2011

Examining the Attitudes and Outcomes of Students Enrolled in a Developmental Mathematics Course at a Central Florida Community College

Leila Sisson
University of South Florida, lsisson@valenciacollege.edu

Follow this and additional works at: https://scholarcommons.usf.edu/etd

Part of the American Studies Commons, and the Other Education Commons

Scholar Commons Citation
Sisson, Leila, "Examining the Attitudes and Outcomes of Students Enrolled in a Developmental Mathematics Course at a Central Florida Community College" (2011). Graduate Theses and Dissertations. https://scholarcommons.usf.edu/etd/3348

This Dissertation is brought to you for free and open access by the Graduate School at Scholar Commons. It has been accepted for inclusion in Graduate Theses and Dissertations by an authorized administrator of Scholar Commons. For more information, please contact scholarcommons@usf.edu.
Examing the Attitudes and Outcomes of Students Enrolled in a Developmental Mathematics Course at a Central Florida Community College

by

Leila H. Sisson
A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Education
Department of Adult, Career, and Higher Education
College of Education
University of South Florida

Major Professor: Donald A. Dellow, Ed.D.
    John M. Ferron, Ph.D.
    W. Robert Sullins, Ed.D.
    William H. Young, Ed.D.

Date of Approval:
    June 23, 2011

Keywords: assessment, achievement, value, enjoyment, motivation, confidence

Copyright© 2011, Leila H. Sisson
DEDICATION

To my husband, Scott. Your encouragement sustained me through this 10-year process. I never imagined it would take so long or that we would experience what we did along the way. I am ever blessed to have you in my life.

To my sister, Laura. Thank you for always encouraging me especially when I wanted to throw in the towel. You are our family’s angel.

To mom and daddy. I know you would be proud.
ACKNOWLEDGEMENTS

I would like to express my deepest gratitude to my major professor, Dr. Donald Dellow. He has been my teacher and guidance counselor throughout this long process. Dr. Dellow is an extremely busy person, but he always made time for me. His quiet encouragement and patience made me persevere through the program, especially when I had stopped writing.

I would also like to thank my other committee members: Dr. John Ferron, Dr. W. Robert Sullins, and Dr. William Young. I was greatly encouraged to complete my program after Dr. Ferron agreed to be on my committee. I thank him for always making time to read my statistics and results. One of my first classes in the program was taught by Dr. Sullins. At that moment, I knew I wanted his perspective on my committee. Dr. Young always greeted me with a smile and encouraging words. Thank you for completing this journey with me.

An extra special thank you to Deidre Holmes DuBois. Your hours and hours of patience to proof my work has made this endeavor less trying. Special thanks to Gary Kokaisel and Ron Ginn for correcting the technical problems I encountered.

Lastly, I would like to thank all of the professors who allowed me to interrupt their classes twice during the semester. Also, thanks to all of your students who took the time to complete the survey twice. Your participation in the study made it possible.
TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

CHAPTER ONE: INTRODUCTION

Statement of the Problem 7
Rationale for the Study 9
Research Questions 12
Conceptual Framework and Methodology 13
Limitations and Key Assumptions 14
Definitions of Terms 15
Summary 17

CHAPTER TWO: LITERATURE REVIEW

Definition of Attitude 18
Difference between Mathematics Attitude and Attitude Toward Mathematics 20
Relevant Research on Attitude Toward Mathematics 20
Effects of Attitude on Achievement in Mathematics 22
Attitudinal Changes Throughout School (K – 20) 23
Studies Relating Attitude Toward Mathematics and Achievement in Mathematics 24
Community College Studies Relating Attitude Toward Mathematics and Achievement in Mathematics 28
Studies Using the Attitudes Toward Mathematics Inventory 31
Development of the Attitudinal Instruments 32
Attitudes Toward Mathematics Inventory 33
Florida College System 34
Remediation in Florida 36
Placement into Developmental Courses in Florida 37
Placement into Developmental Mathematics in Florida 37
Completion Rates of Developmental Mathematics Students in Florida 39
Factors Affecting the Success of Community College Students 42
Open Admissions Policy 43
Placement Policies and Exams 43
Inadequate Preparation 44
Question #2: Initial Attitudes Toward Mathematics and CPT Scores 127
Question #3: Initial Attitudes Toward Mathematics and State Competency Exam 127
Question #4: Difference Between completers’ and non-completers’ initial attitudinal scores on each factor of the ATMI 128
Question #5: Change Scores Across Classes, Age, Gender, and Ethnicity 134
Themes Across Research Findings 137
Limitations of the Study 139
Implications and Recommendations for Mathematics Professors 140
Recommendations for Further Study 143

REFERENCES 145

APPENDICES 168
Appendix A Attitudes Toward Mathematics Inventory 169
Appendix B Florida College System 175
Appendix C Percentage Per Response for the ATMI Initial Survey 177
Appendix D End of Semester Descriptive Statistics Per Survey Question 182
Appendix E Cover Letter 187
Appendix F Demographic Data 191
Appendix G USF IRB Letter of Approval 192
LIST OF TABLES

Table 1 CPT Mathematics Assessment ........................................... 38
Table 2 Attitude toward Mathematics Inventory Factors .................. 63
Table 3 Factors with Sample Items ............................................. 64
Table 4 Descriptive Statistics Per Survey Question from the ATMI .... 75
Table 5 Initial Composite Mean per ATMI Factor ............................ 80
Table 6 Initial Composite Attitude Scores Across Class Sections .... 82
Table 7 ANOVA Difference of Composite Initial Attitude Scores Across Class Sections ......................................................... 82
Table 8 Fisher’s Z-transformations of Composite Attitude Score and CPT 85
Table 9 Fisher’s Z-transformations of Composite Attitude Scores and State Competency Scores .................................................. 88
Table 10 Initial Attitudes Composite Mean Scores for Completers and Non-completers .......................................................... 92
Table 11 Initial Attitudes per Item Completers’ and Non-completers’ Descriptive Statistics Highest and Lowest ................................................. 93
Table 12 ANOVA Summary Table for Completers and Non-completers Across Class Sections per Factor of the ATMI .................... 95
Table 14 Change Scores for the Four Attitudinal Components of the ATMI ................................................................. 97
Table 15 Change Scores Descriptive Statistics for Factors of the ATMI 98
Table 16 T-test Results for Initial and End-of-Semester Change Scores 98
Table 17 ANOVA Change Scores per Factor Across Class Sections .... 100
Table 18 Age Group Distribution 102
Table 19 ANOVA Change Scores per Factor Based on Age 103
Table 20 Gender Distribution 104
Table 21 ANOVA Change Scores per Factor Based on Gender 105
Table 22 Ethnicity Distribution 106
Table 23 ANOVA Change Scores per Factor Based on Ethnicity 107
LIST OF FIGURES

Figure 1: Endogenous Variables affecting Attitude Toward Mathematics 26
Figure 2: CPT Score and Initial Composite Attitude Score 84
Figure 3: State Competency Scores and Initial Composite Attitude Scores 87
ABSTRACT

Examining students’ attitudes toward mathematics has become extremely popular. This study examined the attitudes and outcomes of Beginning Algebra students at a central Florida community college. Quantitative methods were used to examine the students’ initial composite attitudes toward mathematics. The initial composite attitude was used to examine the relationship between CPT scores and State Competency Exam scores. Further analysis was conducted to examine completers’ and non-completers’ initial attitudes. The composite change score was determined and quantitative methods were used to examine interactions between class sections, age, gender, and ethnicity.

The study began with 217 students and ended with 158. The initial attitude scores were determined for the 217 students who completed the Attitudes Toward Mathematics Inventory (ATMI) in the first week of the fall 2010 semester. The ATMI was administered again in the 12th week of the semester to gather an end-of-semester attitude score. Throughout the semester several students withdrew, and the final sample size was 158 students. A change score was determined using the final sample size and subtracting the beginning attitude scores from the ending attitude scores. The change score was used to examine whether an interaction occurred between class sections, age, gender, and ethnicity. Students’ initial composite attitude was revealed to be slightly positive. Students’ initial composite scores for the factor of value implied that these students valued mathematics. The factors of self-confidence and enjoyment were slightly positive. Motivation was the most negative response with a below neutral composite attitudinal
score. No significance was found between the CPT score and student composite initial attitudinal score, nor was there any significance between the State Competency Exam and composite initial attitudinal score. Completers of the course were found to have a more positive composite attitude score than non-completers. Students’ change score indicated that the students’ overall attitudes had a positive change over the semester. A statistically significant association was found in change scores in the ATMI factor of value among these age groups. These findings have implications for professors who seek to identify students’ attitudes in order to intervene and assist students to become more positive toward mathematics and thus possibly improve students’ success in mathematics.
CHAPTER ONE: INTRODUCTION

Since the “Space Race” of the 1950s and 1960s, this country has been concerned about mathematics instruction. This concern has increased in the past decade, during which America has entered a new technological age. America has become increasingly dependent upon “technology, science, and research” (Tapia & Marsh, 2001, p. 4), and mathematics has become “critical in the preparation of students for future careers and for the security and progress of the nation” (Tapia & Marsh, 2001, p. 4). In his recent book, *The World Is Flat*, Thomas Friedman (2005) describes how globalization is creating a greater demand for a highly skilled workforce. He also notes that improved computer and communications technology is allowing skilled workers in countries such as China and India to directly compete for the high skill jobs previously held by Americans. He believes that at a time when our country needs even greater levels of highly educated and skilled workers, we are experiencing an educational crisis “that is unfolding very slowly and very quietly” (p. 252). T. Friedman identifies this crisis as “the steady erosion of America’s scientific and engineering base, which has always been the source of American innovation and our rising standard of living” (p. 253). T. Friedman notes that strong mathematics skills are a major foundation for academic study in science and engineering, and the performance of American students on national standardized tests in mathematics lags that of many other countries’ students.

The future of the American economy is built on “information-based industries that need a broadly based, highly skilled workforce” (McCabe, 2003, p. 13). Today’s
worker must be not only a critical thinker and capable of solving complex problems, but also efficient and effective and possess the ability to communicate mathematically (Golfin, Jordan, Hull, & Ruffin, 2005). Employers requiring workers to “know more math [and] the type of math required is also changing” (Golfin, et al., 2005, p. 5).

The Bureau of Labor Statistics (2009) predicted that higher level jobs requiring a postsecondary degree or award would account for nearly 50% of all new jobs between 2008 and 2010 and one-third of total job openings in the same time period. Occupations requiring an Associate’s degree involving education and training categories would grow the fastest at a 19.1% change between 2008 and 2010 (Bureau of Labor Statistics, 2009).

As Tracy Koon, Intel’s Director of Corporate Affairs, states, “[S]cience and math are the universal language of technology,” and these two subjects drive “technology and our [American] standards of living” (T. Friedman, 2005, p. 272). More recently, President Bush addressed the nation during his State of the Union Address in 2004, presenting his initiative entitled Jobs for the 21st Century, suggesting “United States workers will not be able to compete for higher wage jobs in the global economy without a strong foundation in math and science” (Koenig, 2006, p. 11). America’s economic prosperity cannot be maintained without a workforce that is educated in mathematics and science.

Unfortunately, the erosion of America’s scientific and engineering base directly affects the types of courses selected and the types of degrees being awarded in community colleges and universities all over America. As Adelman (2005) found in his research, “[A]t the Bachelor’s level, there was a decline between the 1980s and 1990s in the proportion of students earning degrees in both science and engineering fields and
business, and a rise in the proportion earning degrees in education and the social sciences” (p. 42). The types of degrees have shifted away from engineering, engineering technologies, and mathematics toward other fields, such as visual and performing arts, communications, and theological studies (National Center for Education Statistics, 2006a). This shift in chosen degrees is the “quiet crisis” to which T. Friedman (2005) was referring.

Between 1990 and 2000, the number of Associate’s degrees awarded increased by 20% while the number of Bachelor’s degrees awarded grew by only 14% (National Center for Education Statistics, 2006a). A more current projection by the National Center for Education Statistics (2009) states that between 2006 – 2007 and 2018 – 2019, the number of Associate’s degrees to be awarded may increase by 25% overall: specifically, 16% for men and 31% for women (p. 14). The projected increase in Bachelor’s degrees during this same time period is expected to be 19% overall (National Center for Education Statistics, 2009, p. 14).

Helping students to achieve academic success continues to be a priority for educators and administrators in higher education, and achieving mathematics success has moved to the forefront as a major concern in higher education. Unfortunately, mathematics has become a major barrier to student advancement, and developmental mathematics is a stumbling block for many entering freshmen. Research over the past two decades has shown that on average, “almost 50 percent of first-time community college students test as under-prepared for the academic demands of college-level courses and programs and are advised to enroll in at least one remedial class” (Roueche & Roueche, 1999, p. 5). More specifically, 35% of the freshmen in public two-year colleges
enroll in remedial mathematics (National Center for Education Statistics, 2003). Because all degree programs at a community college require mathematics coursework, students unsuccessful in completing the developmental mathematics coursework face an unobtainable goal of graduation. Recently, several researchers maintained “[S]tudents who took remediation at a two year college had significantly lower graduation rates than students at the same kind of institution who did not take remedial work” (Attewell, Lavin, Dominia, & Levey, 2006, p. 886). Therefore, succeeding in developmental coursework is the foundation for future success.

During the last several decades, the study of attitudes as a predictor of success in mathematics has been very popular. Traditionally, mathematics professors have identified the relationship between attitude toward mathematics and achievement in mathematics as their major concern (Bassette, 2004; Ma & Kishor, 1997; Tapia & Marsh, 2001). One of the most commonly recognized and researched predictors of success in developmental mathematics is attitude (Aiken, 1970; Bassarear, 1991; Fennema & Sherman, 1976; Ma & Kishor, 1997; Sandman, 1980; Tapia, 1996; Waycaster, 2001). Determining whether there is a relationship between attitude toward mathematics and achievement in mathematics has been the focus of several studies (Ma & Kishor, 1997; Tapia & Moldavan, 2004). Research shows “[A]ttitudes toward mathematics are extremely important in the achievement and participation of students in mathematics” (Tapia & Marsh, 2001, p. 5), and attitude toward mathematics may be related to achievement and ability in mathematics (Dwyer, 1993).

In the past, many studies were conducted to determine whether there is a relationship between attitude toward mathematics and achievement in mathematics at the
elementary and high school levels (Ma & Kishor, 1997; Tapia, 1996; Wolf & Blixt, 1981). A small number of studies have examined this relationship at the community college level. One recent study conducted in a Texas community college investigated the level of math anxiety among developmental math students and whether anxiety can be lowered over a semester (Johnson, 2003). Another college study addresses several issues with remedial mathematics students: attitudes of students entering a developmental mathematics course, method of presenting the mathematics material, and relevance of the material to the student’s life (Hammerman & Goldberg, 2003). More recently, another study at Prince George’s Community College examined students’ initial and exiting attitudes toward mathematics and success in developmental mathematics (Bassette, 2004) while another community college study examined math anxiety and the select demographics of mathematics students (Fuson, 2007).

To succeed in mathematics, students with negative attitudes need to turn their negative attitudes into more positive outlooks by putting the past behind them and conquering the future (Hammerman & Goldberg, 2003; Ma & Kishor, 1997). According to Hammerman & Goldberg (2003), the negative attitude is part of a spectrum; at one end, students believe they can do the math because they have been promoted throughout school with grades that “belied the true level of their knowledge” (p. 82). In conjunction with this false perception of success, students resist their placement in developmental mathematics courses; at the other end of the negativity spectrum, students are frightened of the mathematics, possibly due to experiences beyond their control—a move that caused a gap in their learning, a teacher the student was unable to understand, illness, or family problems (Hammerman & Goldberg, 2003). By identifying the students with
negative attitudes in the beginning of the semester, the professor may be able to intervene and assist students to become more positive toward the mathematics course. Although the past cannot be changed, students’ negative attitudes toward mathematics can be addressed. Therefore, it seems appropriate to explore the attitudinal level of community college students, especially in the “high-risk” curricular area of developmental mathematics.

This project examines the attitudes of students toward mathematics in a remedial mathematics course at a Florida community college. Using an attitude survey, the Attitudes Toward Mathematics Inventory (ATMI; Appendix A), which has been used in several previous research studies (Curtis, 2006; Schackow, 2005; Tapia & Marsh, 2000), the study focuses on measuring several dimensions of students’ attitudes toward mathematics, including their perceived value of mathematics, their enjoyment of mathematics, their motivation to learn mathematics, and their self-confidence in working with mathematics. The composite attitude score measures student anxiety toward mathematics. The study first determines the initial attitude of a developmental student. Further study examines the students’ initial composite attitude scores as compared to their Common Placement Test (CPT) scores. The study compares the initial composite attitude scores to the scores on the State Competency Exam. The study then identifies completers and non-completers, using the State Competency Exam scores, to determine whether there is a difference between initial composite attitude scores and scores on each factor of the ATMI. Finally, the four attitude components of the ATMI are examined to determine whether they change during the fall semester in the developmental mathematics course in terms of class section, age, gender, and ethnicity.
Statement of the Problem

Academic success and retention are the primary concerns of researchers, educators, and administrators in higher education. Unfortunately, large numbers of college students enter higher educational institutions without college-level skills, and the responsibility for bringing these students up to college level has fallen upon America’s community colleges. The National Center for Education Statistics (2003) reported that 42% of freshmen entering public two-year colleges enrolled in at least one remedial reading, writing, or mathematics course, compared to 12 to 24% at other types of institutions.

For the most part, Florida’s college system (Appendix B) is charged with the responsibility of remediation because the public universities (with the exception of Florida Agricultural and Mechanical University) do not offer remedial courses and postsecondary mathematics remediation is becoming more significant for the success of community college students (Lyes-MacLachlan, 2004). According to the 2001 – 2002 Florida Readiness Report, approximately 65.3% of Florida public high school graduates were underprepared for college-level mathematics (Florida Department of Education, 2002). Also in Florida, 65% of all incoming college students required remediation in one or more areas of reading, writing, and mathematics (Florida Department of Education, 2005).

Underprepared students are so prevalent in Florida that the Florida Department of Education has developed a Strategic Plan for Florida’s Community College System. In this Strategic Plan a portion of it addresses the need for seamless transitions in the K – 20 system in order to provide an opportunity for students to achieve their highest educational
opportunities (Your Florida Department of Education, 2006). The Strategic Plan addresses goals, which emphasize a commitment to educational equity, open access, diversity, community responsiveness, quality, and affordability (Your Florida Department of Education, 2006).

Contrary to common belief, “[D]evelopmental education programs are cost effective” and serve “one million students a year and successfully remediate half that number for an expenditure of only 1 percent of the national higher education budget and 4 percent of federal student financial aid” (McCabe, 2003, p. 19). Because these developmental students would otherwise be lost to society, the cost-benefit ratio is exceptional (McCabe, 2003). However, Hamm (2004) questions the moral and economic obligations of community colleges in his working brief: “Is the community college investment in remedial education good for economic development? Is it good for the local community?” (p. 31). Hamm (2004) answers his own question, “Indeed it is, for students who are successfully remediated become productively employed” (p. 31). Unfortunately, some college students who need remediation and are placed in developmental courses “do not have a chance to succeed due to a negative attitude and/or outlook with respect to the subject or the need for remediation” (Hammerman & Goldberg, 2003, p. 93).

Recent studies have found that students “required to take developmental mathematics suffer from mathematics deficiencies that harm their ability to succeed in other, non-mathematics courses” (Johnson & Kuennen, 2004, p. 28). Therefore, it seems a worthy endeavor to identify those students with negative attitudes toward mathematics in the beginning of the semester. While a general understanding of these attitudes is
important, a specific and more complete understanding of attitudinal effect on the learning of mathematics might enable institutions to identify students with negative attitudes—students who are most likely at risk of avoidance and failure of mathematics—and help these students to persevere in mathematics.

Providing professors with information regarding the students’ attitudes may encourage the professors to help those students overcome their negative attitudes. The purpose of this study is to examine the attitudes and outcomes of students in a beginning algebra course. Students’ initial attitudes were gathered in the first week of the semester in order to compare to the CPT scores and State Competency Exam scores. Completers’ and non-completers’ initial attitude scores were compared to determine whether there is a difference between the two groups. Ultimately, a composite attitude change score is examined to determine the extent of the students’ attitude change across class sections, age, gender, and ethnicity. This study does not intervene inside the classroom with teaching suggestions or strategies. However, identifying and implementing strategies to change attitudinal problems would be an excellent endeavor for future research.

**Rationale for the Study**

It is evident that remediation is a necessary part of the enrollment path for the majority of community college students (Adelman, 2006). Unfortunately, students who enroll in remedial courses are less likely to succeed; that is to say, students who enroll in remedial courses are 42% less likely to graduate than those who are not mandated to take remedial courses (Calcagno, Crosta, Bailey, & Jenkins, 2006). More research reveals “[S]tudents who took remediation at a two-year college had significantly lower graduation rates than students at the same kind of institution who did not take remedial
work” (Attewell, et al., 2006, p. 886). Progress for students who need remediation is slower and shows significant gaps between remediation levels (Valencia Community College Achieving the Dream College Wide Meeting, 2005). Valencia Community College (VCC) identified 74% of first-time-in-college (FTIC) students as non-college ready in fall 2000, and 26% of FTIC as college-ready (2005). Of those non-college ready students, only 48% completed remediation in two years, 51% completed 15 college-level hours in three years, and 15% completed the A.A. degree in four years, as compared to the 26% college-ready students of whom 72% completed 15 college-level hours in three years, and 31% completed the A.A. degree in four years (Valencia Community College Achieving the Dream College Wide Meeting, 2005).

In fall 2004, VCC identified 10 courses with the lowest success rates; of the 10 courses, 7 are mathematics courses, and, of the 7 mathematics courses, 4 are considered remedial. These remedial mathematics courses are the following: Pre-Algebra (MAT 0012), Beginning Algebra (MAT 0024), Preparatory Math Intensive (MAT 0020), and Intermediate Algebra (MAT 1033). The success rate for Beginning Algebra (MAT 0024) was 42.3%, the second lowest, just above Preparatory Mathematics Intensive (MAT 0020), which has a success rate of 39.4% (Valencia Community College Achieving the Dream College Wide Meeting, 2005).

During the last few decades, many characteristics have been identified that put students mandated to take developmental mathematics courses at risk: first-generation learner status, poor self-image, an attitude of failure or self-defeatism, academically weak preparation, and low test score results (Roueche & Roueche, 1999). Older studies have examined attitude and mathematics, such as those of Dutton (1951) and Poffenberger and
Norton (1959). In the early 1970s, Fennema and Sherman (1976) developed an instrument to measure attitude and mathematics, which focused on the affective domain and how it is related to an individual’s attitude toward mathematics. More recently Tapia (1996) developed the ATMI, which measures several dimensions of students’ attitudes toward mathematics.

Very few studies have explored the relationship between attitude toward mathematics and achievement in mathematics in community colleges. Thus, the impetus for this study was the paucity of studies that specifically analyze attitude and success in mathematics. At VCC, the graduation rate for FTIC students mandated into a preparatory course was 15.4% in summer 2008 (Valencia Community College, 2009). Moreover, students who were mandated into at least one remedial course take approximately four years to complete a two-year degree. Research has shown completion of developmental mathematics during the first year of entrance into the college positively affects the success of future coursework (Adelman, 2005). Therefore, quick completion of remedial courses could have a positive impact on graduation rates.

Mathematics educators generally believe that students will have greater success in mathematics if they have a positive attitude toward the subject (Koch, 1992; Tapia, 1996; Willoughby, 1990). Curtis (2006) clearly communicated the need for further research regarding attitude and mathematics in her dissertation:

National reports call educators’ attention to the lack of motivation students have for mathematics. College instructors must also become aware of the attitudes students bring with them to the mathematics classroom. If college students continue to show a negative disposition for mathematics, our
society will see fewer mathematics majors and a workforce with minimal mathematical skills. (p. 163)

The findings of this study allow professors to learn more about how attitude may impede academic success. This research seeks to examine the relationship between attitude and academic success of completers and non-completers in a developmental mathematics course as well as to determine a relationship between the students’ CPT and State Competency Exam scores. If the results of this study lead to a connection between attitude and success, it adds to the scarce body of literature that specifically addresses community college remedial students and attitude.

Research Questions

1a. What are the initial attitudes of community college students entering a Beginning Algebra course as indicated by the four attitudinal components of the ATMI: value of mathematics, enjoyment of mathematics, motivation for mathematics, and self-confidence with mathematics?

1b. To what extent are the initial attitude scores different across class sections?

2a. What is the relationship between community college Beginning Algebra students’ initial attitudes toward mathematics and their scores on the CPT?

2b. To what extent is the relationship between attitude and CPT score different across class sections?

3a. What is the relationship between community college Beginning Algebra students’ initial attitudes toward mathematics and their scores on the State Competency Exam?

3b. To what extent is the relationship between attitude and State Competency Exam score different across class sections?
4a. What is the difference between completers’ and non-completers’ initial attitudinal scores on each factor of the ATMI: value of mathematics, enjoyment of mathematics, motivation for mathematics, and self-confidence?

4b. To what extent is the difference between completers and non-completers different across class sections?

5a. To what extent do the four attitudinal components of the ATMI—value of mathematics, enjoyment of mathematics, motivation for mathematics, and self-confidence—change during the developmental mathematics course?

5b. To what extent do the attitudinal score changes differ across class sections?

5c. To what extent do the attitudinal score changes differ based on age?

5d. To what extent do the attitudinal score changes differ based on gender?

5e. To what extent do the attitudinal score changes differ based on ethnicity?

Conceptual Framework and Methodology

Statistical analyses are used to explore the descriptive statistics of the initial attitudes toward mathematics as measured by the ATMI and to explore the relationship, if any, of initial attitude scores and the CPT and the State Competency Exam. Completers’ and non-completers’ initial attitude scores were examined to determine a difference, if any, on each factor of the ATMI. Change scores, determined by subtracting initial attitude scores from end of semester attitude scores, were examined to determine a difference, if any, on each factor of the ATMI as well as across class sections, age, gender, and ethnicity. Further, statistical analyses are used to explore the specific areas of attitude toward mathematics that the ATMI investigates: value, enjoyment, confidence, motivation, and anxiety. Attitudinal variables include the positive and negative feelings
of students toward mathematics in each of the specific areas addressed in the ATMI. Student outcome variables include the scores on the State Competency Exam, ranging from 0 to 100 points, and the scores on the CPT, ranging from 0 to 100.

The study was conducted during the fall semester 2010 at VCC in Kissimmee, Florida. Approximately 880 students were expected to enroll in Beginning Algebra (MAT 0024C) during the fall semester. Students enrolled in Beginning Algebra were given the ATMI during the first week and the 12th week of the semester by the researcher. Each student in the Beginning Algebra classes was assigned a number to protect his or her identity.

The ATMI contains 40 items utilizing the Likert format. Students were asked to indicate their agreement with each statement. The survey consists of 10 items addressing value, 10 items addressing enjoyment, 15 items addressing confidence, and 5 items addressing motivation. Twenty minutes in class were provided to perform the ATMI pretest and posttest. This study also utilizes existing data, via transcript analysis, to obtain the CPT score of each student. The score on the State Competency Exam was provided by the Valencia Mathematics Coordinator. The use of Statistical Analysis System (SAS), a powerful statistical package, allows data to be analyzed.

Limitations and Key Assumptions

1. This research is limited to those students who attended VCC during the fall semester of 2010 in Kissimmee, Florida.

2. The backgrounds and goals of these students are diverse. Community college students tend to be older than the traditional age of a student at a four-year, public
university. Almost 30% of VCC’s students are older than 25, and 66% of Valencia’s students attend part-time (Valencia Foundation, 2006).

3. The research is limited to the population of students who elected to enroll in Beginning Algebra during the fall semester of 2010. The sample size will be approximately 250 at the beginning of the study and will change throughout the study due to withdrawals.

4. Making generalizations of this study to two-year and four-year institutions may be difficult due to the class sizes at a community college. VCC limits the class size of preparatory courses to 22 students whereas at some four-year universities, the classes tend to be much larger.

5. Administering the ATMI during the first and 12th week of the semester could cause some anxiety or a negative attitude, which could be reflected in the survey results.

6. Students are assured of complete anonymity; however, students may worry that the instructor can identify their responses, and they may feel compelled to respond according to what they believe the instructor wants.

Definitions of Terms

Age Range. Non-traditional students are age 25 and above. Traditional students are age 24 and below.

Attitude. This term will refer to a “predisposition to respond in a favorable or unfavorable manner with respect to a given attitude object” (Oskamp & Schultz, 2005, p. 9).

Attitude toward Mathematics. This study will utilize the definition provided by Haladyna, Shaughnessy & Shaughnessy: “a general emotional disposition toward the school subject of mathematics” (1983, p. 20).
**Beginning Algebra (MAT 0024C).** This term refers to a non-credit mathematics course offered at Florida community colleges. Topics include sets, computations with decimals, percents, integers, operations with rational and polynomial expressions, solving linear equations and expressions, plane geometric figures and applications, graphing ordered pairs and lines, and determining the intercepts of lines. A passing score on the State Competency Exam is required for a course grade of C, which is required for successful completion of the course (Valencia Community College, 2009).

**College Preparatory Courses.** This term will refer to the competency-based instruction for students preparing to enroll in college credit instruction.

**College Preparatory Students.** This term refers to students who scored below the cut-off scores on standardized entrance exams and were thus identified as needing further basic skills enhancement prior to attempting college-level work in that discipline.

**Common Placement Test (CPT).** This term refers to a standardized test designed to measure the basic skills of incoming college freshmen.

**Completers.** This term refers to students who have passed Beginning Algebra with a C or better, and passed the State Competency Exam with an 80% or better.

**First-time-in-college (FTIC).** This term refers to students who have never been admitted to a degree program at any other postsecondary institution.

**Non-completers.** This term refers to students whose grade on the State Competency Exam was below 80% or who withdrew from Beginning Algebra during the semester.

**Under-prepared Students.** This term means the same as College Preparatory Students.
Summary

Negative attitudes among college students in mathematics classrooms are a common occurrence. Community college students have at least 11 years of prior experience with mathematics and may have established a fixed attitude toward mathematics. However, the earlier students are identified as having negative attitudes, the earlier intervention strategies could be implemented. This study is designed to employ analysis of data to assess students’ initial attitudes, end of semester attitude, and attitudinal change scores. This study, exploratory in nature, should add to the scant body of knowledge about attitude and success or failure at the community college preparatory mathematics level.

Chapter 1 introduced the impetus for the study, explaining that attitude has a direct connection to success. The rationale for the proposal described the need to concentrate on developmental students’ attitude and success on the State Competency Exam. The chapter proposed the mission of the study: to determine a clear connection between initial composite attitude score and success in a developmental mathematics course. In conclusion, the researcher provided the limitations and assumptions of the study and definitions of terms. Chapter 2 includes a review of relevant literature. Chapter 3 addresses the research methodology and procedures that will be utilized in this study. Chapter 4 presents the research findings and analysis of the data. Chapter 5 presents the summary, conclusions, and further recommendations for study.
CHAPTER TWO: LITERATURE REVIEW

This section begins with a definition of attitude and includes sections describing the difference between mathematics attitude and attitude toward mathematics, including relevant research on attitude toward mathematics, effects of attitude toward mathematics and achievement in mathematics, and how attitude toward mathematics changes from kindergarten through college. This continues with several studies relating attitude toward mathematics and achievement in mathematics, a chronological review of the history and development of many attitudinal instruments, and the impetus behind the development of the ATMI. The final section describes the Florida College System, remediation in Florida, procedures on how students are placed in developmental courses—specifically mathematics in the community college—and concludes with the rates of completion of developmental mathematics students in Florida. Two themes that have emerged on the subject of attitude and success in mathematics are the factors affecting the success of college students and class effect on student success in developmental mathematics.

Definition of Attitude

Since the 1940s, research has been conducted on students’ attitudes and the possible influence college has on any behavioral change (Astin, 1977, p. 59). Although discussion continues among psychologists as to how to define attitude, a respected social psychologist, Allport (1935), developed a comprehensive definition of attitude: “An attitude is a mental or neural state of readiness, organized through experience, exerting a
directive or dynamic influence upon the individual’s response to all objects and situations with which it is related” (p. 810).

Since that time, most definitions of attitude have followed Allport’s lead and “have become rather similar in their main emphases, though differing in some details” (Oskamp & Schultz, 2005, p. 8). In the 1970s, Aiken (1970) and Bem (1970) developed their own definitions of attitude. Aiken’s (1970) definition states that attitude is “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). Bem’s (1970) definition states simply, “Attitudes are likes and dislikes” (p. 14). Bem’s definition was expanded by Fishbein and Ajzen (1975) to include learning and consistency: “An attitude is a learned predisposition to respond in a consistently favorable or unfavorable manner with respect to a given object” (p. 6).

Throughout the years, several additional definitions of attitude have been developed. Almost 20 years after Aiken and Bem developed their definitions, another definition was developed by Eagly and Chaiken (1993), with an emphasis on evaluation: “Attitude is a psychological tendency that is expressed by evaluating a particular entity with some degree of favor or disfavor” (p. 1). Three years later, Morris (1996) defined attitude as a relatively stable organization of beliefs, feelings, and tendencies toward something, that is, the attitude object; moreover, he stated that attitudes can predict behavior and are acquired through learning and then developed through experience. In 1997, Lefton viewed attitudes as long-lasting patterns of feelings and beliefs about other people, ideas, or objects that are based on people’s past experiences and shape their future behavior. Hannula (2002) describes attitude as “someone’s basic liking or disliking
of a familiar target” (p. 25). Oskamp and Schultz (2005) blend all of the previous
definitions into a concise definition: “An attitude is a predisposition to respond in a
favorable or unfavorable manner with respect to a given attitude object” (p. 9).

Difference between Mathematics Attitude and Attitude Toward Mathematics

The previous definitions of attitude imply that the person has positive or negative
feelings toward some object. There are two different views of attitude and mathematics.
One view attempts to connect the students’ math attitudes with achievement in
second view examines the students’ attitude toward mathematics with reference to
achievement in mathematics (Shashaani, 1995; Tapia & Marsh, 2004). These two views
tend to be confused because of the similarity of the wording. Students’ math attitudes and
achievement in mathematics have been examined in terms of a causal relationship of
attitude and achievement (Haladyna et al., 1983; Wolf & Blixt, 1981) whereas Ma and
Kishor (1997) examine the relationship between attitude toward mathematics (ATM) and
achievement in mathematics (AIM) in their meta-analysis. This study examines students’
attitudes toward mathematics and achievement in mathematics.

Relevant Research on Attitude Toward Mathematics

Attitude toward mathematics has been examined extensively (Aiken, 1970;
Aiken, 1976; Ma & Kishor, 1997; Shaughnessy & Haladyna, 1981; Tapia & Marsh,
2001). Many definitions of attitude toward mathematics have been developed over the
years. Neale (1969) defines attitude toward mathematics as an aggregated measure of “a
liking or disliking of mathematics, a tendency to engage in or avoid mathematics
activities, a belief that one is good or bad at mathematics, and a belief that mathematics is
Haladyna et al. (1983) define attitude toward mathematics as “a general emotional disposition toward the school subject of mathematics” (p. 20). Haladyna et al. (1983) warn that this definition should not be confused with an “attitude toward the field of mathematics, toward one’s ability to perform in the field of mathematics, or toward some specific area with mathematics (e.g., geometry, word problems)” (p. 20). Ma and Kishor (1997) extend Neale’s definition of attitude toward mathematics to include students’ affective responses to the easy/difficult dimension as well as the importance/unimportance dimension of mathematics. Tapia and Marsh (2000) suggest society needs to recognize that the importance of attitude and development of a positive attitude toward a subject are “probably one of the most prevalent educational goals” (p. 5). More recently, Hannula (2002) states that attitude can also be seen as an emotional disposition toward mathematics. Hannula’s definition has four components:

1) the emotions the student experiences during mathematics related activities;

2) the emotions that the student automatically associates with the concept ‘mathematics’;

3) evaluations of situations that the student expects to follow as a consequence of doing mathematics; and

4) the value of mathematics-related goals in the student’s global goal structure. (p. 26)

Some researchers have found a direct relationship between attitude toward mathematics and success in a mathematics course. A student’s attitude toward mathematics directly influences many areas of a student’s college career: His or her
success in mathematics courses, selection of mathematics courses, and selection of a mathematics-related career or a mathematics-related degree.

Effects of Attitude on Achievement in Mathematics

Research on attitude toward mathematics and achievement in mathematics reveals a positive relationship. Shashaani (1995) suggests an extremely important relationship among attitude toward mathematics, achievement, and participation by students in mathematics. If students have good attitudes about learning math, they will be more likely to understand the concepts, which will help them develop confidence in their ability to work mathematical operations (Furner & Berman, 2003). In both theory and practice, a strong relationship between attitude toward mathematics and mathematics achievement has long been assumed.

Suydam and Weaver (1975) suggest that educators involved with teaching mathematics believe that if children are interested in mathematics, they will learn more effectively and achieve higher grades. Suydam and Weaver also propose that special attention should be directed toward “creating, developing, maintaining and reinforcing positive attitudes” (p. 45). Thorndike-Christ (1991) found that attitude is an excellent predictor of the final grade in a course. Students with positive feelings about mathematics exert more effort, spend more time on mathematics tasks, and are more effective learners than students with poor attitudes (Ma & Kishor, 1997). More recently, researcher Bassette (2004) found that the more positive the Aiken Attitude Survey scores, the higher the final exam score (p. 66). Therefore, developing and maintaining a positive attitude toward mathematics are important factors in student success.
Attitudinal Changes Throughout School (K – 20)

Negative attitude affects performance at all levels of learning. Tapia and Marsh (2004) suggest “[S]tudents with negative attitudes toward mathematics have performance problems simply because of anxiety” (p. 16). When children enter school as elementary students, they have a more positive attitude toward mathematics; unfortunately, as they progress through school, their attitude becomes more negative. As Curtis (2006) states, children enter school eager to learn mathematics; they see mathematics as a “meaningful, interesting and a worthwhile subject” (p. 12). Young students view the subject of mathematics as important and feel that they can learn the material (Curtis).

However, as students enter middle and high school, their level of enjoyment has decreased drastically (McLeod, 1992; Middleton & Spanias, 1999). By the time they reach college, students have generally formed stable attributions regarding their successes in mathematics (Middleton & Spanias, 1999). Thorndike-Christ (1991) found that attitude is correlated with a student continuing in advanced mathematics courses once course selection is optional. As students enter college, their attitude about mathematics affects their decisions to enroll in mathematics courses (Bassette, 2004). Haladyna, et al. (1983) developed three reasons a positive attitude toward mathematics is important:

1. A positive attitude is an important school outcome in and of itself.
2. Attitude is often positively, although slightly, related to achievement.
3. A positive attitude toward mathematics may increase one’s tendency to elect mathematics courses in high school and college and
possibly one’s tendency to elect careers in mathematics or mathematics-related fields. (p. 20)

The tendency of students to shy away from mathematics or mathematics-related fields is an example of the quiet crisis involving the “steady erosion of America’s scientific and engineering base” to which T. Friedman (2005) refers (p. 253).

Schackow (2005) states that if students continue to have “repeated negative experiences with a particular area of mathematics, the intensity of the emotional impact will usually lessen over time” (p. 22). Eventually, students’ reactions to mathematics stabilize and become more automatic, which allows their attitudes to be measured by a survey or questionnaire (Schackow).

Studies Relating Attitude Toward Mathematics and Achievement in Mathematics

Research indicates students’ attitudes toward mathematics have a direct influence on achievement, with varying degrees of confirmation (Aiken, 1972; Braswell, Lutkus, Grigg, Santapau, Tay-Lim & Johnson, 2001; DeCorte & Op’tEynde, 2003; Gallagher & De Lisi, 1994; Ma & Kishor, 1997; Neale, 1969; Shashaani, 1995; Singh, Granville, & Dika, 2002; Thorndike-Christ, 1991). Furthermore, Aiken (1972) found “the correlation between attitudes and achievement is frequently higher for mathematics than for school subjects with more verbal content” (p. 231).

Many researchers have attempted to determine a relationship between attitude toward mathematics and achievement in mathematics. Stage and Kloosterman (1991) explored the relationship among ability, attitudes (belief) about mathematics, and achievement in developmental mathematics at a public research university in the Midwest. The purpose of the study was to measure college students’ beliefs about
mathematics and to identify the relationships between those beliefs and achievement in the developmental mathematics classroom.

Thorndike-Christ (1991) conducted a study involving public middle and high school students. The study investigated the relationship of attitude toward mathematics to performance in a mathematics course, gender, mathematics course selection, and career interests. Thorndike-Christ utilized the Fennema-Sherman Math Attitude scale to assess students’ attitudes toward mathematics. The results indicated that attitude toward mathematics was “predictive of [the] final mathematics course grade and the intention to continue to participate in mathematics courses once enrollment becomes optional” (Thorndike-Christ, abstract).

Haladyna, et al. (1983) conducted a study which involved a sample of 2,000 students in grades 4, 7, and 9, representing urban and rural locations and various school environments (p. 22). Haladyna, et al. had the following focus: “Class attitude toward mathematics, the major dependent variable, was examined in relationship to student motivation (SM), teacher quality (TQ), the social-psychological class climate (SP), and management-organization class climate (MO)” (p. 24). The study examined only endogenous variables affecting attitude toward mathematics, identified as teacher (teacher quality) and learning environment (social-psychological and management-organization climate) (Figure 1).
Haladyna et al. (1983) recognized that exogenous variables such as a student’s sex, social class, and aptitude may contribute to attitude formation, but, as found in earlier analyses (Haladyna & Shaughnessy, 1982; Shaughnessy, et al., 1981), these exogenous variables have a limited relationship to attitude. Haladyna et al. utilized the Inventory of Affective Aspects of Schooling (IAAS), which studies five dimensions of attitude toward mathematics: “(a) student motivation, (b) teacher quality, (c) social-psychological class climate, (d) management-organization class climate, and (e) attitude toward mathematics” (p. 22). The results of the IAAS showed a strong association between “teacher quality measure and both attitude toward mathematics and student motivation” (p. 24).

Ma and Kishor (1997) conducted a meta-analysis to investigate the relationship between attitude toward mathematics and achievement in mathematics of 82,941 students.
at the elementary and secondary school levels (p. 28). In their research, Ma and Kishor attempted to answer four research questions:

1. Can a relationship between ATM and AIM be determined using the metric correlation coefficient?
2. Is there a relationship among gender, grade, ethnicity, sample selection, sample size, and time period?
3. Is there an interaction among gender, grade, and ethnicity?
4. Can the magnitude of the causal relationship between ATM and AIM be determined? (p. 29)

The conclusions were positive for the overall effect between attitude toward mathematics and achievement in mathematics, indicating a positive and reliable relationship (p. 35).

Johnson (2000) investigated the factors influencing the college student’s attitude toward mathematics in several college-level mathematics courses and compared different types of college students’ attitudes toward mathematics. The study included 70 – 75 students enrolled in the following courses: Precalculus, Introduction to Calculus I, Introduction to Probability and Statistics I, and Mathematics for Elementary School Teachers I – III (p. 125). Johnson used two types of instruments: a 26-item attitude questionnaire developed by Suydam and Trueblood administered in the first two weeks of the fall quarter and researcher-generated interview questions for six students from each course. The results indicated a significant difference in attitude among the four courses examined. The Precalculus students had a more positive attitude toward mathematics as compared to the students in Introduction to Calculus I and Introduction to Probability and
Statistics I. The students with the least positive attitudes toward mathematics were the students in the Mathematics for Elementary School Teachers I – III.

Hammerman and Goldberg (2003) presented a paper discussing strategies employed to help students gain the necessary mathematics background needed to be successful in college-level mathematics. The goals of their strategies were threefold:

1. to reverse the negative student attitudes toward the remediation materials;
2. to present the material in a meaningful way that is geared for understanding rather than for pure memorization; and
3. to incorporate relevance to the students’ lives outside of the classroom in the examples presented during the lectures. (p. 79)

No statistical evidence was presented in this paper. The authors simply stated that in general, developmental students’ success depends on their attitudes and/or outlooks regarding the subject and need for remediation (p. 93). Hammerman and Goldberg’s desire is to change the students’ attitudes regarding remediation through the application of positive reinforcement by changing the students’ views about themselves by providing them with the mathematical tools to overcome their fears about mathematics; students also need to positively accept that the need for remediation is not a punishment but that remediation will help them succeed (p. 93).

Community College Studies Relating Attitude Toward Mathematics and Achievement in Mathematics

Cox (1993) conducted a study of at-risk community college students. The study investigated whether performance in basic mathematics could be predicted from norm
and criterion referenced assessment. Cox administered the Aiken-Dreger Revised Mathematics Attitude Test during the first week of the winter semester to students while they completed other required material for the basic mathematics and intermediate algebra courses. The results revealed no difference between successful and non-successful students. Achievement and attitude toward mathematics were not related (p. 72).

Bershinsky (1993) conducted a study which involved 456 developmental mathematics students in mathematics courses offered by Laramie County Community College at the University of Wyoming. The purpose of the study was to identify the demographic, attitudinal, and achievement variables that are important in predicting student outcomes in developmental mathematics courses. Bershinsky utilized the Affective Questionnaire developed by Brown (1986) in the course of her dissertation (p. 19). The Affective Questionnaire consists of 25 yes/no questions. The first 15 questions measure the students’ feelings about mathematics, and all 25 questions measure the students’ feelings about school and self (p. 193). Bershinsky’s study found “feelings about math, feelings about school and self, and marital status [were each] related to student outcomes” (p. 135). These findings supported “a direct relationship between attitudinal scores and outcome; the higher the [attitudinal] scores, the more likely a successful outcome [in mathematics]” (p. 135).

Johnson (2003) conducted a study involving a sample of students enrolled in the second sequence of a developmental mathematics course and students enrolled in a college algebra course at a community college. The purpose of the study was to investigate the impact of math anxiety on developmental students, to measure the decline
of anxiety over one semester, and to determine what effect addressing anxiety issues and pedagogical practices had on attitudinal perspective toward mathematics. The intervention for the treatment group consisted of a presentation on math anxiety. Both groups participated in the pre-survey to determine a baseline anxiety level. The pre and post anxiety surveys were parallel surveys and were adapted from a math anxiety survey developed by E. Friedman (1997). The survey consisted of seven questions using a Likert scale. The results revealed no significant difference between the two groups’ anxiety level in the beginning of the course and at the end of the course.

Bassette (2004) investigated the effect of the initial and exiting attitudes toward mathematics and academic outcomes of students placed in a developmental mathematics course at a community college in Maryland. The following demographic variables were selected as potential discriminators: age, gender, ethnicity, and birth date. Attitudinal variables in the study included the students’ general attitude toward mathematics, such as like/dislike. The dependent variables included attitude difference, final exam score, and final grade. Student outcome at the end of the developmental mathematics course was the criterion variable in the study and was classified as either achiever or non-achiever. The findings indicated a strong linear relation between pre-test and post-test attitudinal score. Attitudinal scores for female students were positively related to placements and final exam scores. Achievers and non-achievers had the same attitudes toward mathematics. There were no significant differences between the means of initial and exiting attitudes based on age, gender, or age by gender. Females showed an increase in attitudinal change score, but there was no increase in the scores for males. Scores on the placement test and
the final grade were found to be highly significant, with a positive linear relationship. Thus, gender and age are related to the final exam score and are highly significant.

Studies Using the Attitudes Toward Mathematics Inventory

Schackow’s (2005) study examined the “attitudes [toward] mathematics of pre-service elementary teachers entering an introductory mathematics methods course” (p. xi). Students were asked to complete the ATMI in the beginning and end of the course. Schackow also employed the use of journal writing. Therefore, this research project utilized a qualitative and quantitative approach. Participants’ mean composite ATMI in the beginning of the course was 3.12 on a scale of 5. This is just above neutral. The mean change score from the end of term ATMI score for the participants was 17.03, and the median change score was 15, indicating a “statistically significant positive change in attitude” (p. 217).

Curtis (2006) conducted a study to assess the impact of student attitudes in a college algebra mathematics classroom when lessons were primarily composed of standards-based pedagogy. Specifically, did such a learning environment have an impact on students’ perceptions of being a student of mathematics in the areas of confidence, anxiety, enjoyment, motivation, and relevance of mathematics, as measured by the ATMI? Changes in attitude were measured utilizing attitudinal surveys, student questionnaires, observations, and focus groups. Although confidence, motivation, and value did not experience a statistically significant change, the qualitative data indicated that a change in these attitudes did occur. This study identified four teaching procedures that positively affected students’ attitudes toward mathematics: cooperative learning, problem solving, discourse, and use of graphing calculators.
Fuson (2007) conducted a quantitative study to determine a relationship between math anxiety and demographic factors of age, gender, and ethnicity. The study consisted of 57 adult mathematics students at three universities in the United Kingdom. Fuson utilized the ATMI. Fuson found that math anxiety is not predictable by age or ethnicity, but anxiety factors were predictable by gender.

Development of the Attitudinal Instruments

One of the first attitudinal instruments developed was the Dutton Scale, which measured “feelings” toward mathematics (Dutton, 1954). In the 1960s, one-dimensional scales were developed by Gladstone, Deal, and Drevdahl (1960) and Dreger (1961). In the 1970s, Aiken (1974) developed an attitudinal instrument designed to measure the enjoyment and value of mathematics. Michaels and Forsyth (1977) and Sandman (1980) developed multidimensional attitudinal scales.

The Fennema-Sherman Mathematics Attitude Scales were developed in 1976 and consist of a group of nine instruments: (1) Attitude Toward Success in Mathematics Scale, (2) Mathematics as a Male Domain Scale, (3) and (4) Mother/Father Scale, (5) Teacher Scale, (6) Confidence in Learning Mathematics Scale, (7) Mathematics Anxiety Scale, (8) Effectance Motivation Scale in Mathematics, and (9) Mathematics Usefulness Scale (1976). Even though these scales are more than 30 years old, have 108 items, and take 45 minutes to complete, the Fennema-Sherman Mathematics Attitude Scales are one of the more popular instruments used in research over the last three decades.

However, Tapia and Marsh (2004) identified a need for a shorter instrument which addresses factors important to research in attitudes toward mathematics, such as
confidence, anxiety, value, enjoyment, and motivation. Thus, Tapia and Marsh developed the ATMI.

*Attitudes Toward Mathematics Inventory*

The ATMI was developed by Tapia and Marsh to address mathematics attitudes with regard to confidence, anxiety, value, enjoyment, and motivation (2004). They developed the ATMI to “address factors reported to be important in research” (p. 16). The ATMI was originally a 49-item scale with a Likert-scale format. It has since been shortened by the original developers to a 40-item Likert-scale questionnaire.

The ATMI specifically assesses confidence, value, enjoyment, motivation, and anxiety. Confidence measures students’ confidence and how students perceive their performance in mathematics; value measures the students’ beliefs regarding the usefulness, relevance, and worth of mathematics as it pertains to their personal and professional lives; enjoyment measures the students’ enjoyment of attending mathematics classes; and motivation measures the interest and desire a student has for taking mathematics classes (Tapia & Marsh, 2004). The anxiety component is a composite score that measures the students’ overall anxiety toward mathematics.

The ATMI was selected to be used in this study because it has previously been used in a college environment and administered to college algebra students to analyze the change in attitude of community college students in a college algebra course (Curtis, 2006). It was also recently utilized to study university students enrolled in a mathematics methods course to determine the extent to which their attitude changed during the methods course (Schackow, 2005). Fuson (2007) utilized the ATMI to determine whether
a relationship exists between anxiety and age and gender and ethnicity for adult students attending universities in the United Kingdom.

Determining attitude about mathematics in the beginning of a semester may provide instructors with vital information regarding the potential success or failure of certain students. The following has been shown:

[S]uccess or failure in mathematics is greatly determined by personal beliefs [...]. Regardless of the teaching method used students are likely to exert effort according to the effect they anticipate, which is regulated by personal beliefs about their abilities, the importance they attach to mathematics, enjoyment of the subject matter, and the motivation to succeed. (Tapia & Marsh, 2004, p. 8)

Florida College System

The Florida College System comprises 28 institutions that respond to community needs for postsecondary education (Appendix B) and provide two-year and four-year academic degrees. Some of the programs provided include technical programs, career and specialized training, and general education programs, as well as support services such as assessment, counseling, and remediation (Office of Program Policy Analysis & Government Accountability, 2010). The idea for a state college system emerged in 1998 from the Postsecondary Education Planning Commission acknowledging that baccalaureate access was a major concern for Florida students (Horne, 2003). In 2001, with the enactment of Senate Bill 1162, St. Petersburg Junior College was re-established as St. Petersburg College and granted the ability to confer baccalaureate degrees addressing workforce demands in nursing, education, and information technology
In 2007, the Pappas Consulting Group, working with a Board of Governors study, again suggested the state college system (Floyd, Falconetti, & Hrabak, 2009). The Pappas Consulting Group suggested that the new state college system would provide a cost-effective path for students to attain a baccalaureate degree (Floyd et al., 2009).

In 2008, Florida’s Senate Bill 1716 was enacted, which changed the name of the Florida Community College System to the Florida College System in “recognition of the importance these institutions play in the economic future of Florida” (Florida College System Task Force, October 2008; Floyd et al., 2009, p. 195). The purpose of the Florida College System is stated concisely from Chapter 1001.60(1), Florida Statutes:

In order to maximize open access for students, respond to community needs for postsecondary academic education and career degree education, and provide associate and baccalaureate degrees that will best meet the state’s employment needs, the Legislature established a system of governance for the Florida College System. (Florida College System Task Force, October 2008, p. 1)

In the Florida College System Task Force report from December 2008, the Task Force recommended to the Legislature that all Florida College System institutions retain their open admissions policies and continue to provide remedial education programs (p. 13). The Task Force recommended that the Florida College System continue outreach programs to underserved populations, continue 2 + 2 articulation policies and practices, and continue to respond to local educational and employment needs (p. 11 and p. 13).
Remediation in Florida

According to the Office of Program Policy Analysis & Government Accountability’s (OPPAGA) April 2006 report, the remediation rate of Florida high school graduates has changed very little since 1997 when 46% of Florida’s high school graduates entering either a university or a college needed remediation (p. 4). In 2003, 45% of FTIC students who graduated from a Florida high school required at least some remediation before entering a university or college (p. 4). Furthermore, 62% of FTIC students not ready for college needed remediation in multiple subject areas, 89% needed remediation in math, 59% needed remediation in reading, and 46% needed remediation in writing (p. 3). Moreover, of the 55% FTIC students entering Florida’s university and college system needing remediation in at least one subject area, 78% attending community colleges in 2003 – 2004 required remediation (p. 3). Of those students who needed remediation in 2003, 94% attended community colleges (OPPAGA, 2007, p. 1).

The Florida Assessment and Accountability Statute (2009) authorizes remediation services as a function of the Florida College System and of one university: Florida Agricultural and Mechanical University. Remediation courses are designed to provide students with the necessary instruction to address their academic deficiencies in order for them to be successful in college-level courses. According to the Florida Assessment and Accountability Chapter, students enrolled in “a college-preparatory course may concurrently enroll only in college credit courses that do not require the skills addressed in the college-preparatory course” (Florida Assessment and Accountability Statute, 2009).
Placement into Developmental Courses in Florida

Placement testing ensures that students enroll in courses that challenge their current knowledge level. Assessing students’ proper level of knowledge and placing them in the proper level college course will avoid frustration, which can lower the students’ motivation to perform. The most common placement test utilized is the College Board’s ACCUPLACER. This placement test is a computer-adaptive testing system so the student receives either easier or more difficult questions based on his or her previously answered questions.

The CPT, which is part of the College Board’s ACCUPLACER system, is used for placement at all Florida community colleges for most degree programs (Calcagno & Long, 2009). The CPT assesses the students’ knowledge in reading, sentence skills, and mathematics. Specific cut scores for each assessment have been set by the State Board of Education (2009). Students whose CPT results are below the state cutoff on elementary algebra, reading comprehension, and/or sentence skills are mandated to take remedial courses before they can begin college-level work (2009).

Placement into Developmental Mathematics in Florida

Placement into a remedial mathematics course depends on the student’s score on the CPT. There are three remedial mathematics courses into which students can be placed: Pre-Algebra (MAT 0012C), Preparatory Mathematics Intensive (MAT 0020C), and Beginning Algebra (MAT 0024C). As shown in Table 1, students are assigned into one of these three mathematics courses based on their CPT score.
<table>
<thead>
<tr>
<th>Assessment</th>
<th>Score</th>
<th>Placement</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACT Mathematics (M)</td>
<td>19 or more</td>
<td>MAT 1033C</td>
</tr>
<tr>
<td></td>
<td>21 or more</td>
<td>MAC 1105 or MGF 1106 or MGF 1107</td>
</tr>
<tr>
<td>SAT Mathematics (M)</td>
<td>440 or more</td>
<td>MAT 1033C</td>
</tr>
<tr>
<td></td>
<td>500 or more</td>
<td>MAC 1105 or MGF 1106 or MGF 1107</td>
</tr>
<tr>
<td>CPT Arithmetic (M)</td>
<td>71 or less</td>
<td>MAT 0012C</td>
</tr>
<tr>
<td></td>
<td>72 or more</td>
<td>MAT 0020C</td>
</tr>
<tr>
<td>CPT Elementary Algebra (A)</td>
<td>41 or less</td>
<td>MAT 0012C</td>
</tr>
<tr>
<td></td>
<td>42 - 71</td>
<td>MAT 0024C</td>
</tr>
<tr>
<td></td>
<td>72 - 89</td>
<td>MAT 1033C</td>
</tr>
<tr>
<td></td>
<td>90 or more</td>
<td>MAC 1105 or MGF 1105 or MGF 1107</td>
</tr>
<tr>
<td>CPT College-Level Math (I)</td>
<td>64 or less</td>
<td>MAC 1105 or MGF 1106 or MGF 1107</td>
</tr>
<tr>
<td>Requires minimum score of:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CPT Elem Algebra = 90 or</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SAT Mathematics = 500 or</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ACT Mathematics = 21 or</td>
<td></td>
<td></td>
</tr>
<tr>
<td>successful completion of a</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gordon Rule math course.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>65 or more</td>
<td>MAC 1114 or MAC 1140 or MAC 2233 or</td>
</tr>
<tr>
<td></td>
<td>77 or more</td>
<td>MAE 2801 or MAT 2930 or MHF 2300 or</td>
</tr>
<tr>
<td></td>
<td>89 or more</td>
<td>STA 2023</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MAC 1147</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MAC 2311</td>
</tr>
</tbody>
</table>

*Note.* Adapted from VCC Catalog, 2009/2010
Completion Rates of Developmental Mathematics Students in Florida

Students placed in remedial courses due to their placement test scores (CPT) or who require remediation in several areas are at risk of dropping out of college (OPPAGA, 2007, p. 1). According to Calcagno and Long (2009), “[R]emediation might promote early persistence in college, but it does not necessarily help students who are on the margin of passing the cutoff make progress toward a degree” (p. 3). Unfortunately, students with the greatest remediation needs are less successful in completing the college preparatory program because these students must pass multiple remedial courses before they can enroll in college-level coursework (OPPAGA, 2007).

On a more positive note, students who persevere and complete their college preparatory programs perform almost as well as those students in college-level courses (OPPAGA, 2007). Furthermore, the Florida Department of Education Commissioner, John Winn, states that in the Florida 2004 Accountability Measures, “[D]evelopmental students who successfully complete their college prep courses have the same success rate as Associate in Arts (AA) Degree students in general” (Armstrong, 2005, p. 1).

Several studies have been conducted in Florida focusing on components contributing to student success in remedial courses. Bush (2001) examined six student characteristics to determine if they affected student success in students’ first college preparatory mathematics course at a community college. The six characteristics were high school grade point average (GPA), gender, ethnicity, CPT scores, enrollment status, and financial aid. Bush found that female students were less likely to fail. The only significant factors for failure were high school GPA and ethnicity.
Clemons (2002) explored whether math anxiety scores, perceived usefulness of mathematics, score on the CPT, and completion of elementary algebra were predictors of eligibility to take the Florida Basic Skills Exit Test (FBSET). In the past, students had to pass the elementary algebra course to be eligible to take the FBSET. Clemons also examined whether gender had an influence on students’ success and the FBSET. Clemons’ findings revealed that only the CPT score was a valid predictor of the FBSET score.

In 1999, Achieving the Dream: Community Colleges Count began its initiative across the nation with six states, Connecticut, Florida, North Carolina, Ohio, Texas, and Virginia, to develop new methods to track student success by following a cohort of students from each state, except for Connecticut, which started in 2000, and North Carolina, which started in 2001. The initiative focused on designing methods to help students succeed to earn degrees or certificates or to transfer to other institutions (Achieving the Dream, 2008). Each state, except North Carolina, tracked FTIC full-time and part-time students for six years.

According to the Achieving the Dream report dated 2008, Florida’s six-year outcome by age and college readiness reported that a total of 33,295 students of the fall 1999 cohort completed the six years, with a total success rate of 44%. Students were grouped according to age. There were 26,582 total students in the 22 and under cohort, with 38.1% needing lower-level developmental mathematics and 17.6% needing upper-level developmental mathematics. Of the students needing lower-level developmental mathematics, four percent earned an award of less than an Associate’s Degree without transfer, four percent earned an Associate’s Degree without transfer, seven percent were
awarded an Associate’s Degree or higher and transferred, seven percent transferred without an award, and nine percent still enrolled without an award with 30+ credits, with a total success rate of 31%. Of the students needing upper-level developmental mathematics, four percent earned an award of less than Associate’s Degree without transfer, seven percent earned an Associate’s Degree without transfer, 15% were awarded an Associate’s Degree or higher and transferred, nine percent transferred without an award, and nine percent still enrolled without an award with 30+ credits, with a total success rate of 44% (p. 26).

There were 6,250 students in the 23 – 45 cohort, with 69.7% needing lower-level developmental mathematics, and 12% needing upper-level developmental mathematics. Of the students needing lower-level developmental mathematics, five percent earned an award of less than an Associate’s Degree without transfer, eight percent earned an Associate’s Degree without transfer, zero percent earned less than an Associate’s Degree and transferred, five percent were awarded an Associate’s Degree or higher and transferred, four percent transferred without an award, and seven percent still enrolled without an award with 30+ credits, with a total success rate of 28%. Of the students needing upper-level developmental mathematics, seven percent earned an award of less than an Associate’s Degree without transfer, 13% earned an Associate’s Degree without transfer, one percent earned less than an Associate’s Degree and transferred, nine percent were awarded an Associate’s Degree or higher and transferred, six percent transferred without an award, and eight percent still enrolled without an award with 30+ credits, with a total success rate of 44% (p. 26).
At the end of the six years, the success of these 33,295 students was measured with the following outcomes: six percent with less than an Associate’s Degree with or without transfer to a four-year institution within the six-year period, 22% completed an Associate’s Degree with or without transfer to a four-year institution within the six-year period, seven percent transferred to a four-year institution without an award, and eight percent still enrolled without an award with at least 30 credits (Achieving the Dream, 2008, p. v and p.29).

Factors Affecting the Success of Community College Students

Community colleges have clearly conveyed the concept that they are institutions that welcome anyone. Students know they have access to a community college; however, most students are not aware of the requirements to succeed in a community college (Bueschel, 2004; Rosenbaum, 2001). Many studies have addressed the misconceptions about community college and student success (Bueschel, 2004; Bueschel, 2009; Calcagno et al., 2006; Rosenbaum & Person, 2003). Other researchers have explored how to improve student performance in the early semesters of their college experience (Bueschel, 2009; Rosenbaum & Person, 2003; Shugart & Romano, 2008).

One major theme emerging regarding student success at the community college is the confusion during the transition phase from high school to college. This transition phase exposes the high school student to many unfamiliar facets of academia. Tinto (1993) asserted that “The beginning of the sequence of events leading to student departure can be traced to students’ first formal contact with the institution” (p. 154).

Community colleges serve as the point of entry for students who otherwise would not participate in post-secondary education. Students are often surprised by the
requirements necessary to attend a community college. Students encounter admission policies, must take placement exams, pay tuition, and schedule classes (Bueschel, 2004; Shugart & Romano, 2008). It is at this time that some students realize they are inadequately prepared academically for college (Bueshel, 2004). Improving students’ experiences during their first encounters with college will greatly improve their success (Shugart & Romano, 2008).

Open Admissions Policy

Community colleges are recognized by their mission of maintaining their open access, thus reinforcing the “college for all” notion that Rosenbaum (2002) coined (p. 3). Rosenbaum asserted that America’s high school counselors and educators adopted the “college for all” concept in response to the misconception that, after high school, college is for everyone and that jobs are undesirable (p. 1). The “college for all” policy is in direct response to the poor labor market, which implies that graduating seniors need a college degree to succeed in the labor market (Rosenbaum, 2002). Another misconception regarding the open admission policy is that all students will be placed into college-level classes (Rosenbaum & Person, 2003, p. 253). Students are unaware of the placement policies community colleges enforce.

Placement Policies and Exams

Students entering college for the first time are required to take placement tests. The placement exams address skills in reading, writing, and mathematics. Students are often surprised to find themselves placed in remedial courses. High rates of remediation call attention to the “lack of alignment between the systems regarding the standard for college-level work” (Bueschel, 2004, p. 258). According to the Achieving the Dream
initiative (2008), nearly 60% of FTIC students take at least one remedial course during their enrollment in community college. With this high of a percentage, it is reasonable to conclude that at least 60% of “community college students enter college with academic skills weak enough in at least one major subject area to threaten their ability to succeed in college-level courses” (Bailey, 2009, p. 1).

**Inadequate Preparation**

Community colleges have been criticized for “cooling out” students’ plans when, in fact, students are failing to prepare for college in high school (Rosenbaum, 1998). Rosenbaum and Person (2003) address the misconception that having college plans leads to increased effort in high school (pp. 253 – 254). It is assumed that students with plans to attend college will put forth more effort while in high school (Rosenbaum & Person, 2003, p. 254). Due to the open access policy, which allows anyone to enter college, no matter how poorly he or she does in high school, students believe “they can wait until college to exert effort” (p. 254). A past study in eight diverse urban and suburban high schools found that counselors do not dissuade students from attending college—even if they have poor achievement in high school and poor chances to succeed in college (Krei & Rosenbaum, 2001; Rosenbaum, Miller, & Krei, 1997).

The National Center for Education Statistics (2006b) reports how well high school students are prepared for their future in college from the Program for International Student Assessment, stating that in 2003, the U.S. 15-year-olds scored well below average in mathematics literacy and problem solving and were ranked 24th among 29 developed countries (National Center for Education Statistics, 2006b). Greene and Winters (2005) stated that only 50% of graduating high school students will be
academically prepared for college-level courses. Plucker, Zapf and Spradlin (2004) examined the transcripts of U.S. high school graduates and found that only 36% had taken courses necessary to prepare them for success in college. Students have an optimistic outlook; unfortunately, only 70% will graduate from high school (Greene & Winters, 2006) while 81% expect to attend college (High School Survey of Student Engagement, 2005). Therefore, graduating from high school does not guarantee that a student is prepared for college.

Class Effect on Student Success in Developmental Mathematics

Most studies ignore the social context of the classroom (Haladyna, et al., 1983). That is to say, studies tend to focus on the associations among the student’s mathematics attitude and achievement, grade point average, gender, age, family background, scores on placement tests, and participation in innovative programs (Bassette, 2004; Brocato, 2009; Haladyna, 1983; Shelton, 2008; Tapia & Marsh, 2004). This study examines the class sections and how, if at all, they affect the success of students in developmental mathematics.

Haladyna, et al. (1983) suggested that most classrooms are organized to produce different effects. Two variables that may have the most telling effects at the class level are teacher quality and learning environment (1983). Haladyna developed an extensive study examining the teacher and the learning environment and how these two variables affect the students’ attitudes toward mathematics. See Figure 1.

The findings suggested a strong association among teacher quality, attitude toward mathematics, and student motivation; there was also a strong connection between teacher quality and management organization climate. The social-psychological climate
had its strongest influence at grade 9 (p. 28). The classroom environment consists of several factors which may be influenced by the method of delivery.

*Traditional Lecture*

In the traditional lecture classroom, the learning is primarily teacher-centered. As Haladyna et al. (1983) suggested, success is influenced by the teacher and the learning environment (p. 20). In the past, the learning environment in a traditional lecture classroom was seen as very rigid. The method of delivery is abstract and more of a presentation of the material. There is no chance for collaborative learning, discussions, or spontaneous creativity (Rovai & Jordan, 2004).

More recently, the traditional lecture class has morphed into a constructivist approach wherein the learning is viewed as a “process where students interpret information in light of existing knowledge, and actively construct and reconstruct understandings, rather than receive information from an authoritative source such as a teacher” (Huffman, Goldberg, & Michlin, 2003, p. 152). The teacher should create situations for students that will encourage their making the necessary mental constructions between information that they already know and understand to the new material they are learning (Math Forum, 2007).

A recent study conducted in 2007 by Mentzer, Cryan, and Tetelehaimanot compared traditional face-to-face classrooms with web-based classrooms. The results found that completed assignments and motivation were higher in the face-to-face classes (p. 233). Teal (2008) compared test scores of traditional lecture courses and computer-aided instruction and found no statistical differences between the two modes of instruction (p. 130).
Computer-Aided Instruction

Computer-aided instruction utilizes online material to supplement regular instruction. In the past 10 years, several studies have been conducted on the effects of computer-aided instruction (Kinney & Kinney, 2002; Kinney & Robertson, 2003; Kinney, Stottlemyer, Hatfield, & Robertson, 2004). One such study of 123 colleges and universities revealed that students utilizing computer-aided instruction as a tutor experienced three positive effects: (1) more learning occurred in less time, (2) higher grades were achieved on exams, and (3) attitudes were improved (Kinney, et al., 2004; Kulik & Kulik, 1986).

Mathematics textbooks utilize different types of computer enhancement. One specific type is MyMathLab©. With this enhancement, students can access an infinite number of mathematics problems for practice. Another computer-aided type of instruction is Assessment and Learning in Knowledge Spaces (ALEKS)©. This computer-aided instruction is specialized for each individual student. First, ALEKS administers an assessment to determine the student’s academic mathematics level; then, ALEKS develops a personalized mathematical “prescription” for each student (Taylor, 2008). Another popular computer-aided software is Academic Systems – PLATO Learning©. This computer-aided instruction is customized for each mathematics class. Students are required to complete specific activities of the mathematics curriculum on the computer. This system provides immediate feedback to the student. This system can be utilized as computer-aided instruction or for a completely online course.

Brocato (2009) examined developmental students at a community college in Mississippi over 13 semesters in two types of classes: traditional lecture and computer-
aided instruction. For the first seven semesters, students attended traditional lectures and for the next six semesters were taught in a computer-aided laboratory with a computer software program utilizing a specific curriculum developed by the Mathematics Department from the community college (p. 10). Brocato found that there were significant increases in grades as well as withdrawals in the computer-aided classroom (p. v). The final GPA in the traditional delivery class was 2.087 on a scale of 4.0, and the final GPA in the computer-based course was 2.397 on a scale of 4.0 (pp. 52 – 53).

Two other studies, Hagerty and Smith (2005) and Li and Edmonds (2005), both found students received higher grades when receiving computer-assisted instruction in mathematics. Taylor (2008) examined the differences between student achievement in a web-based, computer-assisted intermediate algebra program and in a traditional lecture class utilizing the computer software ALEKS (p. 37). Taylor also examined the students’ “mathematics anxiety and mathematics attitude” (p. 37). The study found that mathematics achievement improved with the computer-aided instruction (p. 43).

Duka (2009) examined incorporating a technology-based component, called MyMathLab, into a developmental mathematics course. Duka (2009) found that the average grade for students using the technology component was higher, 76.1%, as compared to the non-technology group with a 69.7% average (p. 19). Duka (2009) also examined gender and found that male students’ mean grade of 77.8% in the MyMathLab group was higher than the female students, who averaged 74.9%. The non-technology male group, with an average of 67.8% performed less well than the female non-technology group, which averaged 71% (pp. 22 – 23).
Online Instruction

Online courses, also called distance learning, are those courses in which at least 80% of the course curriculum is delivered online (Allen & Seaman, 2010, p. 4). Online education utilizes the Internet, video-conferencing, discussion boards, and electronic mail to create two-way communication between students and instructors. Online learning provides students with privacy to ask questions without the fear of embarrassment (Bailey, Hall, & Cifuentes, 2001; Smith, Ferguson, & Caris, 2003) and gives students a certain comfort level since they are at ease with technology (Allen, 2003; Brown, 2000b; Sitzmann, Kraiger, Stewart, & Wisher, 2006; Trenholm, 2006; Zhao, Lei, Yan, Lai, & Tan, 2005).

Allen and Seaman (2010), with the support of the Sloan Consortium, have researched the trend in online learning in the United States for the past seven years. Their most recent publication examined online education in the United States in 2009. The number of students taking online courses increased from 1.6 million in Fall 2002 to 4.6 million in Fall 2006, which represents a growth rate of 19%. Between 2002 and 2007, faculty acceptance of online courses increased almost six percent because of the acceptance of the “value and legitimacy” of online courses (p. 12). However, in the most recent year of research, this acceptance dropped almost three percent (p. 12).

Many recent studies have examined the different class effects of online learning (Cowart, 2009; Hu, 2009; Pearcy, 2009; Tirrell, 2009). Cowart (2009) studied the completers and non-completers of online courses. Cowart examined attrition and instructor performance through the use of a survey. Comparisons were made between completers and non-completers as to the best practices of the instructor in terms of
implementation (p. 24). Cowart found no significant difference between completers and non-completers with respect to age, gender, comfort level with computers, and educational experience (p. 50). Cowart also found no significant difference between completers and non-completers in how they valued teaching strategies of an online course (p. 52).

Hu (2009) examined the relationship between “the design preferences of students enrolled in online courses . . . and the preferences of faculty . . . in the development and teaching of online courses” (p. 54). Hu utilized a 63-item survey inquiring about pedagogy features and the design of the online course (p. 70). The design features were similar in both groups. The pedagogy items resulted in a correlation coefficient $r = .868$ (p. 88). This indicates a strong correlation between pedagogical items and design features for both students and instructors in online courses.

Pearcy (2009) compared three teaching methods: face-to-face, online, and blended instruction, with respect to interactions among students, instructor, and content of the course (p. 21). The blended course provided a higher final score of 74.03% as compared to the online final score of 67.58% (p. 44).

Tirrell (2009) examined Chickering’s seven principles of good practice as related to student attrition in online learning at the community college. Tirrell surveyed faculty at three community colleges with a 37-item questionnaire about how faculty employ Chickering’s seven principles in online courses and the relation of the principles to attrition of the student. The correlation coefficient, of $r = .047$, indicates a slight positive relationship between survey scores and attrition rates of students (p. 70). This indicates a
minor correlation between faculty who employ Chickering’s principles and student success rate.

Conclusion

Attitude has been examined for decades. Through this research many definitions of attitude have been developed. In the early 1970s mathematicians began studying attitude toward mathematics and how this affects achievement in mathematics. Students’ attitudes toward mathematics has been shown to have a positive correlation with success in mathematics courses. Attitude toward mathematics can positively or negatively influence the students’ college career in their selection of mathematics courses, success in mathematics courses, and selection of mathematics-related careers or mathematics-related degrees.

As students progress through school, from elementary to high school, their attitudes toward mathematics change considerably. The younger the students the more positive their attitudes toward mathematics but as students enter middle and high school their attitudes change drastically. By the time they reach college, students have formed an unwavering opinion regarding their success in mathematics which then influences their career or degree choice.

Upon entering college, students face many new obstacles. Getting through the paperwork to be admitted and the required placement tests hinders the students’ progress toward taking college-level courses. Students are surprised to be placed in remedial courses. Being placed in remedial courses often affects their attitudes toward college as well as their advancement toward a degree.
Students placed into remedial courses are at risk of not completing their degree requirements. Getting discouraged in the early years of college can drastically affect success. Attitudinal surveys are one method to assess the students’ attitude and anxiety in the beginning of the course. It has been shown that students with a strong negative attitude do not succeed as well as students with a more positive attitude. Therefore, assessing the students’ initial and end-of-semester attitude may show a correlation between success and attitude. Based on this review of literature, this study appropriately addresses how attitude change can affect success and investigates how the class sections can influence student success at a community college.
CHAPTER THREE: METHODOLOGY

This chapter presents the research methods and procedures used in this study, the design of the study, population, student placement into Beginning Algebra, instrument, data collection procedure, and methods of data analysis. The purposes of this study are to determine the initial attitudes of Beginning Algebra students and examine the relationship, if any, of the initial attitudes, CPT scores, and State Competency Exam scores. Completers and non-completers are determined and examined for differences in initial attitude scores. Change scores are calculated and examined across the factors of the ATMI, class sections, age, gender, and ethnicity.

The research questions addressed by the study are the following:

1a. What are the initial attitudes of community college students entering a Beginning Algebra course as indicated by the four attitudinal components of the ATMI: value of mathematics, enjoyment of mathematics, self-confidence with mathematics, and motivation for mathematics?

1b. To what extent are the initial attitudinal scores different across class sections?

2a. What is the relationship between community college Beginning Algebra students’ initial attitudes toward mathematics and their scores on the CPT?

2b. To what extent is the relationship between attitude and CPT score different across class sections?

3a. What is the relationship between community college Beginning Algebra students’ initial attitudes toward mathematics and their scores on the State Competency Exam?
3b. To what extent is the relationship between attitude and State Competency Exam score different across class sections?

4a. What is the difference between completers’ and non-completers’ initial attitudinal scores on each factor of the ATMI: value of mathematics, enjoyment of mathematics, motivation for mathematics, and self-confidence?

4b. To what extent is the difference between completers and non-completers different across class sections?

5a. To what extent do the four attitudinal components of the ATMI—value of mathematics, enjoyment of mathematics, motivation for mathematics, and self-confidence—change during the developmental mathematics course?

5b. To what extent do the attitudinal score changes differ across class sections?

5c. To what extent do the attitudinal score changes differ based on age?

5d. To what extent do the attitudinal score changes differ based on gender?

5e. To what extent do the attitudinal score changes differ based on ethnicity?

Design of the Study

Trochim (2001) states, “Research design provides the glue that holds the research project together” (p. 171). It provides structure and guidance so that the research is completed in a timely manner with diligence. Quantitative research allows numeric data to be condensed into manageable forms. Gravetter and Wallnau (2007) stated, “Statistical procedures help ensure that the information or observations are presented and interpreted in an accurate and informative way” (p. 4).

The population for this study consists of the students enrolled in day classes of Beginning Algebra (MAT 0024C) at VCC, a central Florida community college in
Osceola County. Correlation analysis was used to explore the initial attitude scores as measured by the ATMI (Tapia & Marsh, 2004) and to explore the relationship, if any, of initial attitude scores and the CPT scores and State Competency Exam scores. Descriptive statistics such as mean, standard deviation, measures of skewness and kurtosis were used to explore the differences between completers and non-completers based on the ATMI. Further statistical analysis comparing composite attitudinal scores of completers and non-completers across class sections are examined to determine any interactions. Additional statistical analyses were used to explore the specific areas of attitude toward mathematics that the ATMI investigates: value; enjoyment; self-confidence; motivation; and how these areas differ across class sections, age, gender and ethnicity. Attitudinal variables include the positive and negative feelings of students toward mathematics in each of the specific factors addressed in the ATMI as well as a composite attitudinal score. Student outcome variables include scores on the CPT, ranging from 0 to 100, and scores on the State Competency Exam, ranging from 0 to 100 points.

The study was conducted in two phases during the 2010 fall semester at the Osceola campus of VCC. Approximately 40 Beginning Algebra class sections were offered, with approximately 880 students expected to enroll. Eleven of the 40 class sections were selected for this study. These eleven classes were selected by convenience from the researcher. None of these class sections was taught by the researching professor. All classes were taught by adjunct professors and full time senior staff.

In the first phase, the students enrolled in Beginning Algebra (MAT 0024C) were given the ATMI to assess their initial attitudes toward mathematics. The ATMI was
administered during the first week of classes. The research professor personally administered the survey to each class. In the 12th week of the semester, the ATMI again was administered personally by the research professor. The end-of-the-semester ATMI results provided a final attitude score for each student.

The ATMI (Appendix B) contains 40 items utilizing a Likert format. Students were asked to indicate their agreement with each statement. The survey consists of 10 items addressing value, 10 items addressing enjoyment, 15 items addressing confidence, and 5 items addressing motivation. Twenty minutes in class was provided to perform the ATMI pretest and posttest. Each student in the Beginning Algebra classes was assigned a number to protect his or her identity.

This study also used existing data, via transcript analysis, to obtain the CPT score of each student. The score on the State Competency Exam was provided by the Valencia Mathematics Coordinator. The use of Statistical Analysis System (SAS), a powerful statistical package, allowed data to be analyzed.

Population

VCC has four campuses located in two counties in central Florida: Orange and Osceola. The four campuses of VCC are titled as follows: East – located in the eastern portion of Orange County; West – located in the western portion of Orange County; Winter Park – located in the town of Winter Park, Florida; and Osceola – located in the town of Kissimmee, Florida, in Osceola County. Participants of this study were selected from the Osceola County campus of VCC. Kissimmee is located in central Florida, with a population of approximately 58,000 (U. S. Census, 2000), with 71.9% Caucasian, 15.2% African American, 1.2% American Indian, 4.2% Asian, and 11.7% Other. VCC has a
total yearly enrollment of approximately 50,255 students with an average age of 23.4 years. In 2008/2009, the enrollment for the Osceola Campus was 5,646 full-time and part-time students with 33.5% Caucasian, 10.9% African American, 39.9% Hispanic, 5.1% Asian, 0.4% Native American, and 10.1% Other. The gender composition of the Osceola Campus consists of 35.8% male, 63.5% female, and 0.7% unknown. Of this student population, 50.3% are considered full-time students (Valencia Community College, 2008, p. 10).

Placement Procedures for Incoming Students

For all new students at VCC, entry testing is mandatory. Students must take the CPT before being allowed to register for classes. The CPT is one of the most commonly used tests for college placement purposes. The CPT is a computer-adaptive program which assesses students’ knowledge and skills in six dimensions: “reading comprehension, sentence skills, arithmetic, elementary algebra, college-level mathematics, and writing” (Mattern & Packman, 2009, p. 2). This test is used at all community colleges in Florida for placement into degree programs.

Students who are entering VCC for the first time must take the CPT exam. Every student is assessed for proper placement into one of the following mathematics courses: Pre-algebra (MAT 0012C), Beginning Algebra (MAT 0024C), Intermediate Algebra (MAT 1033), or College Algebra (MAC 1105). One alternative for students is to provide a current college-level ACT or SAT mathematics score and, based on the score on either of these college-level tests, the student will be placed into the proper mathematics course. The CPT also provides the student with entry into the New Student Orientation/Advisement session, which is required prior to any registration. If the
students’ mathematics skills are below the required level, they are restricted to college-preparatory courses. Table 1 shows each of the required mathematics scores for mathematics placement.

*Beginning Algebra – MAT 0024C*

Beginning Algebra is the second lowest mathematics course taught at VCC. Mathematical topics covered in this course include sets, polynomial operations, introductory applications and graphing of linear equations, applications of inequalities, factoring and its connection to algebra, introduction to radicals, and use of calculators to enhance certain algebraic topics (Valencia Community College Catalog, 2009/2010, p. 268). This course fulfills an elective requirement and does not apply toward any mathematics requirement in general education or toward any Associate degree (Valencia Community College Catalog, 2009/2010, p. 268). In order to continue to the next mathematics course (Intermediate Algebra, MAT 1033), students must pass a Basic Skills Exit Test, also known as the State Competency Exam, with a minimum final grade of 80%.

Forty sections of Beginning Algebra were expected to be taught during the fall semester. These courses were taught mostly by adjunct professors on the Osceola Campus of VCC. Students who participated in this study were enrolled in the fall Beginning Algebra (MAT 0024C) courses. Approximately 22 students enroll in each Beginning Algebra course. Eleven sections were selected for this study with approximately 22 students each; therefore, approximately 242 students were asked to participate in this study.
Data Collection Procedures

The researcher conferred with each professor teaching the eleven Beginning Algebra courses that were selected in fall 2010 prior to the beginning of the fall term and asked for permission to visit his or her classes to administer the ATMI during the first and 12th week of the semester. The researcher met with the class while the professor was present to explain the survey. Students received a packet containing a cover letter explaining the project (Appendix E), a form to be completed by the student requesting demographic data and the Valencia student identification number (Appendix F) as well as the survey (Appendix A). Students were asked to participate and assured that all answers would be confidential. Students were also assured that non-participation would not result in negative consequences. The scores on the first administration of the ATMI provided an initial attitude score for each student. Completion of the ATMI was purely voluntary. The Institutional Review Board (IRB) granted approval from the University of South Florida (Appendix G) and VCC (Appendix H). Identity was preserved through the use of students’ Valencia identification numbers. The researcher accessed the students’ CPT scores during the fall 2010 term. This information was provided through student records. Permission to retrieve this information was provided through the approval of each IRB request granted from VCC and University of South Florida.

Students took the State Competency Exam during the last week of classes. Scores for these exams were provided by the Mathematics Coordinator. During the 12th week of classes, the researcher administered the ATMI. This administration provided a final attitude score. The State Competency Exam is a timed exam and very stressful for many
students; therefore, administration of the post-test took place at least three weeks prior to the week of the State Competency Exam.

College Board ACCUPLACER CPT

Permission was granted to access the students’ records to determine their scores on the CPT. Each exam score was correlated to each student by his or her VCC identification number. No names were associated with scores.

State Competency Exam

Students’ scores on their State Competency Exam were reported by the Osceola Campus Mathematics Coordinator. Each exam score was identified by the class section and the Valencia student’s identification number. Students who passed the State Competency Exam were considered as completers of the course and those who did not pass the State Competency Exam were considered as non-completers.

Attitudes Toward Mathematics Inventory

The ATMI was developed to investigate the underlying dimensions of students’ attitude toward mathematics (Tapia & Marsh, 2004). To test for internal consistency and construct validity, the authors administered the ATMI to 544 high school mathematics students in Mexico City. The students represented all grades of the high school. The reliability coefficient was alpha = .97 (Tapia, 1996). Originally, there were five factors, including parent/teacher expectations. Further analyses through item-deletion based on their item-total correlation revealed that nine items had correlations lower than .49; these nine items were deleted. After deletion of the nine items, the alpha increased from .96 to .97 (Tapia & Marsh, 2004). The revised inventory resulted in a 40-item instrument. The factors of the ATMI consist of the following: value, enjoyment, self-confidence, and
motivation. In 2005, Schackow determined the ATMI’s scores reliability in a pilot study of 31 university students attending the University of South Florida’s education program for elementary education majors. Schackow utilized Cronbach’s Coefficient Alpha in the pilot study and found a strong internal consistency with an alpha of .98 (Schackow, 2005).

**Validity and Reliability**

Tapia and Marsh (2004) explained the validity and reliability of score of the ATMI:

The factor structure of the ATMI covers the domain of attitudes toward mathematics, providing evidence of content validity. Content validity was established by relating the items to the variables: confidence, anxiety, value, enjoyment, and motivation. This structure is explained by the four-factor model supporting different interpretations for 34 students’ self-confidence, value, enjoyment, and motivation as underlying dimensions of attitudes [toward] mathematics. (p.15)

**Survey Questions and Components of the ATMI**

This research project utilized the current 40-item version of the ATMI. The entire ATMI uses a Likert-type scale with 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree. Twenty-nine items are positively arranged, for instance, *Mathematics is a very worthwhile and necessary subject*. Conversely, 11 items are negatively arranged, for instance, *Mathematics makes me feel uncomfortable*. For these items, the scale is reversed: 5 = strongly disagree, 4 = disagree, 3 = neutral, 2 = agree, and 1 = strongly agree. The composite attitude score is the sum of these ratings;
therefore, a higher score implies a more positive attitude. Total composite attitude scores could range from 40 – 200.

There are four components of the ATMI addressing value, enjoyment, self-confidence and motivation. Each component has an unequal number of survey questions: 10 items assess the value of mathematics, 10 items assess the enjoyment of mathematics, 15 items assess self-confidence with mathematics, and 5 items assess the motivation for mathematics. Since the ATMI contains unequal attitudinal components for each factor, an average score has been found for each factor in order to make comparisons.

An initial composite attitude score was computed for each student in the Beginning Algebra course. The initial composite attitude scores were used to answer research questions 1, 2, 3, and 4. Question 1 examines initial attitude scores as indicated by the four factors of the ATMI. Question 2 investigates a relationship between all students’ initial composite attitudes to their CPT scores. Question 3 investigates a relationship between all students’ initial composite attitudinal scores to their State Competency Exam scores. Question 4 compares the initial composite attitudinal scores of the completers and non-completers to each factor of the ATMI. Research question 5 examined the students’ change score of the four components of the ATMI: value, enjoyment, self-confidence, and motivation as the score changed across class sections, age, gender, and ethnicity to determine whether there is a relationship among these variables. Table 2 shows the factors defined while Table 3 matches some of the survey questions with the factor.
Table 2 Attitude Toward Mathematics Inventory Factors

<table>
<thead>
<tr>
<th>Factors Considered</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Confidence: The confidence category was designed to measure students’ confidence and self-concept of their performance in mathematics (Goolsby, 1988; Linn &amp; Hyde, 1989; Randhawa, Beamer, &amp; Lundberg, 1993).</td>
</tr>
<tr>
<td>2. Value: The value of mathematics category was designed to measure students’ beliefs regarding the usefulness, relevance, and worth of mathematics in their life now and in the future (Longitudinal Study of American Youth, 1990).</td>
</tr>
<tr>
<td>3. Enjoyment: The enjoyment of mathematics category was designed to measure the degree to which students enjoy working in mathematics and mathematics classes (Ma, 1997; Thorndike-Christ, 1991).</td>
</tr>
<tr>
<td>4. Motivation: The motivation category was designed to measure interest in mathematics and desire to pursue studies in mathematics (Singh, Granville, &amp; Dika, 2002; Thorndike-Christ, 1991).</td>
</tr>
</tbody>
</table>

Table 3 Factors with Sample Items

<table>
<thead>
<tr>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Mathematics is a very worthwhile and necessary subject.</td>
</tr>
<tr>
<td>• Mathematics is important in everyday life.</td>
</tr>
</tbody>
</table>

Self-confidence

| • Mathematics is one of my most dreaded subjects.                   |
| • My mind goes blank, and I am unable to think clearly when working with mathematics. |

Enjoyment

| • I get a great deal of satisfaction out of solving a mathematics problem. |
| • I would prefer to do an assignment in math than to write an essay.    |

Motivation

| • I am confident that I can learn advanced mathematics.               |
| • I am willing to take more than the required amount of mathematics. |


Data Analysis

Students were asked to complete the ATMI twice, once during the first week of class and again during the 12th week of the semester. Completers of the Beginning Algebra course have composite initial and end-of-semester scores ranging from 40 – 200 as well as initial and end-of-semester averages for each of the four attitude components of
the ATMI. Non-completers have initial composite scores and initial scores for each factor of the ATMI. These scores were used for statistical analyses for all research questions using SAS.

Question #1 asked:

1a. What are the initial attitudes of community college students entering a Beginning Algebra course as indicated by the four attitudinal components of the ATMI: value of mathematics, enjoyment of mathematics, motivation for mathematics, and self-confidence with mathematics?

1b. To what extent are the initial attitudinal scores different across class sections?

For Question #1, the pre-attitudinal scores were collected from 11 Beginning Algebra class sections. Descriptive statistics were calculated for participants’ initial composite attitude scores, scores on each of the four factors, and each survey question. The scale for the composite attitude score can fall within 40 – 200. Within the ATMI, 10 factors address value, 10 address enjoyment, 15 address confidence, and 5 address motivation. Since the ATMI contains unequal attitude components for each factor, an average score was found for each factor in order to make comparisons. The descriptive statistics include means, standard deviations, and measures of skewness and kurtosis.

Initial composite attitude scores for each class section were compared to determine whether a relationship exists across class sections. A single-factor analysis of variance was conducted across each class section.

Question #2 asked:

2a. What is the relationship between community college Beginning Algebra students’ initial attitudes toward mathematics and their scores on the CPT?
2b. To what extent is the relationship between attitude and CPT score different across class sections?

The students’ composite attitudinal scores were correlated to their CPT scores to determine a relationship. A scatter plot was generated with attitude as the explanatory variable and CPT score as the response variable.

To determine whether attitude affects the students’ scores on the CPT exam, a linear model of CPT score as a function of initial composite attitude score was generated. To determine the effect of CPT scores and initial composite attitude scores across class sections, Fisher’s Z-transformations were calculated to determine independent correlations.

Question #3 asked:

3a What is the relationship between community college Beginning Algebra students’ initial attitudes toward mathematics and their scores on the State Competency Exam?

3b. To what extent is the relationship between attitude and State Competency Exam score different across class sections?

The students’ composite attitudinal scores were correlated to their State Competency Exam scores to determine a relationship. A scatter plot was generated with attitude as the explanatory variable and State Competency Exam score as the response variable.

To determine whether attitude affects the students’ scores on the State Competency Exam, a linear model of State Competency Exam score as a function of initial composite attitude score was generated. To determine the effect of State
Competency Exam scores and initial composite attitude scores across class sections

Fisher’s Z-transformations were calculated to determine independent correlations.

Question #4 asked:

4a. What is the difference between completers’ and non-completers’ initial attitudinal scores on each factor of the ATMI: value of mathematics, enjoyment of mathematics, motivation for mathematics, and self-confidence?

4b. To what extent is the difference between completers and non-completers different across class sections?

To determine if the ATMI differentiates between students who pass and students who fail the Beginning Algebra course, descriptive statistics were computed for completers’ and non-completers’ composite attitudinal scores, scores on each of the four attitudinal components being measured (value, enjoyment, motivation, and self-confidence), and on each individual survey question. The scale for the composite attitudinal scores falls within 40 – 200. There are unequal attitudinal components for each factor within the ATMI: 10 factors address value, 10 address enjoyment, 15 address confidence, and 5 address motivation. An average score was found for each factor. Each individual survey question was compared. The scale on the individual survey questions falls between one and five, with one being the most negative, three being neutral, and five indicating the most positive attitude. The statistics include means, standard deviations, measures of skewness and kurtosis. Highest and lowest items are identified and discussed.

To determine if there was a difference between completers’ and non-completers’ attitudinal scores for each factor and the class sections they attended, multiple two-factor
analyses of variance were calculated to determine interactions between completers, non-completers, factors and class sections.

Question #5 asked:

5a. To what extent do the four attitudinal components of the ATMI—value of mathematics, enjoyment of mathematics, motivation for mathematics, and self-confidence—change during the developmental mathematics course?

5b. To what extent do the attitudinal score changes differ across class sections?

5c. To what extent do the attitudinal score changes differ based on age?

5d. To what extent do the attitudinal score changes differ based on gender?

5e. To what extent do the attitudinal score changes differ based on ethnicity?

The change score was calculated by subtracting the initial composite attitude score from the end-of-the-semester attitude score. Change scores could range from -160 to 160, where a negative change score indicates a negative change in attitude, and a positive change score indicates a positive change in attitude.

Descriptive statistics were calculated for the composite change scores for each factor of the ATMI. A t-test was conducted using the composite initial attitude score and the composite end-of-semester attitude score to determine if there was a significant change in attitude over the course of the semester. Multiple single-factor analyses of variance were calculated for each factor of the ATMI across class sections, age, gender and ethnicity.

Summary

By using a quantitative design, this study will utilize statistical analyses to assess students’ attitudes at the beginning of the semester, and correlate the initial attitudes to
CPT exam and State Competency Exam scores. Identifying completers and non-completers and examining the initial attitudes of these students with each factor of the ATMI and across class sections helps to determine if these students have different initial attitudes. Calculating the change score for completers and examining these scores across class sections, age, gender, and ethnicity will determine whether a difference exists.

This study sought to discover if initial attitudes were affected by class sections, CPT scores, State Competency Exam scores, and completion or non-completion of the course. The study also sought to discover whether change scores were affected by class sections, age, gender, and ethnicity. The quantitative data provided statistics which support the conclusions. This will provide valuable information for professors who wish to use attitude assessment as a portion of their course.
CHAPTER 4: RESULTS

The purpose of this study is to examine the relationship between students’ attitudes toward mathematics, and their performance in a Beginning Algebra course focusing on the following factors: value, enjoyment, self-confidence, and motivation. Descriptive statistics for each composite attitudinal score were applied to measure individual survey questions. Linear models and correlation were used to determine relationships between initial composite attitudes and CPT scores as well as initial composite attitudes and State Exit Exam scores. Descriptive statistics were computed for completers’ and non-completers’ composite attitudinal scores, each component, and individual survey questions. This study examines the extent to which students’ attitudinal scores changed during the semester and how this change differed across class sections, age, gender, and ethnicity. This chapter presents the analysis of the data. The presentation of the data analysis is organized according to the five research questions.

Question #1: Initial Attitudes Toward Mathematics

Question #1 asked:

1a. What are the initial attitudes of community college students entering a Beginning Algebra course as indicated by the four attitudinal components of the ATMI: value of mathematics, enjoyment of mathematics, self-confidence with mathematics, and motivation for mathematics?

1b. To what extent are the initial attitudinal scores different across class sections?
For question 1a, initial attitude scores were collected from 11 Beginning Algebra classes in the first week of the fall 2010 semester. Descriptive statistics were calculated for each survey question including mean, standard deviation, skewness, and kurtosis. Composite attitudinal scores were then calculated for each of the four factors of the ATMI. Initial composite attitudes were compared across class sections to determine if there was a difference between class sections.

Descriptive statistics were calculated for each survey question. Within the ATMI, 10 factors address value, 10 address enjoyment, 15 address confidence, and 5 address motivation. The average per-item scores range from one to five, with one indicating the most negative attitude and five indicating the most positive attitude. Using the software program SAS, a Cronbach’s alpha was calculated to determine reliability; it was found to be .97, indicating a strong internal consistency.

Table 4 lists the descriptive statistics for each individual survey item per factor and Appendix C shows the percent of students’ response to each item. The highest scoring item for value was also the highest scoring item for the entire survey: I want to develop my mathematical skills. The mean rating for this item was 4.29, with 87.6% of students selecting agree or strongly agree. This is a strong indication that students want to improve their mathematical skills. The second highest scoring item was Mathematics helps develop the mind and teaches a person to think with 84.4% of the students responding to this question with agree or strongly agree. This implies that a majority of these students have a desire to develop their mathematical skills and believe that mathematics helps develop the mind. The lowest scoring item for value was I think studying advanced mathematics is useful. This item had a mean rating of 3.26, with
41.1% of the students selecting agree or strongly agree. Nine out of the 10 value items had total percentage of students selecting agree or strongly agree above 64.5%, indicating that more than half of these students value mathematics.

In the enjoyment factor, the highest scoring item, *I get a great deal of satisfaction out of solving a mathematics problem*, had a mean of 3.56, with 59% of these students selecting agree or strongly agree. This indicates that a significant number of students perceive they get satisfaction from solving mathematics problems. There was also a large number of students indicating a strong agreement, 40.6%, on the item asking, *I am comfortable expressing my own ideas on how to look for solutions to a difficult problem in math*. It appears that a large number of students in these Beginning Algebra classes may enjoy solving mathematics problems and feel comfortable looking for solutions to mathematics problems. The lowest scoring item for enjoyment was *I am happier in a math class than in any other class*, with a mean score of 2.46, and 18.4% of students selecting agree or strongly agree for with this item. The majority, 54.9% of the students selected disagree or strongly disagree for the same item *I am happier in a math class than any other class*. Only two out of the 10 enjoyment items had total percentage above 50% agreeing or strongly agreeing, those two items are: *I get a great deal of satisfaction out of solving a mathematics problem* and *I am comfortable answering questions in a math class*.

In the self-confidence factor, the item with the highest mean, *I am always confused in my mathematics class*, had a mean score of 3.54. This item was stated from the negative perspective; for that reason, a response of strongly agree was scored as one point and a response of strongly disagree was scored as five points. The percentage of
students selecting agree or strongly agree for this item is 61.7%, which indicates that a majority of these students feel confused in math class. The item with the highest percentage of students selecting agree or strongly agree was, I expect to do fairly well in any math class I take, with 67% agreeing or strongly agreeing to this statement. Unfortunately, for this group of students, many feel confused in math classes but also have confidence that they will do fairly well. The lowest scoring self-confidence item, Mathematics is one of my most dreaded subjects, had a mean score of 2.77, with 33.7% of these students selecting agree or strongly agree for this item. This item was also stated from the negative perspective. Therefore, the low mean indicates slight agreement and the low percentage agreeing implies that this sample of students do not dread mathematics. The results from these questions indicate that although a significant number of students feel confused in math classes, but they do not dread these classes, and a significant number feel they do “fairly well” in the classes.

In the motivation factor, the highest scoring item, I am confident that I could learn advanced mathematics, had the highest mean score of 3.22, with 45.6% of these students selecting agree or strongly agree for this item. Since the mean score is slightly above neutral, this indicates these students have slightly positive attitudes towards learning advanced mathematics but less than 50% feel confident that they can learn advanced mathematics. The item with the highest percentage selecting agree or strongly agree is, I would like to avoid using mathematics in college, with 46.5% indicating they agree or strongly agree with this item. The lowest scoring item, I am willing to take more than the required amount of mathematics, had a mean score of 2.46, with 18.5% of these students selecting agree or strongly agree for this item. The results for these two
questions indicate a reluctance of a significant number of these Beginning Algebra students to take more than the required amount of mathematics courses. It should be noted that these students are already mandated to take more mathematics courses than they anticipated upon entering college, so perhaps this result is not surprising. One item in the motivation factor was stated from the negative perspective. This item, *I would like to avoid using mathematics in college*, had 46.5% selecting agree or strongly agree. It appears for this sample of students, less than 50% do not want to take more math classes than necessary and would like to avoid using mathematics in college.
<table>
<thead>
<tr>
<th>Item</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Skewness</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Value of Mathematics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Mathematics is a very worthwhile and necessary subject.</td>
<td>3.96</td>
<td>0.90</td>
<td>-0.84</td>
<td>1.03</td>
</tr>
<tr>
<td>2. I want to develop my mathematical skills.</td>
<td>4.29</td>
<td>0.80</td>
<td>-1.27</td>
<td>2.19</td>
</tr>
<tr>
<td>3. Mathematics helps develop the mind and teaches a person to think.</td>
<td>4.18</td>
<td>0.78</td>
<td>-0.86</td>
<td>0.98</td>
</tr>
<tr>
<td>4. Mathematics is important in everyday life.</td>
<td>4.04</td>
<td>0.84</td>
<td>-0.90</td>
<td>1.30</td>
</tr>
<tr>
<td>5. Mathematics is one of the most important subjects for people to study.</td>
<td>3.72</td>
<td>0.96</td>
<td>-0.53</td>
<td>-0.2</td>
</tr>
<tr>
<td>6. Math courses would be very helpful no matter what I decide to study.</td>
<td>3.83</td>
<td>0.98</td>
<td>-0.70</td>
<td>0.06</td>
</tr>
<tr>
<td>7. I can think of many ways that I use math outside of school.</td>
<td>3.83</td>
<td>0.95</td>
<td>-0.83</td>
<td>0.56</td>
</tr>
<tr>
<td>8. I think studying advanced mathematics is useful.</td>
<td>3.26</td>
<td>0.97</td>
<td>-0.23</td>
<td>-0.22</td>
</tr>
<tr>
<td>9. I believe studying math helps me with problem solving in other areas.</td>
<td>3.68</td>
<td>0.95</td>
<td>-0.70</td>
<td>0.24</td>
</tr>
<tr>
<td>10. A strong math background could help me in my professional life.</td>
<td>4.03</td>
<td>0.91</td>
<td>-1.10</td>
<td>1.52</td>
</tr>
</tbody>
</table>

Continued on next page
Table 4 (Continued)

<table>
<thead>
<tr>
<th>Item</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Skewness</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Enjoyment of Mathematics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. I get a great deal of satisfaction out of solving a mathematics problem.</td>
<td>3.56</td>
<td>1.03</td>
<td>-0.53</td>
<td>-0.22</td>
</tr>
<tr>
<td>12. I have usually enjoyed studying mathematics in school.</td>
<td>2.71</td>
<td>1.20</td>
<td>0.14</td>
<td>-0.99</td>
</tr>
<tr>
<td>13. I like to solve new problems in mathematics.</td>
<td>3.09</td>
<td>1.07</td>
<td>-0.11</td>
<td>-0.78</td>
</tr>
<tr>
<td>14. I would prefer to do an assignment in math than to write an essay.</td>
<td>3.07</td>
<td>1.46</td>
<td>-0.02</td>
<td>-1.38</td>
</tr>
<tr>
<td>15. I really like mathematics.</td>
<td>2.79</td>
<td>1.21</td>
<td>0.11</td>
<td>-0.83</td>
</tr>
<tr>
<td>16. I am happier in a math class than in any other class.</td>
<td>2.46</td>
<td>1.12</td>
<td>0.47</td>
<td>-0.48</td>
</tr>
<tr>
<td>17. Mathematics is a very interesting subject.</td>
<td>3.14</td>
<td>1.11</td>
<td>-0.29</td>
<td>-0.61</td>
</tr>
<tr>
<td>18. I am comfortable expressing my own ideas on how to look for solutions to a difficult problem in math.</td>
<td>3.10</td>
<td>1.04</td>
<td>-0.35</td>
<td>-0.55</td>
</tr>
<tr>
<td>19. I am comfortable answering questions in math class.</td>
<td>3.27</td>
<td>1.04</td>
<td>-0.54</td>
<td>-0.47</td>
</tr>
<tr>
<td>20. Mathematics is dull and boring.*</td>
<td>3.20</td>
<td>1.15</td>
<td>-0.20</td>
<td>-0.77</td>
</tr>
</tbody>
</table>

Continued on next page
Table 4 (Continued)

<table>
<thead>
<tr>
<th>Item</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Skewness</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Self-Confidence in Mathematics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21. Mathematics is one of my most dreaded subjects.*</td>
<td>2.77</td>
<td>1.30</td>
<td>0.15</td>
<td>-1.15</td>
</tr>
<tr>
<td>22. When I hear the word mathematics, I have a feeling of dislike.*</td>
<td>2.92</td>
<td>1.26</td>
<td>0.08</td>
<td>-1.18</td>
</tr>
<tr>
<td>23. My mind goes blank, and I am unable to think clearly when working with mathematics.*</td>
<td>3.24</td>
<td>1.03</td>
<td>-0.34</td>
<td>-0.59</td>
</tr>
<tr>
<td>24. Studying mathematics makes me feel nervous.*</td>
<td>3.15</td>
<td>1.15</td>
<td>-0.22</td>
<td>-0.90</td>
</tr>
<tr>
<td>25. Mathematics makes me feel uncomfortable.*</td>
<td>3.23</td>
<td>1.10</td>
<td>-0.34</td>
<td>-0.80</td>
</tr>
<tr>
<td>26. I am always under a terrible strain in a math class.*</td>
<td>3.26</td>
<td>1.09</td>
<td>-0.33</td>
<td>-0.72</td>
</tr>
<tr>
<td>27. It makes me nervous to even think about having to do a mathematics problem.*</td>
<td>3.44</td>
<td>1.06</td>
<td>-0.54</td>
<td>-0.45</td>
</tr>
<tr>
<td>28. I am always confused in my mathematics class.*</td>
<td>3.54</td>
<td>0.92</td>
<td>-0.90</td>
<td>0.72</td>
</tr>
<tr>
<td>29. I feel a sense of insecurity when attempting mathematics.*</td>
<td>3.29</td>
<td>1.09</td>
<td>-0.43</td>
<td>-0.72</td>
</tr>
</tbody>
</table>

Continued on next page
<table>
<thead>
<tr>
<th>Item</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Skewness</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Self-Confidence in Mathematics (continued)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30. Mathematics does not scare me at all.</td>
<td>2.99</td>
<td>1.10</td>
<td>0.15</td>
<td>-0.80</td>
</tr>
<tr>
<td>31. I have a lot of self-confidence when it comes to mathematics.</td>
<td>2.83</td>
<td>1.01</td>
<td>0.16</td>
<td>-0.49</td>
</tr>
<tr>
<td>32. I am able to solve mathematics problems without too much difficulty.</td>
<td>2.84</td>
<td>0.99</td>
<td>-0.07</td>
<td>-0.78</td>
</tr>
<tr>
<td>33. I expect to do fairly well in any math class I take.</td>
<td>3.53</td>
<td>0.94</td>
<td>-0.60</td>
<td>0.24</td>
</tr>
<tr>
<td>34. I learn mathematics easily.</td>
<td>2.82</td>
<td>1.06</td>
<td>0.09</td>
<td>-0.79</td>
</tr>
<tr>
<td>35. I believe I am good at solving math problems.</td>
<td>3.05</td>
<td>1.00</td>
<td>-0.12</td>
<td>-0.49</td>
</tr>
<tr>
<td><strong>Motivation with Mathematics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>36. I am confident that I could learn advanced mathematics.</td>
<td>3.22</td>
<td>1.02</td>
<td>-0.43</td>
<td>-0.41</td>
</tr>
<tr>
<td>37. I plan to take as much mathematics as I can during my education.</td>
<td>2.78</td>
<td>1.15</td>
<td>0.08</td>
<td>-0.90</td>
</tr>
<tr>
<td>38. The challenge of math appeals to me.</td>
<td>2.78</td>
<td>1.06</td>
<td>0.09</td>
<td>-0.76</td>
</tr>
</tbody>
</table>

Continued on next page
<table>
<thead>
<tr>
<th>Item</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Skewness</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>39. I am willing to take more than the required amount of mathematics.</td>
<td>2.46</td>
<td>1.07</td>
<td>0.33</td>
<td>-0.68</td>
</tr>
<tr>
<td>40. I would like to avoid using mathematics in college.*</td>
<td>3.11</td>
<td>1.15</td>
<td>-0.37</td>
<td>-0.87</td>
</tr>
</tbody>
</table>

*Scoring for these items is reversed and uses anchors of 1: strongly agree, 2: agree, 3: neutral, 4: disagree, 5: strongly disagree. Therefore, on all items, scores range from 1 to 5, with 1 indicating the most negative attitude and 5 indicating the most positive attitude.

Note.© Martha Tapia. ATMI used with permission of author. Scoring for most items uses anchors of 1: strongly disagree, 2: disagree, 3: neutral, 4: agree, and 5: strongly agree.
Because the ATMI contains unequal number of attitudinal components for each factor, an average score was found for each factor in order to make comparisons. Scores range from 1 to 5: a score of one indicates the most negative attitude, a score of three indicates a neutral attitude, and a score of five indicates the most positive attitude. On the 5-point scale, a value of 1 indicates strongly disagree and a value of 5 indicates strongly agree. Average scores for each component are found in Table 5. Participants’ initial composite survey scores were highest for the attitudinal component of value, with a mean score of 3.88. The lowest initial composite survey scores were for the attitudinal component of motivation, with a mean score of 2.87.

Table 5 Initial Composite Mean per ATMI Factor

<table>
<thead>
<tr>
<th>Component</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Skewness</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
<td>3.88</td>
<td>0.94</td>
<td>-0.78</td>
<td>-0.39</td>
</tr>
<tr>
<td>Enjoyment</td>
<td>3.04</td>
<td>1.19</td>
<td>-0.13</td>
<td>-0.90</td>
</tr>
<tr>
<td>Self-Confidence</td>
<td>3.13</td>
<td>1.11</td>
<td>-0.22</td>
<td>-0.81</td>
</tr>
<tr>
<td>Motivation</td>
<td>2.87</td>
<td>1.12</td>
<td>-0.06</td>
<td>-0.92</td>
</tr>
<tr>
<td>Composite</td>
<td>3.26</td>
<td>1.15</td>
<td>-0.31</td>
<td>-0.76</td>
</tr>
</tbody>
</table>

*Note. Per factor scores range from 1 to 5, with 1 indicating the most negative attitude and 5 indicating the most positive.*

Question #1b asked:

To what extent are the initial attitudinal scores different across class sections?

In an attempt to determine whether the composite attitudinal scores differed across class sections, a single-factor analysis of variance was calculated across class sections. The validity of the ANOVA depends on the assumptions of independence, normality and equal variances between class sections. The initial composite attitudinal...
scores are independent. The distributions of the initial composite attitudinal scores are slightly positively skewed. However, with the large sample size (n = 217), an ANOVA is relatively robust to violations of the normality assumption. The results of the initial composite attitude scores across class sections are displayed in Table 6. The mean composite score for the ATMI could range from 40 to 200, with 40 indicating a negative attitude and 200 indicating a positive attitude. If students selected neutral on all questions, the composite attitudinal score would be 120. As shown in Table 6, all class sections had mean composite scores above 120, which indicates that on average the students have a slightly positive attitude toward mathematics. The mean composite scores range from 124.53 to 139.45. Six of the class sections were slightly skewed to the left and five were slightly skewed to the right. Left skewness indicates that most of the responses were toward the agree or strongly agree area. Right skewness indicates that most of the responses were toward the disagree or strongly disagree area. Nine of the class sections had a negative kurtosis, indicating a platykurtic shape, and two sections had a positive kurtosis value, indicating a leptokurtic shape. The platykurtic shape indicates that the responses were evenly spread across the spectrum of strongly disagree or strongly agree. And a leptokurtic shape indicates that the responses were slightly clustered around a certain response.
Table 6 Initial Composite Attitude Scores Across Class Sections

<table>
<thead>
<tr>
<th>Class Sections</th>
<th>Count</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Skewness</th>
<th>Kurtosis</th>
<th>Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class 1</td>
<td>15</td>
<td>128.80</td>
<td>23.24</td>
<td>0.70</td>
<td>-0.67</td>
<td>540.17</td>
</tr>
<tr>
<td>Class 2</td>
<td>20</td>
<td>132.45</td>
<td>33.45</td>
<td>-0.16</td>
<td>0.21</td>
<td>1118.85</td>
</tr>
<tr>
<td>Class 3</td>
<td>22</td>
<td>126.18</td>
<td>23.70</td>
<td>0.72</td>
<td>-0.75</td>
<td>561.49</td>
</tr>
<tr>
<td>Class 4</td>
<td>21</td>
<td>129.67</td>
<td>28.34</td>
<td>-0.24</td>
<td>-0.43</td>
<td>802.93</td>
</tr>
<tr>
<td>Class 5</td>
<td>20</td>
<td>139.45</td>
<td>27.51</td>
<td>-0.20</td>
<td>-0.91</td>
<td>756.79</td>
</tr>
<tr>
<td>Class 6</td>
<td>22</td>
<td>129.82</td>
<td>36.22</td>
<td>-0.06</td>
<td>-0.26</td>
<td>1311.58</td>
</tr>
<tr>
<td>Class 7</td>
<td>22</td>
<td>124.88</td>
<td>25.30</td>
<td>0.46</td>
<td>0.64</td>
<td>639.97</td>
</tr>
<tr>
<td>Class 8</td>
<td>22</td>
<td>128.32</td>
<td>26.45</td>
<td>0.18</td>
<td>-0.41</td>
<td>699.85</td>
</tr>
<tr>
<td>Class 9</td>
<td>18</td>
<td>137.83</td>
<td>31.64</td>
<td>-0.42</td>
<td>-0.65</td>
<td>1000.85</td>
</tr>
<tr>
<td>Class 10</td>
<td>18</td>
<td>129.23</td>
<td>31.36</td>
<td>0.01</td>
<td>-0.82</td>
<td>983.15</td>
</tr>
<tr>
<td>Class 11</td>
<td>17</td>
<td>124.53</td>
<td>22.14</td>
<td>-0.08</td>
<td>-0.56</td>
<td>490.01</td>
</tr>
<tr>
<td>Summary</td>
<td>217</td>
<td>130.03</td>
<td>28.29</td>
<td>0.06</td>
<td>-0.41</td>
<td>800.05</td>
</tr>
</tbody>
</table>

A single-factor analysis of variance was calculated to determine whether there was a difference in the initial composite attitudinal scores across class sections. There was no statistically significant difference in initial composite attitudinal scores of these Beginning Algebra students across class sections (Table 7).

Table 7 ANOVA Difference of Composite Initial Attitude Scores Across Class Sections

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>4526.72</td>
<td>10</td>
<td>452.67</td>
<td>0.55</td>
<td>0.85</td>
</tr>
<tr>
<td>Within Groups</td>
<td>168549.90</td>
<td>206</td>
<td>818.20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>173076.62</td>
<td>216</td>
<td>818.20</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Question #2: Initial Attitudes Toward Mathematics and CPT Scores

Question #2 asked:

2a. What is the relationship between community college Beginning Algebra students’ initial attitudes toward mathematics and their scores on the CPT?

2b. To what extent is the relationship between attitudes and CPT scores different across class sections?

For question 2a, initial composite attitudinal scores and CPT scores were collected from eleven Beginning Algebra classes in the first week of the fall semester. The students’ initial composite attitudinal scores were correlated to their CPT scores. Using SAS software, the Pearson product correlation coefficient was calculated to determine how well composite attitudinal scores predicted CPT scores. A linear model was created to estimate CPT scores from composite attitudinal scores. Fisher’s Z-transformations were used to further examine relationships between composite attitude scores and CPT scores across class sections.

The Pearson product correlation coefficient between composite attitude scores and CPT scores was found to be 0.09 (p = .18), indicating a weak positive relationship. The scatter plot (Figure 2) shows the weak relationship between CPT scores and initial attitude scores. Since the p-value is larger than 0.05, we can conclude that for this sample there is no statistically significant evidence of a relationship between CPT scores and initial composite attitudinal scores. The linear regression model for this sample becomes:

\[
\text{CPT SCORE} = 38.32 + 0.05(\text{INITIAL COMPOSITE ATTITUDE SCORE})
\]

According to the F value, F(1, 215) = 1.83, this linear regression model is not effectively representing a relationship between CPT scores and initial composite attitudinal scores.
Question #2b asked:

To what extent is the relationship between attitudes and CPT scores different across class sections?

To examine the effect of CPT scores and initial composite attitude scores across class sections, the researcher utilized Fisher’s Z-transformations to determine the independent correlations, $r$, of initial attitude and CPT score (Table 8). Since it was already shown in Question #1a that there was no statistically significant difference across class sections and the unanticipated large number of class sections, it was determined feasible to analyze the data grouped by professor. Therefore, the $z$-ratio was calculated for each combination of class sections as grouped per professor to test $H_0: \rho_1 = \rho_2$ with significant level set to 0.05. There were five different professors; therefore, there were ten combinations of class sections. For each of the ten combinations, all observed $z$-ratios were between the $z$-value of ±1.96; therefore, the hypothesis of $H_0: \rho_1 = \rho_2$ for all comparisons cannot be rejected at the $\alpha = .05$ level. Consequently, the correlation

Figure 2: CPT Score and Initial Composite Attitude Score
between CPT scores and initial composite attitudinal scores of students taught by different professors was not significantly different. These results indicate no statistically significant difference between CPT scores and composite attitudinal scores across class sections.

Table 8 Fisher’s Z-transformations of Composite Attitude Score and CPT

<table>
<thead>
<tr>
<th>Comparison</th>
<th>n₁</th>
<th>n₂</th>
<th>r₁</th>
<th>r₂</th>
<th>z-ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>A to B</td>
<td>36</td>
<td>42</td>
<td>-0.0049</td>
<td>0.2211</td>
<td>0.18</td>
</tr>
<tr>
<td>A to C</td>
<td>36</td>
<td>82</td>
<td>-0.0049</td>
<td>0.0199</td>
<td>-0.07</td>
</tr>
<tr>
<td>A to D</td>
<td>36</td>
<td>35</td>
<td>-0.0049</td>
<td>0.1048</td>
<td>-0.40</td>
</tr>
<tr>
<td>A to E</td>
<td>36</td>
<td>22</td>
<td>-0.0049</td>
<td>0.0528</td>
<td>-0.52</td>
</tr>
<tr>
<td>B to C</td>
<td>42</td>
<td>82</td>
<td>0.2211</td>
<td>0.0199</td>
<td>1.05</td>
</tr>
<tr>
<td>B to D</td>
<td>42</td>
<td>35</td>
<td>0.2211</td>
<td>0.1048</td>
<td>0.50</td>
</tr>
<tr>
<td>B to E</td>
<td>42</td>
<td>22</td>
<td>0.2211</td>
<td>0.0528</td>
<td>0.25</td>
</tr>
<tr>
<td>C to D</td>
<td>82</td>
<td>35</td>
<td>0.0199</td>
<td>0.1048</td>
<td>-0.41</td>
</tr>
<tr>
<td>C to E</td>
<td>82</td>
<td>22</td>
<td>0.0199</td>
<td>0.0528</td>
<td>-0.53</td>
</tr>
<tr>
<td>D to E</td>
<td>35</td>
<td>22</td>
<td>0.1048</td>
<td>0.0528</td>
<td>-0.17</td>
</tr>
</tbody>
</table>

Question #3: Initial Attitudes Toward Mathematics and State Competency Exam

Question #3 asked:

3a. What is the relationship between community college Beginning Algebra students’ initial attitudes toward mathematics and their scores on the State Competency Exam?

3b. To what extent is the relationship between initial attitudes and State Competency Exam scores different across class sections?
For question 3a, initial composite attitudinal scores were collected from eleven Beginning Algebra classes in the first week of the fall semester. The State Competency Exam was administered during final exam week of the semester. Scores for the State Competency Exam were collected from the Math Coordinator. The students’ initial composite attitudinal scores were correlated with their State Competency Exam scores. Using SAS software, the Pearson product correlation coefficient was calculated to determine how well composite attitudinal scores predict State Competency Exam scores. A linear model was created to estimate State Competency Exam scores from composite attitudinal scores. Fisher’s Z-transformations were used to further examine relationships between composite attitude scores and State Competency Exam scores across class sections.

Thirty students had withdrawn from the Beginning Algebra courses during the semester. The new sample size (n = 187) was used to calculate the Pearson product correlation coefficient to determine whether there is a relationship between State Competency Exam scores and initial attitude scores. The calculated correlation coefficient of 0.19 indicates a positive relationship, significant at the p = .01 level. The scatter plot (Figure 3) shows the relationship between State Competency Exam scores and initial attitude scores. The p-value is less than .05, implying a statistically significant association between State Competency Exam scores and initial composite attitude scores. The linear regression model for this sample becomes:

STATE COMPETENCY EXAM = 22.23 + 0.02(INITIAL ATTITUDE SCORE)
According to the F value, F(1, 215) = 7.13, this linear regression model is not effectively representing a relationship between State Competency Exam scores and initial composite attitudinal scores.

Figure 3: State Competency Scores and Initial Composite Attitude Scores

Question #3b asked:

To what extent is the relationship between initial attitudes and State Competency Exam scores different across class sections?

To examine the effect of students’ initial attitude scores and State Competency Test scores across class sections, the researcher utilized Fisher’s Z-transformations to determine the independent correlations, $r$, of initial attitudes and State Competency Exam scores (Table 9). The $z$-ratio was calculated for each combination of class sections as grouped per professor to test $H_0$: $\rho_1 = \rho_2$ with $\alpha = .05$. There were five different professors; therefore, there are ten combinations of class sections. For each of the ten combinations, all observed $z$-ratios were between the $z$-value of $\pm1.96$; therefore, the hypothesis of $H_0$: $\rho_1 = \rho_2$ for all comparisons cannot be rejected at the $\alpha = .05$ level.
Consequently, the correlation between State Competency Exam scores and initial composite attitudinal scores of students taught by different professors were not significantly different. These results indicate that there is no significant evidence of a difference between the correlation of State Competency Exam scores and composite attitudinal scores across class sections.

Table 9 Fisher’s Z-transformations of Composite Attitude Scores and State Competency Scores

<table>
<thead>
<tr>
<th>Comparison</th>
<th>n_1</th>
<th>n_2</th>
<th>r_1</th>
<th>r_2</th>
<th>z-ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>A to B</td>
<td>29</td>
<td>32</td>
<td>0.1373</td>
<td>0.2507</td>
<td>-0.44</td>
</tr>
<tr>
<td>A to C</td>
<td>29</td>
<td>78</td>
<td>0.1373</td>
<td>0.2131</td>
<td>-0.34</td>
</tr>
<tr>
<td>A to D</td>
<td>29</td>
<td>31</td>
<td>0.1373</td>
<td>0.3557</td>
<td>-0.86</td>
</tr>
<tr>
<td>A to E</td>
<td>29</td>
<td>17</td>
<td>0.1373</td>
<td>-0.4155</td>
<td>-0.92</td>
</tr>
<tr>
<td>B to C</td>
<td>32</td>
<td>78</td>
<td>0.2507</td>
<td>0.2131</td>
<td>0.18</td>
</tr>
<tr>
<td>B to D</td>
<td>32</td>
<td>31</td>
<td>0.2507</td>
<td>0.3557</td>
<td>-0.44</td>
</tr>
<tr>
<td>B to E</td>
<td>32</td>
<td>17</td>
<td>0.2507</td>
<td>-0.4155</td>
<td>-0.57</td>
</tr>
<tr>
<td>C to D</td>
<td>78</td>
<td>31</td>
<td>0.2131</td>
<td>0.3557</td>
<td>-0.70</td>
</tr>
<tr>
<td>C to E</td>
<td>78</td>
<td>17</td>
<td>0.2131</td>
<td>-0.4155</td>
<td>-0.78</td>
</tr>
<tr>
<td>D to E</td>
<td>31</td>
<td>17</td>
<td>0.3557</td>
<td>-0.4155</td>
<td>-0.21</td>
</tr>
</tbody>
</table>
Question #4: Difference between completers’ and non-completers’ initial attitudinal scores on each factor of the ATMI

Question #4 asked:

4a. What is the difference between completers’ and non-completers’ initial attitudinal scores on each factor of the ATMI: value of mathematics, enjoyment of mathematics, motivation for mathematics, and self-confidence?

4b. To what extent is the difference between completers and non-completers different across class sections?

In the final week of the semester students take the State Competency Exam to determine whether they pass the Beginning Algebra course. The State Competency Exam scores were used to determine completers and non-completers of the course. Students’ initial attitude composite scores were divided into two groups: completers and non-completers. Descriptive statistics were calculated for initial composite scores for completers and non-completers for each factor of the ATMI: value, enjoyment, self-confidence, and motivation. These statistics include mean, standard deviation, skewness, and kurtosis. Descriptive statistics were also calculated for each survey question for completers and non-completers. Completers’ survey questions with the highest and lowest means for each factor were compared to the non-completers’ means for the same questions. To determine whether there is a difference between completers and non-completers, a composite initial attitude score was determined for each student and a two-sample t-test was performed.

Initial attitude scores were separated into completers and non-completers. Within the ATMI, 10 factors address value, 10 address enjoyment, 15 address self-confidence,
and 5 address motivation. The average per factor score ranges from 10 to 50 for value and enjoyment, 15 to 75 for self-confidence, and 5 to 25 for motivation. Initial attitude composite scores can range from 40 to 200. As described earlier, composite attitude scores above 120 indicate an above neutral attitude.

As shown in Table 10, the composite scores for completers and non-completers are above neutral. The completers’ initial composite score of 132.67 is higher than the non-completers’ initial composite score of 123.69 indicating, as a group, a more positive overall attitude for completers. This trend continues when examining the average scores for each factor of the ATMI for completers and non-completers. Completers’ mean scores for each factor are greater than non-completers’ mean scores. A mean score above 30 for value and enjoyment indicates an above neutral attitude. The mean score for completers in the value factor is 39.04, and for non-completers the mean is 38.19. These means are well above neutral, which would appear to suggest both completers and non-completers groups scored in the positive attitude ranges for the factors of value and enjoyment. A mean score above 15 for motivation indicates an above neutral attitude. The mean score for completers in the motivation factor is 14.62, and for non-completers the mean score is 13.50. These means are below neutral, which would appear to suggest both completers and non-completers groups scored in the negative attitude ranges for the factor of motivation. This may indicate that many students are not motivated by mathematics.

Descriptive statistics were calculated for each survey question for completers and non-completers. Completers’ survey questions with the highest and lowest mean score within each factor were identified and compared to non-completers’ means for the same
question. Table 11 provides a summary of the highest and lowest factors for the completers. All means for completers are higher than non-completers for all questions identified. Skewness was negative for all factors among the completers and non-completers except the following: *I am happier in a math class than any other class (Enjoyment); Mathematics is one of my most dreaded subjects (Self-confidence) and I am willing to take more than the required amount of mathematics (Motivation).*

The t-test was conducted to examine significant differences in completers and non-completers composite attitude score and composite attitude score for each factor of the ATMI. Table 12 shows significant differences between completers and non-completers composite initial attitude (*p* = .02), between the ATMI factor of enjoyment (*p* = .04), and between the ATMI factor of self-confidence (*p* = .02). This indicates that completers and non-completers have a significant difference in their composite initial attitude scores and their composite scores for enjoyment of mathematics.
Table 10 Initial Attitudes Composite Mean Scores for Completers and Non-completers

<table>
<thead>
<tr>
<th>Composite Mean Score</th>
<th>Completers</th>
<th>Non-completers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Value</td>
<td>Enjoyment</td>
</tr>
<tr>
<td>Low</td>
<td>Neutral</td>
<td>High</td>
</tr>
<tr>
<td>10</td>
<td>30</td>
<td>50</td>
</tr>
<tr>
<td>10</td>
<td>30</td>
<td>50</td>
</tr>
<tr>
<td>15</td>
<td>45</td>
<td>75</td>
</tr>
<tr>
<td>5</td>
<td>15</td>
<td>25</td>
</tr>
<tr>
<td>40</td>
<td>120</td>
<td>200</td>
</tr>
<tr>
<td>Item</td>
<td>Completers</td>
<td>Non-completers</td>
</tr>
<tr>
<td>------------------------------------</td>
<td>---------------------</td>
<td>----------------------</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>Standard Deviation</td>
</tr>
<tr>
<td><strong>Value of Mathematics</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I want to develop my mathematical</td>
<td>4.30</td>
<td>0.80</td>
</tr>
<tr>
<td>skills.*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I think studying advanced mathematics is useful.**</td>
<td>3.29</td>
<td>0.96</td>
</tr>
<tr>
<td><strong>Enjoyment of Mathematics</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I get a great deal of satisfaction out of solving a mathematics problem.*</td>
<td>3.58</td>
<td>1.01</td>
</tr>
<tr>
<td>I am happier in a math class than any other class.**</td>
<td>2.56</td>
<td>1.20</td>
</tr>
<tr>
<td><strong>Self-confidence</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am always confused in my mathematics class.*</td>
<td>3.60</td>
<td>0.91</td>
</tr>
<tr>
<td>Mathematics is one of my most dreaded subjects.**</td>
<td>2.85</td>
<td>1.32</td>
</tr>
<tr>
<td><strong>Motivation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am confident that I could learn advanced mathematics.*</td>
<td>3.26</td>
<td>1.05</td>
</tr>
<tr>
<td>I am willing to take more than the required amount of mathematics.**</td>
<td>2.51</td>
<td>1.09</td>
</tr>
</tbody>
</table>

*Item with highest mean. **Item with lowest mean.
Table 12 T-test Results for Difference between Completers and Non-completers

<table>
<thead>
<tr>
<th>Factor</th>
<th>t-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
<td>0.87</td>
<td>0.39</td>
</tr>
<tr>
<td>Enjoyment</td>
<td>2.03</td>
<td>0.04*</td>
</tr>
<tr>
<td>Self-confidence</td>
<td>2.43</td>
<td>0.02*</td>
</tr>
<tr>
<td>Motivation</td>
<td>1.81</td>
<td>0.07</td>
</tr>
<tr>
<td>Composite</td>
<td>2.31</td>
<td>0.02*</td>
</tr>
</tbody>
</table>

*significant at p < 0.05

Question #4b asked:

To what extent is the difference between completers and non-completers different across class sections?

Table 13 shows no significant difference between completers and non-completers per professor for the factors of value, self-confidence, and motivation in the ATMI. Enjoyment shows a significant difference in the main effect of completers and non-completers. Further analysis shows the F-value, F(1, 207) = 3.91 and p = .05 indicating that the completers are significantly different than non-completers in the factor of enjoyment of mathematics. All interaction terms are not statistically significant, thus there is not evidence that differences between completers and non-completers differ across class sections.
Table 13 ANOVA Summary Table for Completers and Non-completers Across Class Sections per Factor of the ATMI

<table>
<thead>
<tr>
<th>VALUE</th>
<th>Source of Variation</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Completers</td>
<td>10.96</td>
<td>1</td>
<td>10.96</td>
<td>0.26</td>
<td>0.61</td>
</tr>
<tr>
<td></td>
<td>Professor</td>
<td>110.43</td>
<td>4</td>
<td>27.61</td>
<td>0.65</td>
<td>0.63</td>
</tr>
<tr>
<td></td>
<td>Comp*Prof</td>
<td>101.31</td>
<td>4</td>
<td>25.33</td>
<td>0.60</td>
<td>0.66</td>
</tr>
<tr>
<td></td>
<td>Within Groups</td>
<td>8796.43</td>
<td>207</td>
<td>42.49</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>9020.25</td>
<td>216</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ENJOYMENT</th>
<th>Source of Variation</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Completers</td>
<td>293.00</td>
<td>1</td>
<td>293.00</td>
<td>3.91</td>
<td>0.05*</td>
</tr>
<tr>
<td></td>
<td>Professor</td>
<td>116.34</td>
<td>4</td>
<td>29.09</td>
<td>0.39</td>
<td>0.82</td>
</tr>
<tr>
<td></td>
<td>Comp*Prof</td>
<td>409.95</td>
<td>4</td>
<td>102.49</td>
<td>1.37</td>
<td>0.25</td>
</tr>
<tr>
<td></td>
<td>Within Groups</td>
<td>15504.37</td>
<td>207</td>
<td>74.90</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>16359.01</td>
<td>216</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SELF-CONFIDENCE</th>
<th>Source of Variation</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Completers</td>
<td>613.49</td>
<td>1</td>
<td>613.49</td>
<td>3.66</td>
<td>0.06</td>
</tr>
<tr>
<td></td>
<td>Professor</td>
<td>438.03</td>
<td>4</td>
<td>109.51</td>
<td>0.65</td>
<td>0.63</td>
</tr>
<tr>
<td></td>
<td>Comp*Prof</td>
<td>713.23</td>
<td>4</td>
<td>178.31</td>
<td>1.06</td>
<td>0.38</td>
</tr>
<tr>
<td></td>
<td>Within Groups</td>
<td>34711.48</td>
<td>207</td>
<td>167.69</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>36638.67</td>
<td>216</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MOTIVATION</th>
<th>Source of Variation</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Completers</td>
<td>51.45</td>
<td>1</td>
<td>51.45</td>
<td>2.64</td>
<td>0.11</td>
</tr>
<tr>
<td></td>
<td>Professor</td>
<td>25.86</td>
<td>4</td>
<td>6.47</td>
<td>0.33</td>
<td>0.86</td>
</tr>
<tr>
<td></td>
<td>Comp*Prof</td>
<td>66.12</td>
<td>4</td>
<td>16.53</td>
<td>0.85</td>
<td>0.50</td>
</tr>
<tr>
<td></td>
<td>Within Groups</td>
<td>4038.38</td>
<td>207</td>
<td>19.51</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>4180.44</td>
<td>216</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

n = 217, p < 0.05
Question #5: Change Scores Across Classes, Age, Gender, and Ethnicity

Question #5 asked:

5a. To what extent do the four attitudinal components of the ATMI—value of mathematics, enjoyment of mathematics, motivation for mathematics, and self-confidence—change during the developmental mathematics course?

5b. To what extent do the attitudinal score changes differ across class sections?

5c. To what extent do the attitudinal score changes differ based on age?

5d. To what extent do the attitudinal score changes differ based on gender?

5e. To what extent do the attitudinal score changes differ based on ethnicity?

The ATMI was administered during the first week of classes to determine an initial attitude score; it was then administered during the 12th week of classes to determine an end-of-semester attitude score. The change scores are not independent and are determined by subtracting the end-of-semester scores from the corresponding initial attitude scores for each factor of the ATMI. The change scores could range between -160 to 160. The resulting sample size of students who participated in the end-of-semester survey is 159. Descriptive statistics were computed for change scores. Highest and lowest mean change scores are discussed. To determine if change scores differ across class sections, age, gender and ethnicity a single-factor analysis was performed individually.

To examine how the composite attitudinal scores changed over the course of the semester, the end-of-semester composite attitude scores were subtracted from the initial composite attitude scores. As displayed in Table 14, the only factor resulting in negative change scores is the factor of value with a -0.06 change. All other factors had positive changes over the semester. The initial composite attitudinal score for the entire group was
3.26 and the end-of-semester attitudinal score was 3.39 indicating a slight increase in attitude score. The composite attitudinal change score resulted in an increase of 0.13. This indicates that many students’ average overall composite attitudes had a positive change over the fall semester.

Table 14 Change Scores for the Four Attitudinal Components of the ATMI

<table>
<thead>
<tr>
<th>Component</th>
<th>Initial Attitude Mean</th>
<th>End-of-Semester Mean</th>
<th>Change Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
<td>3.88</td>
<td>3.82</td>
<td>-0.06</td>
</tr>
<tr>
<td>Enjoyment</td>
<td>3.04</td>
<td>3.26</td>
<td>0.22</td>
</tr>
<tr>
<td>Self-Confidence</td>
<td>3.13</td>
<td>3.33</td>
<td>0.20</td>
</tr>
<tr>
<td>Motivation</td>
<td>2.87</td>
<td>2.96</td>
<td>0.09</td>
</tr>
<tr>
<td>Composite</td>
<td>3.26</td>
<td>3.39</td>
<td>0.13</td>
</tr>
</tbody>
</table>

Descriptive statistics were computed for the composite change scores and each factor of the ATMI. As displayed in Table 15, the descriptive statistics included mean, standard deviation, skewness, and kurtosis. The mean composite change score was 3.33 (SD = 17.74) and was negatively skewed (Sk = -0.69) with a kurtosis of 2.37, indicating that the distribution was leptokurtic. The negative skewness and leptokurtic distribution indicate a high concentration of scores in the region of agree or strongly agree responses.
Table 15 Change Scores Descriptive Statistics for Factors of the ATMI

<table>
<thead>
<tr>
<th>Factor</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Skewness</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
<td>-0.73</td>
<td>5.26</td>
<td>-0.57</td>
<td>0.52</td>
</tr>
<tr>
<td>Enjoyment</td>
<td>1.49</td>
<td>5.83</td>
<td>-0.23</td>
<td>1.46</td>
</tr>
<tr>
<td>Self-Confidence</td>
<td>2.31</td>
<td>8.63</td>
<td>-0.22</td>
<td>2.16</td>
</tr>
<tr>
<td>Motivation</td>
<td>0.17</td>
<td>3.56</td>
<td>-0.10</td>
<td>2.11</td>
</tr>
<tr>
<td>Composite</td>
<td>3.33</td>
<td>17.74</td>
<td>-0.69</td>
<td>2.37</td>
</tr>
</tbody>
</table>

A t-test was conducted using composite survey initial scores and end-of-semester scores to determine if there was a significant change in attitude over the course of the semester. A significance level of .05 was used to determine whether the results were significant. The difference between the initial composite scores and the end-of-semester composite scores was determined and a t-test was performed to test if the mean change score in the population was zero. The t-test results are shown in Table 16. They reveal a statistically significant difference in change score between the initial composite attitudinal score (p = .0149), enjoyment (p = 0.00) and self-confidence (p = 0.00).

Table 16 T-test Results for Initial and End-of-Semester Change Scores

<table>
<thead>
<tr>
<th>Factor</th>
<th>Mean Change Score</th>
<th>t-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
<td>-0.73</td>
<td>1.75</td>
<td>0.08</td>
</tr>
<tr>
<td>Enjoyment</td>
<td>1.49</td>
<td>-3.23</td>
<td>0.00*</td>
</tr>
<tr>
<td>Self-confidence</td>
<td>2.31</td>
<td>-3.38</td>
<td>0.00*</td>
</tr>
<tr>
<td>Motivation</td>
<td>0.17</td>
<td>-0.61</td>
<td>0.54</td>
</tr>
<tr>
<td>Composite</td>
<td>3.33</td>
<td>2.46</td>
<td>0.0149*</td>
</tr>
</tbody>
</table>

*significant at p < 0.05

Question #5b asked:
To what extent do the attitudinal score changes differ across class sections?

Four single-factor analyses of variance were calculated for each factor of the ATMI across each class section to examine the changes in attitudinal scores and determine whether there was a significant difference across class sections. As shown in Table 17, the p-values for all factors across class sections are greater than 0.05. Therefore, there was no statistically significant difference in attitudinal score changes of Beginning Algebra students for each factor of the ATMI across class sections.
Table 17 ANOVA Change Scores per Factor Across Class Sections

<table>
<thead>
<tr>
<th>VALUE</th>
<th>Source of Variation</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Between Groups</td>
<td>144.11</td>
<td>10</td>
<td>14.41</td>
<td>0.50</td>
<td>0.89</td>
</tr>
<tr>
<td></td>
<td>Within Groups</td>
<td>4231.26</td>
<td>148</td>
<td>28.59</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>4375.37</td>
<td>158</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ENJOYMENT</th>
<th>Source of Variation</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Between Groups</td>
<td>243.01</td>
<td>10</td>
<td>24.30</td>
<td>0.70</td>
<td>0.72</td>
</tr>
<tr>
<td></td>
<td>Within Groups</td>
<td>5118.73</td>
<td>148</td>
<td>34.59</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>5361.74</td>
<td>158</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SELF-CONFIDENCE</th>
<th>Source of Variation</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Between Groups</td>
<td>1293.03</td>
<td>10</td>
<td>129.30</td>
<td>1.83</td>
<td>0.06</td>
</tr>
<tr>
<td></td>
<td>Within Groups</td>
<td>10483.25</td>
<td>148</td>
<td>70.83</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>11776.28</td>
<td>158</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MOTIVATION</th>
<th>Source of Variation</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Between Groups</td>
<td>71.74</td>
<td>10</td>
<td>7.17</td>
<td>0.67</td>
<td>0.76</td>
</tr>
<tr>
<td></td>
<td>Within Groups</td>
<td>1609.33</td>
<td>148</td>
<td>10.87</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>1681.07</td>
<td>158</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Question #5c asked:

To what extent do the attitudinal score changes differ based on age?

Age was self-reported by the students, and they were separated into the following age groups: less than or equal to 20, between 21 and 29, between 30 and 39, and more than 40. The percentage of age distribution is displayed in Table 18.

Four single-factor analyses of variance were calculated for each factor of the ATMI based on age group to examine the changes in attitudinal scores and determine whether there was a significant difference based on age. As shown in Table 19, the ATMI factor of value (p = 0.03) reveals a statistically significant association was found in change scores in the ATMI factor of value among these age groups. Further analysis with a Tukey test indicates that the value change scores are significantly different between the two age groups of “less than or equal to 20” and “40 and above”. The younger students’ age group of “less than or equal to 20” mean was higher than the age group of “40 and above” by 5.11, 95% CI [.704, 9.522]. Which indicates that we are 95% confident the change score for the age group of “less than or equal to 20” will fall within .704 to 9.522 points. No statistically significance difference was found in change scores in these Beginning Algebra students among the ATMI factors of enjoyment, self-confidence, and motivation among these age groups.
Table 18 Age Group Distribution

<table>
<thead>
<tr>
<th>Age Group in Years</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than or equal to 20</td>
<td>103</td>
<td>64.8</td>
</tr>
<tr>
<td>21 – 29</td>
<td>30</td>
<td>18.9</td>
</tr>
<tr>
<td>30 – 39</td>
<td>16</td>
<td>10.1</td>
</tr>
<tr>
<td>40 and above</td>
<td>10</td>
<td>6.3</td>
</tr>
<tr>
<td>Total</td>
<td>159</td>
<td>100.0</td>
</tr>
</tbody>
</table>
Table 19 ANOVA Change Scores per Factor Based on Age

### VALUE

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>247.78</td>
<td>3</td>
<td>82.59</td>
<td>3.10</td>
<td>0.03*</td>
</tr>
<tr>
<td>Within Groups</td>
<td>4127.59</td>
<td>155</td>
<td>26.63</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>4375.37</td>
<td>158</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### ENJOYMENT

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>209.42</td>
<td>3</td>
<td>69.81</td>
<td>2.10</td>
<td>0.10</td>
</tr>
<tr>
<td>Within Groups</td>
<td>5152.32</td>
<td>155</td>
<td>33.24</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>5361.74</td>
<td>158</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### SELF-CONFIDENCE

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>102.23</td>
<td>3</td>
<td>34.08</td>
<td>0.45</td>
<td>2.66</td>
</tr>
<tr>
<td>Within Groups</td>
<td>11674.05</td>
<td>155</td>
<td>75.32</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>11776.28</td>
<td>158</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### MOTIVATION

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>43.68</td>
<td>3</td>
<td>14.56</td>
<td>1.37</td>
<td>0.25</td>
</tr>
<tr>
<td>Within Groups</td>
<td>1637.36</td>
<td>155</td>
<td>10.63</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1681.04</td>
<td>158</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*significant based on p = 0.05
Question #5d asked:

To what extent do the attitudinal score changes differ based on gender?

Gender was self-reported by the students. The gender groupings show more female students than male students (Table 20).

Four single-factor analyses of variance were calculated for each factor of the ATMI based on gender to examine the changes in attitudinal scores and determine whether there was a significant difference based on gender. As shown in Table 21, there was no statistically significant difference in attitudinal score changes of these Beginning Algebra students for any factor of the ATMI based on gender.

Table 20 Gender Distribution

<table>
<thead>
<tr>
<th>Gender</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>102</td>
<td>64.2</td>
</tr>
<tr>
<td>Male</td>
<td>57</td>
<td>35.8</td>
</tr>
<tr>
<td>Total</td>
<td>159</td>
<td>100</td>
</tr>
</tbody>
</table>
Table 21 ANOVA Change Scores per Factor Based on Gender

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>93.86</td>
<td>1</td>
<td>93.86</td>
<td>3.44</td>
<td>0.07</td>
</tr>
<tr>
<td>Within Groups</td>
<td>4281.51</td>
<td>157</td>
<td>27.27</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>4375.37</td>
<td>158</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>60.51</td>
<td>1</td>
<td>60.51</td>
<td>1.79</td>
<td>0.18</td>
</tr>
<tr>
<td>Within Groups</td>
<td>5301.23</td>
<td>157</td>
<td>33.77</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>5361.74</td>
<td>158</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>123.04</td>
<td>1</td>
<td>123.04</td>
<td>1.66</td>
<td>0.20</td>
</tr>
<tr>
<td>Within Groups</td>
<td>11653.24</td>
<td>157</td>
<td>74.22</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>11776.28</td>
<td>158</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>13.28</td>
<td>1</td>
<td>13.28</td>
<td>1.25</td>
<td>0.27</td>
</tr>
<tr>
<td>Within Groups</td>
<td>1667.79</td>
<td>157</td>
<td>10.62</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1681.07</td>
<td>158</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Question #5e asked:

To what extent do the attitudinal score changes differ based on ethnicity?

Ethnicity was self-reported by the students. The ethnicity groupings show more Hispanic students (52.2%) than the other groups (Table 22).

Four single-factor analyses of variance were calculated for each factor of the ATMI based on ethnicity to examine the changes in attitudinal scores and determine whether there was a significant difference based on ethnicity. As shown in Table 23, there was no statistically significant difference in attitudinal score changes of these Beginning Algebra students for any factor of the ATMI based on ethnicity.

Table 22 Ethnicity Distribution

<table>
<thead>
<tr>
<th>Ethnicity</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caucasian</td>
<td>46</td>
<td>28.9</td>
</tr>
<tr>
<td>Hispanic</td>
<td>83</td>
<td>52.2</td>
</tr>
<tr>
<td>African American</td>
<td>22</td>
<td>13.8</td>
</tr>
<tr>
<td>Other</td>
<td>8</td>
<td>5.1</td>
</tr>
<tr>
<td>Total</td>
<td>159</td>
<td>100</td>
</tr>
</tbody>
</table>
Table 23ANOVA Change Scores per Factor Based on Ethnicity

<table>
<thead>
<tr>
<th>VALUE</th>
<th>Source of Variation</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Between Groups</td>
<td>8.74</td>
<td>3</td>
<td>2.91</td>
<td>0.10</td>
<td>0.96</td>
</tr>
<tr>
<td></td>
<td>Within Groups</td>
<td>4366.63</td>
<td>155</td>
<td>28.17</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>4375.37</td>
<td>158</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ENJOYMENT</th>
<th>Source of Variation</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Between Groups</td>
<td>10.21</td>
<td>3</td>
<td>3.40</td>
<td>0.10</td>
<td>0.96</td>
</tr>
<tr>
<td></td>
<td>Within Groups</td>
<td>5351.53</td>
<td>155</td>
<td>34.53</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>5361.74</td>
<td>158</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SELF-CONFIDENCE</th>
<th>Source of Variation</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Between Groups</td>
<td>40.21</td>
<td>3</td>
<td>13.40</td>
<td>0.18</td>
<td>0.91</td>
</tr>
<tr>
<td></td>
<td>Within Groups</td>
<td>11736.07</td>
<td>155</td>
<td>75.72</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>11776.28</td>
<td>158</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MOTIVATION</th>
<th>Source of Variation</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Between Groups</td>
<td>29.21</td>
<td>3</td>
<td>9.74</td>
<td>0.91</td>
<td>0.44</td>
</tr>
<tr>
<td></td>
<td>Within Groups</td>
<td>1651.86</td>
<td>155</td>
<td>10.66</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>1681.07</td>
<td>158</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Summary

This chapter presented the findings of the research study on attitudes toward mathematics in eleven Beginning Algebra classes, focusing on the specific factors of value, enjoyment, self-confidence, and motivation. Descriptive statistics were calculated to determine the students’ initial composite attitudes. Correlations were calculated to determine whether relationships existed between CPT scores and composite attitudinal scores and State Competency Exam scores and composite attitudinal scores. Completers and non-completers were determined by the State Competency Exam scores, and initial composite attitude scores were examined. Attitudinal change scores were determined for completers and examined for statistical significance across class sections, age, gender, and ethnicity.

The average initial composite attitudinal scores were above the mean of 120 and may indicate that many students had a positive attitude toward mathematics going into the course. No statistical significance was determined across class sections with regard to initial composite attitudinal scores. No significant relationship was found between CPT scores and initial composite attitudinal scores. A significant relationship was found between State Competency Exam scores and initial composite attitudinal scores. An examination of the initial attitude scores for completers and non-completers revealed no significant differences. When examining an association between change scores of completers and the factors of the ATMI among age groups, a statistically significant association was found in change scores in the ATMI factor of value among the age groups of “less than or equal to 20” and “40 and above”. All others change scores for the factors of enjoyment, self-confidence, and motivation in the age groups were found to be
non-significant. Further examination of change scores for the factors of the ATMI with gender and ethnicity were found to be non-significant.
CHAPTER 5: SUMMARY, CONCLUSIONS, IMPLICATIONS, AND RECOMMENDATIONS

This chapter contains four sections. The first section is a summary of the study, including the purpose and statement of the problem. The second section contains the summary of the findings. This section is organized according to the research questions. The third section contains the discussion, conclusions, and implications of the findings. The fourth section discusses recommendations for future study.

Summary of the Study

The purpose of this study was to examine students’ attitudes toward mathematics and outcomes of Beginning Algebra students at Valencia Community College, Osceola Campus. This study focused on the following attitudinal factors of the ATMI: value, enjoyment, self-confidence, and motivation. Quantitative measures were used to explore the attitudes of these students. Initial composite attitude scores were determined, and descriptive statistics and percentages were provided for each factor. The initial composite scores for each class section were examined to determine whether there were differences between class sections. The study also examined whether there was a relationship between the students’ initial composite attitude scores, their CPT scores, and their State Competency Exam scores. The study further examined completers’ and non-completers’ initial attitude scores. Descriptive statistics were determined for each factor of the ATMI for completers and non-completers. A t-test was completed to determine whether there was a difference between completers and non-completers initial attitude. The composite
attitude scores for each of the ATMI factors for completers and non-completers were examined to determine whether there were differences across class sections. A change score was calculated by subtracting the initial attitude scores and end-of-semester attitude scores for each factor of the ATMI. Descriptive statistics were determined for each factor of the ATMI for the change scores. The change scores were analyzed to determine whether there were differences across class sections, age, gender, and ethnicity.

The population of this study consisted of day students enrolled in a Beginning Algebra course at the Osceola Campus of VCC. Community colleges offer two remedial mathematics courses: Pre-Algebra, the first remedial mathematics course, and Beginning Algebra, the second remedial mathematics course. Eleven traditional class sections were chosen for the study. These class sections were not hybrid, online, or computer-aided. Each class met twice per week for 1 hour and 50 minutes. The study began with a sample size of 217 students. The final sample size (n = 159) consisted of students who participated in both the end-of-semester ATMI survey and who passed the State Competency Exam. Non-completers (n = 58) consisted of withdrawals and those who failed to score above 24 on the State Competency Exam.

Students’ attitudes were measured using the ATMI (Tapia, 1996). The ATMI contains 40 items (Appendix A) with 10 items addressing value, 10 items addressing enjoyment, 15 items addressing self-confidence, and 5 items addressing motivation. Students were asked to indicate their agreement with each statement using a Likert scale, with 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree. Twenty-nine items are positively arranged, for instance, Mathematics is a very worthwhile and necessary subject. Conversely, 11 items are negatively arranged, for
instance, *Mathematics makes me feel uncomfortable*. For these items, the scale is reversed: 5 = strongly disagree, 4 = disagree, 3 = neutral, 2 = agree, and 1 = strongly agree. The composite attitude score is the sum of these ratings; therefore, a higher score implies a more positive attitude. Total composite attitude scores can range from 40 – 200.

Because the ATMI contains unequal attitudinal components for each factor, an average score was found for each factor to make comparisons. Descriptive statistics were computed for participants’ composite attitude scores, their scores on each of the four attitudinal factors, and each individual survey item.

The study collected the attitude scores twice during the semester. In stage one, the students were asked to complete the ATMI in the first week of the semester. In stage two, the students were asked to complete the ATMI again in the 12th week of the semester. The second assessment of attitude was used to calculate the students’ change scores.

There were five different instructors who participated. Four were adjunct professors and one was a full time staff member at the Osceola Campus. The instructors have Master’s degrees in the following fields: Computer Programming, Mathematics Education, Instructional Technology, or Mathematics.

**Summary of Research Questions Results**

*Question #1: Initial Attitudes Toward Mathematics*

Question #1 asked:

1a. What are the initial attitudes of community college students entering a Beginning Algebra course as indicated by the four attitudinal components of the ATMI: value of mathematics, enjoyment of mathematics, motivation for mathematics, and self-confidence with mathematics?
1b. To what extent are the initial attitudinal scores different across class sections?

Table 4 and Appendix C show the descriptive statistics and percentages, respectively, that were calculated for each factor of the ATMI. Composite initial attitude scores for each factor of the ATMI are displayed in Table 5. The mean composite initial attitude score for these students is 3.26 on the 5-point scale. The composite initial attitude could range from -160 to 160, with 120 neutral. The students’ composite initial attitude scores ranged from 59 to 200, with 59.9% having composite initial attitude scores above 120. This shows that more than 50% of the students began the semester with an overall positive attitude toward mathematics. The average initial survey scores were highest for value of mathematics with a mean score of 3.88. The composite initial attitude score for value could range from 10 to 50, with 30 being neutral. The students’ composite initial attitude scores for value ranged from 15 to 50, with 87.6% having composite initial attitude scores above 30. This shows that almost 90% of the students began the semester valuing mathematics. Enjoyment and self-confidence were slightly above neutral with mean scores of 3.04 and 3.13 respectively. The composite initial attitude score for enjoyment could range from 10 to 50, with 30 being neutral. The students’ composite initial attitude scores for enjoyment ranged from 10 to 50, with 48.4% having composite initial attitude score above 30. This shows that less than half of the students began the semester enjoying mathematics. The composite initial attitude score for self-confidence could range from 15 to 75, with 45 being neutral. The students’ composite initial attitude scores for self-confidence ranged from 15 to 75, with 54.4% having composite initial attitude scores for self-confidence above 45. This shows that over half of the students began the semester with self-confidence toward mathematics. The lowest initial
composite attitude scores were for motivation, with mean score of 2.87. The composite initial attitude score for motivation could range from 5 to 25, with 15 being neutral. The students’ composite initial attitude scores for motivation ranged from 5 to 25, with 40.6% having composite initial attitude score above 15. This shows that fewer than 50% of the students began the semester with motivation towards mathematics, as measured by the ATMI. It appears that in the beginning of the semester, more than 50% of the students in these 11 class sections indicated that they valued and felt confident about mathematics, but less than 50% enjoyed and were motivated toward the study of mathematics.

Table 4 lists the descriptive statistics for each individual survey item and Appendix C shows the percentage per item of the ATMI. The highest scoring item for value was also the highest scoring item for the entire survey: I want to develop my mathematical skills with a mean rating of 4.29 and 87.6% of these students indicating they agree or strongly agree with this statement. The lowest scoring item for value was I think studying advanced mathematics is useful, with a mean rating of 3.26 and 41.4% of these students indicating they agree or strongly agree with this statement. Nine out of the 10 value items had more than 50% of the students agreeing or strongly agreeing with the item.

In the enjoyment factor, the highest scoring item, I get a great deal of satisfaction out of solving a mathematics problem, had a mean of 3.56 with 59% of these students indicating agree or strongly agree. The lowest scoring item for enjoyment was I am happier in a math class than in any other class, with a mean score of 2.46 and a percentage of 18.4 selecting agree or strongly agree and 54.9% selecting disagree or
strongly disagree. Only 2 out of the 10 enjoyment items had more than 50% of the students agreeing or strongly agreeing with the item.

In the self-confidence factor, the highest scoring item, *I am always confused in my mathematics class*, was stated from the negative perspective. This item had a mean score of 3.54 with 61.7% agreeing or strongly agreeing to this statement. The lowest scoring self-confidence item, *Mathematics is one of my most dreaded subjects*, is also stated from the negative perspective. With a mean score of 2.77, 33.7% of these students agreed or strongly agreed with this statement. Five out of the 15 self-confidence items had more than 50% of the students agreeing or strongly agreeing with the item.

In the motivation factor, the highest scoring item, *I am confident that I could learn advanced mathematics*, had a mean of 3.22 and 45.6% of these students agreeing or strongly agreeing with this statement. The lowest scoring item, *I am willing to take more than the required amount of mathematics*, had a mean of 2.46 and 18.5% of these students agreeing or strongly agreeing to this statement. None of the items in the motivation factor had more than 50% of the students agreeing or strongly agreeing with the item.

When examining whether there was a difference in initial composite attitude scores and class sections, no statistically significant difference was found.

**Question #2: Initial Attitudes Toward Mathematics and CPT Scores**

Question #2 asked:

2a. What is the relationship between community college Beginning Algebra students’ initial attitudes toward mathematics and their scores on the CPT?
2b. To what extent is the relationship between attitudes and CPT scores different across class sections?

The relationship between CPT scores and composite initial attitude scores was calculated by completing a Pearson product correlation coefficient. The Pearson product correlation coefficient of .09 (p = .18) indicates a weak positive relationship. Since the p-value is larger than .05, we can conclude that for this sample there is no statistically significant evidence of a relationship between CPT scores and initial composite attitude scores.

To examine the effect of CPT and initial attitude scores across class sections, independent correlations were calculated using Fisher’s Z-transformations for 10 combinations of classes (Table 8). None of the observed z-ratios fell in the desired z-value of ±1.96. Consequently, the correlation between CPT scores and initial composite attitude scores of students taught by different professors was not significantly different. These results indicate no statistically significant difference between CPT scores and composite attitude scores across class sections.

Question #3: Initial Attitudes Toward Mathematics and State Competency Exam

Question #3 asked:

3a. What is the relationship between community college Beginning Algebra students’ initial attitudes toward mathematics and their scores on the State Competency Exam?

3b. To what extent is the relationship between initial attitudes and State Competency Exam scores different across class sections?

The relationship between State Competency Exam scores and composite initial attitude scores was calculated by completing a Pearson product correlation coefficient.
The calculated Pearson product correlation coefficient of .19 indicates a positive relationship, significant at the \( p = .01 \) level. The \( p \)-value was less than .05, implying a statistically significant association between State Competency Exam scores and initial composite attitude scores.

To examine the effect of State Competency Exam and composite attitude scores across class sections, independent correlations were calculated using Fisher’s Z-transformations for 10 combinations of classes (Table 9). For each of the 10 combinations, all observed \( z \)-ratios were between the \( z \)-value of ±1.96. Consequently, the correlation between State Competency Exam scores and initial composite attitudinal scores of students taught by different professors was not significantly different. These results indicate that there was no significant evidence of a difference between State Competency Exam scores and composite attitude scores across class sections.

Question #4: Difference between completers’ and non-completers’ initial attitudinal scores on each factor of the ATMI

Question #4 asked:

4a. What is the difference between completers’ and non-completers’ initial attitudinal scores on each factor of the ATMI: value of mathematics, enjoyment of mathematics, motivation for mathematics, and self-confidence?

4b. To what extent is the difference between completers and non-completers different across class sections?

Completers and non-completers were determined by the State Competency Exam scores. Table 10 displays the descriptive statistics of composite initial attitude and composite attitude for each factor of the ATMI of completers and non-completers. The
completers’ composite initial attitude and attitude for each factor are higher than the non-completers.

Individual questions were identified (Table 11) for completers with the highest and lowest means for each factor of the ATMI and compared to non-completers’ responses. The questions answered by the completers with the highest means were the following: I want to develop my mathematical skills (Value); I get a great deal of satisfaction out of solving a mathematics problem (Enjoyment); I am always confused in my mathematics class (Self-Confidence); and I am confident that I could learn advanced mathematics (Motivation). The questions answered by completers with the lowest means were the following: I think studying advanced mathematics is useful (Value); I am happier in a math class than any other class (Enjoyment); Mathematics is one of my most dreaded subjects (Self-Confidence); I am willing to take more than the required amount of mathematics (Motivation). All responses by non-completers were also the highest and lowest means for all questions identified with highest and lowest means of completers. That is to say, both completers and non-completers had the same questions with the highest and lowest means. A significant difference was found between completers and non-completers composite initial attitude and composite enjoyment attitude scores (Table 12).

When examining whether there was a difference in completers and non-completers across class sections, no significant difference was found between completers and non-completers for the factors of value, self-confidence, and motivation for the ATMI (Table 13). A significant difference was found for the ATMI factor of enjoyment of completers and non-completers. Further analysis using a Tukey test showed that the
completers were significantly different than non-completers in the factor of enjoyment of mathematics, but there was no evidence that this difference varied across class sections.

**Question #5: Change Scores Across Class Sections, Age, Gender, and Ethnicity**

Question #5 asked:

5a. To what extent do the four attitudinal components of the ATMI—value of mathematics, enjoyment of mathematics, motivation for mathematics, and self-confidence—change during the developmental mathematics course?

5b. To what extent do the attitudinal score changes differ across class sections?

5c. To what extent do the attitudinal score changes differ based on age?

5d. To what extent do the attitudinal score changes differ based on gender?

5e. To what extent do the attitudinal score changes differ based on ethnicity?

The change scores were determined by subtracting the end-of-semester composite attitude scores from the initial composite attitude scores. The resulting sample was determined by those students who completed the post-survey (n = 159). Descriptive statistics were calculated (Table 15) for the composite change score and for each factor of the ATMI. The mean composite change score was 3.33, and the only factor with a negative change score was value.

The composite change scores for these Beginning Algebra students ranged from -70 to 39, with a change score of zero representing no change in attitude. Ninety-four of 159 of the students, 59.1%, had a positive change in attitudinal score. Sixty-five of 159 of the students, 40.9%, had a negative change in attitudinal score.

A t-test was conducted using the difference between initial composite attitude survey scores and end-of-semester composite attitude scores to determine if there was a
significant change in attitudes over the course of the semester for each factor. An alpha level of .05 was used to determine whether the results were significant. The t-test revealed a statistically significant difference between the initial attitude and end-of-semester composite attitudinal scores (p = .0149) indicating an attitude change over the semester (Table 15).

Four single-factor analyses of variance were calculated for each factor of the ATMI based on class sections to examine the changes in attitudinal scores and determine whether there was a significant difference based on class sections. There was no statistically significant difference in attitudinal score changes of Beginning Algebra students for each factor of the ATMI across class sections (Table 17).

Four single-factor analyses of variance were calculated for each factor of the ATMI based on age group to examine the changes in attitudinal scores and determine whether there was a significant difference based on age. A statistically significant difference was found in change scores for the factor of value among these age groups. Further analysis using a Tukey test found the value change scores are significantly different between the two age groups of less “than or equal to 20” and “40 and above.” The younger students’ age group of “less than or equal to 20” mean was higher than the age group of “40 and above” by 5.11, 95% CI [0.704, 9.522]. No statistically significant difference was found in change scores in these Beginning Algebra students among the ATMI factors of enjoyment, self-confidence, and motivation among these age groups.

Four single-factor analyses of variance (Table 21) were calculated for each factor of the ATMI based on gender to examine the changes in attitudinal scores and determine whether there was a significant difference based on gender. As shown in Table 21, there
was no statistically significant difference in attitudinal score changes of these Beginning Algebra students for any factor of the ATMI based on gender.

Four single-factor analyses of variance (Table 23) were calculated for each factor of the ATMI based on ethnicity to examine the changes in attitudinal scores and determine whether there was a significant difference based on ethnicity. No statistically significant difference was found in attitudinal score changes of these Beginning Algebra students for any factor of the ATMI based on ethnicity.

Discussion and Limitations of the Study

Question #1: Initial Attitudes Toward Mathematics

Question #1 asked:

1a. What are the initial attitudes of community college students entering a Beginning Algebra course as indicated by the four attitudinal components of the ATMI: value of mathematics, enjoyment of mathematics, self-confidence with mathematics, and motivation for mathematics?

1b. To what extent are the initial attitudinal scores different across class sections?

One recent study that is similar to this current study was completed by Schackow in 2005 at the University of South Florida. Schackow (2005) studied the initial attitude scores and attitude change scores of pre-graduate elementary school teachers with the ATMI. The descriptive statistics calculated for each survey question were similar to the current study completed in 2011.

Schackow (2005) examined the initial and attitude change scores of pre-graduate elementary school teachers enrolled in an introductory mathematics methods course. She calculated descriptive statistics for the initial attitudes and each factor of the ATMI. The
The current research study also found value to have the highest mean and motivation to have the lowest mean. It is interesting that both populations had value of mathematics as their highest scoring factor and both populations had the lowest scoring factor for motivation in mathematics, since the population in the Schackow study was pre-graduate elementary school teachers while the population in the current study consisted of developmental mathematics students at a community college. Although neither of these studies will allow generalization to the entire population of students, it is interesting to find that these two diverse populations have a positive attitude toward the value of mathematics and a low attitude toward the motivation of mathematics.

In the current study when examining the results of the value factor of the ATMI, the highest scoring item for value was I want to develop my mathematical skills. Eighty-seven percent of the Beginning Algebra students either agreed or strongly agreed with this statement. The second highest item for value, Mathematics helps develop the mind and teaches a person to think, had 84.4% of the students agreeing or strongly agreeing with this item. The lowest scoring item for the value section of the survey I think studying advanced mathematics is useful with forty-one percent of the Beginning Algebra students agreeing or strongly agreeing with this item. Nine out of the 10 value items have 50% or more students agreeing or strongly agreeing to the value statements. This shows that many freshmen in this current study value mathematics, feel that studying advanced mathematics is useful to them, and have a desire to improve their mathematical skills. One might conclude from the results from these questions that students understand the need to improve their mathematics skills and want to do so, but have little desire to go
beyond the minimum and would apparently not see the need for taking advanced math courses. These findings confirm the experience of the researcher, an advanced mathematics teacher, that students know they need to have mathematics in their programs, but want to take the minimum number of math courses in the process.

In comparing the results of the current research in the value section of the ATMI with Schackow’s results, the students in both studies had the same lowest scoring item, *I think studying advanced mathematics is useful.* It is interesting that both populations had the same lowest scoring item, since Schackow’s population consisted of university students and the current student population consisted developmental mathematics students.

In reviewing the results of the enjoyment section of the ATMI, the highest scoring item was, *I get a great deal of satisfaction out of solving a mathematics problem,* with which 59% of the students agreed or strongly agreed. The second highest scoring item, a surprising 40.6%, of the students indicated they strongly agreed with the statement, *I am comfortable expressing my own ideas on how to look for solutions to a difficult problem in math.* This indicates that a significant number of students do experience enjoyment in solving mathematics problems and looking for solutions to solve difficult math problems. The lowest scoring item for the enjoyment sections was, *I am happier in a math class than in any other class* with which only 18.4% of the students agreed or strongly agreed and 54.9% disagreed or strongly disagreed. When the combined disagree students (54.9%) are combined with those who indicated a neutral perspective (26.7%), it appears that the vast majority of students in this sample would not anticipate experiencing a great deal of happiness in taking mathematics classes, compared to other classes they might
take. Also, only two out of the 10 items in the enjoyment section had 50% or more of the students agreeing or strongly agreeing to the statements. So, the Beginning Algebra students in the current study seem to enjoy solving mathematics problems, but do not enjoy doing so in math classes.

In comparing the results of the current research in the enjoyment section of the survey with those of Schackow, the students in both studies had the same highest scoring item, *I get a great deal of satisfaction out of solving mathematics problems*, and the same lowest scoring item, *I am happier in a math class than in any other class*. Some studies have found that as students progress from elementary school through middle school and enter high school; their level of enjoyment of mathematics decreases drastically (McLeod, 1992; Middleton & Spanias, 1999). One might ask why students appear to enjoy solving mathematics problems, but do not particularly enjoy being in a math class.

In the self-confidence sections of the survey, the highest scoring item was, *I am always confused in my mathematics classes*, with which 61.7% of the Beginning Algebra students agreed or strongly agreed. The second highest scoring item, *It makes me nervous to even think about having to do a mathematics problem*, had 57.7% agreeing or strongly agreeing. Both of these statements are from the negative perspective. With such a high percentage of respondents agreeing or strongly agreeing with these statements, it raises the question of why the students feel confused and nervous in math classes. The lowest scoring item in this section of the survey was, *Mathematics is one of my most dreaded subjects*, with which 33.7% either agreed or strongly agreed and 45.6% either disagreed or strongly disagreed. Several students asked the survey administrator to define the word “dreaded.” This may indicate that the terminology used in the survey needs to be
submitted to a reading difficulty analysis for future use. The results from these questions indicate that although a significant number of students feel confused in math classes, about one-third of them feel dread toward mathematics. With one-third of the students entering the class with a feeling of “dread” for the subject, it begs the question, “How and where are negative feelings toward mathematics developed?” In an earlier study, it was found that children enter school eager to learn mathematics; they see mathematics as a “meaningful, interesting and a worthwhile subject” (Curtis, 2006, p. 12). The researcher of the current study questions why college students dread mathematics and when these feelings begin to develop.

The item with the highest scoring percent in motivation is, *I would like to avoid using mathematics in college*, with 46.5% selecting agree or strongly agree. This item was stated from the negative perspective and many students still agree or strongly agree with this item. The second highest item in the motivation section was, *I am confident that I could learn advanced mathematics*, with which 45.6% either agreed or strongly agreed and only 23.6% either disagreed or strongly disagreed. A significant number of students in these mathematics classes feel confident that they can learn advanced math, but want to avoid using mathematics in college.

The lowest scoring item for the motivation section was, *I am willing to take more than the required amount of mathematics*, with which only 18.5% either agreed or strongly agreed and 54.3% either disagreed or strongly disagreed. It is evident that many of these students feel confident that they could learn advanced mathematics, but do not want to take more than the required number of mathematics classes necessary to graduate. It is interesting to note that 74 of the original 217 students had CPT scores low
enough to mandate them to take the previous mathematics class (Pre-Algebra MAT 0012). So 34.1% of these students had possibly taken a mathematics course prior to this Beginning Algebra course. It should also be noted that these students are not receiving mathematics credit for these courses, only elective credit toward their A.S. or A.A. degree.

When examining the composite attitude score results for the ATMI to determine whether there was a difference across the 11 class sections in this study, it is interesting to note that no significant differences were found. This would seem to indicate that the students in this study entering the Beginning Algebra course in fall 2010 began the course with similar initial attitudes about mathematics. Past research has shown that by the time they reach college, students have generally formed stable attributions regarding their successes in mathematics (Middleton & Spanias, 1999). It is interesting to note that these students seem to have similar initial attitudes about mathematics and the mean composite initial attitude (3.26) was above neutral, indicating that, on average, these Beginning Algebra students began the semester with generally positive attitude.

Some researchers suggest a strong relationship between attitude toward mathematics, achievement, and participation by students in mathematics. Students with good attitudes about learning mathematics will be more likely to understand the concepts, which will help them develop confidence in their ability to work mathematical operations (Furner & Berman, 2003; Shashaani, 1995).
Question #2: Initial Attitudes Toward Mathematics and CPT Scores

Question #2 asked:

2a. What is the relationship between community college Beginning Algebra students’ initial attitudes toward mathematics and their scores on the CPT?

2b. To what extent is the relationship between attitudes and CPT scores different across class sections?

No statistical significance was found between the community college Beginning Algebra students’ initial attitudes toward mathematics and their scores on the CPT for all 11 class sections of the course surveyed.

Students apparently are not prepared for college as stated in the 2006 National Center for Education Statistics report, which indicated that in the United States 15-year-olds scored well below average in mathematics literacy and problem solving, and were ranked 24th among 29 developed countries (National Center for Education Statistics, 2006b). Greene and Winters (2005) stated that only 50% of graduating high school students will be academically prepared for college-level courses. Because there was no statistical relationship found between CPT scores and students’ attitudes toward mathematics in the current study, it would seem to indicate that student performance on the CPT exam was influenced by factors other than the students’ attitudes toward mathematics.

Question #3: Initial Attitudes Toward Mathematics and State Competency Exam

Question #3 asked:

3a. What is the relationship between community college Beginning Algebra students’ initial attitudes toward mathematics and their scores on the State Competency Exam?
3b. To what extent is the relationship between initial attitudes and State Competency Exam scores different across class sections?

A statistically significant Pearson product coefficient of .19 (p = .01) indicated a positive relationship between initial composite attitude scores and the State Competency Exam scores. However, the low to moderate correlation does not provide strong evidence of a relationship between the students’ initial attitudes toward mathematics and their achievement on the State Competency Exam. In addition, no statistical difference was found between State Competency Exam scores and initial composite attitudinal scores of students taught by different professors or across the 11 different sections of the course. This seems a bit surprising since there are inevitable differences in the way professors teach their classes. Yet, no difference was found between the State Competency Exam scores and initial composite attitude scores, regardless of class section or professor.

**Question #4: Difference Between completers’ and non-completers’ initial attitudinal scores on each factor of the ATMI**

Question#4 asked:

4a. What is the difference between completers’ and non-completers’ initial attitudinal scores on each factor of the ATMI: value of mathematics, enjoyment of mathematics, motivation for mathematics, and self-confidence?

4b. To what extent is the difference between completers and non-completers different across class sections?

Scores on the State Competency Exam determine whether students complete the Beginning Algebra course. Students were separated into completers and non-completers to examine whether there was a difference of initial attitude scores on each factor of the
ATMI: value of mathematics, enjoyment of mathematics, motivation for mathematics, and self-confidence. Multiple t-tests were calculated to determine significant differences between completers’ and non-completers’ initial composite attitude scores and initial composite attitude scores on each factor of the ATMI.

The descriptive statistics show the completers’ initial composite score of 132.27 is higher than the non-completers’ initial composite score of 123.69 indicating, as a group, a more positive overall attitude for completers. This gives some support to previous research that found a relationship between attitude toward mathematics and performance in math classes. The t-test results found a significant difference in completers’ and non-completers’ initial attitude score. A significant difference was also found between completers and non-completers in the enjoyment and self-confidence factors of the ATMI.

Some research indicates students’ attitudes toward mathematics have a direct influence on achievement (Aiken, 1972; Braswell, Lutkus, Grigg, Santapau, Tay-Lim & Johnson, 2001; DeCorte & Op’tEynde, 2003; Gallagher & De Lisi, 1994; Ma & Kishor, 1997; Neale, 1969; Shashaani, 1995; Singh, Granville, & Dika, 2002; Thorndike-Christ, 1991). Furthermore, Aiken (1972) found “the correlation between attitudes and achievement is frequently higher for mathematics than for school subjects with more verbal content” (p. 231). The current study gives some support to previous studies that have found significant relationships between attitudes toward mathematics and achievement in math classes.

It may be useful for professors to administer the ATMI in the beginning of the semester to measure the strength of the students’ attitudes toward mathematics, identify
those students with the most negative attitudes, and provide an affective component to the course that incorporates building a more positive attitude. For example, it may be reassuring to students in similar developmental classes if they are told that a high percentage of similar students seem to enjoy solving math problems, but are not particularly happy doing so math courses. The professor may have a brief discussion about how negative attitudes affect performance and provide methods for success in the math class. Some methods that have been successful in improving students’ attitudes toward mathematics are cooperative learning, discussion, and use of the graphing calculator (Curtis, 2006).

A significant difference was also found between completers and non-completers in the enjoyment and self-confidence factor. The completers’ composite attitude for enjoyment was higher than the non-completers’. This may indicate that those who enjoy mathematics will have greater success in their mathematics courses. Several researchers have found that as students enter middle and high school their level of enjoyment of mathematics drastically decreases (McLeod, 1992; Middleton & Spanias, 1999). It seems prudent to examine the individual factors of the ATMI and identify students’ enjoyment factor. Professors could incorporate strategies to make mathematics more enjoyable for students. For instance, students may enjoy mathematics more if their self-confidence was improved. Utilizing strategies in the classroom to improve the self-confidence of students may be as simple as allowing students small increments of success solving mathematics problems. Other strategies that have shown to improve students’ self-confidence are journal writing (Schackow, 2009) and use of mathematics computer software (Brocato, 2009).
The results of this study indicate that initial attitudes toward mathematics, as measured by the ATMI, may have had some modest influence on whether students passed the State Competency Exam; however, the strength of this relationship is not sufficient to use to identify students who will pass the course. When examining each factor of the ATMI, completers’ mean scores per factor are greater than the mean scores for non-completers. This indicates that the students with higher mean scores in the factors of value, enjoyment, self-confidence, and motivation had greater success in completing their mathematics course. However, there is a significant difference between completers and non-completers in the factors of enjoyment and self-confidence. Thorndike-Christ (1991) investigated the relationship of attitudes toward mathematics to mathematics performance, gender, and mathematics course-taking plans and career interests and found that attitude toward mathematics could predict the final grade in a mathematics course. The current research was not as conclusive, finding a low to moderate level of correlation of composite attitude scores and final grades. This study did find a difference between completers and non-completers in the factors of enjoyment and self-confidence.

When examining the initial attitude scores and individual questions of the ATMI, completers and non-completers have the highest mean scores for the items, *I want to develop my mathematical skills* (Value); *I get a great deal of satisfaction out of solving a mathematics problem* (Enjoyment); *I am always confused in my mathematics class* (Self-Confidence); and *I am confident that I could learn advanced mathematics* (Motivation). Of the students in these Beginning Algebra courses, 87.6% have a strong desire to develop their mathematics skills. This may be due to the fact that these students are in the second lowest mathematics class offered by Valencia Community College and
understand that they must complete at least two more mathematics courses before they are eligible to graduate. As a group, these Beginning Algebra students have a desire to develop their math skills, enjoy solving math problems, and feel confident that they can learn advanced mathematics, but are not interested in taking more than the minimum number of math classes and indicate they are confused in math class.

Both groups, completers and non-completers, had the lowest mean score for the items, *I think studying advanced mathematics is useful (Value); Mathematics is one of my most dreaded subjects (Self-Confidence); I am willing to take more than the required amount of mathematics (Motivation)*. The group, as a whole, indicates that advanced mathematics is useful, although they dread the subject, and are not willing to take more than the required number of math courses.

The lowest scoring item in the enjoyment section was different between completers and non-completers. Completers’ lowest scoring item was, *I am happier in a math class than in any other class (Enjoyment)*. The non-completers’ lowest scoring item was, *I really like mathematics (Enjoyment)*. It appears that the completers feel more comfortable in other classes than math and the non-completers do not like mathematics.

In conclusion, completers and non-completers have the same highest scoring items for value, enjoyment, self-confidence, and motivation. These scores indicate a common desire between the completers and non-completers for developing their math skills, getting satisfaction from solving math problems, being confident they could learn advanced math, and feeling confused in their math classes. The lowest scoring items were the same for completers and non-completers in the sections of value, self-confidence, and motivation. As a whole, the Beginning Algebra students do not want to study advanced
mathematics, dread math, and are not willing to take more than the required amount of
math courses. The completers and non-completers are different with regards to the lowest
scoring item in the enjoyment section of the ATMI. The completers would rather not be
in a math class, and the non-completers do not enjoy mathematics. This supports the
results of the findings of this current research that completers and non-completers are
different in the enjoyment and self-confidence factors of the ATMI. The issue of why
students do not want to be in math classes and do not enjoy mathematics would seem to
warrant additional research. Why do so many students think advanced math is not useful
and why do they dread math? How, as mathematics teachers, can we share our passion
for mathematics so as to ignite a spark of the same excitement and appreciation of
mathematics in our students?

Because it was already shown in Question #1b that there was no statistically
significant difference across class sections and the unanticipated large number of class
sections, it was determined feasible to analyze the data grouped by professor. To
determine whether there was a difference between completers and non-completers per
professor for the initial attitude per factor of the ATMI, multiple analyses of variance
were calculated and no significant differences were found between completers and non-
non-completers initial attitude for the factors of value, self-confidence, and motivation on the
ATMI per professor.

The ATMI section on enjoyment shows a significant difference in the main effect
of completers’ and non-completers’ initial attitude per professor. A Tukey test shows the
that the initial attitude of completers was significantly different than the initial attitude of
non-completers per professor in the factor of enjoyment of mathematics. This result
indicates that different professors do not influence completers and non-completers in their views of mathematics when examined according to value, self-confidence, and motivation. As previously discussed, the t-test results revealed a significant difference between completers’ and non-completers’ initial composite attitude scores in the enjoyment factor of the ATMI. These results from the Tukey test support the previous conclusion, but also identify that there is a difference by professor for completers and non-completers in the factor of enjoyment. It seems that completers and non-completers have a different view of enjoyment of mathematics and that the professor is an influence on this factor. It appears to warrant some further research to determine what some professors did to make their math classes more enjoyable.

Question #5: Change Scores Across Classes, Age, Gender, and Ethnicity

Question #5 asked:

5a. To what extent do the four attitudinal components of the ATMI—value of mathematics, enjoyment of mathematics, motivation for mathematics, and self-confidence—change during the developmental mathematics course?

5b. To what extent do the attitudinal score changes differ across class sections.

5c. To what extent do the attitudinal score changes differ based on age?

5d. To what extent do the attitudinal score changes differ based on gender?

5e. To what extent do the attitudinal score changes differ based on ethnicity?

A t-test was performed to determine if the mean change scores were significantly different for the composite change score and each factor of the ATMI. The students’ change score was determined by subtracting their initial attitude score from their end-of-semester attitude score. Change scores could range from -160 to 160, indicating a
negative or positive change in attitude. The mean composite change score was 3.33 and was found to be a statistically significant positive change in attitude. This indicated that the students’ attitudes had a significant positive change over the course of the semester. The composite change scores for the current study ranged from -70 to 39, with ninety-seven of the 158 students, or 61.4%, showing positive change scores.

The findings also reveal positive change scores for enjoyment, self-confidence, and motivation, although statistically significant differences in change scores were found for enjoyment and self-confidence. These findings indicate that the students as a group had a significant positive attitude change for the factors of enjoyment and self-confidence in mathematics. The factor of value was the area in which there was a negative change score; however that change was not significant. It is interesting to note that the value factor began with the highest mean. Also, the significant difference in change scores of the students in the enjoyment and self-confidence factor coincides with the results previously found indicating a significant difference between completers’ and non-completers’ composite attitude scores for the factors of enjoyment and self-confidence.

It seems prudent for professors of mathematics to examine how to improve students’ value, enjoyment, and self-confidence in mathematics. Some suggested teaching methods found to improve students’ enjoyment and self-confidence are journal writing, teaching concepts in more than one way (Schackow, 2005), cooperative learning, problem solving, discourse, and use of graphing calculators (Curtis, 2006).

Four single-factor analyses of variance were calculated for each factor of the ATMI across each class section to determine whether there was a significant difference in the change scores across class sections. No statistical difference in attitude change scores
was found across class sections. It was shown that the students’ overall attitude change score was not significant which indicates the changes were generalized across class sections and different professors. Even though there was an attitude change over the course of the semester, it appears to be the result of factors other than the professor.

In this study, the students in general had a positive composite change score but it was not a significant positive change score. It has been found in a past research study that journal writing had a significant positive influence on attitude change (Schackow, 2005, p. 261). Perhaps, if professors of the students in this study had incorporated journal writing, the positive attitude change may have been significant.

Four single-factor analyses of variance were calculated for each factor of the ATMI based on age group to examine the changes in attitudinal scores and determine whether there was a significant difference based on age. No statistically significant difference was found in change scores in these Beginning Algebra students among the ATMI factors of enjoyment, self-confidence, and motivation among these age groups. This may indicate that with the students in these Beginning Algebra classes, age does not influence their views of mathematics regarding enjoyment, self-confidence, and motivation during the semester. A statistically significant association was found in change scores in the ATMI factor of value among these age groups. Further analysis with a Tukey test indicated that the value change scores are significantly different between the two age groups of “less than or equal to 20” and “40 and above”. The younger students’ age group of “less than or equal to 20” mean was higher than the age group of “40 and above” by 5.11, 95% CI [.704, 9.522]. This indicates that we are 95% confident the change score for the age group of “less than or equal to 20” will fall within .704 to 9.522
points. It may be prudent for professors to be aware that value of mathematics is significantly different between the younger and older students.

Four single-factor analyses of variance were calculated for each factor of the ATMI to determine whether there was a significant difference in change score by gender. No statistically significant difference in attitude change score was found for any factor of the ATMI based on gender. It appears that the attitude changes were distributed equally across male and female students in this study. It is encouraging to note that whatever instructional activities were taking place in the classrooms, male and female students showed increased attitude changes toward mathematics.

Four single-factor analyses of variance were calculated for each factor of the ATMI to determine whether there was a significant difference in change score by ethnicity. No statistical significant difference was found in attitudinal score changes of these Beginning Algebra students for any factor of the ATMI based on ethnicity. It appears that attitude changes were distributed equally across the ethnic groups. It is encouraging to note that ethnicity does not influence attitude change toward mathematics. It appears that participating in a mathematics class does not influence any change in attitude among the different ethnicities.

Themes Across Research Findings

In reviewing themes across the research findings, it is interesting to note that the only significant difference found across class sections was with completers and non-completers initial composite attitude and the factor of enjoyment. No other significant differences were found across class sections for any other research question with initial composite attitude, CPT Scores, State Competency Exam Scores, completers’ and non-
completers’ initial attitude scores, and change scores. Apparently, completers and non-completers view the enjoyment of mathematics differently.

As a whole, the initial composite attitude score (3.26) was slightly above neutral. This indicates that on average the students’ initial composite attitude was just above the neutral position, with 125 students out of the original 217 scoring above neutral. It is interesting to note that the highest initial composite attitude was for the factor of value, the second highest was self-confidence, then enjoyment and last was motivation. When examining the percentage of responses per factor, sixteen of the 40 items on the survey had 50% or more of the students responding that they agree or strongly agree to the item. Most of the items, nine out of 10 were in the value factor while two out of 10 were in the enjoyment factor, and four out of 15 were in the self-confidence factor. None of the items, with 50% or more responding agree or strongly agree, were in the motivation factor of the ATMI.

In the beginning of the semester, most of these Beginning Algebra students valued mathematics and felt self-confident regarding mathematics, but felt less enjoyment toward mathematics. It is interesting to note that the factor of value had the most responses above 50% agreeing or strongly agreeing and that value had the highest mean score for composite initial attitude. Motivation had the lowest mean score and no responses in the motivation factor had more than 50% in which students agreed or strongly agreed to any item in the motivation factor.

It was interesting to discover that completers have a more positive overall initial attitude score than non-completers on all factors of the ATMI. A total of 153 students completed the course with 64 students not completing the course. A significant difference
was found between completers and non-completers on their initial composite attitude scores. It was also found that for the factors of enjoyment and self-confidence initial attitude scores for completers and non-completers were significantly different. This provides some support to previous research that a more positive attitude could influence success.

The t-test on the change scores revealed a statistically significant difference between the initial composite attitude score, and the factors of enjoyment and self-confidence. No statistical difference was found in attitude change scores with gender or ethnicity with regards to value, enjoyment, self-confidence, and motivation. There was a statistical difference found in attitude change score with age among the two age groups of “less than or equal to 20” and “40 or more” in the factor of value. No statistical significance was found in attitude change score with age and the remaining factors of enjoyment, self-confidence, and motivation. Mathematics teachers may be interested in the results of the change scores because the factor of value had a negative change score and the factor of value was found to be significant between the two age groups of younger and older students.

Limitations of the Study

The scope of this study was limited to the study of students in a developmental mathematics course. The study focused on students attending one campus of a central Florida community college. The conclusions from this study may not necessarily be generalized to all students in remedial mathematics courses in Florida community colleges.
The sample was limited to students attending developmental mathematics classes before 3 pm. Students attending late afternoon, evening, or weekend classes may provide different results.

Additionally, the sample size of 159 presents the study with limitations. The sample represents students from a very specific campus of central Florida. The campus has a population of between 10,000 to 12,000 students, and this small sample may not be a good representation of the student population.

The timing of the administration of the survey could greatly influence the results. In the beginning of the semester, students’ attitudes toward mathematics could be inflated because they may feel that they completely understand the material. The material in mathematics in the beginning of the semester tends to be review. Therefore it should be rather easy for the students. As the semester continues, the subject matter gets more difficult and the students may become frustrated. Administering the survey in the 12th week, when a difficult topic may be presented may affect the students’ attitudes in a negative way. On the other hand, the students could have just received the results of a test on which they did particularly well. Another limitation is the truthfulness of student responses to the ATMI.

Implications and Recommendations for Mathematics Professors

Although the results of this study did not find a statistical difference between class sections and initial attitude scores of these Beginning Algebra students, this study may support the previous research findings that a positive attitude can influence success. The completers’ initial composite attitude score was higher than the non-completers’ initial composite attitude score, which seems to support the research that positive
attitudes in mathematics can influence success in a mathematics class. Results from this study may lead to some implications and recommendations for mathematics professors who seek to improve the success and attitude Beginning Algebra students. Mathematics professors may use this information to develop different educational techniques aimed at improving attitude and success in mathematics.

The results of this study indicated that 57.6% of the students had initial composite attitude scores slightly above the neutral of 120. These results also reveal no relationship between the CPT score and initial attitude for these Beginning Algebra students.

Initial composite attitude scores revealed that the students in this study had a slightly positive overall attitude toward mathematics, with 125 students out of 217 original students having an initial composite attitude score above 120. The literature reveals that students with a more positive attitude towards mathematics are more effective learners than students with poor attitudes toward mathematics (Ma & Kishor, 1997). The ATMI revealed that most students have a positive attitude towards mathematics for the factors of value, enjoyment, and self-confidence, although in the beginning of the semester motivation is slightly lower than the other factors. Composite attitude across class sections were not significantly different. Johnson (2003) found that the “teacher’s style and professionalism were fundamental to student success” (p. 94). This indicates that if teachers were aware of their influence on the students’ math experience, they might become more receptive to other teaching methods that have shown student success. Possibly by identifying students with a negative attitude in the beginning of the semester and implementing a multitude of different teaching strategies, the teacher may influence attitude in a positive way.
Students are required to take the State Competency Exam at the end of the semester. Students must score 80% or better on this exam to advance to the next level mathematics course. The study examined whether initial composite attitudes had any relationship with the students’ State Competency Exam scores. A low to moderate positive relationship was found between initial composite attitude and State Competency Exam score. The number of students who completed the course (n = 158), 72.8%, is testament that the five professors participating in the study had success in the number of students passing the State Competency Exam. Perhaps if professors of developmental students addressed the negative attitudes some students begin the semester with, more students would pass the State Competency Exam and continue to the next mathematics course.

Completers and non-completers attitudes were also examined in this study and it was found that the completers group had a more positive composite attitude score and a more positive attitude score toward the factors of value, enjoyment, self-confidence, and motivation. It seems plausible that if professors identified the students with the most negative attitude in the beginning of the semester, they could attempt to change the students’ attitudes utilizing teaching strategies that have shown to improve success.

The study also examined whether attitudes would change over the course of the semester in regards to class sections, age, gender, and ethnicity. The change score was determined by subtracting the end-of-semester attitude scores from the initial attitude scores. The end-of-semester attitude scores were gathered during the 12th week of the semester. Overall, the attitude scores increased during the semester. The change scores indicated that many students’ attitudes became slightly more positive for the factors of
enjoyment, self-confidence, and motivation. Unfortunately, many students’ value for mathematics decreased slightly over the course of the semester. There was no statistical significance among attitude change and class sections, gender or ethnicity. Curtis (2006) examined attitude change scores and also found no significant change in composite attitude, but when examining the different teaching strategies Curtis found that students’ value, enjoyment and self-confidence was greatly influenced by the use of cooperative learning; enjoyment and self-confidence were influenced by the use of graphing calculators; and motivation was influenced by cooperative learning and discourse. In the Curtis study, students found that when they discussed the mathematics topics with their peers, they found value in mathematics (p. 154). Students’ attitudes may be greatly influenced by the teaching strategies the professor use. Thus, it may be beneficial for professors to make use of different teaching strategies, such as cooperative learning, in their classrooms.

Gender and ethnicity were not found to be significant influences on attitude change. Students in two age groups “less than or equal to 20” and “40 or more” were found to have a significant attitude change score. Perhaps if professors utilized different teaching strategies, identified the students with the most negative attitudes, and realized their influence on the students’ mathematics attitude, more students would have success in developmental mathematics courses and thus reach their education goal.

Recommendations for Further Study

During the course of this study, a number of ideas about further research became evident. Some recommendations for future study are:

- Examine the attitudes of students who are mandated to take the Pre-Algebra
course prior to taking this Beginning Algebra course.

- Conduct longitudinal research to study how attitudes toward mathematics changes over time, from beginning to college level mathematics.

- Replicate the current study, examine the use of cooperative learning, multi-media, and other alternative presentations of subject material to determine whether specific instructional approaches influence attitudes and course performance.

- Replicate the current study, but add a qualitative component to interview students during the semester to possibly determine how their attitudes are influenced as a result of class activities, test performance and other factors.

The results of this research provide some support for the theory that attitudes toward mathematics may influence performance in mathematics courses. The evidence was not strong, but it seems strong enough to warrant further research to examine the relationship between attitudes and performance to determine whether intervention for students with negative attitudes toward mathematics could be improve performance.
REFERENCES


Hagedorn, L. S. (2006). *Traveling successfully on the community college pathway*. The research findings of the transfer and retention of urban community college students project (TRUCCS). University of Southern California.


Office of Program Policy Analysis & Government Accountability. (2006). *Steps can be taken to reduce remediation rates; 78% of community college students, 10% of university students need remediation*. (Report No. 06-40).
Office of Program Policy Analysis & Government Accountability. (2007). *Half of college students needing remediation drop out; Remediation completers do almost as well as other students.* (Report No. 07-31).


Schackow, J. (2005). *Examining the attitude toward mathematics of preservice elementary school teachers enrolled in an introductory mathematics methods course and the experiences that have influenced the development of these attitudes*. Doctoral dissertation, University of South Florida. Retrieved from ProQuest LLC database. (AAT 3197944)


Appendix A Attitudes Toward Mathematics Inventory

ATTITUDES TOWARD MATHEMATICS INVENTORY

Directions: This inventory consists of statements about your attitude toward mathematics. There are no correct or incorrect responses. Read each item carefully. Please think about how you feel about each item. Circle the choice that most closely corresponds to how the statements best describes your feelings. Use the following response scale to respond to each item.
Complete your responses for all 40 statements.

Value

1. Mathematics is a very worthwhile and necessary subject.
   Strongly Disagree    Disagree    Neutral    Agree    Strongly Agree

2. I want to develop my mathematical skills.
   Strongly Disagree    Disagree    Neutral    Agree    Strongly Agree

3. Mathematics helps develop the mind and teaches a person to think.
   Strongly Disagree    Disagree    Neutral    Agree    Strongly Agree

4. Mathematics is important in everyday life.
   Strongly Disagree    Disagree    Neutral    Agree    Strongly Agree

5. Mathematics is one of the most important subjects for people to study.
   Strongly Disagree    Disagree    Neutral    Agree    Strongly Agree
Appendix A continued

6. Math courses would be very helpful no matter what I decide to study.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>

7. I can think of many ways that I use math outside of school.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>

8. I think studying advanced mathematics is useful.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>

9. I believe studying math helps me with problem solving in other areas.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>

10. A strong math background could help me in my professional life.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>

Enjoyment

11. I get a great deal of satisfaction out of solving a mathematics problem.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>

12. I have usually enjoyed studying mathematics in school.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>

13. I like to solve new problems in mathematics.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>

170
Appendix A continued

14. I would prefer to do an assignment in math than to write an essay.

Strongly Disagree  Disagree  Neutral  Agree  Strongly Agree

15. I really like mathematics.

Strongly Disagree  Disagree  Neutral  Agree  Strongly Agree

16. I am happier in a math class than in any other class.

Strongly Disagree  Disagree  Neutral  Agree  Strongly Agree

17. Mathematics is a very interesting subject.

Strongly Disagree  Disagree  Neutral  Agree  Strongly Agree

18. I am comfortable expressing my own ideas on how to look for solutions to a difficult problem in math.

Strongly Disagree  Disagree  Neutral  Agree  Strongly Agree

19. I am comfortable answering questions in math class.

Strongly Disagree  Disagree  Neutral  Agree  Strongly Agree

20. Mathematics is dull and boring.

Strongly Disagree  Disagree  Neutral  Agree  Strongly Agree

Confidence

21. Mathematics is one of my most dreaded subjects.

Strongly Disagree  Disagree  Neutral  Agree  Strongly Agree
22. When I hear the word mathematics, I have a feeling of dislike.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>

23. My mind goes blank, and I am unable to think clearly when working with mathematics.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>

24. Studying mathematics makes me feel nervous.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>

25. Mathematics makes me feel uncomfortable.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>

26. I am always under a terrible strain in a math class.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>

27. It makes me nervous to even think about having to do a mathematics problem.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>

28. I am always confused in my mathematics class.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>

29. I feel a sense of insecurity when attempting mathematics.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>

30. Mathematics does not scare me at all.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>
Appendix A continued

31. I have a lot of self-confidence when it comes to mathematics.

Strongly Disagree  Disagree  Neutral  Agree  Strongly Agree

32. I am able to solve mathematics problems without too much difficulty.

Strongly Disagree  Disagree  Neutral  Agree  Strongly Agree

33. I expect to do fairly well in any math class I take.

Strongly Disagree  Disagree  Neutral  Agree  Strongly Agree

34. I learn mathematics easily.

Strongly Disagree  Disagree  Neutral  Agree  Strongly Agree

35. I believe I am good at solving math problems.

Strongly Disagree  Disagree  Neutral  Agree  Strongly Agree

Motivation

36. I am confident that I could learn advanced mathematics.

Strongly Disagree  Disagree  Neutral  Agree  Strongly Agree

37. I plan to take as much mathematics as I can during my education.

Strongly Disagree  Disagree  Neutral  Agree  Strongly Agree

38. The challenge of math appeals to me.

Strongly Disagree  Disagree  Neutral  Agree  Strongly Agree
Appendix A continued

39. I am willing to take more than the required amount of mathematics.

   Strongly Disagree   Disagree   Neutral   Agree   Strongly Agree

40. I would like to avoid using mathematics in college.

   Strongly Disagree   Disagree   Neutral   Agree   Strongly Agree

© 1996 Martha Tapia
Appendix B Florida College System

Brevard College
Broward Community College
Central Florida Community College
Chipola College
Daytona State College
Edison State College
Florida Keys Community College
Florida State College at Jacksonville
Gulf Coast Community College
Hillsborough Community College
Indian River State College
Lake City Community College
Lake-Sumter Community College
Miami Dade College
North Florida Community College
Northwest Florida State College
Palm Beach State College
Pasco-Hernando Community College
Pensacola Junior College
Polk State College
St. John’s River Community College
St. Petersburg College
Appendix B continued

Santa Fe College

Seminole State College of Florida

South Florida Community College

State College of Florida, Manatee-Sarasota

Tallahassee Community College

Valencia Community College
### Appendix C Percentage Per Response for the ATMI Initial Survey

<table>
<thead>
<tr>
<th>Item</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value of Mathematics</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Mathematics is a very worthwhile and necessary subject.</td>
<td>2.3</td>
<td>1.8</td>
<td>23.0</td>
<td>43.3</td>
<td>29.5</td>
</tr>
<tr>
<td>2. I want to develop my mathematical skills.</td>
<td>0.9</td>
<td>2.3</td>
<td>0.8</td>
<td>42.4</td>
<td>45.2</td>
</tr>
<tr>
<td>3. Mathematics helps develop the mind and teaches a person to think.</td>
<td>0.5</td>
<td>2.3</td>
<td>12.9</td>
<td>47.5</td>
<td>36.9</td>
</tr>
<tr>
<td>4. Mathematics is important in everyday life.</td>
<td>1.4</td>
<td>2.3</td>
<td>12.9</td>
<td>48.4</td>
<td>30.4</td>
</tr>
<tr>
<td>5. Mathematics is one of the most important subjects for people to study.</td>
<td>1.4</td>
<td>10.6</td>
<td>23.5</td>
<td>43.8</td>
<td>20.7</td>
</tr>
<tr>
<td>6. Math courses would be very helpful no matter what I decide to study.</td>
<td>1.8</td>
<td>8.8</td>
<td>20.3</td>
<td>42.9</td>
<td>26.3</td>
</tr>
<tr>
<td>7. I can think of many ways that I use math outside of school.</td>
<td>2.3</td>
<td>7.4</td>
<td>18.9</td>
<td>47.9</td>
<td>23.5</td>
</tr>
<tr>
<td>8. I think studying advanced mathematics is useful.</td>
<td>4.2</td>
<td>15.7</td>
<td>39.2</td>
<td>32.3</td>
<td>8.8</td>
</tr>
<tr>
<td>9. I believe studying math helps me with problem solving in other areas.</td>
<td>2.3</td>
<td>10.1</td>
<td>21.7</td>
<td>49.3</td>
<td>16.6</td>
</tr>
<tr>
<td>10. A strong math background could help me in my professional life.</td>
<td>2.3</td>
<td>3.7</td>
<td>14.7</td>
<td>47.0</td>
<td>32.3</td>
</tr>
</tbody>
</table>
Appendix C continued

<table>
<thead>
<tr>
<th>Item</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Enjoyment of Mathematics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. I get a great deal of satisfaction out of solving a mathematics problem.</td>
<td>3.7</td>
<td>12.0</td>
<td>25.8</td>
<td>40.1</td>
<td>18.9</td>
</tr>
<tr>
<td>12. I have usually enjoyed studying mathematics in school.</td>
<td>18.9</td>
<td>26.7</td>
<td>24.4</td>
<td>22.6</td>
<td>7.4</td>
</tr>
<tr>
<td>13. I like to solve new problems in mathematics.</td>
<td>6.5</td>
<td>25.3</td>
<td>28.1</td>
<td>31.3</td>
<td>8.8</td>
</tr>
<tr>
<td>14. I would prefer to do an assignment in math than to write an essay.</td>
<td>18.9</td>
<td>20.7</td>
<td>18.0</td>
<td>17.1</td>
<td>25.3</td>
</tr>
<tr>
<td>15. I really like mathematics.</td>
<td>18.0</td>
<td>21.7</td>
<td>32.3</td>
<td>18.0</td>
<td>10.1</td>
</tr>
<tr>
<td>16. I am happier in a math class than in any other class.</td>
<td>21.7</td>
<td>33.2</td>
<td>26.7</td>
<td>12.4</td>
<td>6.0</td>
</tr>
<tr>
<td>17. Mathematics is a very interesting subject.</td>
<td>9.2</td>
<td>17.5</td>
<td>31.3</td>
<td>31.8</td>
<td>10.1</td>
</tr>
<tr>
<td>18. I am comfortable expressing my own ideas on how to look for solutions to a difficult problem in math.</td>
<td>8.3</td>
<td>18.9</td>
<td>32.3</td>
<td>34.1</td>
<td>6.5</td>
</tr>
<tr>
<td>19. I am comfortable answering questions in math class.</td>
<td>6.5</td>
<td>17.5</td>
<td>24.4</td>
<td>43.8</td>
<td>7.8</td>
</tr>
<tr>
<td>20. Mathematics is dull and boring.*</td>
<td>8.3</td>
<td>19.8</td>
<td>28.1</td>
<td>30.0</td>
<td>14.3</td>
</tr>
</tbody>
</table>
### Appendix C continued

<table>
<thead>
<tr>
<th>Item</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Self-Confidence in Mathematics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21. Mathematics is one of my most dreaded subjects.*</td>
<td>20.7</td>
<td>24.9</td>
<td>20.3</td>
<td>22.6</td>
<td>11.1</td>
</tr>
<tr>
<td>22. When I hear the word mathematics, I have a feeling of dislike.*</td>
<td>13.4</td>
<td>31.3</td>
<td>15.2</td>
<td>28.1</td>
<td>12.0</td>
</tr>
<tr>
<td>23. My mind goes blank, and I am unable to think clearly when</td>
<td>5.1</td>
<td>20.3</td>
<td>28.1</td>
<td>38.7</td>
<td>7.8</td>
</tr>
<tr>
<td>working with mathematics,*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>24. Studying mathematics makes me feel nervous.*</td>
<td>8.3</td>
<td>24.0</td>
<td>22.6</td>
<td>35.0</td>
<td>10.1</td>
</tr>
<tr>
<td>25. Mathematics makes me feel uncomfortable,*</td>
<td>6.5</td>
<td>22.6</td>
<td>21.7</td>
<td>40.1</td>
<td>9.2</td>
</tr>
<tr>
<td>26. I am always under a terrible strain in a math class.*</td>
<td>6.0</td>
<td>21.2</td>
<td>24.0</td>
<td>38.7</td>
<td>10.1</td>
</tr>
<tr>
<td>27. It makes me nervous to even think about having to do a</td>
<td>4.1</td>
<td>17.1</td>
<td>20.7</td>
<td>44.7</td>
<td>12.9</td>
</tr>
<tr>
<td>mathematics problem.*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>28. I am always confused in my mathematics class.*</td>
<td>4.2</td>
<td>8.3</td>
<td>25.8</td>
<td>52.5</td>
<td>9.2</td>
</tr>
<tr>
<td>29. I feel a sense of insecurity when attempting mathematics.*</td>
<td>6.0</td>
<td>21.2</td>
<td>20.3</td>
<td>42.9</td>
<td>9.7</td>
</tr>
</tbody>
</table>
### Self-Confidence in Mathematics (continued)

<table>
<thead>
<tr>
<th>Item</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>30. Mathematics does not scare me at all.</td>
<td>6.9</td>
<td>30.9</td>
<td>28.6</td>
<td>24.0</td>
<td>9.7</td>
</tr>
<tr>
<td>31. I have a lot of self-confidence when it comes to mathematics.</td>
<td>8.3</td>
<td>30.9</td>
<td>35.5</td>
<td>20.3</td>
<td>5.1</td>
</tr>
<tr>
<td>32. I am able to solve mathematics problems without too much difficulty.</td>
<td>8.8</td>
<td>30.0</td>
<td>32.3</td>
<td>26.7</td>
<td>2.3</td>
</tr>
<tr>
<td>33. I expect to do fairly well in any math class I take.</td>
<td>3.2</td>
<td>9.7</td>
<td>30.0</td>
<td>45.2</td>
<td>12.0</td>
</tr>
<tr>
<td>34. I learn mathematics easily.</td>
<td>10.1</td>
<td>31.8</td>
<td>28.1</td>
<td>24.9</td>
<td>4.6</td>
</tr>
<tr>
<td>35. I believe I am good at solving math problems.</td>
<td>6.5</td>
<td>22.6</td>
<td>36.9</td>
<td>28.1</td>
<td>6.0</td>
</tr>
</tbody>
</table>

### Motivation with Mathematics

<table>
<thead>
<tr>
<th>Item</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>36. I am confident that I could learn advanced mathematics.</td>
<td>6.5</td>
<td>17.1</td>
<td>30.9</td>
<td>38.2</td>
<td>7.4</td>
</tr>
<tr>
<td>37. I plan to take as much mathematics as I can during my education.</td>
<td>14.7</td>
<td>28.1</td>
<td>26.7</td>
<td>24.0</td>
<td>6.5</td>
</tr>
<tr>
<td>Item</td>
<td>Strongly Disagree</td>
<td>Disagree</td>
<td>Neutral</td>
<td>Agree</td>
<td>Strongly Agree</td>
</tr>
<tr>
<td>-----------------------------------------------------------------------------------------------------</td>
<td>-------------------</td>
<td>----------</td>
<td>---------</td>
<td>-------</td>
<td>----------------</td>
</tr>
<tr>
<td><strong>Motivation with Mathematics (continued)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>38. The challenge of math appeals to me.</td>
<td>11.1</td>
<td>31.3</td>
<td>29.5</td>
<td>23.5</td>
<td>4.6</td>
</tr>
<tr>
<td>39. I am willing to take more than the required amount of mathematics.</td>
<td>20.7</td>
<td>33.6</td>
<td>26.7</td>
<td>15.7</td>
<td>2.8</td>
</tr>
<tr>
<td>40. I would like to avoid using mathematics in college.*</td>
<td>11.1</td>
<td>20.3</td>
<td>22.1</td>
<td>38.7</td>
<td>7.8</td>
</tr>
</tbody>
</table>
## Appendix D End of Semester Descriptive Statistics Per Survey Question

<table>
<thead>
<tr>
<th>Item</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Skewness</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Value of Mathematics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Mathematics is a very worthwhile and necessary subject.</td>
<td>3.96</td>
<td>0.90</td>
<td>-0.61</td>
<td>-0.08</td>
</tr>
<tr>
<td>2. I want to develop my mathematical skills.</td>
<td>4.22</td>
<td>0.82</td>
<td>-1.13</td>
<td>1.90</td>
</tr>
<tr>
<td>3. Mathematics helps develop the mind and teaches a person to think.</td>
<td>4.18</td>
<td>0.73</td>
<td>-0.58</td>
<td>0.10</td>
</tr>
<tr>
<td>4. Mathematics is important in everyday life.</td>
<td>3.95</td>
<td>0.90</td>
<td>-0.75</td>
<td>0.46</td>
</tr>
<tr>
<td>5. Mathematics is one of the most important subjects for people to study.</td>
<td>3.69</td>
<td>0.94</td>
<td>-0.50</td>
<td>-0.19</td>
</tr>
<tr>
<td>6. Math courses would be very helpful no matter what I decide to study.</td>
<td>3.69</td>
<td>0.94</td>
<td>-0.59</td>
<td>0.09</td>
</tr>
<tr>
<td>7. I can think of many ways that I use math outside of school.</td>
<td>3.72</td>
<td>0.97</td>
<td>-0.72</td>
<td>0.24</td>
</tr>
<tr>
<td>8. I think studying advanced mathematics is useful.</td>
<td>3.26</td>
<td>1.03</td>
<td>-0.22</td>
<td>-0.31</td>
</tr>
<tr>
<td>9. I believe studying math helps me with problem solving in other areas.</td>
<td>3.68</td>
<td>0.87</td>
<td>-0.88</td>
<td>0.77</td>
</tr>
<tr>
<td>10. A strong math background could help me in my professional life.</td>
<td>3.90</td>
<td>0.97</td>
<td>-0.89</td>
<td>0.65</td>
</tr>
</tbody>
</table>
### Appendix D continued

<table>
<thead>
<tr>
<th>Item</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Skewness</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Enjoyment of Mathematics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. I get a great deal of satisfaction out of solving a mathematics problem.</td>
<td>3.67</td>
<td>1.04</td>
<td>-0.71</td>
<td>0.03</td>
</tr>
<tr>
<td>12. I have usually enjoyed studying mathematics in school.</td>
<td>2.97</td>
<td>1.24</td>
<td>-0.02</td>
<td>-0.96</td>
</tr>
<tr>
<td>13. I like to solve new problems in mathematics.</td>
<td>3.30</td>
<td>1.06</td>
<td>-0.26</td>
<td>-0.56</td>
</tr>
<tr>
<td>14. I would prefer to do an assignment in math than to write an essay.</td>
<td>3.22</td>
<td>1.47</td>
<td>-0.17</td>
<td>-1.41</td>
</tr>
<tr>
<td>15. I really like mathematics.</td>
<td>3.08</td>
<td>1.20</td>
<td>-0.06</td>
<td>-0.85</td>
</tr>
<tr>
<td>16. I am happier in a math class than in any other class.</td>
<td>2.87</td>
<td>1.22</td>
<td>0.17</td>
<td>-0.87</td>
</tr>
<tr>
<td>17. Mathematics is a very interesting subject.</td>
<td>3.27</td>
<td>1.16</td>
<td>-0.45</td>
<td>-0.57</td>
</tr>
<tr>
<td>18. I am comfortable expressing my own ideas on how to look for solutions to a difficult problem in math.</td>
<td>3.29</td>
<td>0.96</td>
<td>-0.31</td>
<td>-0.29</td>
</tr>
<tr>
<td>19. I am comfortable answering questions in math class.</td>
<td>3.60</td>
<td>1.00</td>
<td>-0.60</td>
<td>0.11</td>
</tr>
<tr>
<td>20. Mathematics is dull and boring.*</td>
<td>3.33</td>
<td>1.15</td>
<td>-0.33</td>
<td>-0.61</td>
</tr>
</tbody>
</table>
Appendix D continued

<table>
<thead>
<tr>
<th>Item</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Skewness</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Self-Confidence in Mathematics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21. Mathematics is one of my most dreaded subjects.*</td>
<td>2.92</td>
<td>1.31</td>
<td>-0.04</td>
<td>-1.21</td>
</tr>
<tr>
<td>22. When I hear the word mathematics, I have a feeling of dislike.*</td>
<td>3.17</td>
<td>1.30</td>
<td>-0.22</td>
<td>-1.20</td>
</tr>
<tr>
<td>23. My mind goes blank, and I am unable to think clearly when working with mathematics.*</td>
<td>3.26</td>
<td>1.17</td>
<td>-0.31</td>
<td>-0.74</td>
</tr>
<tr>
<td>24. Studying mathematics makes me feel nervous.*</td>
<td>3.29</td>
<td>1.10</td>
<td>-0.25</td>
<td>-0.72</td>
</tr>
<tr>
<td>25. Mathematics makes me feel uncomfortable.*</td>
<td>3.42</td>
<td>1.11</td>
<td>-0.47</td>
<td>-0.46</td>
</tr>
<tr>
<td>26. I am always under a terrible strain in a math class.*</td>
<td>3.45</td>
<td>1.15</td>
<td>-0.59</td>
<td>-0.48</td>
</tr>
<tr>
<td>27. It makes me nervous to even think about having to do a mathematics problem.*</td>
<td>3.53</td>
<td>1.13</td>
<td>-0.67</td>
<td>-0.15</td>
</tr>
<tr>
<td>28. I am always confused in my mathematics class.*</td>
<td>3.69</td>
<td>0.95</td>
<td>-0.66</td>
<td>0.29</td>
</tr>
<tr>
<td>29. I feel a sense of insecurity when attempting mathematics.*</td>
<td>3.55</td>
<td>1.08</td>
<td>-0.55</td>
<td>-0.35</td>
</tr>
</tbody>
</table>
Appendix D continued

<table>
<thead>
<tr>
<th>Item</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Skewness</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Self-Confidence in Mathematics (continued)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30. Mathematics does not scare me at all.</td>
<td>3.23</td>
<td>1.09</td>
<td>-0.27</td>
<td>-0.55</td>
</tr>
<tr>
<td>31. I have a lot of self-confidence when it comes to mathematics.</td>
<td>3.20</td>
<td>1.05</td>
<td>-0.08</td>
<td>-0.59</td>
</tr>
<tr>
<td>32. I am able to solve mathematics problems without too much difficulty.</td>
<td>3.18</td>
<td>0.93</td>
<td>-0.08</td>
<td>-0.48</td>
</tr>
<tr>
<td>33. I expect to do fairly well in any math class I take.</td>
<td>3.57</td>
<td>0.92</td>
<td>-0.52</td>
<td>0.00</td>
</tr>
<tr>
<td>34. I learn mathematics easily.</td>
<td>3.13</td>
<td>1.04</td>
<td>-0.23</td>
<td>-0.36</td>
</tr>
<tr>
<td>35. I believe I am good at solving math problems.</td>
<td>3.30</td>
<td>0.99</td>
<td>-0.51</td>
<td>0.20</td>
</tr>
<tr>
<td><strong>Motivation with Mathematics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>36. I am confident that I could learn advanced mathematics.</td>
<td>3.31</td>
<td>1.10</td>
<td>-0.45</td>
<td>-0.36</td>
</tr>
<tr>
<td>37. I plan to take as much mathematics as I can during my education.</td>
<td>2.87</td>
<td>1.20</td>
<td>0.19</td>
<td>-0.84</td>
</tr>
<tr>
<td>Item</td>
<td>Mean</td>
<td>Standard Deviation</td>
<td>Skewness</td>
<td>Kurtosis</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>------</td>
<td>--------------------</td>
<td>----------</td>
<td>----------</td>
</tr>
<tr>
<td>Motivation with Mathematics (continued)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>38. The challenge of math appeals to me.</td>
<td>3.03</td>
<td>1.14</td>
<td>-0.05</td>
<td>-0.77</td>
</tr>
<tr>
<td>39. I am willing to take more than the required amount of mathematics.</td>
<td>2.50</td>
<td>1.16</td>
<td>0.59</td>
<td>-0.31</td>
</tr>
<tr>
<td>40. I would like to avoid using mathematics in college.*</td>
<td>3.07</td>
<td>1.24</td>
<td>-0.25</td>
<td>-1.02</td>
</tr>
</tbody>
</table>
Appendix E Cover Letter

Informed Consent to Participate in Research

Information to Consider Before Taking Part in this Research Study

IRB Study #PRO 00001689

Researchers at the University of South Florida (USF) and Valencia Community College study many topics. To do this, we need the help of people who agree to take part in a research study. This form tells you about this research study.

We are asking you to take part in a research study that is called: Examining the Attitudes and Outcomes of Students Enrolled in a Developmental Mathematics Course at a Central Florida Community College

The person who is in charge of this research study is Leila Sisson. This person is called the Principal Investigator.

The research will be done at Osceola Campus of Valencia Community College

Purpose of the study

The purpose of this study is to:

- Determine your attitude about mathematics in the beginning and end of the semester.
Appendix E continued

• This study is to complete the research on the dissertation for USF.

Study Procedures

If you take part in this study, you will be asked to:

Provide:

1) Completion of the attitudinal survey twice during the semester. Now and in 12 weeks.

2) The survey will take approximately 20 minutes to complete.

3) You will be provided with the survey during class.

4) You will provide your Valencia ID number for coding purposes.

Alternatives

You have the alternative to choose not to participate in this research study. If you choose to not participate, simply place the blank survey in the folder in the back of the room with the other surveys.

Risks or Discomfort

There are no known risks to those who take part in this study. Your professor will not know the results or whether you participated in the survey or not. Your completion of the survey is completely anonymous and will not affect your grade in this course. Non participation is okay and this research is not part of your class. I will be requesting your State Competency Exam scores upon your completion of the course.

Compensation

We will not pay you for the time you volunteer while being in this study.
Appendix E continued
Privacy and Confidentiality

We must keep your study records private and confidential. However, certain people may need to see your study records. By law, anyone who looks at your records must keep them completely confidential. The only people who will be allowed to see these records are:

- The research team, including the Principal Investigator, study coordinator, and all other research staff.
- Certain government and university people who need to know more about the study. For example, individuals who provide oversight on this study may need to look at your records. This is done to make sure that we are doing the study in the right way. They also need to make sure that we are protecting your rights and your safety.) These include:
  - the University of South Florida Institutional Review Board (IRB) and the staff that work for the IRB. Other individuals who work for USF that provide other kinds of oversight may also need to look at your records.
  - the Dept of Health and Human Services can review all research records.

We may publish what we learn from this study. If we do, we will not let anyone know your name. We will not publish anything else that would let people know who you are.

Voluntary Participation / Withdrawal

You should only take part in this study if you want to volunteer. You should not feel that there is any pressure to take part in the study, to please the investigator or the research staff. You are free to participate in this research or withdraw at any time. There will be no penalty or loss of benefits you are entitled to receive if you stop taking part in this study. Decision to participate or not participate will not affect your student status or course grade.

Questions, concerns, or complaints

If you have any questions, concerns or complaints about this study, call Leila Sisson at 407-299-5000 extension 4127 or lsisson@valenciacc.edu

If you have questions about your rights as a participant in this study, general questions, or have complaints, concerns or issues you want to discuss with someone outside the research, call the Division of Research Integrity and Compliance of the University of South Florida at (813) 974-9343.

If you experience an adverse event or unanticipated problem call Leila Sisson at 407-299-5000, extension 4127.
Appendix E continued
Consent to Take Part in this Research Study

It is up to you to decide whether you want to take part in this study. If you want to take part, please sign the form, if the following statements are true.

I freely give my consent to take part in this study. I understand that by signing this form I am agreeing to take part in research. I have received a copy of this form to take with me.

_____________________________________________  _______________________
Signature of Person Taking Part in Study                           Date

_____________________________________________
Printed Name of Person Taking Part in Study
Appendix F Demographic Data

Please supply the correct answers to the following three questions:

1. Your current age ___________________

2. Your correct ethnicity (please circle one)
   
   Caucasian (white)   Hispanic   African American   Other

3. Your Gender (please circle one).
   
   Male   Female
August 18, 2010

Leila Sisson

Adult, Career and Higher Education

RE: Expedited Approval for Initial Review

IRB#: Pro00001689

Title: Examining the Attitudes and Outcomes of Students Enrolled in a Beginning Algebra Course at the Osceola Campus

Dear Leila Sisson:

On 8/18/2010 the Institutional Review Board (IRB) reviewed and APPROVED the above referenced protocol. Please note that your approval for this study will expire on 8-18-11.

Approved Items:

Protocol Document(s):

Sisson Ch1-2-3 5-11-10.doc 7/12/2010 2:54 PM 0.01

Consent/Assent Document(s):

USF Consent Form.pdf 8/18/2010 9:51 AM 0.01
Appendix G continued

It was the determination of the IRB that your study qualified for expedited review which includes activities that (1) present no more than minimal risk to human subjects, and (2) involve only procedures listed in one or more of the categories outlined below. The IRB may review research through the expedited review procedure authorized by 45CFR46.110 and 21 CFR 56.110. The research proposed in this study is categorized under the following expedited review category:

(5) Research involving materials (data, documents, records, or specimens) that have been collected, or will be collected solely for nonresearch purposes (such as medical treatment or diagnosis).

(7) Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

Please note, the informed consent/assent documents are valid during the period indicated by the official, IRB-Approval stamp located on the form. Valid consent must be documented on a copy of the most recently IRB-approved consent form.
Appendix G continued

As the principal investigator of this study, it is your responsibility to conduct this study in accordance with IRB policies and procedures and as approved by the IRB. Any changes to the approved research must be submitted to the IRB for review and approval by an amendment.

We appreciate your dedication to the ethical conduct of human subject research at the University of South Florida and your continued commitment to human research protections. If you have any questions regarding this matter, please call 813-974-9343.

Sincerely,

PhD, Chairperson
USF Institutional Review Board

Cc: Various Menzel, CCRP  USF IRB Professional Staff