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Math Emporium Model: Preparing Developmental Students for College Algebra

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MATH EMPORIUM MODEL: PREPARING DEVELOPMENTAL STUDENTS FOR COLLEGE ALGEBRA

by

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ABSTRACT

MATH EMPORIUM MODEL: PREPARING DEVELOPMENTAL STUDENTS FOR COLLEGE ALGEBRA

by Stephanie Patton Williams

August 2016

This study examined the effectiveness of the Emporium Model in reducing math anxiety and in preparing developmental math students at a community college to be successful in College Algebra. The study involved 59 students enrolled in Intermediate Algebra at a community college and compared those in the Emporium class format to those in the Traditional class format. Participants completed a pre-post math anxiety rating scale questionnaire and a pre-post algebra readiness test to address the research questions of the study. Two mixed model ANOVAs were done, and the findings showed that there was a significant difference in math anxiety level between students enrolled in the Emporium and Traditional class formats. A decrease in math anxiety level was evident in the Traditional group. There was no significant difference between the two groups on the algebra readiness test scores. Additional analysis was conducted using a repeated measures MANOVA on the subscales of the A-MARS to determine which subscale contributed significantly to math anxiety level.

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DEDICATION

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This dissertation is dedicated to all my family and friends who constantly supported, motivated, and encouraged me in pursuing this life-long goal. To my mother, the late Myrtleen Patton Lyons, words cannot express how grateful I am for the unselfish love and guidance you gave me throughout my life. You always wanted the best for me and challenged me to strive for excellence in everything that I desired to do. And although you are not physically present with me to share this moment, I feel your presence spiritually and can hear you saying – “that’s my baby”.

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LIST OF ABBREVIATIONS

AACC	American Association of Community Colleges
A-MARS	Abbreviated Mathematics Anxiety Rating Scale
ANOVA	Analysis of Variances
MANOVA	Multivariate Analysis of Variances
MARS	Mathematics Anxiety Rating Scale
MCA	Mathematics Course Anxiety
MTA	Mathematics Test Anxiety
NADE	National Association for Developmental Education
NCAT	National Center of Academic Transformation
NELS	National Education Longitudinal Study
NTA	Numerical Task Anxiety
SPSS	Statistical Package for the Social Sciences
SREB	Southern Regional Education Board
SRL	Self-regulated learning

CHAPTER I - INTRODUCTION

An alarming number of students entering community colleges are not ready for college-level courses. The American Association of Community Colleges (AACC) estimates that at the community college level, approximately 60% of entering freshmen are not ready for college-level work (Stuart, 2009). To address the problem of underprepared students, most community colleges offer developmental education courses. These courses are designed to strengthen the knowledge of underprepared students and prepare them for success in college-level courses. In 2007, 100% of community colleges offered developmental courses and 63% of students in community colleges enrolled in at least one developmental course (Tierney & Garcia, 2008). Research shows that students are more likely to enroll in a developmental math course than in any other subject area (Bahr, 2007; Le, Rogers & Santos, 2011). Despite the large number of students required to enroll in developmental math courses, the overall success rate of students passing these courses is very low (Bahr, 2008). Developmental math courses are often labeled as barriers or gatekeepers for achieving educational goals because many students never complete these courses. This issue is a serious concern for students and higher education policy makers (Bonham & Boylan, 2011).

One of the reasons for students struggling to pass mathematics courses is their fear of math. Many students do not feel confident in their ability to do math and develop math anxiety (Duffy & Furner, 2002). Math anxiety is a common issue in developmental math community college students (Woodard, 2004). Richardson and Suinn (1972) describe math anxiety as "feelings of tension and anxiety that interfere with the manipulation of mathematical problems in a wide variety of ordinary life and academic situations" (p. 551). Buckley and Ribordy (1982) define math anxiety as "an inconceivable dread of mathematics that can interfere with manipulating numbers and solving mathematical problems with a variety of everyday life and academic situations" (p. 1). Math anxiety is simply a fear of mathematics (Iossi, 2007).

With the low number of community college students passing developmental math courses and the pervasiveness of math anxiety, mathematics departments are exploring different approaches to address both issues in hopes of improving the success rates in developmental courses. The current trend at many community colleges involves implementing course redesign models into the curriculum. The Emporium Model is one type of redesign model that some community colleges are adopting (Bahr, 2008). In implementing the Emporium Model, a significant number of community colleges have experienced improvement in students' passing rates for developmental math courses (Speckler, 2008; Squires, Faulkner, & Hite, 2009; Twigg, 2005). Although examples of improvement in passing rates for developmental courses exist, some scholars question whether the improved results are connected to the Emporium Model (Hodora, 2011).

The Emporium Model involves active learning that uses technology to allow students to work at their own pace. The National Center of Academic Transformation (NCAT) provides guidance and leadership to institutions interested in redesigning their learning environments to produce better learning outcomes for students (NCAT, 2005a, 2005b). According to NCAT's director, Twigg (2011), "the underlying principle is simple: Students learn math by doing math, not listening to someone talk about doing math. Interactive computer software, personalized on-demand assistance, and mandatory student participation are the key elements of success" (p. 26). The Emporium Model achieves reform by changing the instructional method in the classroom. Rather than lecturing during the class time, the instructor allows students to work independently at the computer to master the objectives of the course. As students work at the computer, the instructor is available in the class to assist and answer students' specific questions as needed. Students utilize the features of the software program to receive instruction or review course content by watching videos, viewing examples, assessing the textbook, doing homework problems, and taking quizzes or tests (NCAT, 2012a). Although the model has been implemented in various ways, the critical components involve eliminating lecture, using interactive computer software, and providing personalized, on-demand assistance. The model has four core principles that are believed to be vital to the success of the program:

1. Students spend time doing math problems rather than listening to someone talk about doing math.
2. Students spend more time on skills not mastered and less time on skills already mastered.
3. Students receive assistance as needed.
4. Students are required to do math (Twigg, 2011).

The theoretical framework for this study was the self-regulated learning (SRL) theory. In the Emporium Model classroom, students are expected to take ownership of their own learning. The environment is self-paced and individualized to accommodate the learning preferences of the student. SRL theory encourages learners to be in control, responsible, and actively engaged in the learning process (Sandars, 2013). SRL theory argues that "effective learning is accomplished through the continuous and dynamic adjustment of specific motivational and cognitive components that enable the learner to achieve particular learning goals, both academic and clinical" (Sandars, 2013, p. 1162). According to Pintrich (2000), SRL is an active process that places the learner in control of setting, monitoring, achieving, and re-adjusting one's goals as needed. Self-regulation is the process whereby learners systematically direct their thoughts, feelings, and actions toward the attainment of their goals (Flavell & Miller, 1998). Zimmerman (2001) states that SRL involves being behaviorally, cognitively, meta-cognitively, and motivationally active in one's learning and performance. It is learning that is achieved from the students' own self-generated thoughts and behaviors (Zimmerman, 2001).

The purpose of this study was to investigate the effectiveness of the Emporium Model in reducing math anxiety and in preparing developmental math students at a community college to be successful in College Algebra.

Statement of the Problem

A significant number of community college students are required to take developmental math courses because they are not prepared for college-level work. The Southern Regional Education Board (SREB) reports that the number of students requiring remediation in mathematics exceeds numbers for remediation in either reading or English (Kaye, Lord, & Bottoms, 2006). Approximately 33% of students admitted to post-secondary institutions will enroll in a developmental math course (McCormick & Lucas, 2011). Despite the large number of students in developmental math courses, the overall success rate of students passing these courses is very low (Bahr, 2008). According to Bailey (2009), only 30% of students pass their developmental math courses. Failure to pass developmental math courses usually results in students not obtaining a degree

(Domina & Levey, 2006). Adelman (2006) found that only half of the students taking developmental math courses complete a bachelor's degree compared to 70% of those who did not take a developmental math course.

The problem for institutions is finding effective techniques and methods to use to improve the success rate of students in developmental math courses. Institutions are responding to this problem by changing their instructional methods in hopes of helping students pass developmental math courses. The Emporium Model is one type of redesign model that some community colleges are incorporating into the curriculum (Bahr, 2008). Success stories and examples of institutions that have embraced the Emporium Model format are available on the NCAT website (NCAT, 2005a, 2005b, 2012a, 2012b, 2012c). While an increase in passing rates for developmental math courses has been identified in the literature, questions still exist concerning the effectiveness of the Emporium Model (Hodora, 2011; Speckler, 2008; Squires et al., 2009; Twigg, 2005). Therefore, this research proposes to address the effectiveness of the Emporium Model in reducing math anxiety and preparing students for College Algebra.

Research Questions and Hypotheses

This study compared students who took Intermediate Algebra (a developmental math course) in the Emporium format to students who took Intermediate Algebra in a Traditional format to determine whether the instructional type made a difference in reducing math anxiety and in preparing students for College Algebra. The research questions and hypotheses were as follows:

Research Questions

1. Is there a significant difference in math anxiety level between students who took Intermediate Algebra in an Emporium class versus those who took Intermediate Algebra in a Traditional class as measured by a math anxiety pre- and post-rating scale questionnaire?
2. Are students who took Intermediate Algebra in the Emporium format better prepared for College Algebra than students who took Intermediate Algebra in a non- Emporium format as measured by scores on an algebra readiness pre- and post-test?

Hypotheses

H_1 - There will be a statistically significant difference in math anxiety level between students who take Intermediate Algebra in an Emporium class versus students who take Intermediate Algebra in a Traditional class as measured by a math anxiety rating scale survey.

H_2 – There will be a statistically significant difference in pre- and post-test scores on an algebra readiness test for students who take Intermediate Algebra in an Emporium class versus students who take the course in a Traditional class.

Definition of Terms

1. *College-level courses or college-level work* – credit-bearing courses that count towards obtaining a degree

2. *College ready or college readiness* – academically prepared to take college-level courses

3. Course redesign – restructuring course format to produce better learning outcomes

4. Developmental courses or remedial courses – non-credit courses that do not count towards the requirements of a degree program (Gabbard & Mupinga, 2013)

5. Developmental education or remedial education – refers to programs specifically designed to prepare underprepared students for college-level work; the terms developmental and remedial will be used interchangeably in this study

6. Emporium model – a course redesign model that eliminates lecturing in the classroom and utilizes technology for instruction

7. Underprepared students – refers to students who are not academically ready for college-level courses

Delimitations

This study focused on the effectiveness of the Emporium Model as measured by an algebra readiness pre-and post-test and a math anxiety pre- and post-rating scale survey. A comparison of scores from both tests was done between students in the Emporium class format and those in a Traditional class format. The ability to infer causality was limited. Students were not randomly assigned to the two groups and no interventions were done on the part of the researcher; therefore, causality cannot be claimed. Any relationship or association discovered by the research would only be suggestive of causality. Other variables may explain the observed differences in scores from the tests.

The study was limited to community college students enrolled in Intermediate Algebra at a public, comprehensive community college in Southeastern United States. It was delimited to students who have self-enrolled into the Emporium class or the Traditional class.

The results of the study may not be generalized to an institution of a different size, or one located in a different geographic location, or one that contains a substantially different population in terms of student demographics.

Assumptions

Students enrolled in Intermediate Algebra completed a math anxiety rating scale questionnaire pre-test and an algebra readiness pre-test at the beginning of the semester. The same math anxiety test and algebra readiness test were administered as post-tests near the end of the semester. It was assumed that participants read and responded honestly to each statement on the math anxiety test during both administrations. On the algebra readiness test, it was assumed that the participants worked independently and did their best during both administrations. They were permitted to use the TI-30XIIS calculator provided by the classroom instructor on the test.

Justification

With the alarming number of community college students not passing developmental math courses and the pervasiveness of math anxiety, mathematics departments are exploring different approaches to address both issues in hopes of improving the success rates in developmental courses. The current trend at many community colleges involves implementing course redesign models into the curriculum. The Emporium Model is one type of redesign model that some community colleges are adopting (Bahr, 2008). In implementing the Emporium Model, a significant number of community colleges have experienced improvement in students' passing rates for developmental math courses (NCAT, 2012a, 2012b, 2012c; Speckler, 2008; Squires et al., 2009; Twigg, 2005). Although examples of improvement in passing rate for developmental courses exist, questions continue to remain concerning how the improved results are connected to the Emporium Model (Hodora, 2011). Thus, this study investigated the effectiveness of the Emporium Model in reducing math anxiety and in preparing developmental math students at a community college to be successful in College Algebra.

This study adds to the existing literature concerning the effectiveness of the Emporium Model. Most of the current research focuses on how the Emporium Model has been beneficial in increasing the passing rate of students in developmental math courses (NCAT, 2012a, 2012b, 2012c; Speckler, 2008; Squires et al., 2009; Twigg, 2005). However, there may be additional benefits of the Emporium Model that have not been identified in the literature. This study seeks to possibly identify additional benefits of the Emporium Model, which will strengthen the effectiveness of the model and help institutions in determining whether to implement the Emporium Model for their developmental mathematics courses.

The study is significant because of the large number of students required to take developmental math courses. Failure to complete developmental math courses is often a barrier for students earning college degrees. Attewell, Lavin, Domina, and Levey (2006) found that students who enroll and do not successfully complete their developmental math courses were less likely to earn a degree. Conversely, students who successfully complete their developmental math courses do just as well or better than non-developmental students in college-level work (Waycaster, 2011). Students who remediate successfully in math achieve attainment levels that are comparable to those students who do not take remedial math classes (Bahr, 2008). Realizing the correlation between successfully completing developmental math courses and earning a degree, this study is significant because it seeks to provide institutions with additional research on the benefits of the Emporium Model to improve developmental math programs.

The study was approved by the Institutional Review Board of The University of Southern Mississippi (see Appendix A). Also, permission to conduct research at the participating institution was obtained by the researcher (see Appendix B).

CHAPTER II – LITERATURE REVIEW

Introduction

An alarming number of students entering community colleges are not ready for college-level courses. The American Association of Community Colleges (AACC) estimates that at the community college level, approximately 60% of entering freshmen are not ready for college-level work (Stuart, 2009). To address the problem of underprepared students, most community colleges offer developmental education courses. These courses are designed to strengthen underprepared students and prepare them for success in college-level courses. In 2007, developmental courses were offered at 100% of community colleges and 63% of students in community colleges enrolled in at least one developmental course (Tierney & Garcia, 2008). Research shows that more students are likely to enroll in a developmental math course than in any other subject area (Bahr, 2007; Le et al., 2011). Despite the large number of students required to enroll in developmental math courses, the overall success rate of students passing these courses is very low (Bahr, 2008). Developmental math courses have often been labeled as barriers or gatekeepers for achieving educational goals because many students never complete these courses. This issue has become a serious concern for students and higher education policy makers (Bonham & Boylan, 2011).

In response to the low passing rate of students in developmental math courses, some community colleges are implementing course redesign models into the curriculum. The Emporium Model is one type of redesign model that some community colleges are adopting (Bahr, 2008). In using the Emporium Model, several community colleges have experienced improvement in students' passing rates for developmental math courses

(Speckler, 2008; Squires et al., 2009; Twigg, 2005). Although examples of improvement in passing rates for developmental courses exist, questions continue to remain concerning how the improved results are connected to the Emporium Model (Hodora, 2011).

Thus, the purpose of this study was to investigate the effectiveness of the Emporium Model in preparing developmental math students at a community college to be successful in College Algebra. A comprehensive literature review provides the necessary background information for the study. Chapter two is organized into the following sections: history and mission of the community college, challenges of community colleges, developmental education, developmental mathematics education, math anxiety, course redesign, the Emporium Model and the theoretical framework.

History and Mission of the Community College

The community college is a vital component of 21st- century American higher education. Community colleges include institutions that offer vocational diplomas, along with one- and two- year programs of general and liberal education leading to an associate degree. Although most community colleges are public, they may be private, proprietary or special purpose (Ratcliff, 2014). For a vast number of Americans, the path to higher education starts with a community college. According to Vaughan (2006), "community colleges are, in effect, stewards to the world" (p. 35). Community colleges are recognized as an important sector in the higher education system. No longer should community colleges be treated as the step-child of the college system. President Obama has recognized community colleges nationally as being the point of access to higher education for many students (Ricketts, 2009). Kevin Dougherty, a leading scholar of community college education, states that "the community college is the single largest and most important portal into higher education" (Bragg, 2001, p. 94).

Every state has at least one public community college (Vaughan, 2006). One fourth of all higher education institutions are community colleges. Approximately 45% of all first-time college entrants attend community college (Bragg, 2001). According to the American Association of Community Colleges (2013), more than half of the nation's undergraduates attend community colleges. Since 1901, at least 100 million people have attended community colleges (AACC, 2013). The growth of enrollment in community colleges has surpassed the enrollment growth of 4-year institutions. Enrollment at public 4-year colleges and universities roughly doubled from 1965 to 1999, while enrollment at public community colleges increased about five-fold during the same time span (Kasper, 2002-03). Community colleges have become the largest and fastest growing segment of higher education (Boggs, 2010). By 2009, seven million students were attending community colleges (Darby-Hudgens, 2012).

The predecessors of community colleges were the land-grant institutions established by the Morrill Act of 1862. The focus of these colleges was on agricultural and occupational curriculum. They were an extension of high schools and provided educational opportunities to students who were previously denied a post-secondary education (Ricketts, 2009). The current community college movement began in 1901, near Chicago, Illinois, with the founding of Joliet Junior College by William Rainey Harper and Stanley Brown. Harper, president of the University of Chicago and Brown, principal of Joliet High School, collaborated to find the first community college, Joliet Junior College, in order to expand students' educational opportunities beyond high school and to prepare students for the senior college (Boggs, 2010). The community college served as an intermediate institution. Realizing that many students needed additional study beyond high school because they were not ready for college-level work, Harper and other prominent figures in American higher education argued for the establishment of more intermediate institutions such as Joliet. These institutions would serve a dual purpose: to accommodate students needing further education but not qualified to pursue a bachelor's degree and to provide the general liberal arts curricular to students prior to transferring to four year schools (Ricketts, 2009).

In Neufeldt's (2002) book review of the *Growth of an American Invention: A Documentary History of the Junior and Community College Movement*, junior colleges were founded because of confusion and changes in higher education during the late nineteenth and early twentieth centuries. High schools were duplicating the course offerings of colleges and colleges were being pressured to serve more than elite students. Advocates for junior colleges proposed that junior colleges were a way to promote order and efficiency in higher education. Junior college leaders promised a low cost education, with a diverse curriculum to meet the needs of a broader population (Neufeldt, 2002).

During their early years, community colleges were basically an extension of high schools. The majority were private institutions with low enrollments offering the general liberal arts programs (Kasper, 2002-03). However, two decades after their founding, the number of community colleges grew rapidly, from twenty in 1909 to 170 by 1919 ("Community College Development", 2013). With the increase of community colleges, the American Association of Junior Colleges was organized in 1920 (Ricketts, 2009). By 1922, thirty-seven of forty-eight states had community colleges. By 1930, every state except five had community colleges for a total of 450 community colleges ("Community College Development", 2013). The institutions provided education that was both local and affordable (Ricketts, 2009).

Initially, community colleges focused mainly on general liberal arts studies. However, the focus changed during the Great Depression of the 1930's. Community colleges began to provide job training programs to help with the issues of unemployment. This trend continued through the 1940's and 1950's (Kasper, 2002-03). The passing of the Servicemen's Readjustment Act, also known as the G.I. Bill, in 1944 and the recommendations given by President Truman's Commission on Higher Education sparked the continued growth and expansion of community colleges. A strong emphasis was placed on providing educational opportunities to all aspiring students regardless of race, religion, or economic status (Ricketts, 2009). According to Kasper (2002-03), the number of community colleges and enrollments soared in the 1960s because baby boomers began reaching college age, more parents desired a post-secondary education for their children, and students attended school to avoid the draft during the Vietnam War. Many new public community colleges were built during the 1960's and 1970's. Enrollments increased from about 1 million students in 1965 to about 2.2 million in 1970. Enrollment almost doubled again during the 1970's from 2.2 million to 4.3 million by 1980 and community colleges became a major part of the American educational system (Kasper, 2002-03). By 1993, approximately 5.6 million students were enrolled in community colleges and enrollment numbers increased 17.6% to about 6.6 million students by 2002. The number of community colleges had grown to 1,186 in 2005 (Vaughan, 2006). The enrollment in community colleges had increased to approximately

12.4 million students in 2013. Community colleges awarded 750,399 associate degrees and 459,073 certificates in 2012 - 2013 (AACC, 2013).

The mission of the community college is complex, comprehensive, and continues to evolve in response to all the post-secondary needs of the society. A variety of functions and programs are necessary to provide educational services to the community. “Historically, community colleges have provided a gateway to opportunity for many young people who otherwise would have been denied access to higher education” (Kasper, 2002-03, p. 16). Most community colleges offer students the first two years of a baccalaureate education with the option to transfer to four-year institutions to complete their bachelor’s degree (Ricketts, 2009). Community colleges are designed to serve the post-secondary educational needs of their community by preparing students to transfer to universities or to enter the workforce directly. They provide access to high quality affordable higher education and training in local communities. A community college is within a short commute of 90% of the U.S. population (Boggs, 2010). The community college’s mission is to provide access to post-secondary educational programs at a low cost. Vaughan (2006) identifies the following commitments in the overall mission of community colleges:

1. serving all students equally through an open-door admission policy
2. providing a comprehensive educational program
3. serving the community
4. teaching and learning
5. fostering lifelong learning

In the area of open access and equity, national leaders recognize education as an important means for improving one's economic status and for eliminating poverty. Therefore, one of the nation's goals is to provide the opportunity for a higher education to all citizens and the community college is a key source for achieving that goal. With the Higher Education Act of 1965, the amendments of 1972, and other federal programs, financial assistance to attend college is available to almost all students who desire a post-secondary education. Additionally, entrance barriers are removed at community colleges because they are committed to open access admissions policies. They promise fair and equal treatment of all students (Vaughan, 2006).

As a result of open access and equity, the demographics at community colleges have changed significantly since their inception. Racial and ethnic minorities made up 20% of community college enrollments in 1976. By 1999, total minority enrollments reached 33%. Minorities accounted for 41% of the student population in colleges in 2002 and by 2013, minorities represented 50% of the population. Women's enrollment in community colleges has outgrown that of men. In 1970, 40% of all community college students were women. By 1980, 55% of community college students were women. In 2013, 57% of the students enrolled in community colleges were women (AACC, 2015; Kasper, 2002-03; Vaughan, 2006). The modern-day community college student tends to be older than their 4-year college counterpart. Only 35% of community college students are the traditional college age of 18 through 21. They are usually first-generation college students who also work full- or part-time to support their families (Bragg, 2001). According to Boggs (2010), 47% of first-generation college students attend community colleges.

By providing open access and equity, community colleges serve the diverse needs of their student population by offering various support services, such as counseling, academic advising, financial aid, child care, flexible scheduling, and distance education. "Open access and equity mean that men and women from all ethnic, social, and economic backgrounds can afford to attend the community college and that no one is discriminated against in any academic program or service offered by the college" (Vaughan, 2006, p.4). Community colleges are committed to helping students academically, including those who are not prepared for college-level work. Rather than turn away people who are not prepared, the community college offers programs to help students become prepared for success (Vaughan, 2006).

Community colleges are committed to offering a comprehensive program of study. They provide:

1. general and liberal education,
2. vocational and technical education,
3. adult, continuing, and community education,
4. developmental, remedial, and college-preparatory education, and
5. counseling, placement, and student development services (Ratcliff, 2014).

Community colleges offer programs that are designed to meet the needs of the community and the desires of the students (Vaughan, 2006). Vocational training programs and contract courses are offered to meet the needs of local employers. Community colleges often build partnerships with employers to provide job-specific skill training programs. These programs are important for local economic development. Evidence of the comprehensive role of community colleges is seen by the variety of certificates and degrees that are offered. The certificate programs appeal to those who want to upgrade their current skills or acquire new ones to increase their job opportunities in the marketplace. There are short-term certificate programs requiring less than one year to complete and longer term certificates that require one to four years to complete. Short-term certificate programs allow students to train quickly so that they can enter the workforce; longer term certificates cater to those pursuing careers that require lengthier periods of schooling (Kasper, 2002-03).

Providing an education to its local community is part of the mission of colleges. Although the needs of the community are diverse and ever-changing, community colleges are expected to meet those needs. Communities want programs that are transferable to a university. They want vocational and technical training and a choice of credit and non-credit courses that lead to certificates or degrees. Communities want the community college to offer developmental courses that will help prepare students for college-level work. The communities want community colleges to offer courses and activities that meet the recreational, social, and cultural needs of the community (Vaughan, 2006).

Community colleges are committed to teaching and learning (Vaughan, 2006). They tend to be more experimental and innovative in the development and delivery of instruction than 4-year universities ("Community College Development", 2013). A full range of education and training is offered by community colleges depending on societal needs and demands. They are adaptive and flexible. They train and educate from the bookkeeper to the accountant to those with an associate degree in business administration.

> Community colleges train the legal aid and legal assistant with general and specialized knowledge to support and complement the work of the lawyer. Community colleges educate numerous allied health professionals who work in support of physicians and surgeons. Career and transfer programs are open largely to all, because the community college also provides the development and remedial coursework necessary for individuals with the capacities, but not the formal education prerequisite, for entry into postsecondary education (Ratcliff, 2014, para. 36).

Community colleges' devotion to teaching and learning is also evident in their instructors. Community college leaders encourage faculty members to be devoted scholars by attending various workshops, conferences, and seminars in their area. By keeping up with their specific area of expertise, instructors are able to implement and share new developments with colleagues and students. More importantly, community college instructors need to be able to adjust their teaching styles to accommodate the diverse learning styles of the students (Vaughan, 2006).

Community colleges are committed to lifelong learning. The past trend of attending college for a certain number of years, then graduating and never returning to the classroom is changing. More people are seeing learning as a lifelong process. To keep up with the skills and knowledge required for their jobs, many people are returning to community colleges for formal training and activities. The community college's commitment to lifelong learning is evident in the limitless number of credit and non-credit courses, activities, and programs being offered. These programs are available for the traditional community college student as well as the older adult student returning to upgrade their skills. The programs are designed to enhance the lives of people for as long as they have the desire to learn (Vaughan, 2006).

Challenges of Community Colleges

Although community colleges serve as the access point to higher education for many students, they are faced with a number of challenges in the 21st century. Community colleges have been challenged with the task of increasing the educational attainment levels of Americans (Boggs, 2010). Community colleges are expected to build the nation's future (AACC, 2014). In 2009, President Obama called on community colleges to increase the number of graduates and program completers by five million students over a 10-year period, which represents a 50% increase in completion rates. The Health Care and Education Affordability Reconciliation Act was signed by Obama, providing $2 billion for the Community College and Career Training Grant Program that focuses on workforce preparation. Every American is asked to commit to at least one year of higher education or career training so that the United States would have the highest proportion of college graduates in the world. America's economic strength depends on the associate degree which increases the value of community colleges in society. The challenge is on community colleges to play a dominant role in strengthening local economies (Boggs, 2010).

The open-admissions policy of community colleges will also be challenged in the 21st century because of the large number of underprepared students seeking an education. The policy provides all students an opportunity to receive a post-secondary education thereby creating the most diverse student body in the history of higher education. Students may enter community colleges with low basic skills levels in reading, writing, and mathematics. The task of educating large numbers of underprepared students becomes overwhelming for community colleges. Challenges on how to balance open access while maintaining academic standards will need to be addressed and resolved. So, the question becomes why do community colleges continue to practice the open-door policy if it produces tension and causes community college faculty to work harder. Opponents of open access believe that open admission practices should be abandoned because it lowers academic standards. They believe some admission requirements are needed; otherwise, students are set up for failure. On the other side of the issue, supporters of open admissions believe that the policy should continue because it provides access to a higher education to students who would have been denied the opportunity. If the open admission policy is to continue, it is necessary for community colleges to develop strategies for faculty to implement in helping students with the required skills they need to be successful (Gabbard & Mupinga, 2013).

Bragg (2001) agrees that community colleges' commitment to open access will continue to offer great challenges. Another issue to be addressed is the financial difficulties for community colleges and the students who attend them. Financial difficulties will create limited resources for community colleges.

> Without adequate resources, ensuring access without adequate resources to deliver on opportunities makes for a shallow promise, particularly to those who rely most heavily on these institutions as a stepping stone to further education and viable employment. No doubt, a much more concerted effort needs to be made to examine critical questions surrounding access, mission, and outcomes (Bragg, 2001, p. 112).

Vaughan (2006) identifies preserving access, improving student success rates, responding appropriately to changing demographics, increasing global competition and addressing financial concerns as critical issues that community colleges face.

Community colleges are expected to build the nation's future. A new future for community colleges was envisioned by the 21st Century Commission on the Future of Community Colleges. In the Commission's report, *Reclaiming the American Dream: Community Colleges and the Nation's Future*, the goal of increasing completion rates of community colleges' students was set. The goal is to increase completion rates by 50% by 2020. The Commission recognized that it is necessary for community colleges to transform in order to achieve this goal. The transformation requires community colleges to redesign students' educational experiences, reinvest institutional roles, and reset the community college system so that it better promotes student success. Seven recommendations were given in the Commission's report: increase completion rates by 50% by 2020, improve college readiness, close the American skills gap, refocus the community college mission and redefine institutional roles, invest in collaborative support structures, target public and private investments strategically, and implement policies and practices that promote rigor and accountability. To increase the completion rates, community colleges will need to rethink and revise current practices to provide students with the tools, motivation, and support to finish what they started (AACC, 2014).

Developmental Education

The recurring challenge facing community colleges is increasing completion rates. This is a challenge because more than half of community college students are not prepared to succeed in college. The lack of preparation places many students into developmental education to take remedial courses in math, reading, and writing. Developmental or remedial education refers to a set of courses that help prepare students for success in college-level coursework (Parker, 2012).

Developmental education is not a new phenomenon in the history of American education. As early as the 1700's, colleges such as Harvard and William and Mary offered remedial coursework to their underprepared students. During the early nineteenth century, colleges sometimes admitted sons of wealthy alumni, who were not prepared. As the number of colleges grew in the mid-nineteenth century, entrance requirements became more stringent. Colleges saw an increase in the number of students who were not prepared to meet colleges' entrance requirements. This led to the development of preparatory departments within colleges. With the passing of the Morrill Act and support for women's access to higher education, the number of underprepared students continued to increase. A concern for the growing number of underprepared students led to a report by the Committee of Ten calling for secondary schools to do a better job of preparing students for college. The desires of the committee were not achieved and a growing number of students were still not prepared to meet entrance requirements in 1907 (Wilmer, 2008).

The passage of the G.I. Bill in the 1940's, the Civil Rights Movement of the 1960's, and baby boomers attending colleges were major events in America's history that enormously increased the underprepared population in college. This boost in enrollment allowed universities to become more selective in their admission policies and deny admittance to underprepared students. Many underprepared students turned to the community colleges that provided open access and affordable tuition to underprepared, first-generation students (Wilmer, 2008).

According to the National Association for Developmental Education (NADE), academic preparedness is not the only focus of developmental education. Diagnostic assessment, placement, general and specific learning strategies, and affective barriers are other services included in developmental education programs. The goals of developmental education are:

1. to make educational opportunities possible for each learner
2. to develop the necessary skills and attitudes for learners to achieve their goals
3. to assess and ensure proper placement of learners
4. to help learners acquire competencies needed to succeed in college-level courses
5. to enhance the retention of students
6. to continue to develop the cognitive and affective growth of learners (NADE, 2015).

Remedial or developmental courses are non-credit courses that do not count towards the requirements of a degree program (Gabbard & Mupinga, 2013). The number of students taking developmental courses is alarming. Nearly 60% of community college students take at least one developmental course during their community college career. The true percentage is probably higher because in some states developmental courses are not mandatory for students-although placement tests indicate that they should take a developmental course. Some colleges and professors ignore placement test scores and find ways to exempt some students from enrolling in a developmental course (Bailey, 2009).

The large number of underprepared students affects the goals of developmental education and complicates community colleges' efforts to improve transfer and graduation rates (Bailey, 2003). Although the purpose of developmental education is to prepare students to be successful in college level courses, many students fail to complete developmental courses. Between 33 and 46 percent of students referred to developmental education actually complete their entire developmental sequence (Bailey, Jeong & Cho, 2010). This low developmental education completion rate has caused some policymakers and researchers to question the effectiveness of developmental education in preparing underprepared students. On the contrary, proponents of developmental education argue that it is an effective tool for the underprivileged population (Bailey et al., 2010).

Since the beginning of developmental education programs, there have always been questions concerning the value and necessity of developmental education. Arguments for or against developmental education exist throughout the higher education community. Regardless of one's position on developmental education, a substantial number of underprepared students are present in colleges (Wilmer, 2008). Despite the opposing views, the research on the effectiveness of developmental education is sparse (Bailey et al., 2010). The limited research is inconclusive because institutions do not conduct a systematic evaluation of their developmental education programs (The Institute for Higher Education Policy, 1998). Also, some studies base the effectiveness of developmental education on the number of associate degrees awarded in a three to four-year time period. Such studies do not account for students who attend part-time and require a longer time period to complete their degrees (McCabe, 2000). According to Bailey (2009), “much of the research on developmental education is suggestive but cannot reliably measure the effect of remediation or differentiate among various approaches. The handful of more definitive studies shows mixed results at best” (pp. 24 - 25).

Developmental education seems simple in theory, but it is complex and confusing in practice. One reason for the complexity and confusion of developmental education is the lack of agreement by experts on the meaning of “college ready” or “college-level work” (Bailey et al., 2010). There is no national consensus about what level of skills is needed to be college ready (Bailey, 2009). Policies and practices concerning assessment, placement, completion, and eligibility for enrollment in college-level, credit-bearing courses vary from state to state, college to college, and program to program. Developmental education is also confusing to students who are placed in remedial courses. To some students, developmental education courses appear to be obstacles to degree completion. Students may be assigned to two or more developmental courses based upon their performance on placement tests. They are expected to complete the developmental course sequence in a step-by-step fashion until completion of the highest level developmental course in the assigned remedial area. A fair assessment of developmental education is complex because students do not follow the order of their prescribed sequence and skip steps or enroll in lower level courses (Bailey et al., 2010). Some students resist remediation, become frustrated, and leave community colleges (Bailey, 2009).

Developmental Mathematics Education

Developmental courses are typically offered in the areas of reading, writing, and math. More students need remediation in math than in any other area. In the fall of 2007, 35% of entering freshmen enrolled in a developmental math course, compared to 20% in developmental reading and 23% in developmental writing (Zientek, Ozel, Fong & Griffin, 2013). Bailey (2009) agrees that students struggle more with developmental math courses than any other developmental courses. The Southern Regional Education Board (SREB) reports the number of students requiring remediation in mathematics exceeds numbers for remediation in either reading or English (Kaye et al., 2006). Overall, nearly 33% of students admitted to post-secondary institutions are not prepared for college-level mathematics (McCormick & Lucas, 2011). This lack of mathematics college readiness impacts the success rates of developmental math courses. According to data from the National Education Longitudinal Study (NELS), 68% of students pass developmental writing courses, 71% pass developmental reading courses, but only 30% pass their developmental math courses (Bailey, 2009). Attewell, et al. (2006) found that students who enroll and do not successfully complete their developmental math courses were less likely to earn a degree. However, several researchers have found a positive correlation between developmental programs evaluation and success in developmental math programs (Waycaster, 2011).

A study at Virginia Highlands Community College compared students who were required to take at least one developmental math class before completing a college-level class to those who placed directly into a college-level math course. The study found that the passing rate for the two groups were almost the same with a 77% passing rate for the students who had a developmental math course and a 75% passing rate for those who did not have to take a developmental math course (Waycaster, 2011). Other studies cited by Waycaster (2011) found that students who successfully completed the remedial programs do just as well or better than non-developmental students in college-level work. A study conducted at the University of Minnesota also found no significant difference in the college algebra or pre-calculus passing rates between students who took one or more developmental courses and those who placed directly in college algebra or pre-calculus (Kinney, 2001).

Bahr (2008) notes that students who remediate successfully in math achieve attainment levels that are comparable to those students who do not take remedial math classes, regardless of the initial placement level of the developmental students. In fact, the two groups are indistinguishable from one another in terms of credential attainment and transfer (Bahr, 2008). According to Bonham and Boylan (2011), students who passed their developmental mathematics courses requirements were as successful in subsequent mathematics courses as those who were not required to take developmental mathematics courses. Developmental mathematics courses appear to be effective for those students who successfully complete them. Unfortunately, 75.4% of students referred to developmental courses do not complete their developmental mathematics courses, and 81.5% do not complete a credential or do not transfer (Bahr, 2008).

The initial developmental mathematics placement level affects the successful completion rates of students in developmental mathematics courses. The common courses of the developmental mathematics sequence are Basic Math, Beginning Algebra and Intermediate Algebra. Students who start at the lower levels of the developmental mathematics sequence are less likely to take college-level mathematics courses than those students who start at the highest level of the sequence. In a study conducted by the Community College Research Center, only 19% of students who place into the lowest level developmental course eventually enroll into a college-level math course (Jenkins, Jaggars, & Roksa, 2009). Similar results were found in an analysis of developmental mathematics students who attended one of the 57 community colleges participating in *Achieving the Dream*. Only 16% of students referred to the lowest level of developmental mathematics completed their developmental mathematics coursework. Additionally, only 10% of this group ever completes a college-level mathematics course (Le et al., 2011). On the contrary, students who placed into Intermediate Algebra, the highest developmental course, were more than twice as likely to complete their developmental math courses as students who placed into Beginning Algebra and more than three times as likely as students who placed into Basic Math. About 11% of students who placed into the two lowest levels successfully completed a college-level mathematics course within six years. However, about 54% of students placed into the highest level of the developmental mathematics sequence successfully completed a college-level mathematics course within six years (Bahr, 2007).

The number of students failing to complete their developmental mathematics courses is disappointing. Several reasons for why students fail to complete their developmental mathematics courses have been given by researchers. Hadden (2000) suggests that placing students in low ability groups negatively affects their self-perception and academic performance. Students fail to complete developmental mathematics courses because they become discouraged by the number of non-credit courses they have to pass before enrolling into a college-level mathematics course (McCusker, 1999). If students are required to also take developmental courses in other subject areas, their academic performance in the developmental mathematics courses are lessened (Bahr, 2007). Tapia and Marsh (2004) recognized that students with negative attitudes toward mathematics have performance problems simply because of anxiety.

Math Anxiety

Richardson and Suinn (1972) describe math anxiety as “feelings of tension and anxiety that interfere with the manipulation of mathematical problems in a wide variety of ordinary life and academic situations” (p. 551). Buckley and Ribordy (1982) define math anxiety as “an inconceivable dread of mathematics that can interfere with manipulating numbers and solving mathematical problems with a variety of everyday life and academic situations” (p. 1). Math anxiety is simply a fear of mathematics (Iossi, 2007). Many students do not feel confident in their ability to do math (Duffy & Furner, 2002).

Math anxiety is a common issue in community college students taking/enrolled in developmental math (Woodard, 2004). The passing rates in developmental mathematics classes are below 50% and math anxiety contributes to this dismal statistic (Iossi, 2007). Research has shown relationships between math anxiety and achievement. A negative relationship between math anxiety and math achievement has been found across all grade levels, K – college (Betz, 1978; Ma, 1999; Woodard, 2004).

Math anxious students often complain of not being “good” math students or “not liking” mathematics. They often say that math is their least favorite or worst subject. They have a very negative attitude towards mathematics. Students with high levels of math anxiety display nervousness and an inability to concentrate in a math class. Math anxious students complain of having a blank mind and a sick feeling when confronted with taking a math test (Woodard, 2004). Students with math anxiety may also feel embarrassed, irritated, frustrated, and fearful (Buxton, 1981).

Various reasons for students having math anxiety are identified in the literature. According to Duffy and Furner (2002), math anxiety may be caused by low performance on math tests, challenging math assignments that lead to frustration, or negative opinions of parents and teachers. Parents and teachers who are afraid of mathematics pass that attitude on to their children and students. Woodard (2004) identifies poor math instruction, negative attitudes about math, negative math experiences, and low self-esteem as causes of math anxiety. Math anxiety can result from environmental factors such as myths, teachers, and parents (Steele & Arth, 1998; Trujillo & Hadfield, 1999). Intellectual factors that affect math anxiety include learning styles, persistence, self-doubt and dyslexia (Harper & Daane, 1998; Trujillo & Hadfield, 1999). Low self-esteem, shyness, and intimidation are personality factors that may also cause math-anxious students (Fotoples, 2000; Levine, 1995).

Math anxiety may range from mild to extreme math anxiety (Perry, 2004). Some researchers have developed scales to measure students' math anxiety. One of the first instruments developed was the Duncan Scale in 1954. It measured students' feelings towards arithmetic. Most of the earlier instruments were one-dimensional scales that dealt with enjoyment of subject matter such as those developed by Gladstone, Deal and Drevdahl in 1960 and Aiken and Dreger in 1961. In 1974, Aiken developed an instrument designed to measure enjoyment of mathematics and the value of mathematics.

Multi-dimensional attitude scales were also developed by Michaels and Forsyth in 1977 and Sandman in 1980. Some instruments were developed to measure mathematics anxiety exclusively. Examples of such scales are the Mathematics Anxiety Rating Scale, Mathematics Anxiety Rating Scale Revised and the Mathematics Anxiety Questionnaire (Tapia & Marsh, 2004). The most popular instrument to measure mathematics anxiety is the Fennema-Sherman Mathematics Attitudes Scales, developed in 1976. The instrument consists of 108 items and takes approximately 45 minutes to complete. The Attitudes Toward Mathematics Inventory (ATMI) was designed to investigate the underlying dimensions of attitudes toward mathematics. This instrument is shorter than the Fennema-Sherman Mathematics Attitudes Scales, with only 49 items. The items of the ATMI measure confidence, anxiety, value, enjoyment, motivation, and parent/teacher expectations. Regardless of which instrument is used, high math anxious students are simply less competent at doing math (Tapia & Marsh, 2004). Realizing the impact of high math anxiety on students' performance in class, it is important to find ways to reduce math anxiety.

Reducing Math Anxiety

Teachers can help prevent and reduce math anxiety by being sensitive to the needs and fears of their students. They should become familiar with students' learning styles and be willing to adjust teaching practices to accommodate all students (Cornell, 1999; Fiore, 1999; Fotoples, 2000; Steele & Arth, 1998). Teachers can also help students overcome their fear of mathematics by creating a comfortable atmosphere and providing opportunities for students to be successful in the math classroom (Jackson & Leffingwell, 1999; Steele & Arth, 1998). Provide encouragement to math anxious students to reduce their fear of learning mathematics (Godby, 1997). For students struggling with tests, use alternate forms of assessment to reduce math anxiety (Steele & Arth, 1998). Schwartz (2000) identifies reviewing basic math skills, helping students understand the math language, and providing a support system for students as strategies teachers can implement to help reduce math anxiety. Math teachers need to be excited and motivated about teaching mathematics. They are to encourage the students to keep trying and not to give up (Jackson & Leffingwell, 1999).

Woodard (2004) gives a variety of techniques to help with math anxiety in community college students. Instructors can create an atmosphere where students do not feel threatened when called upon in class. In a relaxed atmosphere, students will not be embarrassed to ask questions or work problems on the board. Allowing the students to work in cooperative groups is another technique to help reduce math anxiety. As students work together in groups, they will see that other students may have similar problems and by working together they can help each other solve problems. Another suggested technique is to give students a second chance at taking a test. This technique reduces stress and builds up students' confidence because they know that if they fail the first time, they will have another attempt to do better. To reduce math anxiety, it is also helpful for students to believe that the instructors genuinely care about them and want them to succeed. Instructors must be available to tutor students as needed (Woodard, 2004).

Iossi (2007) recognizes curricular, instructional, and non-instructional strategies for minimizing math anxiety. Curricular strategies include retesting, self-paced learning, distance education, and math anxiety courses.

Retesting. Retesting is a strategy for minimizing math anxiety because it allows students a second chance to improve their math performance on a test. Knowing that another opportunity will be given to re-do a test helps ease students' fears about taking a test. A study by Juhler, Rech, From, and Brogan (1998) on the results of retests in an intermediate algebra class showed that students viewed retesting as helpful. Approximately 90% of the students improved their performance on the retest. Furthermore, 80% of the students reported that retesting eased anxiety, whether they used the retest option or not. Retests may help students overcome past feelings of failure and offer an emotional safety net for students with test anxiety (Juhler et al., 1998). Iossi (2007) recognizes retesting as a feasible option because of test generators that can create multiple versions of exams.

Self-Paced Learning. Another suggestion for reducing math anxiety is self-paced learning. In a self-paced learning environment, students are allowed to proceed from one topic to the next at their own speed. Eppler, Harju, Ironsmith, and Marva (2003) found that when students were allowed to focus on achieving goals within their own timeline, they were less anxious. The students were more relaxed as they were allowed to work at their own pace.

Distance Education. Distance education may be beneficial in reducing math anxiety. By being allowed to work online at home, students do not have to worry about being called on unexpectedly in class. Taylor and Mohr (2001) found that 90% of students in their sample of developmental distance learning students felt more confident in managing everyday mathematics and mathematics in their future studies. Also, 51%

of the 53 students reported that they had overcome their declared feelings of math anxiety to successfully pass the course (Taylor & Mohr, 2001).

Math Anxiety Courses. A semester long math anxiety course may be beneficial for decreasing math anxiety. Several colleges offer math anxiety relaxation/confidence groups to help students in coping with math anxiety: University of Florida has a math confidence group that meets weekly; Butte College offers a one credit course entitled, *Math Without Fear*; American River College offers a ½ credit course through its counseling department entitled, *Dealing with Math Anxiety* (Iossi, 2007). The goal of these courses is to help students overcome their fears of mathematics and to help them be successful in math classes.

The instructional strategies for reducing math anxiety include teachers' techniques, self-regulation techniques and communication.

Teachers' Techniques. Instructors can incorporate anti-anxiety measures in presentation and assessment of mathematics material (Iossi, 2007). Several studies (Harper & Daane, 1998; Sloan, Vinson, Haynes, & Gresham, 1997; Vinson, 2001) found that the use of manipulatives resulted in a significant reduction in math anxiety. Students enjoyed "doing something" as opposed to sitting back and just taking notes. The manipulatives and hands-on approach helped them better understand math concepts in a tangible way. Sloan, Daane, and Giesen (2002) reported higher levels of math anxiety with traditional methods of instruction. Osborne (2001) advises instructors to caution students against stereotypes and emphasize effort over ability.

Self-Regulation Techniques. Students can also implement techniques to minimize their own math anxiety. Three suggestions were given by Perry (2004) that students can implement for themselves to reduce math anxiety:

1. Students can stop making excuses and direct their energies towards improving their math abilities and solving problems
2. Students should not believe in negative stereotypes that say they cannot do well; and
3. Students should keep a positive attitude.

Steele and Arth (1998) suggest that students can help reduce math anxiety by keeping math journals, identifying what causes the anxiety, and maintaining positive self-talks.

Communication. It is important for instructors to be sensitive when communicating with students and encourage a classroom environment that displays mutual respect (Jackson & Leffingwell, 1999). By allowing students to work with a partner or in small groups, instructors can help reduce math anxiety. Allow students the opportunities for small successes early in the course (Harper & Daane, 1998). Other communication strategies to help reduce math anxiety include flexible methods of content presentation, flashcards, math related computer software, breaking problems into sub-tasks, visual models, using graph paper for organizing numbers, and creating a glossary of math terms and concepts (McGlaughlin, Knoop, & Holliday, 2005).

The non-instructional strategies for reducing math anxiety are relaxation therapy and psychological treatment. Although the research is limited, meditation, yoga, and psychotherapy are strategies for reducing math anxiety (Iossi, 2007). For psychological treatments, Hembree (1990) found that whole class psychological treatments were not effective in reducing math anxiety. A better psychological treatment is out-of-class anxiety management training.

Course Redesigns

With the dismal number of community college students passing developmental math courses and the pervasiveness of math anxiety, mathematics departments are exploring different approaches to address both issues in hopes of improving the success rates in developmental courses. To improve college completion rates, Parker (2012) suggests that it is necessary to reform developmental education. For many community colleges, the current reform involves course redesigns. The program in course redesign is supported by the National Center for Academic Transformation (NCAT). NCAT is an independent, non-profit organization founded in 1999 to provide leadership to institutions in using technology to redesign learning environments to produce better learning outcomes at a reduced cost. According to the NCAT website, 195 redesigned projects have been initiated and 80% of them were completed. Of the completed projects, 72% improved student learning outcomes and 28% showed learning equivalent to traditional formats. Other positive outcomes include increased course-completion rates, improved retention, better student attitudes toward the subject matter, and increased student and faculty satisfaction with the new mode of instruction (NCAT, 2005a).

Course redesign focuses on restructuring whole courses, rather than individual classes or sections, to achieve better learning outcomes. A variety of redesign models exist and different approaches have been taken to redesign the curriculum in developmental mathematics. Courses with high withdrawal/failure rates are recommended as targets for redesigns. The use of multiple teaching methods as opposed to a single method is utilized in course redesign (Bonham & Boylan, 2011).

A number of programs to accelerate students' progress toward earning degrees have been developed. The focus of the programs has been on shortening the time it takes to complete remedial courses. While some of the programs have been effective, they are often small and limited to just a few students or courses. Such programs will not accomplish large scale, systemic change. Neither will top-down, one-dimensional approaches from the college administrator. For meaningful changes to take place, solutions that work must reach many more colleges and students. The Developmental Education Initiative, funded by Bill and Melinda Gates and Lumina foundation, aims to expand promising programs to a larger scale to include more colleges and students (Parker, 2012).

Achieving the Dream: Community Colleges Count is a national program that seeks to help more community college students stay in school and earn a college certificate or degree. The Developmental Education Initiative is supporting the efforts of *Achieving the Dream* by bringing together 15 community colleges to build on developmental education innovations that have been effective at their institutions. The hope of the Initiative is that participating colleges would collaborate and learn about effective programs from each other. The goal is to mimic programs that have proven to be effective with a small group to more colleges and students. For example, if a college has piloted a program that has helped a small number of its students move more quickly through a developmental education sequence, it may seek to expand that project to reach most or all of its students who could benefit from the program. The idea is for colleges to focus on making an impact on a larger scale to have a significant increase in completion rates. The Developmental Education Initiative is a key step in getting beyond interesting, isolated experiments to scalable reforms. One real way to make a difference in the developmental education program is to make sure that effective programs reach as many students as possible (Parker, 2012).

The state of Virginia is a part of the Developmental Education Initiative. In 2013, all 23 colleges in the Virginia Community College System used a new, innovative approach to redesign developmental math and English. In their redesign model, all students will take a common diagnostic placement exam. Developmental math will be taught in a series of nine modules, rather than the traditional semester-long sequence. Students will start where the diagnostic exam places them and take only the modules required for their chosen area of study. For English, depending on placement tests results, some students take an expanded year-long developmental course while others, co-enroll in a developmental course and a college level English composition class (Parker, 2012).

Other colleges are implementing programs to move students more quickly through developmental education programs. In the accelerated learning programs at the Community College of Baltimore County, Community College of Denver, and Chabot College in California, students placed in upper level developmental courses are allowed to enroll in college level courses and take an additional developmental course that meets immediately after the regular class. The follow-up class is taught by the same instructor as the regular class but involves a smaller number of students. This allows the students to have extra support in completing their courses (Parker, 2012).

In Washington State, the Integrated Basic Education and Skills Training Program (I-BEST) has shown positive student outcomes. This strategy involves developmental education faculty teaching courses jointly with faculty in technical skills programs. The idea of I-BEST is to help students see the practical value of their math, reading, and writing skills and move them more quickly to college-level courses. Other redesign approaches include short refresher courses and learning communities. The short refresher courses are beneficial to adult students who need to brush up on their basic skills in certain areas. These courses are usually one to six weeks and target the coursework students need to review. Learning communities are structured to have the same group of students take several courses together and simultaneously receive services and support to help them complete their courses (Parker, 2012).

Community colleges are also increasing their efforts to train faculty who are teaching developmental courses. The training provides best practices and strategies on how to teach underprepared students in an engaging manner. Faculty workshops on developmental education, on students and their needs, on how to best teach these subjects, and on how these courses fit in with the larger work of colleges are being offered to reform teaching in the classroom. Some programs engage faculty in creating curriculum, testing it, receiving student feedback, and continually adjusting as needed (Parker, 2012).

Overall, the need for course redesign is greatest in the area of mathematics. Students are more likely to fail developmental mathematics than any other courses in higher education. Two newly designed pathways involving 27 community colleges across 8 states specifically targeting mathematics redesign are Quantway and Statway.

The focus of these programs is to revamp the developmental math curriculum in community colleges so that it provides students with the skills they need for the 21st century. The project is spearheaded by the Carnegie Foundation for the Advancement of Teaching, in partnership with mathematics professor, Uri Treisman, and the Dana Center at the University of Texas at Austin. It is funded by the Kresge Foundation, the Carnegie Corporation of New York, the William and Flora Hewlett Foundation, the Bill and Melinda Gates Foundation, and Lumina. Both Statway and Quantway target students who are at serious risk of failing mathematics courses at the community college level (Parker, 2012).

Quantway is designed for the non-math and science majors. The emphasis is on helping students to understand basic math concepts and numbers that they face on a daily basis. The focus is on helping students apply mathematical concepts and number sense in decision-making about real world questions and problems. On the other hand, Statway is a pathway that combines statistics with necessary developmental mathematics topics. Successful completion of Statway permits students to receive credit for a college-level transferable statistics course. Both pathways use materials and teaching approaches that engage students. The goal of the programs is to double the proportion of students who are mathematically prepared to succeed in further academic study (Parker, 2012).

Other redesign programs to improve students' success in developmental mathematics include greater use of technology as a supplement to classroom instruction; integration of classroom and lab instruction; offering different delivery formats (on-line, hybrid, face-to-face); project-based instruction; and varied teaching techniques, such as mastery learning, active learning, attention to affective factors, and contextual learning

(Bonham & Boylan, 2011). Twigg (2003) identifies five distinct course redesign models: supplemental, replacement, emporium, fully online, and buffet. Each model is supported by research or has been identified as promising practices in developmental education. In these models, technology is used for homework, quizzes, and exams. Tutorials are delivered through computer-based instruction. The approach of the redesign models is to foster greater student engagement with the material. A major advantage of the redesign models is that students actually learn math by doing math rather than spending time listening to someone talk about doing math. A major disadvantage is the over-reliance on technology to deliver all instruction with little or no intervention (Bonham & Boylan, 2011).

The supplemental model has the basic structure of the traditional class, including the regular number of meeting times, but supplements lecture and textbooks with a variety of computer-based activities. In some of the supplemental redesigns, the computer-based activities are out of class activities to encourage greater student engagement with course content. Others, change the format of the in class meetings in addition to assigning out of class activities (Twigg, 2003).

The replacement model reduces in class meeting times and replaces class time with online, interactive learning activities for students. In some cases, the out of class activities take place in computer labs. For others, the out-of-class activities are done online giving students the freedom of completing the activities anytime and anywhere. The replacement model does not assume that face-to-face meetings are the best setting for student learning (Twigg, 2003).

The emporium model eliminates lecturing in the classroom. Instead of passively listening to lectures, students actively engage in mastering course content by working problems online. Course content is divided into modules with links to a variety of learning tools, such as interactive video lectures, lecture notes, homework exercises, quizzes, and tests. Instructors are available in the lab to answer students' questions, individually. Students can work at their own pace and have the option to view additional explanations and examples as needed. Students are in control of their own learning and may spend as little or as much time as needed to master course content. This model allows students to choose when to access course materials, what types of learning materials to use depending on their needs, and how quickly to work through the materials. In some emporium model formats, an open-attendance format is followed. Others have mandatory attendance and required meetings to ensure that students spend sufficient time on task (Twigg, 2003).

The fully online model is not really fully online as implied by the name. This model assumes that the instructor is responsible for all interactions, personally answering every inquiry, comment, or discussion. As a result, faculty members spend more time teaching in the fully online model than they would in a face-to-face setting. Rather than follow this labor-intensive model, most fully online models adapt many of the principles used by the supplemental, replacement, and emporium models (Twigg, 2003).

In the buffet model, the one-size fits all approach is abandoned. All students are not treated the same. The objective of the buffet model is to tailor instruction to the individual needs of the student. Students are treated like individuals, rather than homogeneous groups. The learning environment is customized for each student, allowing students to have greater choices. For example, students differ in the amount of interaction that they require with faculty. Some students prefer to pursue their studies independently; others have a strong need for interaction. The buffet model suggests a large variety of offerings that can be customized to fit the needs of the individual learner (Twigg, 2003).

Regardless to which redesign model institutions implement, Bonham and Boylan (2011) give the following recommendations: establish clear goals; acquire strong administrative support; be selective in what can be done effectively online; develop a conceptual framework to guide the process; build institution-wide support; and provide a detailed orientation of the program for students. Twigg (2003) recognizes that all the redesign models are works in progress that need to be continuously worked on and improved upon. Twigg (2003) says, “Sustaining innovation depends on a commitment to collaborative development and continuous quality improvement that systematically incorporates feedback from all involved in the teaching and learning process” (p. 38).

Emporium Model

The redesign model of interest in this study is the Emporium Model. This model was first introduced by Virginia Tech in 1999 to utilize technology in the classroom, to accommodate increasing student enrollment, and to assist professors teaching pre-calculus courses (Hirschhorn & May, 2000). The Emporium Model involves active learning that uses technology to allow students to work at their own pace. According to Twigg (2011), “the underlying principle is simple: Students learn math by doing math, not listening to someone talk about doing math. Interactive computer software, personalized on-demand assistance, and mandatory student participation are the key elements of success" (p. 26).

The Emporium Model achieves reform by eliminating all lectures and replacing them with a learning resource or computer lab center featuring interactive software and on-demand personalized help; relying on instructional software that includes homework, quizzes and tests, with immediate feedback to the student; allowing students to work through the material at a pace that is comfortable for them; using a staffing model that involves faculty and both professional and peer tutors; and allowing students to complete more than one course within a semester (NCAT, 2012a). Although the model has been implemented in various ways, the critical components involve eliminating lecture, using interactive computer software, and providing personalized, on-demand assistance. The model has four core principles that are believed to be vital to the success of the program:

1. Students spend time doing math problems rather than listening to someone talk about doing math.
2. Students spend more time on skills not mastered and less time on skills already mastered.
3. Students receive assistance as needed.
4. Students are required to do math (Twigg, 2011).

One of the major instructional strategies of the emporium model is to move students from passive note-taking to active learning. The interactive tutorials and exercises give students needed practice and support. Students are allowed to access, experiment and engage with course materials as often as needed to master concepts. They receive instant feedback when doing homework and guided solutions when their answers are incorrect (NCAT, 2005a).

NCAT identifies ten elements that are essential to the success of the emporium model. To improve student success and reduce cost, institutions will need to integrate all ten elements into their redesign program. The elements are: redesign the whole course sequence and establish greater course consistency, require active learning and ensure that students are “doing” math, hold class in a computer lab or computer classroom using commercial instructional software, modularize course materials and course structure, require mastery learning, build in on-going assessment and prompt (automated) feedback, provide students with one-on-one, on-demand assistance from highly trained personnel, ensure sufficient time on task, monitor student progress and intervene when necessary, and measure learning, completion, and cost (NCAT, 2005b).

In 2009, NCAT launched a three-year program for community colleges to use the emporium model to redesign their entire developmental math sequence to improve student learning and to reduce instructional costs. Thirty-two community colleges participated in the project. NCAT’s staff guaranteed that if the participating institutions followed their advice that the institutions would improve student learning, increase completion rates of the developmental math sequence, prepare students to succeed in college-level math, and reduce institutional costs. A total of 86 developmental math courses were redesigned. The effectiveness of the redesigns was based on common final exam scores, common exam items, and/or gains on pre- and post-tests in the traditional and redesigned formats of the courses. The results were as follows: in the area of student learning, 83% of the redesigned courses showed significant improvements over the traditional format; 6% showed improvements, but not significant; 8% showed no significant difference; 1% showed decreased learning, but not significant; and 2% had insufficient data to make a comparison. At Manchester Community College (CT), a weighted average of correct responses on 15 common test items showed an increase from 49 to 57 in pre-algebra and from 34 to 50 in elementary algebra. Pearl River Community College (MS) compared common final exam scores in the traditional and redesigned courses. The mean scores improved in all three of the redesigned courses: 45% vs. 84% in fundamentals of math; 51% vs. 74% in beginning algebra; and 60% vs. 72% in intermediate algebra. At Roberson Community College (NC), mean scores on common final exams improved from 69% to 85% in essential mathematics and from 69% to 79% in introductory algebra. Northern Virginia Community College (VA) compared performance on 30 exam questions given to both groups of students. Means increased from 66% to 84% in arithmetic, 65% to 91% in Algebra I, and 57% to 87% in Algebra II (Twigg, 2013).

Each participating institution compared course by course completion rates in the traditional and redesigned formats, with the following results: twenty redesigned courses (or 23%) had higher completion rates than the traditional ones; five courses (or 6%) showed no significant difference; thirty-six redesigned courses (or 42%) had lower completion rates; twenty-three of the courses (or 27%) had no basis to calculate completion rates because multiple courses were combined into one; and two of the courses (or 2%) collected insufficient data to make a comparison. Completion of the developmental math sequence and success in subsequent college-level math courses are the two most important data points to use in comparing student success rates between the traditional and redesigned formats. However, the time period of the program was not long enough for most of the participating institutions to gather information on subsequent courses. At Northwest Shoals Community College (AL), the percentage of developmental math students completing a college-level math course increased from 42% before 2011 redesign to 76% after the redesign. The percentage of developmental math students successfully completing college-level courses also increased at Somerset Community College (KY): from 56% to 67% in applied mathematics and from 37% to 43% in intermediate algebra. In the area of cost savings, all but one of the 32 participating institutions reported a reduction in costs. The average cost reduction was about 20% (Twigg, 2013).

The basic structure of the Emporium Model eliminates the traditional classroom lecture and replaces it with students working on math during class in a computer lab/computer classroom. The course content and materials are modularized. Each module contains online homework problems, quizzes, notebook assignments and tests corresponding to learning objectives or competencies within the course sequence. Students can progress quickly or slowly, as needed. They could complete one course early and move into the next course in the same semester. Students who do not finish the required modules in one semester may begin working the next semester where they left off in the previous semester (Twigg, 2013).

Mastery learning is the targeted goal of the Emporium Model program. Students begin each module with a pre-test. Mastery of a pre-test (as determined by the institution's math department) allows a student to by-pass that module and move into the next module of the course. If mastery is not achieved on a pre-test, then the students begin working on the homework assignments for that module. They are required to complete each assignment successfully and can only advance to the next assignment after mastering the previous one. As students work on assignments, instructional software and learning aids are available to explain concepts and provide examples. The software and instructional aids include lecture videos, animated examples, electronic textbook, study plans, and hints on how to solve problems. In addition to the readily available online instructional aids, an instructor and multiple tutors are present in the lab with students to provide one-on-one, personalized, and on-demand assistance to address specific student problems. As students work on homework assignments, the interactive software provides timely feedback to the students. When working a homework assignment, they immediately know if an answer is correct or incorrect. If a problem's answer is incorrect, resources are available for students to view to correct their misunderstandings and try the problem again or do a similar exercise. Students may work on homework assignments, quizzes, and practice tests anywhere and anytime. They are also encouraged to work on the assignments outside of class. After completing all the homework assignments for a module, students take a post-test. Post-tests are proctored and have to be taken in a testing center or computer lab. During a post-test, the learning aids are unavailable and the score on the post-test is not given until the test is complete. Mastery on the post-test has to be achieved before students advance to the next module. Students who fail a post-test meet with the instructor to review their work and identify problem areas. The instructor assigns remediation strategies, such as completing a study plan or mastering a practice test, before students are permitted to take a re-test. The process continues until mastery of the course final exam. Although the class is self-paced, instructors provide students a schedule of weekly expectations for completion. Weekly schedules help students to see where they should be in the course and what they need to work on to complete the course on time (Twigg, 2013).

Several institutions have implemented the emporium model format since its inception in 1999. The major concerns for most of these institutions were increasing success rates in developmental math courses, reducing the amount of time spent in developmental courses, and decreasing the amount of money spent on taking developmental courses. The redesigned projects of Cleveland State Community College and Jackson State Community College were recognized as programs worth replicating at other colleges. At both institutions, three developmental math courses were replaced with a modularized curriculum that allowed students to progress through course content modules at a faster or slower pace. A mastery based learning strategy was used requiring students to demonstrate mastery before moving from one homework assignment to the next. After completing all homework assignments, students take a practice test as many times as needed in preparation for the post-test. Once ready, students must take and pass a proctored post-test to go on to the next module (Twigg, 2011).

In Spring 2008, Jackson State Community College offered 11 sections of the traditional format and 13 sections of the redesigned format. The results showed an average increase of 15 points on post-test scores in the redesigned courses. The average post-test score for all 12 modules was 73% in the traditional sections vs. 83% in the redesign sections. 41% of the students earned a grade of C or better in the traditional sections compared to 54% in the redesigned sections (NCAT, 2012b). Students were able to accelerate through developmental mathematics with 25 students completing one course and part of a second course. 10 students completed two full courses in one term (Epper & Baker, 2009).

At Cleveland State Community College, course completion rates increased from 54% to 72%. The rate of students exiting developmental mathematics courses increased by 47% (NCAT, 2012c). Prior to the redesign, an average of 55% of students taking any developmental math course earned a final grade of C or better. After the redesign, 72% earned a grade of C or better. The completion rate of developmental students in subsequent college-level courses was 71% before the redesign and 81% after the redesign (Twigg, 2011).

Theoretical Framework

Self-regulated theory is an underlying principle in the emporium model classroom. Students are expected to take ownership for their own learning. The environment is self-paced and individualized to accommodate learning preferences of the student. Self-regulated learning (SRL) theory considers the extent to which learners are active participants in their own learning process. "The basic tenet of SRL theory is that effective learning is accomplished through the continuous and dynamic adjustment of specific motivational and cognitive components that enable the learner to achieve particular learning goals, both academic and clinical" (Sandars, 2013, p. 1162). According to Pintrich (2000), SRL is an active process that places the learner in control of setting, monitoring, achieving, and re-adjusting one's goals as needed. Self-regulation is the process whereby learners systematically direct their thoughts, feelings, and actions toward the attainment of their goals (Flavell & Miller, 1998). Zimmerman (2001) states that SRL involves being behaviorally, cognitively, meta-cognitively, and motivationally active in one's learning and performance. It is learning that is achieved from the students' own self-generated thoughts and behaviors (Zimmerman, 2001).

SRL is a highly relevant and valuable concept in higher education. It is an essential requirement for individuals to maintain lifelong learning (Cassidy, 2011). Self-regulated learning is not the same as one's mental ability or academic performance skills. Instead, it refers to a self-directed internal drive that motivates learners to achieve their goals (Zimmerman, 1998). Self-regulation abilities include goal setting, self-monitoring, self-instruction, and self-reinforcement (Harris & Graham, 1999; Schraw, Crippen, & Hartley, 2006; Schunk, 1996).

SRL is a cyclic process that contains feedback loops (Lord, Diefendorff, Schmidt, & Hall, 2010). Self-regulated learners set goals and monitor their progress toward these goals. They respond to their monitoring and make adjustments as needed (Sitzmann & Ely, 2011). Zimmerman (2002) suggests that there are three phases of self-regulated learning: forethought, performance, and self-reflection. During the forethought phase, goals are set and strategic plans for achieving the goals are identified. The performance phase involves self-instruction, self-control, self-recording, and experimentation. The self-reflection phase involves self-judgment, self-evaluation, and self-reaction (Zimmerman, 2002).

According to Butler and Winne (1995), SRL strategies are the skills learners use to improve knowledge. The skills include setting goals, self-instruction, self-monitoring, continuously evaluating strategies, and selecting the most appropriate strategies. During the monitoring process, students may adapt their goals, abandon unnecessary goals, and/or establish new goals. External feedback from teachers and peers allow students to reflect on what they have learned, reassess their program and adjust their learning strategies (Butler & Winne, 1995).

Information processing, social constructivist, and social cognitive theories are the three most common cognitive SRL theories that have been applied to school learning. Information processing theory stresses the cognitive functions of attending to, perceiving, storing and transforming information. Initially, learners process information about the tasks they desire to accomplish. Sources of the information may include directions from the teacher and prior knowledge that learners retrieve from long-term memory such as performance on previous tasks. Next, learners set a goal and determine a plan, including the learning strategies they will use to obtain the goal. Then, learners apply and adjust their strategies based upon self-evaluations of their success. Information processing theory works on using existing information to process new information (Schunk, 2009).

Lev Vygotsky's theory of development provides a social constructivist account of self-regulation. Individuals are believed to construct knowledge and meanings based upon their cultural environments. Through communicating and interacting with people in their environments, learners develop cognitive functions (Schunk, 2009). The social environment is a facilitator of learning (Tudge & Scrimsher, 2003). A student's self-regulated learning processes reflect those that are taught at home. Through interactions with adults, children make the transition from behaviors regulated by others to behavior regulated by themselves, or self-regulated learning (Schunk, 2009).

According to the social cognitive theory, SRL occurs as the result of the interchanges between the leaners' personal choices, individual behaviors, and the learning environment (Cassidy, 2011). The interactions of the learners' personal, behavioral, and social/environmental influences describe the social cognitive theory of SRL (Schunk & Mullen, 2013). This model focuses on the learner being proactive in shaping his thoughts, actions, and environments to produce desirable outcomes that are deemed important to the learner (Pintrich, 2000). Bandura (1986) postulated three aspects of self-regulation: self-observations, self-judgments, and self-reactions. Goal settings, self-evaluations of progress, and self-efficacy or beliefs about one's ability to learn or perform are key self-regulation processes (Bandura, 1997).

Zimmerman (2000) expanded Bandura's model into a three-phase cyclical model to include individuals' actions before and after task engagement. Pintrich's (2000) social cognitive model comprises four phases: forethought, planning, and activation; monitoring; control; and reaction and reflection.

Social cognitive theory predicts that SRL usually develops with social (external) sources and shifts to self (internal) sources over four levels: observation, emulation, self-control, and internalization (Schunk & Mullen, 2013). At the observation level, learners observe and acquire basic skills/strategies. They may not actually perform the task but observe others performing the strategies or tasks. At the emulation level, learners begin to mimic what they have seen performed by others. They begin to practice, seek feedback and encouragement from outside sources during the emulation phase. At the third level, self-control, learners can employ the skills or strategies they have observed on their own. They continue to pattern their actions after models and need less external guidance and feedback. At the final stage, internalization, learners can modify their performances based on their understandings of necessary changes. At this level, learners have internalized skills and strategies. They can transfer their learning to new contexts and maintain their motivation through goal setting (Schunk & Mullen, 2013).

Self-regulated students are active in their own learning processes (Shuy, 2012). They do not passively take in information but rather proactively develop skills and strategies to acquire knowledge. SRL does not occur automatically. Students must be committed to their goals and beliefs about the outcomes of their actions. Research shows that increases in self-regulation result in higher student learning and achievement (Schunk, 2009).

CHAPTER III - METHODOLOGY

Overview

The purpose of this study was to answer two research questions concerning the effectiveness of the Emporium Model in reducing math anxiety and in preparing developmental math students for College Algebra. A pre- and post- math anxiety rating scale questionnaire and a pre- and post- Algebra Readiness Test were administered to students enrolled in Intermediate Algebra. The study compared math anxiety levels and readiness test scores of students who were enrolled in Intermediate Algebra in the Emporium Model class to those in a Traditional class format. This chapter presents the methodology used to test the research questions. The chapter is organized as follows: research design, participants, instrumentation, procedures, limitations, and data analysis.

Research Design

This research was a quantitative study utilizing inferential statistics. A causal-comparative research design was used to answer the research questions. Casual-comparative research attempts to determine cause and effect, but is not as powerful as experimental designs. However, an experimental study was not possible for this research because there was no intervention on the part of the researcher to control the independent variable or to assign participants to a particular group. In causal-comparative research, the independent variable is naturally occurring, does not involve intervention by the researcher, and is made up of two groups or more for comparison (Gay, Mills & Airasian, 2006).

The independent variable for this study was class format. Class format refers to the type of instructional strategy/design implemented in the class or course. Participants were enrolled in either an Emporium class or a Traditional class. The Emporium class involved scheduled, face-to-face class meeting times in a computer-lab setting without group lectures from the instructor. The Emporium Model is a type of course redesign that achieves reform by eliminating all lectures and replacing them with a learning resource or computer lab center featuring interactive software and on-demand personalized help; relying on instructional software that includes homework, quizzes and tests, with immediate feedback to the student; allowing students to work through the material at a pace that is comfortable for them; using a staffing model that involves faculty and both professional and peer tutors; and allowing students to complete more than one course within a semester (NCAT, 2012a). Although the model has been implemented in various ways, the critical components involve eliminating lecture, using interactive computer software, and providing personalized, on-demand assistance. The Traditional class was the traditional, face-to-face lecture class.

The condition within the independent variable was naturally occurring because the institution selected the format of the class offerings and students self-enrolled in the course of their choice. Furthermore, the researcher did not intervene to select participants for the different class formats. The study involved the comparison of two groups: those in an Emporium Model class or those in a Traditional class.

The dependent variables were the level of math anxiety and scores on the algebra readiness test. Students' math anxiety levels were measured twice with a pre-test at the beginning of the semester and the same anxiety test given as a post-test approximately twelve weeks later near the end of the semester. An analysis of the difference between pre- and post-test anxiety levels will be done using the Statistical Package for the Social

Sciences (SPSS) to compare the Emporium group and the Traditional group to determine if the Emporium group had a greater reduction in math anxiety levels. Additionally, the same groups of students took an algebra readiness pre-test at the beginning of the semester and the same algebra readiness test as a post-test twelve weeks later near the end of the semester. An analysis of the difference between pre- and post-test scores on the algebra readiness test was done to determine if there was a significant difference between the group in the Emporium class and the Traditional class.

Each research question attempted to determine if there was a difference between the two groups based upon the format of the class. Intermediate Algebra instructors for the Emporium group adhered to the common course syllabus created by the institution's mathematics department. The instructional strategies/methods were specified and thoroughly explained to students during the first class meeting. The course was comprised of five modules. Students worked independently at their own pace to complete Modules 7 – 11 and a comprehensive final exam. Instructors did not lecture in the Emporium class format. Instructors were present in the lab with the students during their scheduled classroom time. Class met for 75 minutes, two days per week for 16 weeks. Attendance was required. During class meetings, students work independently at a computer to complete course objectives in a student-centered, active learning environment. The method of instruction for the Emporium class utilized computer software and individual assistance from the instructor and/or assistants as needed. The software included help features, examples, videos of problems being worked out and opportunities for multiple homework attempts. Homework and tests were web-based on the Pearson MyLabsPlus platform at www.hindscc.mylabsplus.com. The only type of calculator allowed for online assignments and tests was the TI-30XIIS.

Each of the five modules contained a pre-test, online homework assignments, and a post-test. The pre-test was an optional test that students could take to by-pass doing the assignments within that module. If the pre-test was passed with a score of 80% or higher, the student was allowed to progress to the next module. If a student decided not to take the pre-test or scored less than 80% on the pre-test, he worked to complete all assignments within the module with a score of 80% or higher on each assignment. Mastery on an assignment (80% or higher) had to be achieved before students began the next assignment of the module. Students could work on assignments outside of class with the exception of pre- and post- tests, which were proctored and password protected. After completing all assignments in a module, the student would take the module post-test. The post-test was proctored and may be taken a maximum of three times. To pass the class, students were required to:

1. Complete each of the online assignments for each module in MyLabsPlus with at least a score of 80%;
2. Score a minimum of 60% on each module post-test, but have an overall average of at least 70% on post-tests; and
3. Score a minimum of 70% on the institution's Intermediate Algebra comprehensive final exam.

Students who did not meet criteria #1 and #2 by the last day of class, were not eligible to take the final exam.

The Traditional class was a traditional, lecture based course as outlined in the course syllabus. All students were presented the same content during the scheduled class time. It was not a self-paced course. Instructors for the Traditional class were permitted to exercise academic freedom in selecting instructional methods/strategies to teach the class. Their instructional methods may include lecture, cooperative group activities/projects, and individual student work. Homework assignments were online and utilize the Pearson MyLabsPlus platform at www.hindscc.mylabsplus.com. All homework was completed outside of the class. Instructors were allowed to use their discretion in giving tests either online or by pencil and paper. The course content and objectives were the same as the Emporium class. To pass the class, students were required to complete each of the online assignments in MyLabsPlus for each module with a grade of at least 80%, have an overall average of at least 70% on the unit tests at the end of the semester, and score at least 70% on the district comprehensive final exam. Students who did not meet criteria #1 and #2 by the last day of class, were not eligible to take the final exam.

This study was a prospective causal-comparative research design. The researcher attempted to investigate the effects of students participating in the Emporium class. The analysis was done ex post facto, or after the fact, and indicated that a casual-comparative research design was an appropriate method of analysis (Mertler & Charles, 2008). The causative relationship between the independent variable and the two dependent variables were examined; however, any relationship that was discovered was only suggestive of causation (Gay et al., 2006).

Participants

The targeted population for this study was all community college students enrolled in Intermediate Algebra at institutions that were using the Emporium Model design for developmental mathematics courses. The sample was students enrolled in Intermediate Algebra at a Southeastern, public, comprehensive community college. The community college consisted of six campuses in five counties. Four of the six campuses were included in this study because both the Emporium and Traditional format of instruction was used for the Intermediate Algebra course. The sequence for developmental courses at this institution is Beginning Algebra and Intermediate Algebra, with Intermediate Algebra being the last developmental math course before College Algebra. The College Algebra course was not taught in the Emporium Model format. Students were enrolled in Intermediate Algebra if they have successfully passed Beginning Algebra or have a math sub-score of 17 – 19 on the American College Test. Registration for the class could be done online via the institution's web registration portal. Students were allowed to self-enroll in either class format at two of the campuses in this study. At the other two campuses, enrollment in the Traditional class was restricted. Students could enroll in the Traditional class if one of the following criteria were met: previously failed Intermediate Algebra in the Emporium format, non-traditional student (age 25 or older), or recommendation from current math instructor. The Traditional class was identified as Intermediate Algebra and the Emporium class was identified as Modular Intermediate Algebra in the online web registration. Most of the Intermediate Algebra classes were of the Emporium format. Participants for the study were students enrolled in Intermediate Algebra at the selected community college who voluntarily gave consent to be included in the study. A consent form was signed by all participants prior to administering the anxiety and algebra readiness tests.

Instrumentation

Two instruments were used to answer the research questions of this study: a revised version of the Abbreviated Mathematics Anxiety Rating Scale (A-MARS) (see Appendix C) and an Algebra Readiness Test (see Appendix D). Permission to use A-MARS (see Appendix E) was given by the author of the instrument. The A-MARS is a 25-item anxiety rating questionnaire that is an abbreviated version of the original 98-item Mathematics Anxiety Rating Scale (MARS) developed by Richardson and Suinn in 1972 (Alexander & Martray, 1989; Richardson & Suinn, 1972). It was developed because MARS is a long assessment instrument that is time-consuming to administer and score. Another shortcoming of MARS is that the proposed underlying construct is one-dimensional. However, A-MARS is a mathematics anxiety instrument that assumes the multidimensionality of the construct. There are three subscales of A-MARS to measure the amount of mathematics anxiety that students usually experience: Mathematics Test Anxiety, Numerical Task Anxiety, and Mathematics Course Anxiety (Baloglu & Zelhart, 2007). A-MARS was slightly revised by the researcher to include wording familiar to the students and a 5-point frequency rating scale. The instrument measures anxiety by presenting 25 situations which may cause math anxiety. It was a self-administered questionnaire in which participants were asked to indicate their level of anxiety in each situation. The response scale range was as follows: 1- not at all; 2 – a little; 3 – a fair amount; 4 – much; and 5 – very much. The sum of the item scores provided the total score for the instrument, which ranged from 25 to 125 (Nunez-Pena & Suarez-Pellicioni, 2015).

A-MARS has been widely used in academic research, rigorously tested, and found to be psychometrically sound. Moderate to high reliability evidence was found for total and subscales of the A-MARS. Initial internal consistency reliability coefficients of the A-MARS subscales were .96 for the Mathematics Test Anxiety, .86 for the Numerical Task Anxiety, and .84 for the Math Course Anxiety (Baloglu & Zelhart, 2007). A two-week test-retest analysis of A-MARS showed a reliability of .86. The correlation with the original MARS is .97 (Eden, Heine, & Jacobs, 2013).

The second instrument used in this study was an Algebra Readiness Test, which was the Intermediate Algebra comprehensive final exam. The test was developed by instructors in the mathematics department at the participating institution. The test consisted of 33 multiple choice problems and includes content on factoring polynomials, simplifying rational expressions, solving rational equations, graphing linear equalities in two variables, solving systems of equations, simplifying radical expressions, solving radical equations, solving quadratic equations, and identifying functions. The test was created using TestGen, a test generator program that helps instructors create tests using publisher-supplied test banks. The test was graded for accuracy and high scores indicated readiness for College Algebra.

Procedures

Intermediate Algebra instructors were informed about the study and asked to allow their students to participate in the study. Instructors who allowed their students to participate signed an instructor’s agreement form (see Appendix F) acknowledging their adherence to the instructional methods of that specific type of class format (Emporium or Traditional) as outlined in the course syllabus. Instructors read the oral script (see Appendix G) to the class on Day 2 and passed out a research packet for students to complete. The packet included a consent form (see Appendix H), participant's instruction and information sheet (see Appendix I), the A-MARS questionnaire, and the algebra readiness test. Data was collected from participants who agree to participate in this study as evidenced by a signed consent form. Data from students who did not consent to participate in the study was not included in the final data analysis. Students in Intermediate Algebra completed the packet at the beginning of the semester (pre-test) and completed the packet again approximately twelve weeks later near the end of the semester (post-test). Completion of the entire packet did not take more than one class period or 75 minutes during each administration. Packets were collected by the instructor and returned to the researcher. For the initial administration of the packet, the sum of the ratings for each item on the A-MARS was the pre-test math anxiety level. Math anxiety level could range from 25 to 125. A high sum indicated high levels of math anxiety. Near the end of the semester, the process was repeated to compute the post-test math anxiety level. The difference between the pre- and post-test scores in math anxiety was analyzed to determine if a statistically significant difference exist between students in the Emporium class and those in the Traditional class.

Similarly, the algebra readiness test was given at the beginning of the semester (pre-test) and administered again approximately twelve weeks later near the end of the semester (post-test). The algebra readiness test was included in the research packet with the A-MARS during each administration, so both instruments were completed on the same day by the same students. The algebra readiness test was a paper test and students were allowed to use the TI-30XIIS calculator provided by the instructor. All test papers were collected and returned to the researcher. The difference between the pre- and post-test scores on the algebra readiness test were analyzed to determine if a statistically significant difference existed between students in the Emporium class and those in the Traditional class.

Limitations

The study was limited to a Southeastern, public, comprehensive community college. The results of the study may not be generalized to an institution of a different size, or one located in a different geographic location, or one that contains a substantially different population in terms of student demographics.

To address the research questions of the study, a comparison of students in the Emporium class to those in the Traditional class was done. Although differences between the two groups may exist, the ability to infer causality was limited. Other factors or variables, such as students' motivational level, math abilities, time on task, level of engagement, or instructors' interventions, could explain the differences that occurred.

Another limitation is that the two groups may not be equally balanced because the researcher did not randomly assign students to each group. At two of the campuses, students were allowed to enroll in either class format and may have been bias in course selection. At the other two campuses, enrollment in the Traditional class was restricted. Only students who had failed the course previously in the Emporium format; or a non-traditional student (over the age of 25); or students who received a recommendation from their current math instructor were allowed to enroll in the Traditional class. Most of the Intermediate Algebra classes at the participating institution are Emporium.

Data Analysis

The purpose of this study was to investigate the effectiveness of the Emporium Model in a developmental mathematics course. The study compared students who took Intermediate Algebra in the Emporium format to students who took the course in a Traditional format to determine the effectiveness of the Emporium Model in reducing math anxiety and in preparing students for College Algebra. The research questions were:

1. Is there a significant difference in math anxiety level between students who took Intermediate Algebra in an Emporium class versus those who took Intermediate Algebra in a Traditional class as measured by a math anxiety pre- and post-rating scale questionnaire?
2. Are students who took Intermediate Algebra in the Emporium format better prepared for College Algebra than students who took Intermediate Algebra in a non- Emporium format as measured by scores on an algebra readiness pre- and post-test?

After the data were collected, two mixed model analysis of variances (ANOVAs) were done using SPSS to answer the research questions of the study. The independent variable for each question was the class format: Emporium vs. Traditional class. For research question one, the dependent variable was math anxiety, time was the repeated measure factor, and class format was the between factor. For research question two, readiness test score was the dependent variable, time was the repeated measure factor, and class format was the between factor. Further analysis was done for the 3 sub-scales (math test anxiety, numerical task analysis, and math course anxiety) of A-MARS using a repeated measure MANOVA. The between factor was class format, time was the repeated measure factor, and the dependent variables were the 3 sub-scales. Statistical tests were performed using an alpha of 0.10 to determine significance.

CHAPTER IV – RESULTS

The purpose of this study was to investigate the effectiveness of the Emporium Model in reducing math anxiety and in preparing developmental mathematics students at a community college to be successful in College Algebra. The study compared students who took Intermediate Algebra in the Emporium format to students who took Intermediate Algebra in a Traditional format to determine whether the instructional type made a significant difference in reducing math anxiety and in preparing students for College Algebra. A pre- and post- mathematics anxiety rating scale questionnaire and a pre- and post- algebra readiness test were administered to students who voluntarily consented to participate in the study. Results of both pre- and post- tests were analyzed using SPSS to determine statistically significance. This chapter presents the results of the data analysis as follows: descriptive statistics, inferential statistics, and decisions on the research hypotheses.

Sample

One hundred twenty-two students enrolled in Intermediate Algebra at the participating institution completed the pre-math anxiety rating scale questionnaire and the pre-algebra readiness test at the beginning of the Spring 2016 semester. For the pre-tests, there were 61 participants in the Emporium class and 61 participants in the Traditional class. Of the 122 students who completed the pre-tests, 59 of them also completed the post- math anxiety rating scale questionnaire and the post- algebra readiness test at the end of the semester. Only students who completed both the pre- and post- math anxiety questionnaire and the pre- and post- algebra readiness test were included in the sample. Thus, the sample size for this study was 59. There were 28 students in the Emporium group and 31 students in the Traditional group. The difference between the number of students who took the pre-tests and post-tests was 33 for the Emporium group and 30 for the Traditional group. These differences could be attributed to withdrawals from the class or absentees on the day that the post-tests were given. The composition of the groups was as follows: 13 males, 15 females, 21 Blacks, and 7 Whites in the Emporium group and 11 males, 20 females, 17 Blacks, 12 Whites, and 2 Others in the Traditional group.

Descriptive Analysis of Data

Participants completed a pre- and post- algebra readiness test. The pre-test was taken during the first week of the semester and the same test was taken as a post-test the last week of the semester. The test consisted of 33 multiple choice questions and was graded for accuracy based on a 100-point scale. Scores or the data for each participant on each test were entered into SPSS and descriptive statistics were computed. Scores on the pre-test ranged from 0 to 73 and post-test scores ranged from 0 to 85. The Emporium group had a mean of 24.50, with a standard deviation (SD) of 16.19 for the pre-test and a mean of 35.75, with a SD of 25.68 for the post-test. For the Traditional group, the mean and SD for the pre-test were 23.23 and 9.56, respectively. The mean and SD for Traditional post-test were 40.97 and 19.09, respectively. Table 1 summarizes basic descriptive statistics for the algebra readiness test

Table 1

Descriptive Statistics Algebra Readiness Test

Test/Group	N	Min	Max	Mean	SD
Pre-algebra Emporium	28	0	73	24.50	16.19
Pre-algebra Traditional	31	0	43	23.23	9.56
Post-algebra Emporium	28	0	85	35.75	25.68
Post-algebra Traditional	31	4	85	40.97	19.09
Pre-algebra (All)	59	0	73	23.83	13.03
Post-algebra (All)	59	0	85	38.49	22.41

Figure 1 shows a comparison of group means for the algebra readiness test. The algebra score pre-test mean (M=24.50) for the Emporium group was higher than the algebra score pre-test mean (M=23.23) for the Traditional group. However, the algebra score post-test mean (M=35.75) for the Emporium group was lower than the algebra score post-test mean (M=40.97) for the Traditional group. Both groups increased from pre- to post- tests for the mean algebra scores.

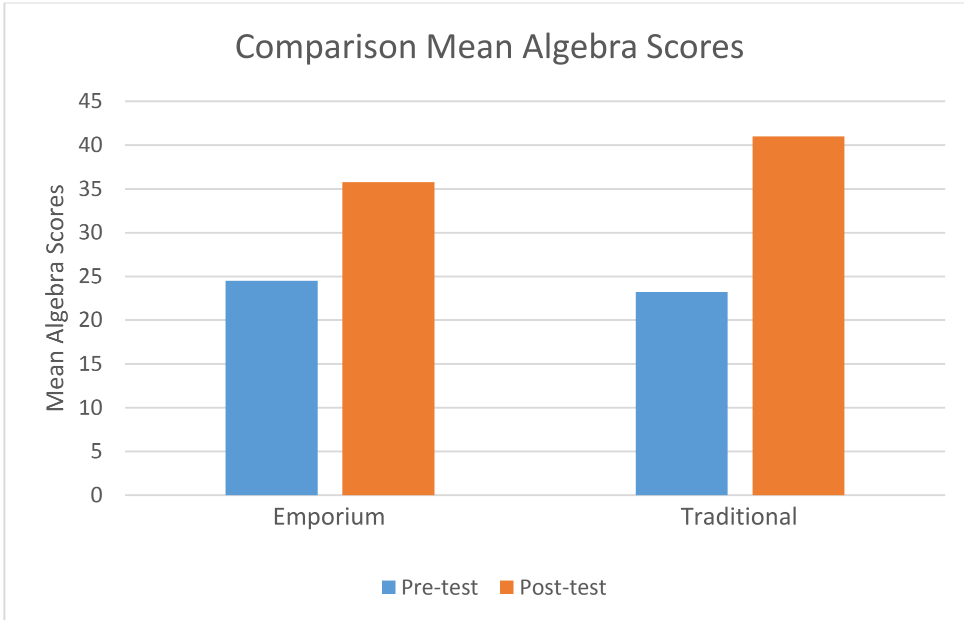


Figure 1. Comparison Mean Algebra Scores.

Note: Mean algebra scores pre-and posttests comparison for the two groups

Participants also completed a pre- and post- survey to measure mathematics anxiety using the abbreviated mathematics anxiety rating scale questionnaire (A-MARS). The A-MARS was completed on the same days as the algebra readiness pre- and post-tests. A rating of 1 to 5 was selected for each statement on the 25-item questionnaire. Data for the participants' pre- and post- test ratings were placed into SPSS for statistical data analysis. The overall pre-anxiety score for both groups ranged from 35 to 118 and the post-anxiety score ranged from 35 to 125. The mean pre-anxiety score for both groups was 77.85, with a SD of 18.37. The mean for the post-anxiety score for both groups was 76.71 and the SD was 22.34. For Emporium, the mean pre-anxiety score and SD were 81.07 and 15.91, respectively. The post-anxiety score mean and SD for Emporium were 85.14 and 22.68. For Traditional, the mean pre-anxiety score and SD were 74.94 and 20.16, respectively. The post-anxiety score mean and SD for Traditional were 69.10 and 19.37. Table 2 summarizes basic descriptive statistics for the math anxiety survey. By inspection of Table 2, the mean anxiety score for Traditional decreased, while the mean anxiety score for Emporium increased from the pre-anxiety survey to the post-anxiety survey.

Table 2

Descriptive Statistics Math Anxiety

Test	N	Min	Max	Mean	SD
Pre-anxiety (Emporium)	28	46	118	81.07	15.91
Pre-anxiety (Traditional)	31	35	116	74.94	20.16
Post-anxiety (Emporium)	28	46	125	85.14	22.68
Post-anxiety (Traditional)	31	38	125	69.10	19.37
Pre-anxiety (all)	59	35	118	77.85	18.37
Post-anxiety (all)	59	35	125	76.71	22.33

Figure 2 presents group means for math anxiety level. The mean pre-test anxiety level for the Emporium group (M = 81.07) was higher than the mean pre-test anxiety for the Traditional group (M = 74.94). The mean post-test anxiety for the Emporium group

(M = 85.14) was also higher than the mean post-test anxiety for the Traditional group (M = 69.10). The mean anxiety level for the Emporium group increased from pre- to post-test. The mean anxiety level for the Traditional group decreased from pre- to post- test.

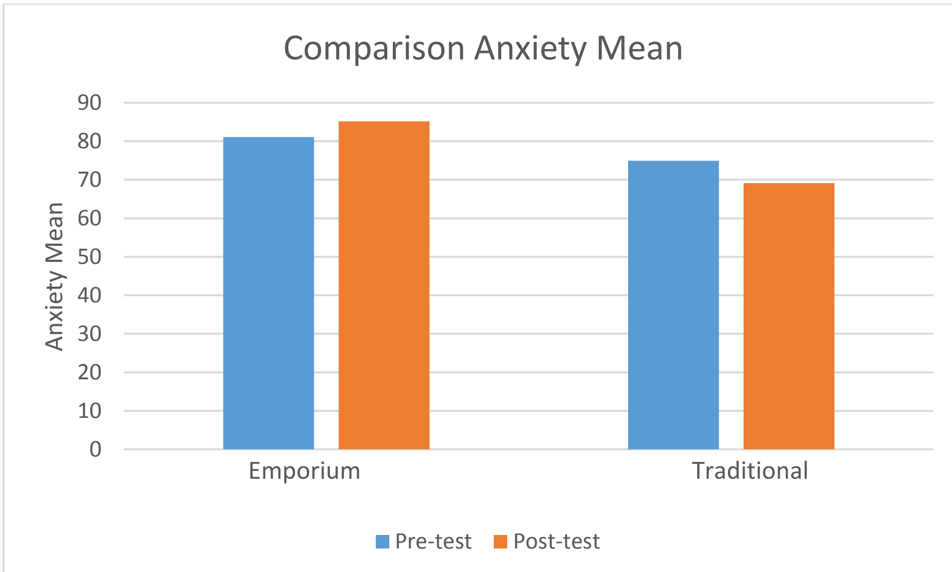


Figure 2. Comparison Math Anxiety Mean.

Note: Graph shows the pre- and post- mean math anxiety level for the two groups

Figure 3 shows the overall comparison of math anxiety mean and algebra test mean for both groups regardless of time.

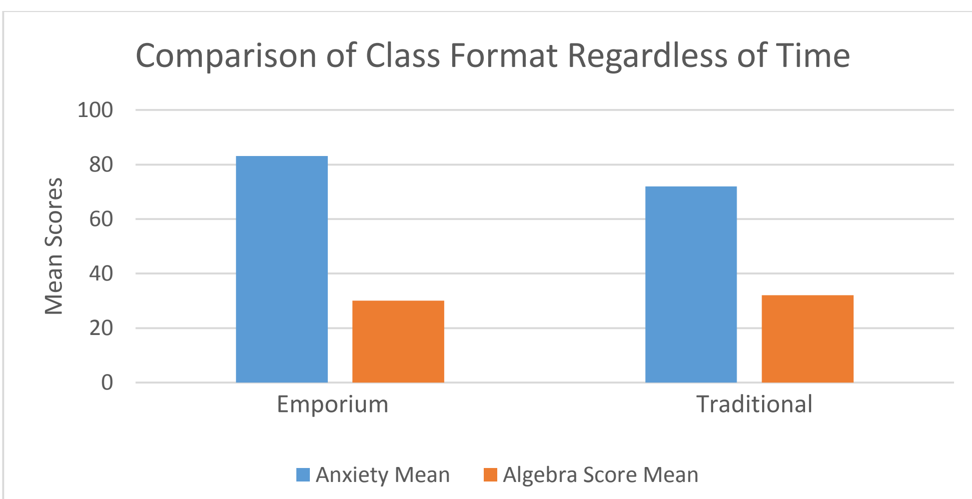


Figure 3. Comparison of Class Format.

The overall math anxiety mean (M = 83.11) for the Emporium group was higher than the overall math anxiety mean (M = 72.02) for the Traditional group with time (pre- post-test scores) combined. The overall algebra score mean with time collapsed was 30.13 for the Emporium group and 32.10 for the Traditional group. Regardless of time, the overall algebra score mean was higher for the Traditional group and the overall anxiety mean was higher for the Emporium group.

Figure 4 shows a comparison of pre- and post- test scores regardless of class format. The overall mean pre-test math anxiety level was 78.00 and the overall mean post-test math anxiety level was 77.12, with groups combined. The overall mean pre- and post- algebra test scores were 23.86 and 38.36, with groups combined.

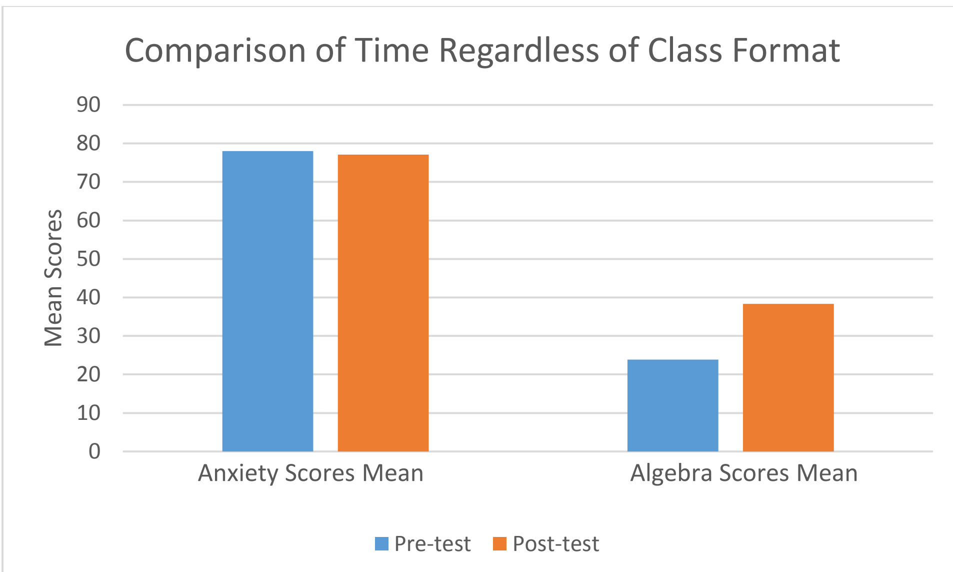


Figure 4. Comparison of pre- and post – test scores.

Additional analysis was performed on the math anxiety questionnaire because the A-MARS had three subscales: Mathematics Test Anxiety (MTA), Numerical Task Anxiety (NTA), and Math Course Anxiety (MCA). Items 1 – 15 of A-MARS comprised the first subscale on math test anxiety. The second subscale of A-MARS was items 16 –

20 for numerical task anxiety. The third subscale consisted of items 21 – 25 on math course anxiety. Table 3 shows descriptive statistics on the subscales of A-MARS for each group.

Table 3

Descriptive Statistics for A-MARS Subscales

Subscale	N	Min	Max	Mean	SD
Pre-MTA (Emporium)	28	30	68	52.39	9.23
Pre-MTA (Traditional)	31	24	66	51.32	11.01
Pre-NTA (Emporium)	28	5	25	13.71	6.44
Pre-NTA (Traditional)	31	5	25	11.55	6.78
Pre-MCA (Emporium)	28	6	25	14.96	5.14
Pre-MCA (Traditional)	31	5	25	12.06	5.57
Post-MTA (Emporium)	28	24	75	54.29	12.22
Post-MTA (Traditional)	31	25	75	46.74	11.33

Post-NTA (Emporium)	28	5	25	14.82	7.09
Post-NTA (Traditional)	31	5	25	10.35	6.97
Post-MCA (Emporium)	28	6	25	16.04	5.47
Post-MCA (Traditional)	31	5	25	12.00	6.13

Note: MTA – Mathematics Test Anxiety, NTA – Numerical Task Anxiety, MCA – Math Course Anxiety

The combined anxiety rating for both groups ranged from 24 to 68, with a mean of 51.83 and SD of 10.12 for the pre-MTA subscale. The combined post-MTA subscale for both groups ranged from 24 to 75, with a mean of 50.32 and SD of 12.26. The combined pre-NTA subscale for both groups ranged from 5 to 25, with a mean of 12.58 and SD of 6.65. The mean and SD of the combined post-NTA subscale for both groups were 12.47 and 7.32, ranging from 5 to 25. For the combined pre-MCA subscale, the range was 5 to 25, with a mean of 13.44 and SD of 5.52. The combined post-MCA subscale ranged from 5 to 25, with a mean of 13.92 and SD of 6.12. On two of the subscales, MTA and NTA, a decrease in mean values was found from pre- to post-test indicating less anxiety. There was an increase in anxiety on the MCA subscale from pre- to post-test.

SPSS was also used to run Cronbach alphas on the three subscales to determine the level of consistency or reliability for each subscale. For math test anxiety, the Cronbach alpha was .892. Numerical task anxiety had a Cronbach alpha of .953 and the

Cronbach alpha for math course anxiety was .851. The overall internal consistency or reliability for all 25 items on the A-MARS had a Cronbach alpha of .937.

Inferential Statistics

The purpose of this study was to compare students who took Intermediate Algebra in the Emporium format to students who took Intermediate Algebra in a Traditional format to determine whether the instructional type made a difference in reducing math anxiety and in preparing students for College Algebra. Participants in the study completed a pre- and post-algebra readiness test. The differences of the pre- and post-tests were analyzed using SPSS, and decisions were made concerning the research hypotheses. The hypotheses of the study were tested using a mixed model ANOVA at an alpha of 0.10 level of significance because of the small sample size.

H_1 stated that there was a statistically significant difference in math anxiety level between students who took Intermediate Algebra in an Emporium class versus students who took Intermediate Algebra in a Traditional class as measured by a pre- and post-math anxiety rating scale questionnaire. The output results of the ANOVA for math anxiety showed the within-subjects effect of time, the between subjects' effect of class format, and the interaction of time*class format. There was no significant main effect on time $F(1, 57) = .155$, $p = .695$, indicating that anxiety pre- and post- test scores were similar within the groups. For class format, $F(1, 57) = 5.773$, $p = .020$, there was a significant effect, indicating that there was a difference in class formats. There also was a significant interaction effect between time and class format, $F(1, 57) = 4.883$, $p =.031$, which indicated that there was a significant difference between the change in anxiety level of students in the Emporium class to students in the Traditional class as measured by the pre- and post-anxiety scale questionnaire. Therefore, our research hypothesis is supported. Class format had an effect on math anxiety level. The decrease in math anxiety level was greater for participants in the Traditional group than for those in the Emporium group. The profile plot in SPSS of the mean difference between math anxiety level from pre-test to post-test (see Figure 5) shows that there was a greater decrease in anxiety level for the Traditional group.

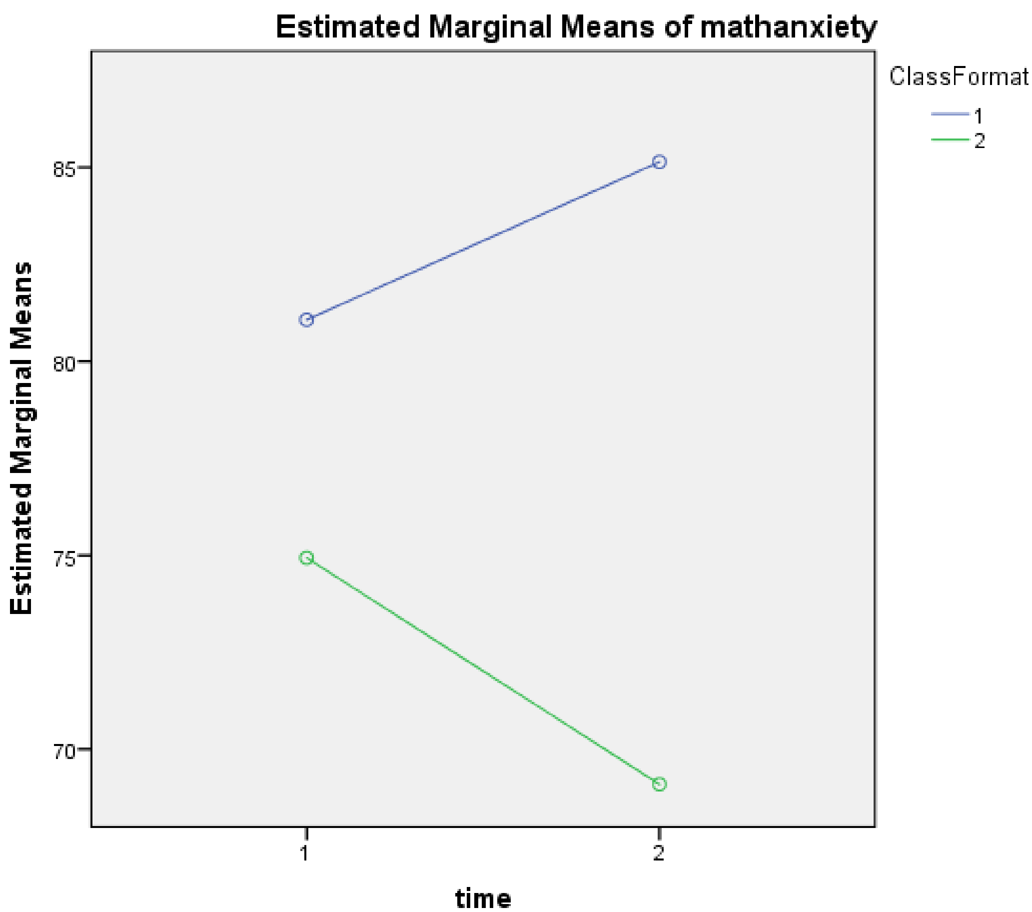


Figure 5. Graph of math anxiety mean

Note: 1 – Emporium group, 2 – Traditional group

H_2 stated that there was a statistically significant difference in pre- and post-test scores on an algebra readiness test for students who took Intermediate Algebra in an Emporium class versus students who took the course in a Traditional class. The output results of the ANOVA for algebra readiness scores showed the within-subjects effect of time, the between subjects' effect of class format, and the interaction of time*class format. The main effect of time was significant, $F(1, 57) = 30.151$, $p<.01$, indicated that pre- and post- algebra readiness test scores were different within the groups. There was no significant effect for class format, $F(1, 57) = .243$, $p = .624$, which indicated that the Emporium and Traditional class formats were similar. There was also no significant interaction between time*class format, $F(1, 57) = 1.512$, $p = .224$, which indicated that there was not a significant difference for pre- and post-test algebra readiness scores between the Emporium and Traditional group. The research hypothesis was not supported. Neither class format had a statistically significant effect on the difference in pre- and post-test algebra readiness scores. The profile plot in SPSS of the mean difference between algebra test scores from pre-test to post-test (see Figure 6) shows that there was an increase in the mean for both groups from pre- to post- test; however, the difference is not significant for either group.

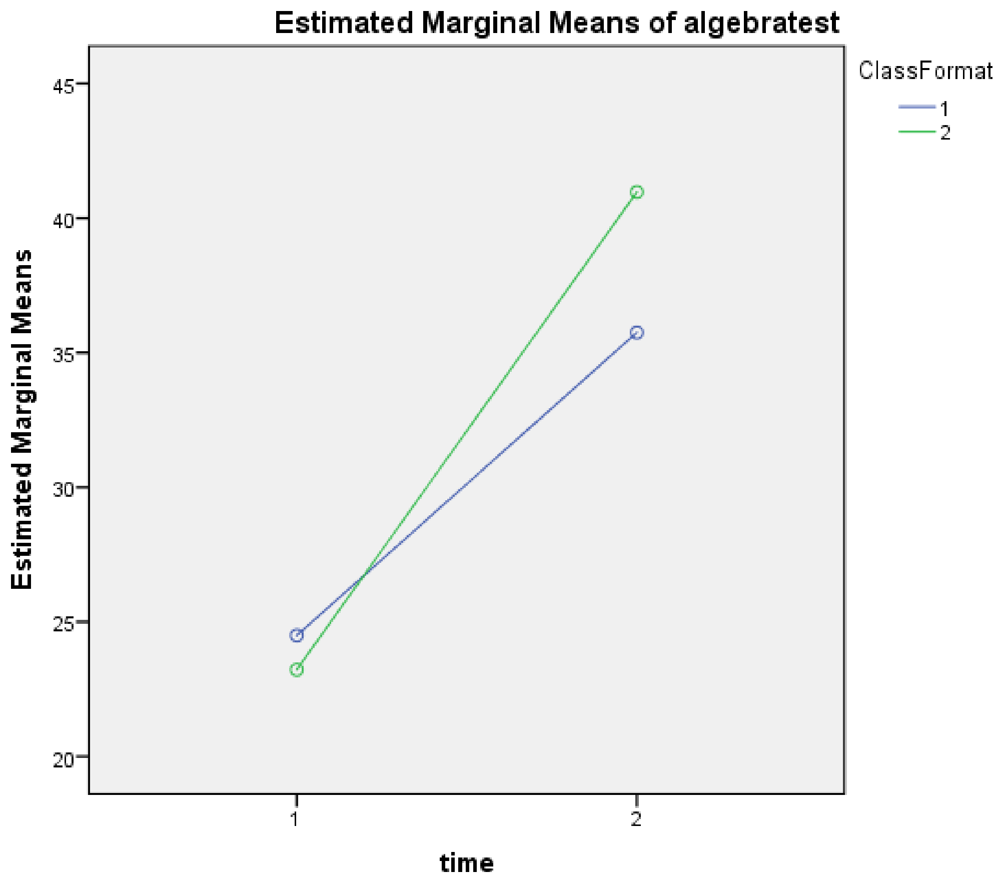


Figure 6. Graph of algebra readiness test mean

Note: 1 – Emporium group, 2 – Traditional group

Further analysis was done on the three subscales of the math anxiety rating scale questionnaire using a repeated measure multivariate analysis of variance (MANOVA). The dependent variables were the three subscales: MTA, NTA, and MCA and the independent variable was class format. Results of the MANOVA examining the effect of the subscales on the interaction of class format and pre- and post-math anxiety level was near significant (Lambda (3, 55) = 1.924, p = .136) based on the small sample size (N = 59) of the study. So, follow-up univariate ANOVAs were done to determine which subscale differentiate or best separated the two groups. Results of the univariate

ANOVAs indicated that subscale 1, MTA, contributed significantly to the difference in math anxiety level ($F(1, 57) = 5.276$, $p = .025$). Figures 7, 8, and 9 show the profile plot of the three subscales.

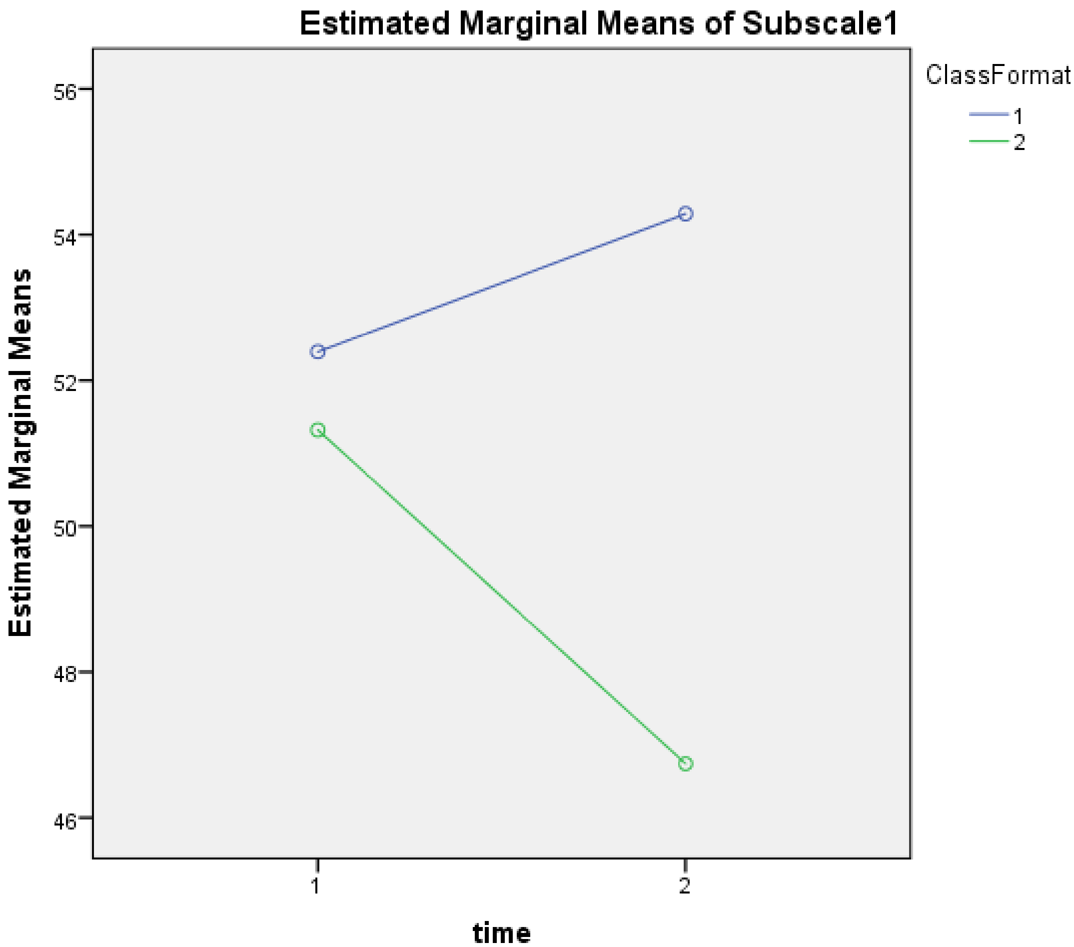


Figure 7. Graph of the means for subscale 1

Note: 1 – Emporium group, 2 – Traditional group

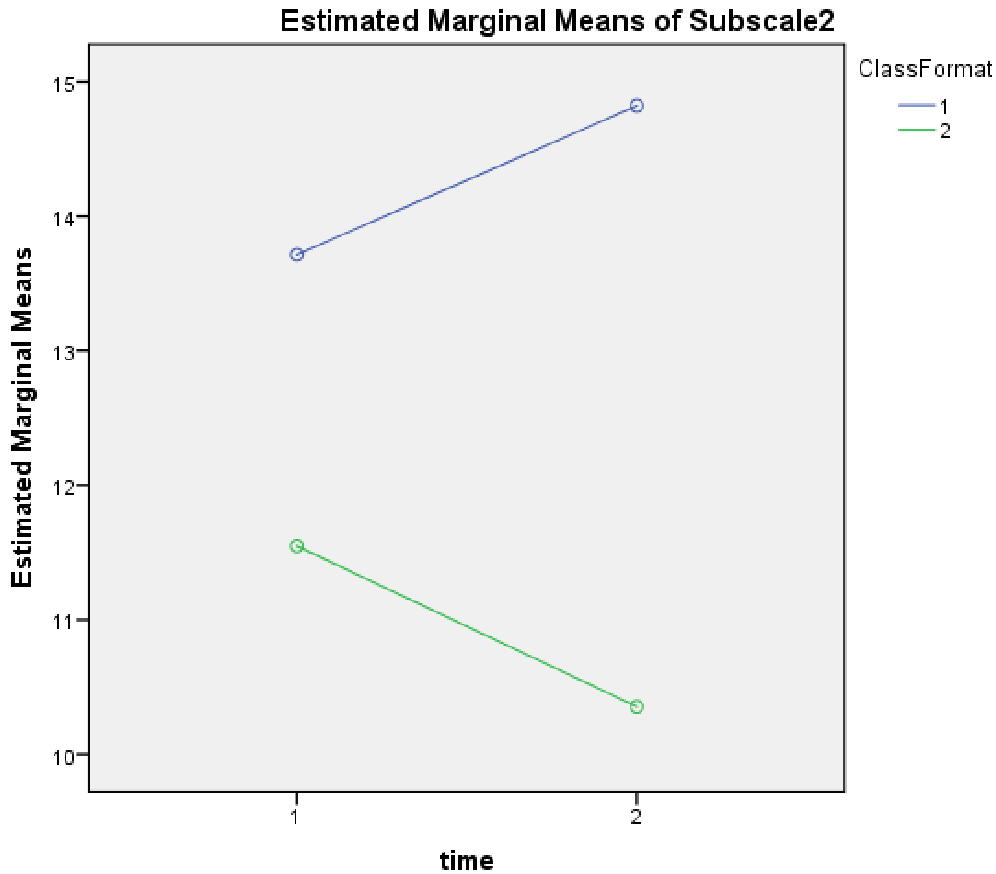


Figure 8. Graph of means for subscale 2

Note: 1 – Emporium group, 2 – Traditional group

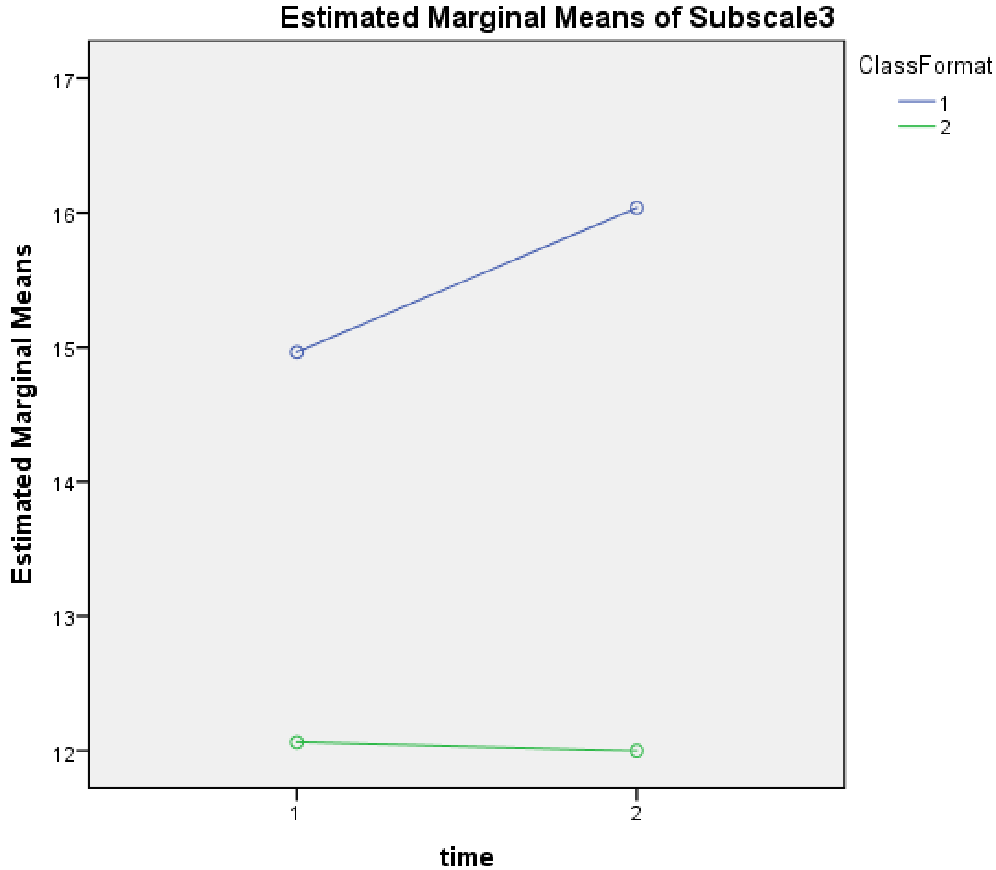


Figure 9. Graph of means for subscale 3

Note: 1 – Emporium group, 2 – Traditional group

Inspection of the graphs shows that for the Emporium group, the anxiety level increased for each subscale (see Figures 7, 8, 9). There appears to be a slight decrease from pre- to post- anxiety for subscale 3 with Traditional (see Figure 9) and some decrease for subscale 2 (see Figure 8), but it was not significant, ($F(1, 57) = 1.450$, $p = ..234$).

CHAPTER V – DISCUSSION

The purpose of this study was to investigate the effectiveness of the Emporium Model in reducing math anxiety and in preparing developmental math students at a community college to be successful in College Algebra. The study compared students who took Intermediate Algebra in an Emporium class format to students who took Intermediate Algebra in a Traditional class format to determine whether the instructional type had an effect on reducing math anxiety and on preparing students for College Algebra. This chapter presents a summary of the study, discussion of the findings, and recommendations for future research.

Summary

The Emporium Model is a type of course redesign that achieves reform by eliminating all lectures and replacing them with a learning resource or computer lab center featuring interactive software and on-demand personalized help; relying on instructional software that includes homework, quizzes and tests, with immediate feedback to the student; allowing students to work through the material at a pace that is comfortable for them; using a staffing model that involves faculty and both professional and peer tutors; and allowing students to complete more than one course within a semester (NCAT, 2012a). Although the model has been implemented in various ways, the critical components involve eliminating lecture, using interactive computer software, and providing personalized, on-demand assistance. The Traditional class was the traditional, face-to-face lecture class.

The focus of this study was guided by two research questions:

1. Is there a significant difference in math anxiety level between students who take Intermediate Algebra in an Emporium class versus those who take the course in a Traditional class as measured by a math anxiety pre- and post- rating scale survey?
2. Are students who take Intermediate Algebra in the Emporium class better prepared for College Algebra than those who take Intermediate Algebra in a Traditional class as measured by pre- and post- test scores on an algebra readiness test?

Each research question attempted to determine if there was a statistically difference between the two groups based upon the format of the class.

The sample consisted of 59 community college students enrolled in Intermediate Algebra during the Spring 2016 semester. Twenty-eight students were in the Emporium class and thirty-one students in the Traditional class. Data collection involved having all participants complete a pre- and post- mathematics anxiety rating scale survey and a pre- and post- algebra readiness test.

A-MARS was the instrument used to measure pre- and post- anxiety levels of the participants. There were 25- items on the A-MARS questionnaire and respondents rated their level of anxiety on a scale of 1 to 5 on the different situations presented on the questionnaire. A rating of 1 indicated no anxiety and 5 corresponded to very high anxiety. The A-MARS had three subscales: Mathematics Test Anxiety (MTA), Numerical Task Anxiety (NTA), and Math Course Anxiety (MCA).

The instrument used to measure algebra readiness was a 33- item multiple choice test developed by instructors in the math department at the participating community college. The test was the comprehensive final exam for Intermediate Algebra. The grading scale for the algebra readiness test was 0 to 100, with high scores indicating readiness for College Algebra.

Two mixed model ANOVAs were done to answer the research questions of the study. For the analysis of the difference between pre- and post- math anxiety levels, results showed that there was a significant difference between the Emporium and Traditional group. Results of an analysis of the difference between pre- and post- scores on the algebra readiness test showed that there was no significant difference between the two groups. A repeated measure MANOVA was done on the subscales of A-MARS, and the results showed that the difference was approaching significance. The follow-up univariate ANOVAs showed that the MTA subscale had the greatest impact on math anxiety level.

Discussion of Findings

Math anxiety is a common issue in developmental math community college students (Woodard, 2004). Research (Iossi, 2007; Tapia & Marsh, 2004; Woodard, 2004) has shown relationships between math anxiety and math achievement exists. A negative relationship between math anxiety and math achievement has been found across all grade levels, K – college (Betz, 1978; Ma, 1999; Woodard, 2004). Realizing the impact of high math anxiety on students’ performance in class, it is important to find ways to reduce math anxiety. Thus, one reason for this study was to determine whether the Emporium Model class format would affect math anxiety level.

Findings of this study showed that there was a significant difference in math anxiety level between students who took Intermediate Algebra in an Emporium class format compared to those in a Traditional class. The research hypothesis of this study proposed that there was a significant difference between the two groups and results of the study supported the research hypothesis. However, the reduction in math anxiety was not found with the Emporium group. Participants in the Traditional class format had a greater reduction in math anxiety level from pre- to post- anxiety level. Conversely, participants in the Emporium class had an increase in the mean anxiety level from pre- to post- math anxiety. The results of this study found no support for the idea that the Emporium class format will decrease students' math anxiety levels.

Results of this current research were similar to the study conducted by Kohler (2015) which found that students in the traditional lecture course had a significant decrease in anxiety levels throughout the semester compared to students in the Emporium class format. Contrary to the findings of this current research, a study by Sloan et al., (2002) found higher levels of math anxiety with traditional methods of instruction. Tawfik (2005) also found that higher math anxiety levels occurred with students taught in the traditional instructional format than when taught in the computer-based instructional format. Throughout the literature, research (Aho, 1992; Baker, 1997; Ganguli, 1992; McKenzie, 1999; Oxford, Proctor, & Slate, 1998) in support of computer-assisted instruction to reduce math anxiety exists along with research (Bain, 2004; Rameau & Louime, 2007; Shields, 2007) that found traditional lecture base instruction more effective than computer-based instruction for reducing math anxiety. Other researchers (Harper, 1995; White, 1998) have found no significant difference in math anxiety for students enrolled in either a computer assisted instructional class or a traditional lecture class. Although previous research is mixed, this current research has shown that there is a significant difference in math anxiety level for the Emporium and Traditional groups as measured by a pre- and post- math anxiety questionnaire.

Statistical analysis of pre- and post- algebra readiness scores indicated no significant difference between students in the Emporium class format to those in the Traditional class. The means of both groups increased from pre- to post- test. However, the increase was not statistically significant. The pre-test mean for the Emporium group (M = 24.50) was higher than the pre-test mean for the Traditional group (M = 23.23). The post-test mean for the Emporium group (M = 35.75) was less than the post-test mean for the Traditional group (M = 40.97). Ye (2010) conducted a study similar to this current research to examine the final exam scores of College Algebra students who received computer-based instruction versus those who received the traditional method of classroom instruction. The results of Ye's study showed that there was no statistically significant difference on College Algebra final exam score between the students with computer-based instruction and the students with traditional classroom instruction for three semesters (Ye, 2010).

Additionally, findings of this current study also agreed with previous studies (Bishop, 2010; Carter, 2004; Kohler, 2015; Lewis, 1995; Spradlin, 2009) that found no significant difference between computer-based instruction and traditional instruction in improving math achievement. Although the mean post- algebra readiness for the Traditional group was higher than the mean post- algebra readiness test for the Emporium group, the improvement was not significant. In contrast to this study, evidence of the improvement in student learning when implementing the Emporium Model was cited by Twigg (2013), when 86 developmental math courses were redesigned. 83% of the redesigned courses showed significant improvement over the traditional format, 6% showed improvements but not significant, 8% showed no significant difference, 1% showed decreased learning but not significant, and 2% had insufficient data to make a comparison (Twigg, 2013). Additional success stories on the effectiveness of the Emporium Model compared to the traditional method of instruction were found at Jackson State Community College, Cleveland State Community College, and Pearl River Community College (Epper & Butler, 2009; NCAT, 2012b, 2012c; Twigg, 2011; Twigg, 2013). Despite the success stories, the findings of the current study indicated no significant difference on algebra readiness between the two class formats.

Findings of this current study will assist curriculum coordinators at the participating institution in making decisions concerning the need to continue to offer both class formats. It seems evident that no one method of instruction has proven to be ideal. Instructors could be interested in offering a combination of both class formats.

For the subscales of the math anxiety rating scale questionnaire, the findings showed that the three subscales were near significant based on the small sample size (N = 59) of the survey. Based on the significant difference between math anxiety level for the two groups, it seems logical that a significant difference in the subscales was expected. The univariate ANOVAs of the subscales showed that subscale 1, MTA, significantly contributed to the difference in math anxiety level for the two groups.

Recommendations for Future Research

More research is needed on the effectiveness of the Emporium Model in reducing math anxiety and in preparing developmental math students for College Algebra. The current study should be expanded to include more community colleges that offer both the Emporium and Traditional instructional formats for developmental math courses. For future research, repeat the study with a larger sample size to determine if significant differences exist between the two class formats. The difference in the number of students who participated in the pre-test and the number remaining by the time of the administration of the post-test was discouraging. Future research could examine if there is a significant difference in withdrawals based on class format. It is recommended that the participating institution research current attendance and withdrawal policies to determine effective strategies for students to successfully complete developmental math courses.

Additional research may also be done to address questions concerning whether males or females perform better in the Emporium or Traditional class format or whether a particular class format is more beneficial to a certain race or age group. Another suggestion for future research is to determine if students with a particular learning style perform better in the Emporium or Traditional class format.

Another recommendation for future research from this study is to conduct a qualitative research design to determine the effectiveness of the Emporium Model in reducing math anxiety and in preparing developmental students for College Algebra. The qualitative study could involve interviews with instructors of both class formats to collect information about their perspectives of the strengths and areas for improvement for each class format. Instructors may provide additional insight on the type of learners that are ideal for each class format. Interviews could also be conducted with students who have received instruction in both formats to determine which method is most effective. A qualitative study may provide a more holistic view of the Emporium Model by examining the thoughts, feelings, beliefs, and attitudes of students and instructors.

Contrary to the opinion of the researcher, findings of this study found that the Emporium Model was not effective in reducing math anxiety and in improving math performance scores. The significant difference that was found with math anxiety involved a decrease in anxiety with the Traditional group as measured by the pre-post anxiety rating scale questionnaire. The difference in the pre- and post- algebra readiness scores were not significant for either class format. From these findings, a recommendation for the participating institution is to consider offering a blending of the two class formats. The instructional type for developmental courses would not be exclusively Emporium style or totally Traditional. Instructors should have the discretion to utilize the best practices of both instructional formats to help students succeed in developmental math courses. This blending of the class formats may involve using mini-lectures for brief moments of the class period and also individualize, self-paced work on the computer during class time. Continual research to find the best ways to implement both instructional formats is needed to increase the success rates of students in developmental math courses.

APPENDIX A – IRB Approval Letter

THE UNIVERSITY OF
SOUTHERN MISSISSIPPI.

INSTITUTIONAL REVIEW BOARD
118 College Drive #5147 | Hattiesburg, MS 39406-0001
Phone: 601.266.5997 | Fax: 601.266.4377 | www.usm.edu/research/institutional.review.board

NOTICE OF COMMITTEE ACTION

The project has been reviewed by The University of Southern Mississippi Institutional Review Board in accordance with Federal Drug Administration regulations (21 CFR 26, 111), Department of Health and Human Services (45 CFR Part 46), and university guidelines to ensure adherence to the following criteria:

- The risks to subjects are minimized.
- The risks to subjects are reasonable in relation to the anticipated benefits.
- The selection of subjects is equitable.
- Informed consent is adequate and appropriately documented.
- Where appropriate, the research plan makes adequate provisions for monitoring the data collected to ensure the safety of the subjects.
- Where appropriate, there are adequate provisions to protect the privacy of subjects and to maintain the confidentiality of all data.
- Appropriate additional safeguards have been included to protect vulnerable subjects.
- Any unanticipated, serious, or continuing problems encountered regarding risks to subjects must be reported immediately, but not later than 10 days following the event. This should be reported to the IRB Office via the "Adverse Effect Report Form".
- If approved, the maximum period of approval is limited to twelve months.
  Projects that exceed this period must submit an application for renewal or continuation.

PROTOCOL NUMBER: 15102308
PROJECT TITLE: Math Emporium Model: Preparing Developmental Students for College Algebra
PROJECT TYPE: New Project
RESEARCHER(S): Stephanie P. Williams
COLLEGE/DIVISION: College of Science and Technology
DEPARTMENT: Center for Science and Math Education
FUNDING AGENCY/SPONSOR: N/A
IRB COMMITTEE ACTION: Expedited Review Approval
PERIOD OF APPROVAL: 11/06/2015 to 11/05/2016
Lawrence A. Hosman, Ph.D.
Institutional Review Board

APPENDIX B – Permission from Participating Institution

HINDS COMMUNITY COLLEGE
P.O. BOX 1100 • RAYMOND CAMPUS • RAYMOND, MISSISSIPPI 39154-1100

Office of Institutional Research and Effectiveness

October 14, 2015

To Whom It May Concern:

The purpose of this letter is to grant Stephanie Williams permission to conduct research concerning the effectiveness of the Math Emporium Model in helping prepare students for College Algebra. It is my understanding that the research project will take place in Spring 2016.

All students in the study will only be allowed to participate with consent forms. Special consent forms will be needed for minor students who will be taking the course as well. All student information collected from this study will be de-identified and presented in aggregate form only.

As the Director of Institutional Research and Effectiveness at Hinds Community College, I fully support this research effort, and I will ensure compliance with the objectives of the data collection.

Sincerely,

Carley Dear

Carley Dear
Director of Institutional Research and Effectiveness

APPENDIX C – Abbreviated Mathematics Anxiety Rating Scale

REVISED ABBREVIATED MATHEMATICS ANXIETY RATING SCALE

Please indicate the level of your anxiety in the following situations. Circle ONE number on each line. Use the following scale: 1 - not at all, 2 - a little, 3 - a fair amount, 4 - much and 5 - very much

1.	Studying for a math test.	1	2	3	4	5
2.	Taking math section of the college entrance exam	1	2	3	4	5
3.	Taking a quiz in a math course	1	2	3	4	5
4.	Taking an exam (final) in a math course	1	2	3	4	5
5.	Working on a math homework assignment, online	1	2	3	4	5
6.	Being given homework assignments of many difficult problems that are due the next class meeting	1	2	3	4	5
7.	Thinking about an upcoming math test 1 week before	1	2	3	4	5
8.	Thinking about an upcoming math test 1 day before	1	2	3	4	5
9.	Thinking about an upcoming math test 1 hour before	1	2	3	4	5
10.	Realizing you have to take a certain number of math classes to fulfill requirements	1	2	3	4	5
11.	Reading a math textbook	1	2	3	4	5
12.	Receiving final math grade in the mail or online	1	2	3	4	5
13.	Opening a math book and seeing a page full of problems	1	2	3	4	5
14.	Getting ready to study for a math test	1	2	3	4	5
15.	Being given a "pop quiz" in a math class	1	2	3	4	5
16.	Reading a cash register receipt after your purchase	1	2	3	4	5
17.	Being given a set of numerical problems involving addition to solve on paper	1	2	3	4	5
18.	Being given a set of subtraction problems to solve	1	2	3	4	5
19.	Being given a set of multiplication problems to solve	1	2	3	4	5
20.	Being given a set of division problems to solve	1	2	3	4	5
21.	Buying a math textbook	1	2	3	4	5
22.	Watching a teacher work an algebraic equation on the board	1	2	3	4	5
23.	Enrolling in a math class	1	2	3	4	5
24.	Listening to another student explain a math formula	1	2	3	4	5
25.	Walking into a math class	1	2	3	4	5

APPENDIX D – Algebra Readiness Test

Algebra Readiness Test

Student ID #: ______________________ **Date:** ______________

Solve each problem. Show all work on the test paper. Do your best!

Solve the equation.

1) $4(5x + 1) + 21 = 13x - 3$ 1) ________

A) -196 B) -4 C) -28 D) 4

2) $\frac{x + 2}{2} - \frac{3x - 12}{10} = 1$ 2) ________

A) -24 B) - 3 C) 6 D) - 6

Solve.

3) Find the measures of the angles of a triangle if the measure of the first angle is four times the measure of the second angle and the third angle is 30° more than the second angle. 3) ________

A) 35°, 5°, 140° B) 55°, 25°, 100° C) 68°, 17°, 95° D) 20°, 5°, 155°

Solve the equation for the specified variable.

4) $F = \frac{9}{5}C + 32$ for C 4) ________

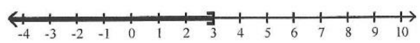
A) $C = \frac{5F-160}{9}$ B) $C = \frac{9}{5}(F - 32)$ C) $C = \frac{5}{F - 32}$ D) $C = \frac{F - 32}{9}$

Spring 2016 Algebra Readiness Test (pre-test) 1

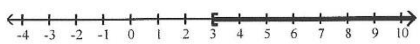
Graph the solution set of the inequality and write it in interval notation.

5) $-7a + 2 \geq -2a - 13$ 5) ______

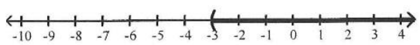
A) $(-\infty, 3]$



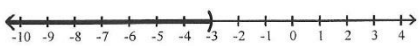
B) $[3, \infty)$



C) $(-3, \infty)$

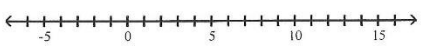


D) $(-\infty, -3)$

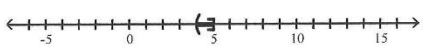


Solve the compound inequality. Graph the solution set.

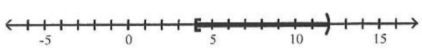
6) $-4 \leq \frac{3}{4}x - 7 < 2$ 6) ______



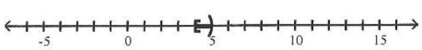
A) $(4, 5]$



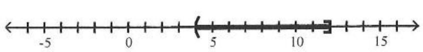
B) $[4, 12)$



C) $[4, 5)$



D) $(4, 12]$



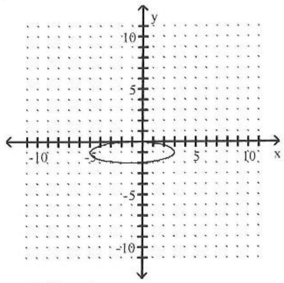
Solve the absolute value equation.

7) $|2x + 5| = 2$ 7) ________

A) $\frac{3}{2}, \frac{7}{2}$ B) $-\frac{3}{5}, -\frac{7}{5}$ C) $-\frac{3}{2}, -\frac{7}{2}$ D) $\varnothing$

Use the vertical line test to determine whether the graph is the graph of a function.

8) 8) ________



A) function B) not a function

Find the indicated value.

9) Find f(-3) when $f(x) = 2x^2 + 3x - 4$ 9) ________

A) 23 B) 18 C) 5 D) 13

Determine whether the lines are parallel, perpendicular, or neither.

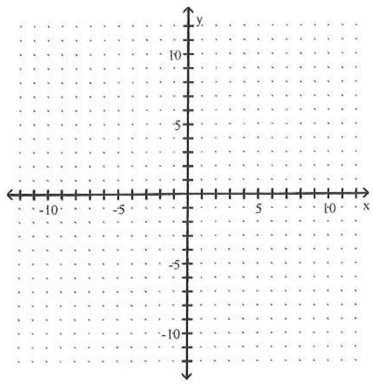
10) $15x - 5y = 8$ 10) ________

$3x - y = 15$

A) parallel B) perpendicular C) neither

Graph the equation.

11) $7x + 8y = 40$ 11) ____________



Solve the system of equations by the elimination method. Find the value of x (if it exists) in the ordered pair solution.

12) $7x - 7y = 56$ 12) ______
$-4x + 5y = -32$

A) 8 B) No solution C) 5 D) -6

Factor the polynomial completely.

13) $3xy + 9x + 8y + 24$ 13) ____________

14) $7x^2 + 23x - 20$ 14) ____________

15) **Factor tbe polynomial completely.** 15) ________

$14x^3 - 34x^2 + 12x$

16) $9x^2 - 16$ 16) ________

Solve the equation.

17) $3x^2 - 5x - 8 = 0$ 17) ______

A) $x = \frac{8}{3}, x = -1$ B) $x = \frac{3}{8}, x = 0$ C) $x = \frac{3}{8}, x = 1$ D) $x = \frac{3}{8}, x = -1$

Solve.

18) A window washer accidentally drops a bucket from the top of a 144-foot building. The height h of the bucket after t seconds is given by $h = -16t^2 + 144$. When will the bucket hit the ground? 18) ______

A) − 5 sec B) 3 sec C) 9 sec D) 48 sec

Simplify the rational expression.

19) $\frac{x^2 + 11x + 30}{x^2 + 13x + 42}$ 19) ______

A) $-\frac{x^2 + 11x + 30}{x^2 + 13x + 42}$ B) $\frac{11x + 5}{13x + 7}$ C) $\frac{x + 5}{x + 7}$ D) $\frac{11x + 30}{13x + 42}$

Multiply or divide as indicated. Simplify completely.

20) $\frac{x^2 + 12x + 27}{x^2 + 13x + 36} \cdot \frac{x^2 + 4x}{x^2 - 5x - 24}$ 20) ______

A) $\frac{1}{x - 8}$ B) $\frac{x^2 + 4x}{x - 8}$ C) $\frac{x}{x - 8}$ D) $\frac{x}{x^2 + 13x + 36}$

21) $\frac{x^2 - 6x + 9}{9x - 27} \div \frac{8x - 24}{72}$ 21) ______

A) 72 B) $\frac{x^2 - 6x + 9}{(x - 3)^2}$ C) 1 D) $\frac{(x - 3)^2}{81}$

Perform the indicated operation. Simplify if possible.

22) $\frac{x^2 - 9x}{x - 4} + \frac{20}{x - 4}$ 22) ______

A) x - 4 B) $\frac{x^2 - 9x + 20}{x - 4}$ C) x - 5 D) x + 5

23) $\frac{5x}{x + 1} + \frac{6}{x - 1} - \frac{10}{x^2 - 1}$ 23) ______

A) $\frac{5x - 4}{x + 1}$ B) $\frac{5x}{x - 1}$ C) $\frac{5x - 4}{x - 1}$ D) $\frac{x + 1}{x - 1}$

Solve the equation.

24) $\frac{4}{x+5} - \frac{8}{x-5} = \frac{8}{x^2-25}$ 24) ______

A) 17 B) -17 C) 68 D) $\sqrt{49}$

Find the cube root.

25) $\sqrt[3]{-125x^6}$ 25) ______

A) $11x^2$ B) $25x^2$ C) $-5x^2$ D) not a real number

Use the quotient rule to divide and simplify.

26) $\sqrt{\frac{48x^2y}{25}}$ 26) ______

A) $\frac{4x\sqrt{3y}}{5}$ B) $x\sqrt{\frac{48y}{5}}$ C) $\frac{4\sqrt{3x^2y}}{5}$ D) $16x\sqrt{3y}$

Add or subtract. Assume all variables represent positive real numbers.

27) $-8\sqrt{2} - 3\sqrt{18}$ 27) ______

A) $-17\sqrt{2}$ B) $18\sqrt{2}$ C) $12\sqrt{2}$ D) $-12\sqrt{2}$

Multiply, and then simplify if possible. Assume all variables represent positive real numbers.

28) $\sqrt{3}\,(\sqrt{6} + \sqrt{3})$ 28) ______

A) $9\sqrt{2} + 3$ B) $3\sqrt{2} + 9$ C) $3\sqrt{2} + 3$ D) $6 + 9$

Rationalize the denominator and simplify. Assume that all variables represent positive real numbers.

29) $\dfrac{-7}{\sqrt{x} + 3}$ 29) ______

A) $\dfrac{21 + 7\sqrt{x}}{x + 9}$ B) $\dfrac{21 - 7\sqrt{x}}{x - 9}$ C) $\dfrac{21 - 7\sqrt{x}}{x^2 - 9}$ D) $\dfrac{21 + 7\sqrt{x}}{x - 9}$

Solve.

30) $\sqrt{5x + 5} + 4 = 8$ 30) ______

A) $\dfrac{5}{11}$ B) 55 C) $\dfrac{11}{5}$ D) $\varnothing$

31) Scott set up a volleyball net in his backyard. One of the poles, which forms a right angle with the ground, is 8 feet high. To secure the pole, he attached a rope from the top of the pole to a stake 5 feet from the bottom of the pole. To the nearest tenth of a foot, find the length of the rope. 31) ______

A) 6.2 ft. B) 89 ft. C) 9.4 ft. D) 3.6 ft.

Use the square root property to solve the equation.

32) $(x - 2)^2 = 49$ 32) _______

A) -5, -9 B) 51 C) 7, -7 D) 9, -5

Use the quadratic formula to solve the equation.

33) $5x^2 - 3x - 1 = 0$ 33) _______

A) $\frac{3-\sqrt{29}}{10}, \frac{3+\sqrt{29}}{10}$ B) $\frac{-3-\sqrt{29}}{5}, \frac{-3+\sqrt{29}}{5}$

C) $\frac{3-\sqrt{29}}{5}, \frac{3+\sqrt{29}}{5}$ D) $\frac{3-\sqrt{29}}{2}, \frac{3+\sqrt{29}}{2}$

APPENDIX E – Permission to use A-MARS

Williams, Stephanie P.

From:	Alexander, Livingston <lalexand@pitt.edu>
Sent:	Tuesday, July 07, 2015 5:01 PM
To:	Williams, Stephanie P.
Subject:	RE: Permission to use A-MARS

Dear Ms. Williams,

Please regard this email as my approval for you to use the Abbreviated MARS, and to modify it as you proposed.

Livingston Alexander

Livingston Alexander
President
University of Pittsburgh at Bradford and Titusville Campuses
300 Campus Drive
Bradford, PA 16701
814-362-7501
814-362-7690 (Fax)
lalexand@pitt.edu

From: Williams, Stephanie P. [mailto:SPWilliams@hindscc.edu]
Sent: Tuesday, July 7, 2015 5:00 PM
To: alexand@pitt.edu
Subject: Fw: Permission to use A-MARS

Dr. Alexander,

Please read the message below and let me know if permission is given.

Stephanie

From: Williams, Stephanie P.
Sent: Thursday, June 11, 2015 12:04 AM
To: lalexand@pitt.edu
Cc: Williams, Stephanie P.
Subject: Permission to use A-MARS

Dr. Alexander,

My name is Stephanie Williams and I am a doctoral candidate at the University of Southern Mississippi in Hattiesburg, MS. I am writing to ask for permission to use your abbreviated version of the mathematics anxiety rating scale in my research. The questionnaire would be administered to a group of students in Intermediate Algebra at Hinds Community College. Your permission to use it would be greatly appreciated.

1

APPENDIX F – Instructor's Agreement Form

Date: ____________________ ID #: __________________________________

Course Number & Title: ____

Class Meeting Time/Day: ____

Class Format (check one): □ Emporium (Modular) □ Traditional

My signature below indicates that as the Intermediate Algebra instructor for this class, I have explained the requirements and class format of this course to the students. I agree to adhere to the policy/procedures of the syllabus concerning the instructional methods of the class specified above. The method of instruction in the Modular class will not be lecture based. Students will work on mastering course objectives during class time and also outside of class. The Traditional class is lecture based and requires students to complete homework assignments outside of class. I further acknowledge that I read the oral script to my class prior to them participating in the study.

Instructor's signature: ____

APPENDIX G – Oral Script for Instructors

Stephanie Williams, an instructor at Hinds Community College and a graduate student at the University of Southern Mississippi is asking for your participation in a research project for her dissertation. The title of the project is: Math Emporium Model: Preparing Developmental Students for College Algebra. The purpose of the study is to compare math anxiety and preparation of students who take Intermediate Algebra in the Emporium class format to students who take Intermediate Algebra in a Traditional format. Results of the study may be used to assist the mathematics department in determining future course offerings. Participants in the study will complete an abbreviated mathematics anxiety rating scale questionnaire and an algebra readiness test at the beginning of the semester and again near the end of the semester. The estimated classroom time is no longer than one class period for each administration.

Participants must be at least 18 years of age. Your participation is completely voluntary and your identity will not be revealed. Participating in the study will subject you to no risks greater than those you normally encounter in everyday life. If you are willing to participate, a consent form must be signed. You may choose not to answer any questions, or you may withdraw from the study at any time without consequences to you. Your confidentiality will be strictly protected. All data obtained will be securely stored in a locked file cabinet in the researcher's office until the end of the semester. After the semester ends, the data will be analyzed to prepare a final report of the findings.

Please feel free to ask any questions during or after your participation in the study. If you have questions or concerns about this study, you may contact Stephanie Williams at (601) xxx-xxxx or stephanie.p.williams@eagles.usm.edu. You may also contact the student research advisor, Sherry Herron via phone at (601) xxx-xxxx or email, sherry.herron@usm.edu. This project and consent form have been reviewed by the Human Subjects Protection Review Committee, which ensures that research projects involving human subjects follow federal regulations. Any questions or concerns about rights as a research participant should be directed to the Chair of the Institutional Review Board, The University of Southern Mississippi, 118 College Drive #5147, Hattiesburg, MS 39406-0001, (601)xxx.xxxx.

Your signature on the consent form indicates you have received a copy of the informed consent and agree to participate in this study. Thank you for your willingness to be a participant for this study.

APPENDIX H – Consent Form

Participant's Name _______________________________

Consent is hereby given to participate in this research project entitled, Math Emporium Model: Preparing Developmental Students for College Algebra. All procedures and/or investigations to be followed and their purpose, including any experimental procedures, were explained. Information was given about all benefits, risks, inconveniences, or discomforts that might be expected.

The opportunity to ask questions regarding the research and procedures was given. Participation in the project is completely voluntary, and participants may withdraw at any time without penalty, prejudice, or loss of benefits. All personal information is strictly confidential, and no names will be disclosed. Any new information that develops during the project will be provided if that information may affect the willingness to continue participation in the project.

Questions concerning the research, at any time during or after the project, should be directed to Stephanie Williams at (601) xxx-xxxx or stephanie.p.williams@eagles.usm.edu. This project and this consent form have been reviewed by the Institutional Review Board, which ensures that research projects involving human subjects follow federal regulations. Any questions or concerns about rights as a research participant should be directed to the Chair of the Institutional Review Board, The University of Southern Mississippi, 118 College Drive #5147, Hattiesburg, MS 39406-0001, (601) xxx-xxxx.

____ ____________________

Research Participant's Signature Date

APPENDIX I – Participant's Instruction & Information Sheet

DIRECTIONS: After signing the consent form to participate in this project, please complete this informational sheet, the abbreviated math anxiety rating scale questionnaire, and the algebra readiness test. When you finish, place all papers in the envelope, seal it, and return the envelope to your instructor. Thank you for participating in this study.

Date: ____________________ ID #: ______________________________________

Class Meeting Time/Day: ___________________________________

Gender (check one):

- □ Male
- □ Female

Race/Ethnicity (check one)

- □ White
- □ Black or African American
- □ Hispanic
- □ Asian
- □ Other, specify ___________________________________

Classification (check one)

- □ Freshman
- □ Sophomore

Status (check one)

- □ Full-time
- □ Part-time

Age (check one)

□ 18 – 24 □ 25 – 34 □ 35 - 44
□ 45 – 54 □ 55 or older

Class Format (check one)

- □ Emporium (Modular) Class
- □ Traditional Class

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