine how PowerPoint® presentations affect students' attitudes toward economics. Moreno and Mayer (2000) both concluded the use of PowerPoint® presentations had neutral to negative effects on student performance in psychology classes.

Daniels (1999) conducted a study with students from a principles of macroeconomics class and an intermediate microeconomics theory class. The first year the classes were taught without the use of PowerPoint® presentations while the second year classes were taught with the aid of PowerPoint® presentations. An analysis of a set of core final exam questions common to all four classes revealed that the "use of PowerPoint slides was not significant in either set of classes" (p. 50). However, in a survey concerning the students'

views toward the PowerPoint® presentations, the majority of the students preferred the presentations (1999).

Susskind (2005) found similar results in a study with psychology students. In alternating order, two sections of introduction to psychology were taught with traditional lectures for five weeks and with PowerPoint® presentations for five weeks. While Susskind's study shows no significant effect on performance when students are exposed to both traditional and multimedia lectures over the course of the semester, student surveys indicated the students perceived the PowerPoint® presentations to be "more organized and easier to understand" (p. 211). Finally, students reported greater positive attitudes and self-efficacy beliefs when PowerPoint® presentations were used (Susskind, 2005).

Lowry (1999) conducted a longitudinal study of the retention of material by students enrolled in a first-year environmental science course during their first semester. During the first year of the study, much of the information, including the teaching of problem solving in the course, was presented using transparencies. During the second and third year, all information previously presented with transparencies was presented with PowerPoint® slides. The author cites the primary benefits of PowerPoint® presentations to be "consistent use of color; easily created signposting/summaries; gradual building of text; simple animation of diagrams; [and] facilities for simple editing and updating" (Lowry, 1999, p. 19). Lowry found that for two successive years following the introduction of PowerPoint® presentations, the mean examination performance during the second year of the course was significantly increased.

Mantei (2000) conducted a similar study with students enrolled in physical geology. Exam scores from five years of courses that consisted of traditional lectures were compared to the exam scores of the following two years when PowerPoint® were incorporated into lectures. In the two years when PowerPoint® presentations were used, hard copies of the slides were made available to students prior to the lesson. The mean exam scores from each of the two years in which PowerPoint® presentations and hard copies were used were significantly higher than the mean exam scores for each of the previous five years in which traditional lectures were used (2000).

Finally, Szabo and Hastings (2000) found positive results when first and third year university students were surveyed in two modules of two courses in which PowerPoint® presentations were utilized, “Motor Learning” and “Sport and Exercise Psychology”. The majority of these students reported the presentations motivated them to attend lectures, that they felt the presentations were more interesting than traditional lectures, believed the presentations were more attention-capturing than traditional lectures, and felt the presentations were beneficial for their learning. In addition, grades on the exams covering each module were compared to grades on the same exam the previous year. No significant differences were found between the grades of the students taught with and without PowerPoint® presentations.

In a second study by Szabo and Hastings (2000), second year university students taking a “Research Methods in Sports and Exercise” module were exposed to three lecture methods for three consecutive weeks. During week

one, the lecture was delivered with an overhead projector and blackboard. During week two, the lecture was delivered with the use of PowerPoint® presentations and some use of the blackboard. During week three, the lecture was delivered with the use of PowerPoint® presentations and some use of the blackboard; also, students were supplied with the printed slides before class. Multiple-choice exams were administered covering the topics from each week. The results indicated that the PowerPoint® presentation lectures "resulted in better performance on the multiple-choice test" (p. 183) as compared to the other two conditions.

In a third study by Szabo and Hastings (2000), one group of first year sport science students and one group of first year combined science students received the first thirty minutes of their three hour class using an overhead projector based lecture and PowerPoint® presentation based lecture in counterbalance order. Students in both classes were given a multiple-choice test covering their respective classes one week after their lectures. Results indicated the students in the sports science class performed better on the test covering material presented by the PowerPoint® presentations while the combined science students performed better on the test covered by the overhead based lectures (2000). As a result, Szabo and Hastings suggest the efficacy of PowerPoint® presentations may be case-specific with regard to content rather than universal (2000).

Summary

Numerous studies have examined presentation software with mixed results in relation to its effects on student achievement. However, there is some indication that presentation software has a positive effect on student attitudes. Furthermore, presentation software provides opportunities for the use of color and organization, both of which have been shown to be effective learning tools. Developmental students have been found to be weak in their ability to organize information and could benefit from structured environments. Finally, student attitudes have been found to have some effect on student achievement, which is the ultimate goal of any instructional practice, and these attitudes can be modified.

CHAPTER III

Research Methodology

Research Questions

The purpose of this study is to look at the effects of using technologically enhanced presentations on the attitudes of students enrolled in elementary algebra and whether these effects are influenced by gender, locale, or age. The specific research questions follow:

1. Does the use of presentation software affect elementary algebra students' attitudes toward mathematics?
2. Does the use of presentation software affect the attitudes of any subgroup more than others, specifically gender, locale, and age?

Subjects

The students who participated in this study were all enrolled in one community college in eastern Tennessee in one of eight sections of elementary mathematics during the spring semester of 2006. These sections were taught on one of two campuses. Random assignment of students was assumed because there is no control over who registers for what class. Furthermore, it was not publicized which instructors would be participating in the study. Initially, 163 students participated in the study with 99 of those completing all three surveys.

Fifty-one (51.5%) students were enrolled in the traditional classes, the control group, while forty-eight (48.5%) students were enrolled in the

presentation software classes, the experimental group. Of the 99 participants, 42 (42.4%) were male and 57 (57.6%) were female. Thirty-eight (39.4%) of the 99 participants were classified as non-rural by the Johnson Codes of their high schools (Johnson Code of 1 – 6), 57 (57.6%) of the participants were classified as rural (Johnson Code of 7 or 8), and 4 (4.0%) were excluded from the locale analysis due to being educated outside the United States or not presenting adequate information to classify. Finally, the ages of the participants who completed the study ranged from 18 to 49 with a mean of 25.8 years of age. Of the 99 participants that completed the study, 42 (42.2%) were classified as traditional (under 21) while 57 (57.6%) were classified as nontraditional (21 or older).

Design

Four instructors participated in the study with each instructor teaching one class using presentation software, the experimental group, and one class using traditional lectures, the control group. Thus, the eight classes participating in the study created a 2 x 4 design. The delivery method was the only planned difference between the two types of classes. To control for the potential bias from the time of day, the faculty involved in the study participated in the scheduling of spring classes in order to decrease the probability of bias in course selection. Two instructors taught their experimental class earlier in the day while the other two instructors taught their control class earlier in the day. Three of the

four instructors taught their two sections on the same day, either on Monday / Wednesday / Friday or on Tuesday / Thursday. The fourth instructor taught one section on Monday / Wednesday and the other section on Tuesday / Thursday.

Instructors

Three of the four instructors have doctoral degrees, and the fourth is in the process of writing his/her dissertation. All four instructors have been teaching at the community college level for at least five years and have successfully taught this course previously using traditional delivery. All of the instructors voluntarily agreed to participate in the study. (See Appendix A for the instructors' vitas.) All of the sections used the same text, the same syllabi, the same final exam, and graphing calculators. To ensure similar experiences for the students in each delivery, the instructors engaged in web-based discussions throughout the semester concerning teaching methods, assessment practices, and pacing. Furthermore, the researcher collected the presentation software lessons for each section taught by each instructor. (See Appendix B for sample PowerPoint® lessons.)

Classroom Conditions

Although located in two different campuses, each classroom was outfitted with similar equipment. Each classroom housed a ceiling-mounted LCD

projector that was connected to a computer and a document camera. Furthermore, each classroom projector projected onto an interactive whiteboard. While teaching the control classes, instructors were allowed to use the document camera for the projection of the graphing calculator, textbook pages, graphs, and handouts. Furthermore, in the control classes instructors were not allowed to print slides from the PowerPoint® presentations used in the experimental classes for display with the document camera in the control classes nor were they allowed to use the interactive whiteboard. While teaching the experimental classes, instructors were limited in their use of the document camera to the projection of the graphing calculator and textbook pages. In addition, in the experimental classes, the instructors were only allowed to utilize the SmartBoard to write on a PowerPoint® slide. Finally, the PowerPoint® slides were not made available to students on the web or in hardcopy form in order to exclude possible benefits from additional notes.

Measures

Students in all classrooms were surveyed on four of the seven domains of the Fennema-Sherman Mathematics Attitudes Scales (1976) three times during the semester. The four domains used in the survey include the following: Attitude Toward Success in Mathematics, Confidence in Learning Mathematics, Mathematics Anxiety Scale, and the Mathematics Usefulness Scale. Each scale contains 12 items that were scored on a 5-point Likert scale from A (strongly

agree) to E (strongly disagree). Letters were used in place of numbers on the survey in order to not sway students of the desirability of a response. Half of the items on each scale are positively worded and half are negatively worded. The procedures described by the authors of the instrument were used to analyze the responses: positively worded items were reverse-scored before analysis so that a 5 represents a strongly agree response and a 1 represents a strongly disagree response. Thus, a high mean on a scale represents a positive attitude toward mathematics or less mathematics anxiety. Responses that were left blank were assigned a value of three, a neutral response. The surveys used for the week nine test and week fifteen test were randomized versions of the week one test (see Appendix C).

The survey was administered during the first week of classes (pre-test), between tests two and three at week nine (mid-test), and during the last week of classes, week fifteen (post-test). Students were given the opportunity to decline participation without penalty to their class standing. All administrations of the surveys were given during a regularly scheduled class meeting, usually consuming approximately fifteen minutes of class time.

Data Analysis

Data were analyzed using SPSS 14. All four of the Fennema-Sherman Mathematics Attitudes Scales (1976) on each of the three administrations of the survey were tested for reliability using Cronbach's Alpha. To determine if each of

the Fennema-Sherman Mathematics Attitude Scales differed over time or by class, Multivariate Analysis of Variance with repeated measures was run using the Wilk's Lambda as an indicator for significance. Additional MANOVAs with repeated measures were run to test if gender, locale, or age had an effect on time or class. For the purposes of this study "time" will refer to the three different administrations of the survey (pre-test, mid-test, and post-test) and "class" will refer to the delivery method (experimental group vs. control group). If a MANOVA with repeated measures indicated significance, appropriate post-hoc analyses were run to explore how the scales differed. Data were analyzed with respect to class, time, gender, locale, and age.

Summary

A total of four instructors, each teaching an experimental and control group, participated in the study as did 163 students in their intact classroom. All students were administered the Fennema-Sherman Mathematics Attitudes Scales (1976) at three points during the semester: week one (pre-test), week nine (mid-test), and week fifteen (post-test). A total of 99 students completed all three administrations of the Fennema-Sherman Mathematics Attitudes Scales (1976). The experimental group received instruction in elementary algebra using presentation software, textbook pages, graphing calculator, and handouts. The control group received instruction in elementary algebra in a traditional means, including a graphing calculator. Multivariate Analysis of Variance with repeated

measures was used to measure the effect of classroom delivery method (experimental vs. control) on three administrations of the Fennema-Sherman Mathematics Attitudes Scales (1976). Post hoc analyses also considered the effects of time, gender, locale (rural vs. non-rural), and age (traditional vs. non-traditional).

CHAPTER IV

Results

Introduction

Data were analyzed using the Statistical Package for the Social Sciences (SPSS v. 14). In order to answer the research questions posed, both descriptive and inferential statistics were used. The report of the analysis will be divided into three parts: an examination of the reliability and correlations of the four scales used in the study, the effects of the treatment on the four attitude scales as compared to the control group, and the effects that gender, locale, and student age had upon the four attitude scales. The Fennema-Sherman Mathematics Attitudes Scales (1976) survey used to collect data for the pre-test for this research can be found in Appendix C.

Reliability of Instrument Between Administrations

Before performing any analysis, the four scales of the Fennema-Sherman Mathematics Attitudes Scales (1976) used in the study were examined for reliability. Cronbach's Alpha was used to test for reliability. All scales were above 0.80 for all three administrations except one scale at the pre-test which was 0.793, close enough to be considered. Also, this scale was above 0.80 at the mid-test and post-test. (See Table 4.1).

Table 4.1 Reliability for Subscales and Overall Instrument

	Pre	Mid	Post
Confidence	.913	.932	.943
Usefulness	.923	.900	.907
Success	.793	.897	.890
Anxiety	.919	.937	.942
Overall	.930	.940	.950

The Pearson Correlation was used to test for correlations between the four scales of the Fennema-Sherman Mathematics Attitudes Scales (1976) used in the study. For all three administrations of the survey, confidence had a significant positive correlation with usefulness at the 0.01 level, confidence had a significant positive correlation with anxiety at the 0.01 level, and usefulness had a significant positive correlation with anxiety at the 0.05 level. (See Table 4.2, 4.3, and 4.4). For the third administration of the survey, usefulness and success had a significant positive correlation at the 0.01 level. (See Table 4.4).

Confidence, Usefulness, Success, and Anxiety

A Multivariate Analysis of Variance with repeated measures was run using the Wilk's Lambda as an indicator for significance for each of the scales with respect to time and class. The Wilk's Lambda revealed a significant interaction for confidence with respect to time and class ($F_{2, 96} = 4.053$, $p = .020$). (See Figure 4.1). To further examine this, an independent sample t-test was run for each time period comparing the experimental group and control group. This analysis showed that the experimental and control groups did not significantly differ at the time of the pre-test or post-test; however, at the mid-test, the two groups did significantly differ ($p = .024$) with the control group having a higher confidence level than the experimental group. (See Table 4.5).

Table 4.2 Pre-test Correlations

		confidence1	usefulness1	success1	anxiety1
confidence1	Pearson Correlation	1	.389(**)	.007	.889(**)
	Sig. (2-tailed)		.000	.942	.000
usefulness1	Pearson Correlation	.389(**)	1	.006	.210(*)
	Sig. (2-tailed)	.000		.956	.037
success1	Pearson Correlation	.007	.006	1	-.011
	Sig. (2-tailed)	.942	.956		.910
anxiety1	Pearson Correlation	.889(**)	.210(*)	-.011	1
	Sig. (2-tailed)	.000	.037	.910	

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

Table 4.3 Mid-test Correlations

		confidence2	usefulness2	success2	anxiety2
confidence2	Pearson Correlation	1	.310(**)	-.008	.886(**)
	Sig. (2-tailed)		.002	.937	.000
usefulness2	Pearson Correlation	.310(**)	1	.043	.253(*)
	Sig. (2-tailed)	.002		.672	.012
success2	Pearson Correlation	-.008	.043	1	-.010
	Sig. (2-tailed)	.937	.672		.924
anxiety2	Pearson Correlation	.886(**)	.253(*)	-.010	1
	Sig. (2-tailed)	.000	.012	.924	

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

Table 4.4 Post-test Correlations

		confidence3	usefulness3	success3	anxiety3
confidence3	Pearson Correlation	1	.271(**)	.056	.895(**)
	Sig. (2-tailed)		.007	.582	.000
usefulness3	Pearson Correlation	.271(**)	1	.268(**)	.237(*)
	Sig. (2-tailed)	.007		.007	.018
success3	Pearson Correlation	.056	.268(**)	1	-.005
	Sig. (2-tailed)	.582	.007		.960
anxiety3	Pearson Correlation	.895(**)	.237(*)	-.005	1
	Sig. (2-tailed)	.000	.018	.960	

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

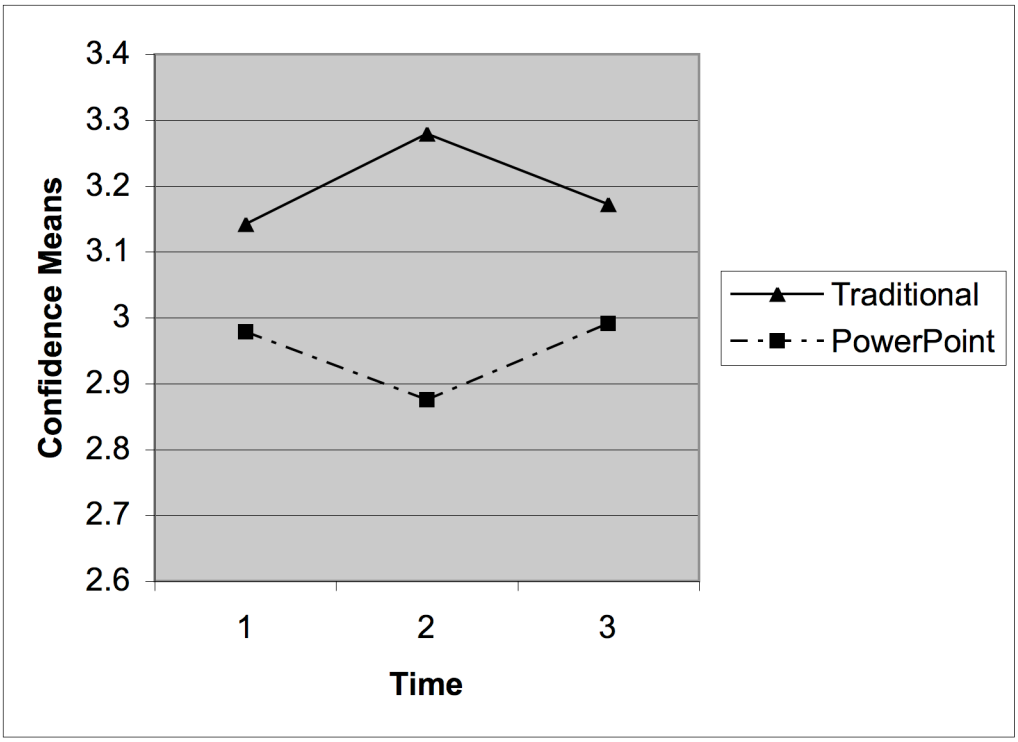


Figure 4.1 Confidence Means

Table 4.5 Independent Sample t-tests for Confidence

	t	df	Sig. (2-tailed)
Pre-test confidence	.924	97	.358
Mid-test confidence	2.292	97	.024
Post-test confidence	.987	97	.326

There was no significant difference for students' attitudes toward mathematics on the scale of mathematical usefulness with respect to class over time ($F_{2, 96} = 1.458$, $p = .238$). However, regardless of class, student attitudes toward mathematical usefulness declined significantly over time ($F_{2, 96} = 4.735$, $p = .011$). (See Table 4.6).

There were no significant differences ($F_{2, 96} = 0.018$, $p = .982$) for students' attitudes toward success in mathematics with respect to class over time. Furthermore, there were no significant differences ($F_{2, 96} = 2.828$, $p = .064$) for students' attitudes toward success in mathematics with respect to time.

There were no significant differences for students' attitudes toward mathematics on the scales of mathematics anxiety with respect to class over time ($F_{2, 96} = 0.193$, $p = .825$). However, regardless of class, student mathematics anxiety levels declined significantly over time ($F_{2, 96} = 3.234$, $p = .044$). Since a higher score on the mathematics anxiety scale means a lower level of mathematics anxiety, a significant decline, although slight, in the mathematics anxiety levels means that student mathematics anxiety slightly increased from the pre-test to the post-test. (See Table 4.7).

Gender, Locale, and Age

A Multivariate Analysis of Variance with repeated measures was run using the Wilk's Lambda as an indicator for significance for each of the scales with respect to time and class and subgroup (gender, locale, and age). The first

Table 4.6 Usefulness Means Over Time

time	Mean
Pre-test usefulness	3.733
Mid-test usefulness	3.724
Post-test usefulness	3.581

Table 4.7 Anxiety Means Over Time

time	Mean
Pre-test anxiety	2.934
Mid-test anxiety	2.807
Post-test anxiety	2.775

subgroup to be examined was gender. There were no significant differences between the confidence in learning mathematics level, attitude toward mathematics usefulness, attitude toward success in mathematics, or mathematics anxiety level with respect to class and gender over time. However for students' attitudes toward their confidence in learning mathematics, regardless of class, there was an interaction between time and gender ($F_{2, 94}$ = 3.612, p = .031). (See Figure 4.2). T-tests were run for each time point comparing gender. At the pre-test during week one (p = .006) and the mid-test during week nine (p = .029), there were significant differences between the mean of the confidence in learning mathematics scores of males and females at each administration with males being more confident. However, by the post-test during week fifteen (p = .339), the mean of the confidence in learning mathematics scores had trended together to the point that no significant difference existed.

The second subgroup to be examined was locale (rural vs. non-rural). There were no significant differences between the confidence in learning mathematics level, attitude toward mathematical usefulness, attitude toward success in mathematics, or mathematics anxiety level with respect to class and locale over time. However, there was an interaction between locale and class ($F_{1, 91}$ = 4.277, p = .041). (See Figure 4.3). To examine this interaction, all mathematics anxiety scores were averaged since time was not an effect. T-tests for each locale was run comparing classes. For non-rural students,

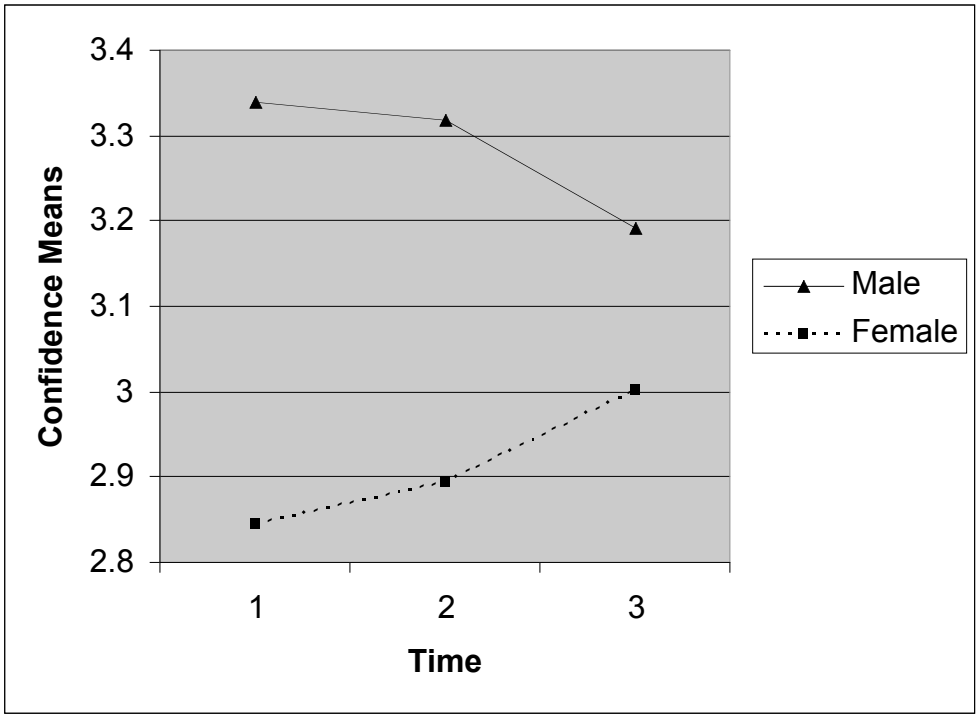


Figure 4.2 Confidence Means by Gender Over Time

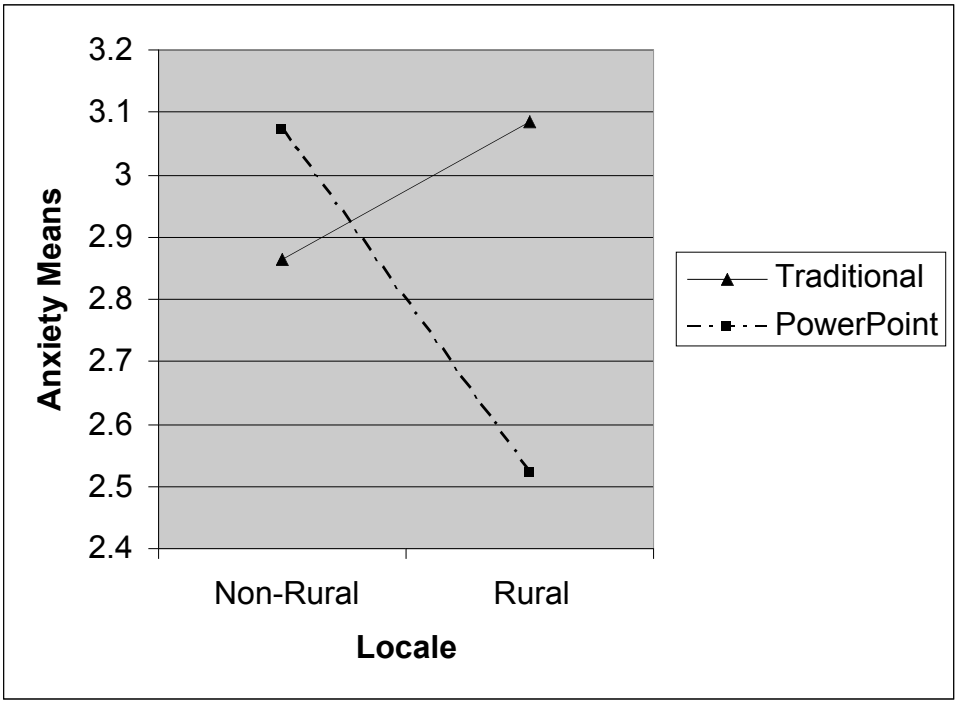


Figure 4.3 Anxiety Means by Locale

there was no significant difference between the mean of all mathematics anxiety scores of students in the control group versus the mean of all mathematics anxiety scores of students in the experimental group (p = .474).

However, for rural students, there was a significant difference between the mean of all mathematics anxiety scores of students in the control group versus the mean of all mathematics anxiety scores of students in the experimental group (p = .019). The experimental group had significantly lower mathematics anxiety scores ($\overline{x} = 2.52$), which translated to higher levels of mathematics anxiety reported by students in the experimental group than the students in the control group ($\overline{x} = 3.09$).

Finally, the last subgroup to be examined was age (traditional vs. non-traditional). There were no significant differences between the confidence in learning mathematics levels of students with respect to class and age over time. Nor were there any significant differences between the attitudes toward mathematical usefulness, attitude toward success in mathematics, or mathematics anxiety levels with respect to class and age over time.

Summary

Chapter IV presented the results from an examination of the reliability and correlations of the four scales used in the study, the effects of the treatment on the four attitude scales as compared to the control group, and the effects that gender, locale, and student age had upon the four attitude scales. Tests for

reliability using Cronbach's Alpha showed that all three administrations of the instrument were reliable.

When considering confidence in learning mathematics, mathematics usefulness, success in mathematics, and mathematics anxiety, a significant difference was found at the time of the mid-test during week nine for confidence in learning mathematics levels with the control group having a higher confidence in learning mathematics level than the experimental group. Furthermore, regardless of class, student attitudes toward mathematical usefulness significantly declined over time. In addition, regardless of class, mathematics anxiety levels significantly increased over time.

Finally, when examining gender, locale, and age, a significant difference was found for rural students between the mathematics anxiety scores of students in the control group versus the mathematics anxiety scores of students in the experimental group, with the experimental group reporting significantly higher mathematics anxiety levels. Furthermore, significant differences between the confidence in learning mathematics scores of males and females at the pre-test and mid-test were revealed with males being more confident in learning mathematics in both settings. However, at the post-test, no significant differences were found between males and females with respect to their confidence in learning mathematics.

CHAPTER V

Conclusions

Students often come to college lacking the basic skills in mathematics needed to be successful. As community colleges operate with an open enrollment policy, all students are accepted and then steps are taken to help them reach the necessary level of proficiency in mathematics. Developmental mathematics classes were created to meet this need. Today, a rising number of students require developmental education. Therefore, research into ways to improve these classes is critical. Developmental students' attitudes toward mathematics tend to be quite negative, in part as a result of being unsuccessful in previous mathematics courses. If students' attitudes could be improved, research shows this would possibly improve their achievement.

The purposes of this study are two-fold: to investigate whether the use of presentation software as the primary delivery system would affect student attitudes toward mathematics and to investigate the differential impact presentation software might have the attitudes toward mathematics of rural and non-rural students. Presentation software effectively utilizes two aspects of instruction shown to be advantageous when working with developmental students: the use of color and facilitation of organization.

Summary of the Study

In order to better understand how the use of presentation software effects student attitudes toward mathematics, an experimental study was conducted in the spring semester of 2006 with four instructors each teaching two classes at a community college in eastern Tennessee. Each instructor taught two sections of elementary algebra, one with a traditional delivery system and one with presentation software as the primary delivery system. The students in these classes completed four subscales of the Fennema-Sherman Mathematics Attitude Scales (1976) in order to detect any change in their attitudes toward mathematics three times during the semester: during the first week of classes (pre-test), between tests two and three at week nine (mid-test), and during the last week of classes, week fifteen (post-test). The four subscales of the Fennema-Sherman Mathematics Attitude Scales (1976) used were the Confidence in Learning Mathematics Scale, the Mathematics Usefulness Scale, the Attitude Toward Success in Mathematics, and the Mathematics Anxiety Scale.

In addition to examining the effects that presentation software had on student attitudes toward mathematics, three student characteristics (gender, locale [rural vs. non-rural], and student age [traditional vs. non-traditional]) were examined to determine whether or not they had any interaction with student attitudes and delivery. The student's locale was determined by the Johnson code assigned to their high school as determined by the National Center for Education Statistics. With respect to student age, a student was classified as

traditional if he or she were under 21 years of age and non-traditional if he or she were 21 years of age or older.

Each classroom used in the study housed a ceiling-mounted LCD projector that was connected to a computer and document camera and projected onto an interactive whiteboard. While teaching the control classes, instructors were allowed to use the document camera for the projection of the graphing calculator, textbook pages, graphs, and handouts. Furthermore, in the control classes instructors were not allowed to print slides from the PowerPoint® presentations used in the experimental classes for display with the document camera nor were they allowed to use the interactive whiteboard. While teaching the experimental classes, instructors were limited in their use of the document camera to the projection of the graphing calculator and textbook pages. In addition, in the experimental classes, the instructors were allowed to utilize the SmartBoard only to write on a PowerPoint® slide. Finally, the PowerPoint® slides were not made available to students in either class in hardcopy form or on the web.

Findings

The findings of this study will be presented based on the results for the overall change in attitudes toward mathematics for both the control and experimental class together with the attitude changes with respect to gender, locale, and student age.

Confidence, Usefulness, Success, and Anxiety

The analysis showed that the experimental and control groups did not significantly differ in their confidence level at the time of the pre-test or post-test; however, at the mid-test, the two groups did significantly differ on confidence with the control group having a higher confidence in learning mathematics than the experimental group. There were no significant differences for students' attitudes toward success in mathematics or students' attitudes toward mathematical usefulness with respect to class over time; however, regardless of class, student attitudes toward mathematical usefulness declined significantly over time. There were no significant differences for students' attitudes toward mathematics anxiety with respect to class over time. However, in all classes student mathematics anxiety scores increased slightly from the pre-test to the post-test.

Gender, Locale, and Age

With respect to gender, there were no significant differences between the confidence in learning mathematics scores, attitude toward mathematical usefulness, attitude toward success in mathematics, or mathematics anxiety scores with respect to class and gender over time. However, with respect to confidence in learning mathematics, regardless of class, there was an interaction between time and gender. Significant differences were found between the mean of the confidence in learning mathematics scores of males and females at both pre-test and mid-test with males being more confident, a finding which is in agreement with the findings of Eccles (1984), Fennema and Sherman (1978),

Shashaani (1995), and Sax (1992). However, by the post-test during week fifteen, the mean of the confidence in learning mathematics scores had trended together to the point that no significant difference existed.

The absence of an interaction between students' attitude toward mathematical usefulness with respect to time and gender is in agreement with the research of Thorndike-Christ (1991). However, this finding contradicts the research of Benton (1979), De Corte and Op't Eynde (2003), Eccles (1984), Fennema and Sherman (1976), Pederson et al. (1985), and Perl (1982). The lack of interaction between students' attitude toward success in mathematics with respect to time and gender confirms the results found by Fennema and Sherman's (1978) but contradicts the findings of Eccles' (1984) and Thorndike-Christ (1991). Finally, the lack of an interaction between students' attitude toward mathematics anxiety and gender stands in contrast to Hembree's (1990) meta-analysis findings of college females reporting higher mathematical anxiety levels than college males.

Due to the absence of any literature concerning the attitudes of students based on locale, all of the following findings begin a knowledge base in the intersection of mathematics education and locale. There were no significant differences between the confidence in learning mathematics scores, attitude toward mathematical usefulness, attitude toward success in mathematics, or mathematics anxiety level with respect to class and locale over time. However, there was an interaction between locale and class. The rural students in the

experimental group reported significantly higher levels of mathematics anxiety than the students in the control group. This was not true for non-rural students.

With respect to student age, traditional and non-traditional students showed no significant differences between the confidence in learning mathematics scores, attitude toward mathematical usefulness, attitude toward success in mathematics, or mathematics anxiety scores with respect to class and age over time. These findings are similar to the findings of Elliot (1990) and Lehmann (1987) but in contrast to the research of Brown (1991). The lack of an interaction between students' mathematics anxiety levels with respect to student age is similar to the findings of Woodard (2002) and Bitner, Austin, and Wadlington (1994) and in opposition of the research of Betz (1978).

Discussion

Several issues warrant further discussion. These include the importance of attitude, elements that were missing from the study, the researcher's thoughts and reactions to the findings, and a discussion of problems that arose during the study.

Students in developmental education classes are there because they, for one reason or another, have not yet mastered or were never exposed to high school level algebra. Boylan and Saxon (1999) note that these students have been exposed to traditional skill and drill instruction with nominal success. As a result, these students often have negative attitudes toward mathematics. As

noted by Mager (1968), favorable attitudes toward academic areas will maximize the likelihood that students will remember what they have learned, willingly learn more about the subject, and use what they have learned. Furthermore, parents pass on scholastic attitudes to their children. Students enrolled in developmental courses at the community college level often have school age children to whom they, in turn, pass on their negative attitudes. Therefore, improving developmental students' mathematical attitudes could have the added benefit of improving the attitudes that they pass on to their children. This study attempted to determine whether the use of presentation software would improve the attitudes of these students who in the past have been largely unsuccessful in mathematics.

The substantial missing element from this study was an examination of student achievement. The study was limited in pursuing this end by certain constraints outside the researcher's control. The idea that achievement in mathematics is tied to attitude toward mathematics has been central in the literature for quite some time. This study should be conducted again with achievement included as a factor to be examined since improving student achievement should be the main driving force of pedagogical change. This could be accomplished through examining the end of course grade, by examining the final exam grade, by administering a pre-test and post-test, or by constructing teacher-made instruments. In this way, the study could examine whether the use of presentation software with its benefits of color and organization had an impact on mathematics achievement.

The absence of a change in attitude as measured by the Fennema-Sherman Mathematics Attitude Scales (1976) across time for each type of class was disappointing. Informal observation and experience of the researcher indicates that the use of presentation software does improve students' satisfaction level with the class and thereby improves their attitudes toward mathematics. Numerous students have expressed their opinions of the use of presentation software in mathematics classes to the researcher in casual conversation with most comments centered around the benefits of the structure the presentation software gives their notes and how beneficial the color and graphics are to focusing their attention. However, given that developmental students have been largely unsuccessful in their past mathematical courses, it should not be surprising that their attitudes did not drastically change in only one semester. In reality, several semesters would probably be required in order to detect changes in mathematical attitudes. Although research indicates that attitudes can be changed (Hembree, 1990; Tobias & Weissbrod, 1980), the research does not indicate the length of time required for attitude changes to be measurable. Furthermore, while the Fennema-Sherman Mathematics Attitude Scales (1976) are the gold standard in mathematics attitude scales, newer research in cognitive science and psychology may lay the groundwork for more sensitive measures. However, educators should not give up on improving student attitudes toward mathematics. At least the lack of a negative effect on student attitudes as a result of the use of presentation software was comforting

and may indicate that this avenue of delivery can assist educators without the risk of further damaging student attitudes.

Students were not questioned about whether they liked or disliked the presentation software to which they were exposed. In addition, students in the experimental classrooms were not exposed to any presentation software other than the one used in this study. Using different presentation software might result in different student attitudes, in different faculty frustrations or satisfaction, or in different pedagogical methodology surrounding presentation software. Therefore, the results of this study cannot imply that students do or do not prefer presentation software as the primary delivery system.

Teacher attitudes toward presentation software became an issue recognized during the course of the study. The community college where the study took place has a rather small pool of faculty who teach developmental studies courses, with even fewer teaching elementary algebra. The instructors who participated in the study volunteered to teach the necessary classes. The researcher consulted the faculty members when setting up the study and asked for input as to what would and would not be allowed in the experimental and control classes. Three of the four instructors have doctoral degrees and were thus fully aware of the necessary constraints that must be in place to effectively conduct an experimental study. Extensive discussions were held, both face to face and through a discussion board, surrounding the use of presentation software. Before the study began, all four instructors expressed confidence in their ability to use and create lessons with presentation software.

Throughout the study the instructors were asked to post responses to the online discussion board each week concerning their teaching methodologies, pacing, and assessments for each type of class in order to ensure similar experiences for students regardless of instructor. While the discussion board postings were planned as part of the study to provide validity, there was no qualitative component to the study to analyze the discussion board messages. However, when the study had concluded, the researcher began to see a pattern in the discussion board postings that might provide some explanation to one of the more unusual findings. As the study unfolded, the faculty members began posting comments that revealed high levels of frustration toward the daily use of presentation software and the constraints imposed surrounding the use of presentation software. For example, one instructor wrote:

> I am discovering that I am not comfortable being restricted to power point as my instructional mechanism. Maybe power point is designed to make presentations while my teaching methodology is more inclined to conversations (give and take) with my students. Maybe I have not determined how to integrate power point with my teaching style. (Gregory, 2006)

All of the instructors at some point in time during the semester wrote that they missed not having access to the white board (Gregory, 2006). These frustrations undoubtedly affected the instructors' attitudes toward the use of presentation software and were probably exhibited in some manner in the classroom. As a result, there may have been some bleed-over from teacher to students with

respect to frustration levels. These elevated frustration levels should not be surprising. It is well known throughout the education community that the adoption of new teaching methodologies and relinquishing of old – sometimes quite routine – methodologies is often a long process that requires much support and long-term professional development.

However, to have alleviated the circumstances of these frustrations during the study would have created another limitation. There were two options available in which to design this study. The first option was for half of the instructors to teach only the experimental classes while the other half of the instructors would teach only the control classes. This option would allow for the instructors who were most comfortable teaching with the use of presentation software to be assigned to teach the experimental classes. However, this design would not account for teacher differences, thus creating a limitation. The second option was for all instructors to teach both an experimental and a control class. This is the option most favored by researchers in that it will account for teacher differences. However, the unintentional consequence of this choice is that not all instructors may be ready to adopt a new teaching methodology for one course while still using their preferred methodology for another course. Unless a design structure exists or is created that can address both issues at once, any experimental study designed to compare traditional delivery versus presentation software delivery will face one of these limitations.

The researcher was concerned that students with different characteristics might react in different ways to presentation software. The results of this study

were reassuring in that there were no significant gender, locale, or age differences in student attitudes across time and class. Surprisingly though, rural students enrolled in the presentation software delivery classes reported higher mathematics anxiety levels than rural students in the traditional delivery classes. Additional studies are needed in order to reaffirm and account for the higher mathematics anxiety levels of rural students in the presentation software delivery classes. One area to consider is whether or not rural students have had less experience and familiarity with presentation software in particular or with technology in general or in the classroom. Another area to consider is whether teacher interaction had negative effects on students' attitudes with respect to the use of the presentation software. Considering the frustrations of the instructors teaching the presentation software classes, are there some characteristics of rural students that predispose them to detect and absorb teacher attitudes and internalize those attitudes toward classroom content and methodology?

While this study did indicate that the attitudes of rural students toward success in mathematics, confidence in learning mathematics, mathematics usefulness, and mathematics anxiety are roughly the same as those of non-rural students, a more in-depth analysis of rural and non-rural students' mathematical attitudes and background characteristics should be examined in order to better understand the similarities and differences between rural and non-rural students. Furthermore, there is no assurance that students from different rural communities will hold the same mathematical attitudes (for an explanation of different types of rural areas see Nachtigal, 1982).

Although these findings are encouraging in that students – regardless of gender, locale, or age – reacted to presentation software in approximately the same manner, there is no evidence that students enrolled in college-level courses or students at the university level would react in the same manner. It is possible that students in college level courses or at the university level have had more positive experiences with mathematics or bring more refined study and learning characteristics to the classroom and would thus have different reactions to the use of presentation software.

If the researcher were to conduct this study again, several alterations should be made in the design and implementation as a result of problems that arose during this study. If the object of the study is the use of presentation software, all instructors in the study should have extensive experience using presentation software on a daily basis as the primary delivery system. While all instructors included in this study reported that they were comfortable with the use of presentation software before the study took place, discussions throughout the study indicated that they were not as comfortable using the software on a daily basis as they thought they would be. Instructor frustrations with the daily use of presentation software may have negatively affected students.

In repeating the study or replicating the design the researcher would measure the interaction of teacher attitude on student attitude in a finely grained manner. The instructors could be given a pedagogical attitude survey and a technology comfort level survey. This would help to determine how teachers' beliefs and comfort levels affect student attitudes since it is quite possible that

students could internalize and adopt teacher attitudes, both positive and negative.

If the study were repeated, the researcher would conduct the study in the fall semester so as to have fewer students who are repeating the class. Students who are repeating a developmental class are more likely to have greater negative attitudes as a result of having to repeat a course as compared to students who are taking the course for the first time. Repeating students are in the most need of assistance and may require several semesters to be able to display a change in attitude. Further, the issue of attitudes toward mathematics is already complex enough without adding the additional problem of repeating students.

Finally, the researcher would use an instrument that was designed to detect more subtle changes in attitude. While the Fennema-Sherman Mathematics Attitude Scales (1976) is an excellent instrument for gauging students' overall mathematical attitudes in a single administration, it may not be the best instrument for detecting slight shifts in attitude over time or it may not be finely grained enough to detect attitudes connected to the specific pedagogy involved in presentation software.

Conclusions

The researcher is deeply concerned with helping students succeed in mathematics and investigating how student attitudes influence their success.

While this study did not definitively provide guidance with respect to pedagogical choices, it did highlight some interesting issues. The use of presentation software did not appear to significantly affect the attitudes of students, either positively or negatively, based on gender, locale, or age as compared to students in traditional delivery classes expect for one instance. Rural students enrolled in the presentation software classes displayed higher levels of mathematics anxiety than did rural students enrolled in traditional classes. Overall, rural and non-rural students reported similar mathematical attitudes with respect to confidence, usefulness, success, and anxiety. Finally, while this study did not reveal that the use of presentation software as the primary delivery system alone could improve student attitudes toward mathematics in one semester, it may still be part of a larger strategy to assist students in their academic endeavors.

Implications for Further Research

Several questions of interest arise with respect to mathematics that should be considered for further research. First, the interaction between the use of presentation software as the primary delivery system and student achievement should be investigated. Such research would add to the knowledge that an instructor might consider when planning how to best present mathematics lessons. The remaining questions fall into two main categories: questions concerning mathematics attitude research and questions concerning rural mathematical education research.

Mathematics Attitude Research

A more sensitive instrument would be helpful in order to measure student attitudes toward mathematics. The instrument used, while highly valid, may not be sensitive enough to detect the changes in attitude over a relatively short period of time. Informal comments from students indicate that they like the use of presentation software. Thus, an apparent mismatch occurred between what the instrument detected and informal observation.

This study should be replicated over a longer time period and perhaps in a different setting. The research does not indicate how long it may take to change attitudes. More than one semester may be needed in order for a measurable change to occur. Perhaps a longitudinal study of developmental students over several courses might be more productive for studying developmental students' attitudes. Furthermore, students in a different setting, such as college level mathematics or university settings, might respond differently to presentation software than developmental mathematics students at the community college level.

The effects of teacher interaction on student attitudes toward mathematics in conjunction with the use of presentation software should be investigated. Teacher attitudes with respect to presentation software may affect student attitudes as much or more than the use of presentation software. The limited data from the discussion board suggests that teachers have both positive and negative attitudes concerning the use of presentation software. While all of the teachers conveyed that presentation software had potential benefits, all of the

teachers voiced frustrations in the daily use of presentation software. Thus, more research examining both teacher and student attitude might be productive.

Rural and Mathematics Education Research

The literature in mathematics education concerning the intersection between mathematics and rural education is rather sparse. The results of this study demonstrate a need to investigate why rural students in presentation software delivery classes report higher mathematics anxiety levels than rural students in traditional delivery classes. This finding was both strong and somewhat surprising but may be an anomaly. If research confirms a significant difference in rural students' anxiety levels, then there is a need to investigate in more detail the mathematical attitudes of rural vs. non-rural students. Such an investigation would help educators better understand the needs and characteristics of students from different locales, which in turn would help educators better serve and advise students. In addition, this investigation should be replicated across the United States to see if there are any significant differences in rural students' mathematical attitudes from different types of rural areas as classified by Nachtigal (1982).

REFERENCES

Abraham, Ansley A., & Creech, Joseph D. (2000). Reducing Remedial Education: What Progress Are States Making? Educational Benchmarks 2000 Series. Atlanta, GA: Southern Regional Education Board. (ERIC Document Reproduction Service No. ED 445 588)

Academic Enrichment. (2005). ACT and COMPASS Placement Charts. Appleton Community College, Appleton, TN.

Ai, Xiaoxia. (2002). Gender Differences in Growth in Mathematics Achievement: Three-Level Longitudinal and Multilevel Analyses of Individual, Home, and School Influences. *Mathematical Thinking and Learning*, 4(1), 1-22.

Aiken, Lewis R. (1976). Update on Attitudes and Other Affective Variables in Learning Mathematics. *Review of Educational Research.* 46(2), 293-311.

Aiken, Lewis R. (1972). Research on attitudes toward mathematics. *The Arithmetic Teacher*, 19(3), 229–234.

Aiken, Lewis R. (1970). Attitudes Toward Mathematics. *Review of Educational Research.* 40(4), 551–596.

Appleton Community College. (2005). First-Time Freshmen Data Base Retention Report, Appleton, TN.

Atkins-Sayre, Wendy, Hopkins, S., Mohundro, & S., Sayre, W. (1998, November). Rewards and Liabilities of Presentation Software as an Ancillary Tool: Prison or Paradise? Paper presented at the Annual Meeting of the National Communication Association, New York, NY. (ERIC Document Reproduction Service No. ED 430 260)

Atkinson, Rhonda H., & Longman, Debbie G. (1995). *Getting Oriented*. Minneapolis, MN: West Publishing Company.

Austin-Martin, George, Waddell, L., & Kincaid, M. (1980). Correlates of Math Anxiety in Female College Freshmen. Paper presented at the Annual Conference of the Rocky Mountain Educational Research Association, Lac Cruces, NM. (ERIC Document Reproduction Service No. ED 194 351)

Austin-Wells, Vonnette, Zimmerman, Teena, McDougall, Graham J. (2003). An Optimal Delivery Format for Presentations Targeting Older Adults. *Educational Gerontology*, 29(6), 493-501.

Bandura, Albert. (1993). Perceived Self-Efficacy in Cognitive Development and Functioning. *Educational Psychology*, 28(2), 117-148.

Benton, Barbara L. (1979). Math Avoidance and Pursuit of Fantasy Careers. Paper presented at the annual meeting of the American Educational Research Association, San Francisco, CA. (ERIC Document Reproduction Service No. ED 169 282)

Berry, Louis H. (1991). Visual Complexity and Pictorial Memory: A Fifteen Year Research Perspective. In proceedings of selected research presentations at the Annual Convention of the Association for Educational Communications and Technology, 98-102. (ERIC Document Reproduction Service No. ED 334 975)

Betz, Nancy E. (1978). Prevalence, Distribution, and Correlates of Math Anxiety in College Students. *Journal of Counseling Psychology*, 25(5), 441-448.

Bitner, Joe, Austin, Sue, & Wadlington, Elizabeth. (1994). A Comparison of Math Anxiety in Traditional and Nontraditional Developmental College Students. *Research and Teaching in Developmental Education*, 10(2), 35-43.

Boylan, Hunter R. & Saxon, Patrick. (1999). What Works in Remediation: Lessons from 30 Years of Research. National Center for Developmental Education. Retrieved on October 26, 2004: http://www.ncde.appstate.edu/reserve_reading/what_works.htm

Braswell, James S., Lutkus, A., Grigg, W., Santapau, S., Tay-Lim, B., Johnson, M. (2001). *The Nation's Report Card: Mathematics, 2000.* (NCES-2001-517). National Center for Education Statistics (ED), Washington, DC.

Brown, Carolyn H. (1991). The relationship between the attitudes of directors and instructors and student ratings in remedial and developmental studies in Tennessee's community colleges. *Dissertation Abstracts International* 52(03), 0787A. (UMI No. AAG9124274)

Carey, Patrick, & Kemper, Mary. (2003). *Creating Web Pages With HTML* (3rd ed.). Boston: Thomson Course Technology.

Casazza, Martha. (1999). Who Are We and Where Did We Come From? *Journal of Developmental Education*, 23(1), 2-8.

Cassity, Constance L. (1997, February). Learning with Technology: Research on Graphing Calculators. In Proceedings of Selected Research and Development Presentations at the 1997 National Convention of the Association for Education and Communications in Technology, Albuquerque, NM. (ERIC Document Reproduction Service No. ED 409 880)

Cassady, Jerrell C. (1998). Student and Instructor Perceptions of the Efficacy of Computer-Aided Lectures in Undergraduate University Courses. *Journal of Educational Computing Research*, 19(2), 175-189.

Cobb, Robert A., McIntire, Walter G., & Pratt, Phillip A. (1989). Vocational and Educational Aspirations of High School Students: A Problem for Rural America. *Research in Rural Education*, 6(2), 11- 16.

Creech, Joseph D. (1997). Better Preparation, Less Remediation. Challenging Courses Make a Difference. Goals for Education: Educational Benchmarks, 1997. Atlanta, GA: Southern Regional Education Board,. (ERIC Document Reproduction Service No. ED 415 741)

Cronbach, Lee J., & Snow, Richard E. (1977). *Aptitudes and Instructional Methods: A Handbook for Research on Interactions*. New York, NY: Irving Publishing Company.

Cross, K. Patricia. (1980). Our Changing Students and Their Impact on Colleges: Prospects For a True Learning Society. *Phi Delta Kappan*, 61(9), 627-630.

Cross, K. Patricia. (1976). *Accent on Learning*. San Francisco, CA: Jossey-Bass.

Curry, L. (1983). An Organization of Learning Styles Theory and Constructs. Paper presented at the 67th Annual Meeting of the American Educational Research Association, Montreal, Quebec. (ERIC Document Reproduction Service No. ED 235 185).

Daniels, Lisa. (1999). Introducing Technology in the Classroom: PowerPoint as a First Step. *Journal of Computing in Higher Education*, 10(2), 42-56.

De Corte, Erik, & Op't Eynde, Peter. (2003, April). When Girls Value Mathematics as Highly as Boys: An Analysis. Paper presented at the Annual Meeting of the American Educational Research Association, Chicago, IL. (ERIC Document Reproduction Service No. ED 476 648)

DeVaney, Thomas A. (1996, November). The Effects of Computers and Calculators on Computation and Geometry Achievement. Paper presented at the Annual Meeting of the Mid-South Educational Research Association, Tuscaloosa, AL. (ERIC Document Reproduction Service No. ED 404 163)

DeYoung, Alan J. (2003, March). *The Social Construction of Rural Mathematics: Conjectures, Contradictions and a few Hypotheses.* Appalachian Center for Learning, Assessment, and Instruction in Mathematics. (Working Paper No. 7). Retrieved August 3, 2006, from http://www.acclaim-math.org/resworking.aspx

DeYoung, Alan J. (2002, October). *Dilemmas of Rural Life and Livelihood: Academics and Community*. Appalachian Center for Learning, Assessment, and Instruction in Mathematics. (Working Paper No. 3). Retrieved August 3, 2006, from http://www.acclaim-math.org/resworking.aspx

Dunham, Penelope H.; Dick, Thomas P. (1994). Connecting Research to Teaching: Research on Graphing Calculators. *Mathematics Teachers*, 87(6), 440-450.

Dwyer, Francis M., & Moore, David M. (1999). A Review of Color Coding and Field Dependence Research. In proceedings of selected Research and Development Papers presented at the National Convention of the Association for Educational Communications and Technology, Houston, TX. (ERIC Document Reproduction Service No. ED 436 131)

Dwyer, Francis M., & Lamberski, Richard J. (1982-83). A Review of the Research on The Effects of the Use of Color In the Teaching-Learning Process. *International Journal of Instructional Media*, 10(4), 303-327.

Eccles, Jacquelynne. (1984). Sex Differences in Achievement Patterns. In R. Dienstbier & T. Sonderegger (Eds.), *Nebraska Symposium on Motivation: Vol. 32. Psychology and Gender* (pp. 97-132). Lincoln: University of Nebraska Press.

Eccles, Jacquelynn S., & Jacobs, Janis E. (1986). Social Forces Shape Math Attitudes and Performance. *Sings*, 11(2), 367-380.

Elliot, John C. (1990). Affect and Mathematics Achievement of Nontraditional College Students. *Journal for Research in Mathematics Education*, 21(2), 160-165.

Fennema, Elizabeth. (2000). Gender Equity for Mathematics and Science. An invited faculty presentation at Gender Equity for Mathematics and Science: A Conference of the Woodrow Wilson Leadership Program for Teachers, Princeton, N.J. (ERIC Document Reproduction Service No. ED 446 968)

Fennema, Elizabeth H., & Sherman, Julia A. (1978). Sex-Related Differences in Mathematics Achievement and Related Factors: A Further Study. *Journal for Research in Mathematics Education,* 9(3), 189-203.

Fennema, Elizabeth H., & Sherman, Julia A. (1976). Fennema-Sherman Mathematics Attitude Scales: Instruments designed to measure attitudes towards the learning of mathematics by females and males. JSAS Catalog of Selected Documents of Psychology, 6, 31. (Ms. No. 1225).

Frey, Barbara A., & Birnbaum, David J. (2002). Learners' Perceptions on the Value of PowerPoint in Lectures. (ERIC Document Reproduction Service No. ED467 192)

Gallagher, Ann M., & De Lisi, Richard. (1994). Gender differences in Scholastic Aptitude Test: Mathematics problem solving among high-ability students. *Journal of Educational Psychology*, 86(2), 204–211.

Gibbs, Robert M., Swain, Paul L., & Teixeira, Ruy (Eds.). (1998). *Rural Education and Training in the New Economy: The Myth of the Rural Skills Gap*. Ames, IA: Iowa State University Press.

Golfin, P., Jordan, W., Hull, D., & Ruffin, M. (2005). Strengthening Mathematics Skills at the Postsecondary Level: Literature Review and Analysis. Retrieved September 20, 2006, from http://www.can.org/document/IPR11659.pdf

Gonske, Teresa Lynn. (2002). Relationships among mathematics anxiety, beliefs about the nature of mathematics and the learning of mathematics, and students' learning approaches in non-traditional aged students at the community college. *Dissertation Abstracts International*, 63 (07), 2484A. (UMI No. AAI3059983)

Goolsby, Charlee, Dwinell, P., Higbee, J., Bretscher, A. (1988). Factors Affecting Mathematics Achievement in High Risk College Students. *Research & Teaching in Developmental Education*, 4(2), 18-27.

Gregory, J. (2006). [Instructor discussion board responses]. Unpublished raw data.

Hackett, Gail, & Betz, Nancy E. (1989). An Exploration of the Mathematics Self-Efficacy/Mathematics Performance Correspondence. *Journal for Research in Mathematics Education*, 20(3), 261-273.

Harknett, Richard J., & Cobane, Craig T. (1997). Introducing Instructional Technology to International Relations. *Political Science and Politics*, 30(3), 496-500.

Hembree, Ray. (1990). The Nature, Effects, and Relief of Mathematics Anxiety. *Journal of Research in Mathematics Education*, 21(1), 33–46.

King, Patricia M. & Bauer, Barbara A. (1988). Leadership Issues for Nontraditional-Aged Women Students. *New Directions for Student Services*, 44(Winter), 77-88.

Kulik, James A., & Kulik, Chen-Lin C. (1991). *Developmental Instruction: An Analysis of the Research*. Boone, NC: National Center for Developmental Education, Appalachian State University.

Lamberski, Richard J., & Dwyer, Francis M. (1983). The Instructional Effect of Coding (Color and Black and White) on Information Acquisition and Retrieval. *Educational Communication and Technology Journal*,31, 9-21.

Lehmann, Christine H. (1987). The Adult Mathematics Learner: Attitudes, Expectations, Attributions. Paper presented at the Annual Meeting of the American Educational Research Association (Washington, DC, April 23025, 1987). (ERIC Document Reproduction Service No. ED 283 680)

Limbert, Claudia A. (1991). The Non-Traditional Female Student: A Report from Both Sides of the Desk. *The Journal of the Midwest Modern Language Association*, 24(2), 1-10.

Longo, Palma J. (2001). What Happens to Student Learning When Color Is Added to a New Knowledge Representation Strategy? Implications from Visual Thinking Networking. Paper presented at the combined Annual Meetings of the National Science Teachers Association and the National Association for Research in Science Teaching (St. Louis, MO, March 5 - 28, 2001). (ERIC Document Reproduction Service No. ED 454 096)

Lowry, Roy B. (1999). Electronic Presentation of Lectures – Effect upon Student Performance. *University Chemistry Education*, 3(1), 18-21.

Ma, Xin & Kishor, Nanad. (1997). Assessing the Relationship Between Attitude Toward Mathematics and Achievement in Mathematics: A Meta-Analysis. *Journal for Research in Mathematics Education*, 28(1), 26-47.

Mager, Robert F. (1968). *Developing Attitude Toward Learning*. Belmont, California: Fearon Publishers.

Mantei, Erwin, J. (2000). Using Internet Class Notes and PowerPoint in the Physical Geology Lecture. *Journal of College Science Teaching*, 29(5), 301-305.

Moore, David M., & Dwyer, Francis M. (1998). Effect of Color-coding on Locus of Control. In: Proceedings of Selected Research and Development Presentations at the National Convention of the Association for Educational

Communications and Technology Sponsored by the Research and Theory Division, February 18 – 22, 1998. (ERIC Document Reproduction Service No. ED 423 851)

Moreno, Roxana, & Mayer, Richard E. (2000). A Coherence Effect in Multimedia Learning: The Case for Minimizing Irrelevant Sounds in the Design of Multimedia Instructional Messages. *Journal of Educational Psychology*, 92(1), 117-125.

Multon, Karen D, & Brown, Steven D. (1991). Relation of Self-Efficacy Beliefs to Academic Outcomes: A Meta-Analytic Investigation. *Journal of Counseling Psychology*, 38(1), 30-38.

Nachtigal, Paul M. (Ed.). (1982). *Rural Education: In search of a better way.* Boulder, CO: Westview Press.

National Center for Education Statistics. (2003). Remedial Education at Degree-Granting Postsecondary Institutions in Fall 2000. Retrieved on August 17, 2006 from http://nces.ed.gov/pubs2004/1004010.pdf

National Center for Education Statistics. (n.d.). Nontraditional Undergraduates: Highlights. Retrieved on August 17, 2006 from http://nces.ed.gov/pubs/97578.pdf

National Center for Education Statistics. (n.d.). Urban/Rural Classification Systems. Retrieved on November 24, 2004 from http://nces.gov/surveys/ruraled/Definitions.asp

Neale, Daniel C. (1969). The role of attitudes in learning mathematics. *The Arithmetic Teacher*, 16(8), 631 – 640.

Nordstrom, Brian H. (1989). Non-Traditional Students: Adults in Transition. (ERIC Document Reproduction Service No. ED 310 686)

Nowaczyk, Ronald H., Santos, L., Patton, C. (1998). Student Perception of Multimedia in the Undergraduate Classroom. *International Journal of Instructional Media*, 25(4), 367-382.

Pajares, Frank. (2002). Gender and Perceived Self-Efficacy in Self-Regulated Learning. *Theory into Practice*, 41(2), 116–125.

Pajares, Frank. (1996). Self-Efficacy Beliefs in Academic Settings. *Review of Educational Research*, 66(4), 543-578.

Parsons, J., & Oja, D. (2004). *New Perspectives on Computer Concepts* (7th ed.). Boston: Thomson Course Technology.

Pascarella, E., Edison, M., Nora, A., Hagedorn, L. S., Braxton, J. (1996). Effects of Teacher Organization/Preparation and Teacher Skill/Clarity on General Cognitive Skills in College. *Journal of College Student Development*, 37, 7-19.

Pedersen, Katherine, Bleyer, Dorothy R., Elmore, Patricia B. (1985). Attitudes and Career Interests of Junior High School Mathematics Students: Implications for the Classroom. *Arithmetic Teacher*, 32(7), 45-49.

Perl, Teri H. (1982). Discriminating Factors and Sex Differences in Electing Mathematics. *Journal for Research in Mathematics Education*, 13(1), 66-74.

Pittman, Robert B. (1985). Perceived Instructional Effectiveness and Associated Teaching Dimensions. *Journal of Experimental Education*, 54, 34-39.

Price, Linda. (2004). Individual Differences in Learning: Cognitive control, cognitive style, and learning style. *Educational Psychology*, 24(5), 681-698.

Pruisner, Peggy A. P. (1995). The Role of Color in Remembering Graphically Presented Information. In: Imagery and Visual Literacy: Selected Readings from the Annual Conference of the International Visual Literacy Association (26th, Tempe, Arizona, October 12-16, 1994). (ERIC Document Reproduction Service No. ED 380 073)

Pruisner, Peggy A. P. (1993). From Color Code to Color Cue: Remembering Graphic Information. In: Visual Literacy in the Digital Age: Selected Readings from the Annual Conference of the International Visual Literacy Association (25th, Rochester, New York, October 13-17, 1993). (ERIC Document Reproduction Service No. ED 370 551)

Rankin, Elizabeth L., Hoaas, David J. (2001). The Use of PowerPoint and Student Performance. *Atlantic Economic Journal*, 29(1), 113.

Richardson, Frank C., & Suinn, Richard M. (1972). The Mathematics Anxiety Rating Scale: Psychometric Data. *Journal of Counseling Psychology*, 19(6), 551-554.

Roueche, John E., & Roueche, Suanne D. (1999). High Stakes, High Performance: Making Remedial Education Work. Annapolis Junction, MD: American Association of Community Colleges. (ERIC Document Reproduction Service No. ED 454 939)

Rural School and Community Trust, The (2005). *Why Rural Matters 2005: The facts about rural education in the 50 states,* May, 2005. Retrieved March 26, 2006, from http://files.ruraledu.org/whyruralmatters/WRM2005.pdf

Sax, Linda J. (1992). Self-Confidence in Math: How and Why Do Men and Women Differ during the College Years? Paper presented at the Annual Meeting of the Association for the Study of Higher Education, Minneapolis, MN. (ERIC Document Reproduction Service No. ED 352 899).

Singh, K., Granville, M., Dika, S. (2002). Mathematics and Science Achievement: Effects of Motivation, Interest, and Academic Engagement. *Journal of Educational Research*, 95(6), 323–332.

Shashaani, Lily. (1995). Gender Differences in Mathematics Experience and Attitude and Their Relation to Computer Attitude. *Educational Technology*, 35(3), 32–38.

Shore, Mark A. (1999). The Effect of Graphing Calculators on College Students' Ability To Solve Procedural and Conceptual Problems in Developmental Algebra. Ed.D. Dissertation, West Virginia University, W.V. *Dissertation Abstracts International*, 61 (10), 3932A. (UMI No. AAI9991773)

Susskind, Joshua E. (2005). PowerPoint's Power in the Classroom: Enhancing Students' Self-Efficacy and Attitudes. *Computers & Education*, 45, 203-215.

Szabo, Attila, & Hastings, Nigel. (2000). Using IT in the Undergraduate Classroom: Should We Replace the Blackboard with PowerPoint? *Computers & Education*, 35(3), 175 – 187.

Tennessee Higher Education Commission. (2001). The Status of Higher Education in Tennessee: Annual Report 2000-01. Nashville, TN: Tennessee Higher Education Commission.

Tobias, Sheila. (1981). Stress in the Math Classroom. *Learning*, 9(6), 34-38.

Tobias, Sheila, & Weissbrod, Carol. (1980). Anxiety and Mathematics: An Update. *Harvard Educational Review*, 50(1), 63–70.

Thorndike-Christ, Tracy. (1991). Attitudes toward Mathematics: Relationships to Mathematics Achievement, Gender, Mathematics Course-taking Plans, and Career Interests. (ERIC Document Reproduction Service No. ED 347 066)

Woodard, Teresa Sharon Horn. (2002). The effects of math anxiety on post-secondary developmental students as related to achievement, gender, and age. *Dissertation Abstracts International*, 63 (06), 2169A. (UMI No. AAI3056167)

Young, Dawn B., Ley, Kathryn. (2002). Brief Report: Self-Efficacy of Developmental College Students. *Journal of College Reading and Learning*, 33(1), 21–31.

Ysseldyke, J., Spicuzza, R., Kosciolek, S., Teelucksingh, E., Boys, C., Lemkuil, A. (2003). Using a Curriculum-Based Instructional Management System To Enhance Math Achievement in Urban Schools. *Journal of Education for Students Placed at Risk*, 8(2), 247-265.

APPENDICES

Appendix A

Teacher Vitas

Teacher A Vita

Educational Background

1999	M.S. Mathematics
1997	B.S. Secondary Education
1995	A.S. Pre-Engineering, A.S. Mathematics Education

Work Experience

2000-present	Assistant Professor, Mathematics
1999-2000	Adjunct Faculty, Mathematics

Grant Experience

2003-2005	Member of professional development team, ACCLAIM Grant, Soldier's Memorial Middle School, Tazewell, Tennessee
2004	Presented "Area" and "Temperature," Improving Teacher Quality Grant, "Exploring Mathematical Concepts through Problem Solving and Manipulatives,"
2003	Co-wrote and awarded an Improving Teacher Quality Grant, "Exploring Mathematical Concepts through Problem Solving and Manipulatives"
2001	Presented "Quadratic Modeling: An Exploration Using the TI-83," Teachers' NSF Grant Workshop

Conference Presentations

2004	Co-presented "Learning with Blocks," SMMEA Meeting, Knoxville, Tennessee

2003	Co-presented “Unit Analysis” and “Developing and Encouraging Intuitive Notions of Percent,” ETEA Conference, Knoxville, Tennessee
2003	Co-presented “Mathematics Classroom Websites,” TMTA Conference, Memphis, Tennessee
2001	Co-presented “Algebra Activities Designed for High School or College Developmental Classes,” TMTA Conference, Nashville, Tennessee

Teacher B Vita

EDUCATION

1998 - 2003
PhD Education; Emphases in Program Evaluation and Student Assessment

1992 - 1993
Completed graduate mathematics courses.

1988
Completed undergraduate history courses.

1986 - 1990
Masters of Arts in Teaching Mathematics. Conducted retention research for University Counseling Services.

1971 - 1975
Bachelor of Arts in Mathematics. Member of Alpha Sigma Phi fraternity. Held offices of Vice President and Secretary.

1967 - 1971
Graduated Phi Beta Kappa. Awarded scholarships: Michigan Competitive Scholarship and University of Michigan Regents Alumni Scholarship.

PROFESSIONAL EXPERIENCE

1992 - Present **Professor of Mathematics**

2000 - 2002	**AEL, Inc.**	Charleston, West Virginia
1989 - 1992	**Dearborn School District**	Dearborn, Michigan
1989 - 1992	**East Detroit School District**	East Detroit, Michigan
1989 - 1990	**Berkley School District**	Berkley, Michigan
1986 - 1988	**Wayne State University**	Detroit, Michigan
1975 - 1985	**The Wyatt Company**	Detroit, Michigan

Dissertation, May, 2003

Received the "Innovations Award" from the Tennessee Board of Regents Distance Education Committee. February 2003.

Conducted faculty interviews pertaining to evaluation study concerning academic department at the University of Tennessee – Knoxville, College of Education. November, 2002

Presentation to the Tennessee Mathematics Teachers Association regarding integration of technology in the classroom. April, 2001

Wrote and received grant from Kmart Corporation for playground surface materials for local elementary school. Summer, 2000

Presented two-day workshop to middle school mathematics teachers regarding teaching activities aligned with state standards. August 1999.

Presented one-day workshop to high school mathematics teachers regarding implementing graphing calculators in the classroom. August 1998.

Chairman of Publicity Committee for National Council of Teachers of Mathematics Southern Regional Conference at Knoxville, Tennessee. Over 2700 teachers and administrators primarily from the Midwest and Southeast attended. 1994 – 1995.

Teacher C Vita

Educational Background

1990	Ph.D. Mathematics
1986	M.S. Mathematics
1979	B.S. Mathematics

Work Experience

1998-present	Professor, Mathematics Division
1990-1998	Assistant Professor

Grant Experience

2004	Co-director for an Improving Teacher Quality Grant, "Exploring Mathematical Concepts"
2000	Taught sessions for Goals 2000 Grant, "Laying the Foundation for Algebra Success"

Conference Presentations

1996	"Modified Moore Method at the Undergraduate Level", KYMAA Meeting, Murray, Kentucky

Publications

Batten, P., _____, & Stitzinger, E. (1996). On Characterizing Nilpotent Lie Algebra by Their Multipliers, *Communications in Algebra.* 24.

_____, (1994). Isoclinisms in Lie Algebras, *Algebras, Groups and Geometries.* 11, 9-22.

_____, & Stitzinger, E. (1991). Some Finite Varieties of Lie Algebra, *Journal of Algebra.* 143, 173-178.

Teacher D Vita

Educational Background

1999	Ph.D. Mathematics Education
1986	M.Ed. Curriculum and Instruction
1966	B. S. Mathematics

Work Experience

1989 - present	Professor, Mathematics Division
1977 - 1988	Mathematics teacher, North Pike Middle School, Summitt, Mississippi
1972 - 1977	Mathematics teacher, Donaldson Junior High School, Nashville, Tennessee
1967 -1968	Mathematics teacher, Chapman Junior High School, Huntsville, Alabama

Selected Grant Work Experience

1996-1997	Coordinated Eisenhower Grant Workshop through Oak Ridge Associated Universities, "Excellence in Appalachia"
1997	Grant director for "Manipulatives in Algebra" workshop for middle and high school algebra teachers through the Tennessee Collaborative for Educational Excellence
2001	Grant director for Dwight D. Eisenhower Grant “Mathematical Modeling for Teachers” workshop for middle and high school algebra teachers.
2004	Grant director for Improving Teacher Quality Grant “Exploring Mathematical Concepts and Manipulatives” for elementary teachers.

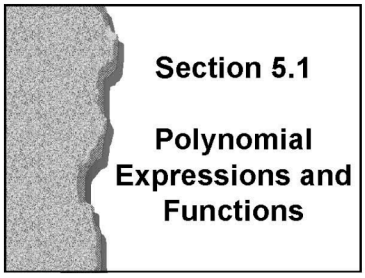
Conference Presentations

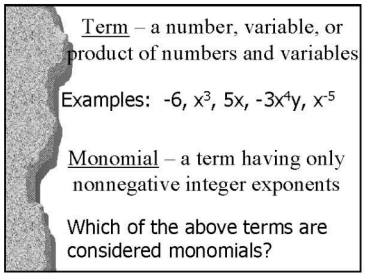
1999	"Reforming the Short Calculus Course-Data Driven and Technology Based," AMATYC Conference, Pittsburgh, Pennsylvania
1999	"Reforming the Short Calculus Course-Data Driven and Technology Based," NCTM Conference, Charlotte, North Carolina
1995	"Using Manipulatives to Introduce Algebra" at NCTM Conference, Atlanta, Georgia
1996	"Teacher Training at Walters State Community College," AMATYC Conference, Chattanooga, Tennessee

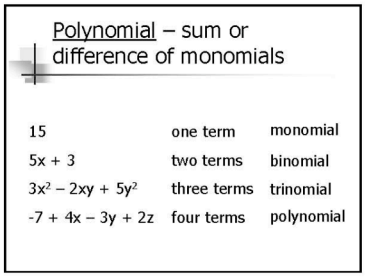
Appendix B

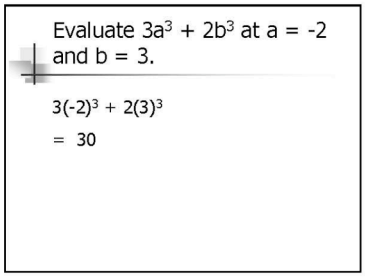
Sample PowerPoint® Lessons

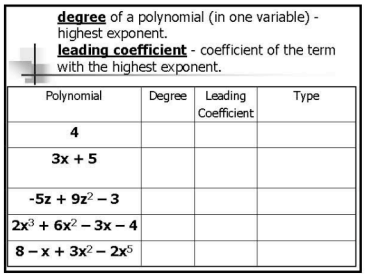
Teacher A

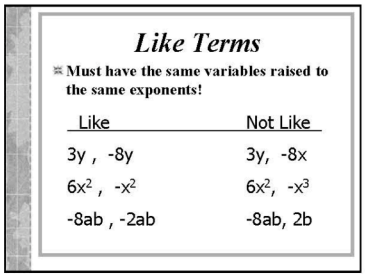












1

Combine (ADD) like terms:

$5x + 3x = 8x$

$3a^2 - 2a^2 = a^2$

$4y^3 - 7y^3 = -3y^3$

$xy + 7xy = 8xy$

$3a^2b - 2ab^2 =$ not like

Combine (ADD) like terms:

$5x + 2y - x - 6y = 4x - 4y$

$2m^2 - 5m + 7 - 4m + m^2 = 3m^2 - 9m + 7$

$\frac{1}{2}a^3 + ab - 3b^2 + \frac{1}{2}a^3 - 4ab + b^2 = a^3 - 3ab - 2b^2$

Add the polynomials:

$(2x^2 - 3x + 7) + (3x^2 + 4x - 2)$

$= 5x^2 + x + 5$

$(z^3 + 4z + 8) + (4z^2 - z + 6)$

$= z^3 + 4z^2 + 3z + 14$

Subtract the polynomials:

$(3y^5 + 3y^3) - (y^5 - y^3 + 2y)$ **distribute**

$= 3y^5 + 3y^3 - y^5 + y^3 - 2y$

$= 2y^5 + 4y^3 - 2y$

$(5x^3 + 9x^2 - 6) - (5x^3 - 4x^2 - 7)$

$= 5x^3 + 9x^2 - 6 - 5x^3 + 4x^2 + 7$

$= 13x^2 + 1$

Polynomial Functions

- **Linear Function: $f(x) = -5x + 1$** (degree 1)
- **Quadratic Function: $f(x) = 3x^2 + 5x - 1$** (degree 2)
- **Cubic Function: $f(x) = x^3 - 4x^2 + 3x - 2$** (degree 3)

Evaluate $f(x) = x^2 - 5x + 4$ at $x=2$.

$f(2) = (2)^2 - 5(2) + 4$

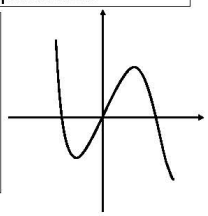
$f(2) = -2$

Use the graph of f to evaluate the expressions.

f(0) = _____

f(3) = _____

f(-2) = _____



#102, p. 312

Worldwide sales of personal computers have climbed as prices have continued to drop. The polynomial function $f(x) = 0.7868x^2 + 12x + 79.5$ models the number of computers sold during year x, where x = 0 corresponds to 1997, x = 1 to 1998, and so on.

Estimate the number of personal computers sold in 2003, using both the graph and the polynomial.

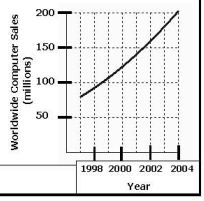


$f(x) = 0.7868x^2 + 12x + 79.5$

x = 0 corresponds to 1997, x = 1 to 1998, …

Estimate the number of personal computers sold in 2003, using both the graph and the polynomial.





Teacher B

Section 2.3
Slope of a Line

Rate of Change

Linear Functions and Tables of Values
Review

- f(x) = 3x + 2
  - Is this a linear function?
  - a = b =
- Complete the following table of values

x	0	1	2	3
y				

- What are the increments on the x's and y's?
- How did you calculate this?
- As x gets bigger by 1, what happens to y?

---

f(x) = -2x +1

- Complete the following table of values

x	-2	0	2	4
y				

- For every one that x gets bigger, what happens to y?
  - What does this have to do with our equation?

---

f(x) = 3x - 4

- Complete the following table

x	-5	0	5	10	15
y					

- What are the increments for x and y?
- For every two that x gets bigger, y
  - How about for every one that x gets bigger

Recall that we only need two points when we graph a line.

- Let's examine the following table

x	2	7
y	1	11

$x_2 - x_1$
$7 -$

- What is the increment for the x's and y's?
  - How did you calculate this?
  - For every one that x gets bigger, what happens to y?
- What points (ordered pairs) would we graph?

Formula for slope (Know this!!)

- Slope formula (pg 104) $\frac{dy}{dx}$

$$m = \frac{\text{increment y's}}{\text{increment x's}} = \frac{\text{difference y's}}{\text{difference x's}} = \frac{y_2 - y_1}{x_2 - x_1}$$

- Use this formula to calculate the slope of the line through the points
  - a. (2, -3) and (5, 3) $x_1\ y_1\ x_2\ y_2$ $a = \frac{y_2 - y_1}{x_2 - x_1} = \frac{3 - -3}{5 - 2} = \frac{6}{3}$
  - b. (-1, 5) and (-4, -1) $x_1\ y_1\ x_2\ y_2$ $a = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-1 - 5}{-4 - -1} = \frac{-6}{-3}$

Find the slope of the line passing through the points (-3,-1) and (4, 5).

(x_1, y_1) (x_2, y_2)

$a = \frac{y_2 - y_1}{x_2 - x_1} = \frac{5 - -1}{4 - -3} = \frac{6}{7}$

How would we interpret this slope?

Find the slope of the line passing through the points (-2, 3) and (1, 5).

(x_2, y_2) (x_1, y_1)

$a = \frac{y_2 - y_1}{x_2 - x_1} = \frac{3 - 5}{-2 - 1} = \frac{-2}{-3} = \frac{2}{3}$

How do we interpret this slope?

Graphing

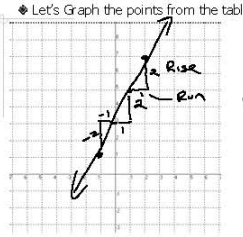
- How to apply the ideas of slope to graphs

$f(x) = 2x + 3$ $a = \frac{2}{1}$

x	-1	0	1	2
y (f(x))	1	3	5	7

Graphing: Slope = Rise / Run

- Let's Graph the points from the table of values:



Leave space in your notes, we're coming back to this.

$a = \frac{2}{1}$

f(x) = -2x +1

- Complete the following table of values

x	-2	0	2	4
y	5	1	-3	-7

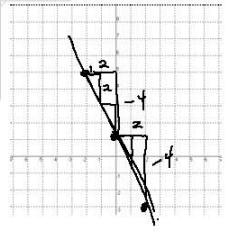
$x_2 - x_1$ $4 - 2 = 2$

$y_2 - y_1$ $-7 - -3$ -4

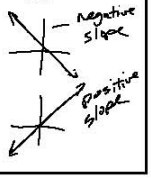
- For every one that x gets bigger, what happens to y? $\frac{-4}{2} = \frac{-2}{1}$ or -2

Graphing: Slope = Rise / Run

- Let's Graph the points from the table of values:



Leave space in your notes. We're coming back to this.



2

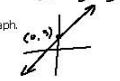
Let's compare the two graphs we just did.

What is the slope of the function $f(x)=2x+3$

How do we interpret this slope?

when $x=0$, $y=3$

How does the graph slope? Sketch the graph.



What is the slope of the function $f(x)=-2x+1$

How do we interpret this slope?

when $x=0$, $y=1$

How does the graph slope? Sketch the graph.



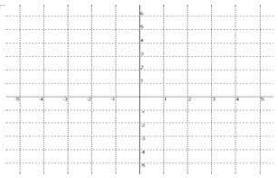
Example: $f(x)=\frac{2}{3}x+2$

- Complete the following table:

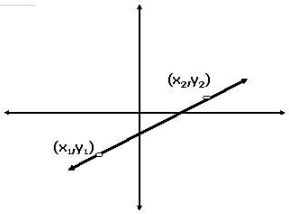
x	-3	0	3
y (f(x))			

- What is the increment of the x's and y's?
- What is the slope of this function?
- How do we interpret this slope?

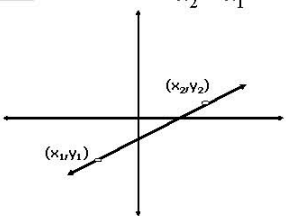
Now let's graph these points



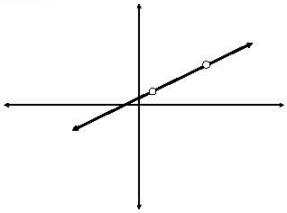
Graphing: SLOPE = $\frac{\text{rise}}{\text{run}}$



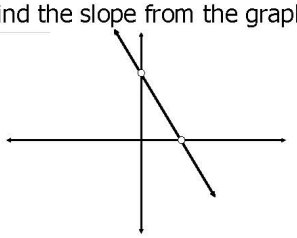
SLOPE = $\frac{\text{rise}}{\text{run}} = \frac{y_2-y_1}{x_2-x_1}$



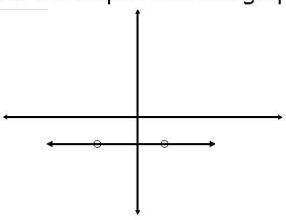
Find the slope from the graph:



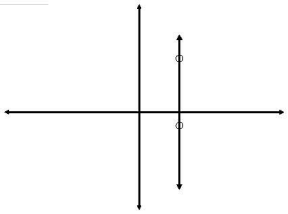
Find the slope from the graph:



Find the slope from the graph:



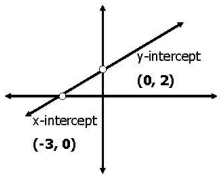
Find the slope from the graph:



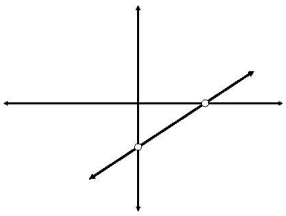
Slope

- Positive Slope
  - Line Increases
- Slope of Zero
  - Horizontal Line
- Negative Slope
  - Line Decreases
- Undefined Slope
  - Vertical Line

Intercepts of a line: where the graph crosses the x and y axis



Find the intercepts.



4

Slope-Intercept Form of a Line:

- The line with slope m and y-intercept b is given by:

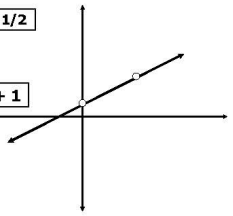
$$y = mx + b$$

Write the slope-intercept form of the line.

m = 2/4 = 1/2

b = 1

y = ½ x + 1

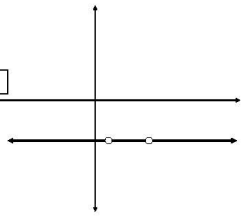


Write the slope-intercept form of the line.

m = 0

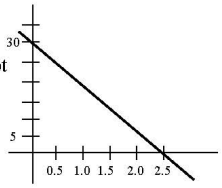
b = -3

y = - 3



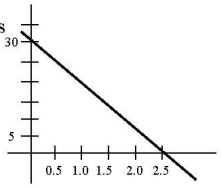
The distance y in miles that an athlete training for a bicycle race is from home after x hours is shown below:

a. Find the y-intercept. What does the y-intercept represent?



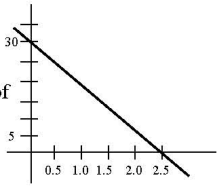
The distance y in miles that an athlete training for a bicycle race is from home after x hours is shown below:

b. The graph passes through the point (2, 6). Discuss the meaning of this point.



The distance y in miles that an athlete training for a bicycle race is from home after x hours is shown below:

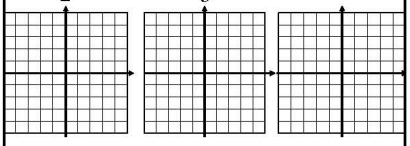
c. Find the slope-intercept form of this line. Interpret the slope as a rate of change.



5

Sketch the following lines using the slope and y-intercept.

$y = \frac{1}{2}x - 3$ $y = -\frac{2}{3}x + 1$ $y = 2x - 4$



Write a linear function to describe the data in the following table:

x	0	1	2	3
f(x)	-5	-3	-1	1

Write a linear function to describe the data in the following table:

Products Sold	0	5	10	20
Total Salary	$100	$350	$600	$1100

The following data is linear. Find the missing value and write an equation for the data.

Credit Hours	0	6	12	15
Total Tuition	$0	$480	$960	?

Sketch a graph that models the following situations:

- The distance that an athlete is from home if the athlete runs away from home at a steady speed for 30 minutes.
- After 30 minutes the athlete walks home slowly.

Sketch a graph that models the following situations:

- **The amount of water in a full swimming pool if the pool is drained half way down.**
- **After cleaning the pool, it is refilled.**



6

Teacher C

Section 1.5

Introduction to Graphing

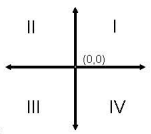
Vocabulary

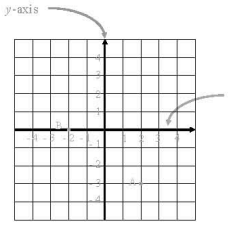
Quadrants

Origin

Ordered Pairs

(x, y)





Plot

A = (2, -3)

B = (-2, 0)

Plot the points and name their quadrants.

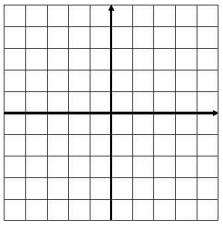
(5, 2)

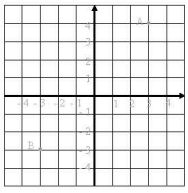
(-3, 4)

(1, -2)

(0, -5)

(-4, -1)





List the coordinates of

A = (3, 4)

B = (- 3, - 3)

Definitions:

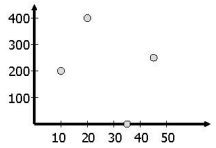
A set of ordered pairs is called a relation.

The set of all input values or x-values is called the domain.

The set of all output values or y-values is called the range.

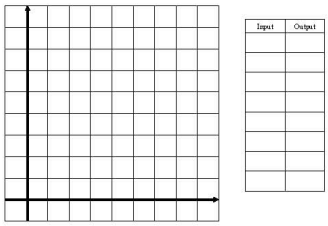
1

Express the relation shown in the graph as a set of ordered pairs. State the domain and the range. Determine the minimum and maximum of the x and y values.



Make a scatter plot of the average prices of Gasoline.

Year	1955	1965	1975	1985	1995
Cost (per gal.)	29¢	31¢	57¢	$1.20	$1.21

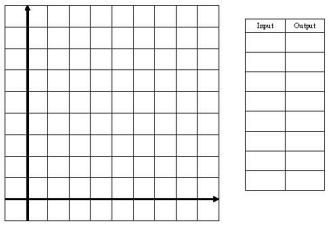


Look at Example 8 page 56.

Make a line graph for the following data.

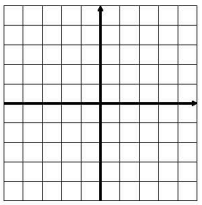
Cordless Phone Sales

Year	1987	1990	1993	1996	2000
Phones (millions)	6.2	9.9	18.7	22.8	33.3

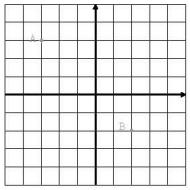


2

Label a graph with the following viewing window. [-25, 25, 5] by [-50, 50, 10]



The following graph uses the viewing window. [-100, 100, 20] by [-25, 25, 5]



List the coordinates of

A

B

3

Teacher D

Section 3.2

Introduction to Problem Solving

Solve d = rt for t in terms of d and r.

- **What does "in terms of" mean?**

$$d = rt$$

$$\frac{d}{r} = \frac{rt}{r}$$

$$d/r = t$$

Get y in terms of x. $2x + y = 3$

$$2x + y = 3$$

Solve for y in 2x - y = 8.

Solve for y: 4x – 2y = 9

Solve for y: $\frac{3}{4}x + 5y = 7$

1

Solve for y: $-3x+\frac{4}{5}y=9$

Translate into an equation and solve:

- **Three less than twice a number is 15.**
- **Four more than half a number is 7.**

The length of a rectangular room is 2 feet more than its width. If the perimeter of the room is 80 feet, write an equation whose solution gives the width of the room. Solve the equation.



x + x + (x + 2) + (x + 2) = 80
4x + 4 = 80
4x = 76
x = 19

The width of the room is 19 feet.

According to a survey, about 32% of adult Americans believe that people will meet their mates on the Internet during this century. In this survey 480 respondents held this belief. Determine the number of people participating in the survey.

Let x = # people participating in survey

.32x = 480

$\frac{.32x}{.32} = \frac{480}{.32}$

x = 1500 people participating in the survey

Solve symbolically--show steps:

1. 3x - 22 = -2x - 7
2. 4(x+ 1) = -2(4 - x)
3. 3x + 6 - 2 = -(5 + x) + x
4. Solve for y: 3x + 2y = - 8

2

Appendix C

Fennema-Sherman Mathematics Attitude Scale

By Elizabeth Fennema and Julia A. Sherman

Below is a series of statements. There are no correct answers for these statements. They have been set up in a way which permits you to indicate the extent to which you agree or disagree with the ideas expressed. There are no "right" or "wrong" answers. The only correct responses are those that are true for you.

As you read the statement, you will know whether you agree or disagree. If you strongly agree, blacken circle A beside the corresponding problem number. If you agree but with reservations, that is, you do not fully agree, blacken circle B. If you disagree with the idea, indicate the extent to which you disagree by blackening circle D for disagree or circle E if you strongly disagree. But if you neither agree nor disagree, that is, you are not certain, blacken circle C for undecided. Also, if you cannot answer a question, blacken circle C.

Do not spend much time with any statement, but be sure to answer every statement. This inventory is being used for research purposes only and no one will know what your responses are.

1. It wouldn't bother me at all to take more math courses.
2. Math doesn't scare me at all.
3. It would be really great to win a prize in mathematics.
4. I think I could handle more difficult mathematics.
5. It would make me happy to be recognized as an excellent student in mathematics.
6. I'm no good in math.
7. If I had good grades in math, I would try to hide it.
8. My mind goes blank and I am unable to think clearly when working mathematics.
9. I have a lot of self-confidence when it comes to math.
10. I expect to have little use for mathematics when I get out of school.
11. I can get good grades in mathematics.
12. A math test would scare me.
13. If I got the highest grade in math I'd prefer no one knew.
14. Math has been my worst subject.
15. I don't think I could do advanced mathematics.
16. I'd be proud to be the outstanding student in math.

17. I usually have been at ease in math classes.
18. I will use mathematics in many ways as an adult.
19. I see mathematics as a subject I will rarely use in my daily life as an adult.
20. I don't like people to think I'm smart in math.
21. I am sure that I can learn mathematics.
22. Being first in a mathematics competition would make me pleased.
23. I usually have been at ease during math tests.
24. Knowing mathematics will help me earn a living.
25. Most subjects I can handle O.K., but I have a knack for flubbing up math.
26. I study mathematics because I know how useful it is.
27. I get a sinking feeling when I think of trying hard math problems.
28. I am sure I could do advanced work in mathematics.
29. Mathematics usually makes me feel uncomfortable and nervous.
30. In terms of my adult life it is not important for me to do well in mathematics in high school.
31. Mathematics is of no relevance to my life.
32. Mathematics makes me feel uncomfortable, restless, irritable, and impatient.
33. Taking mathematics is a waste of time.
34. I'll need a firm mastery of mathematics for my future work.
35. It would make people like me less if I were a really good math student.
36. Mathematics makes me feel uneasy and confused.
37. Being regarded as smart in mathematics would be a great thing.
38. I haven't usually worried about being able to solve math problems.
39. Mathematics will not be important to me in my life's work.
40. Mathematics is a worthwhile and necessary subject.
41. I'd be happy to get top grades in mathematics.
42. People would think I was some kind of a grind if I got A's in math.
43. I'll need mathematics for my future work.
44. For some reason even though I study, math seems unusually hard for me.
45. I almost never have gotten shook up during a math test.
46. Generally I have felt secure about attempting mathematics.
47. I'm not the type to do well in math.
48. Winning a prize in mathematics would make me feel unpleasantly conspicuous.

Vita

Julianna Gregory was born in Parsons, Tennessee. She attended school at Parsons Elementary School, Parson Junior High School, and Riverside High School, all of which are located in Decatur County, Tennessee. She received her Bachelors Degree in Mathematics from Middle Tennessee State University in 1995. Julianna then went on to earn her Masters Degree in Mathematics of Science in Teaching from Middle Tennessee State University in 1998.

Upon graduation, Julianna joined the faculty of a rural east Tennessee community college teaching mathematics. Her teaching duties included teaching developmental mathematics, college-level mathematics, and dual-enrollment classes. It was here that Julianna was first given the opportunity to participate in professional development workshops for area mathematics teachers. Since being hired, she has participated in facilitating numerous grant workshops and has co-written a grant for elementary teachers emphasizing problem solving. Currently, Julianna is a faculty consultant for the local P-16 Council whose focus is raising high school students' college readiness.

In June of 2002 Julianna, along with thirteen other mathematics teachers from across the Appalachian region, began the first doctoral cohort of the ACCLAIM (Appalachian Collaborative Center for Learning, Assessment, and Instruction in Mathematics) program funded by the National Science Foundation in Mathematics Education with an emphasis in Rural Appalachian Sociology.