EFFECTS OF A DEVELOPMENTAL BOOT CAMP: IMPROVING STUDENT PERFORMANCE ON A COLLEGE PLACEMENT TEST

by

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ABSTRACT

Heather Hill. EFFECTS OF A DEVELOPMENTAL BOOT CAMP: IMPROVING STUDENT PERFORMANCE ON A COLLEGE PLACEMENT TEST. (under the direction of Dr. Gary Kuhne) School of Education, Liberty University, April, 2012.

Nationwide, students are entering college unprepared for college-level work. Recent high school graduates are placing into developmental courses at an alarming rate. The purpose of this research study is to examine the effect of a developmental boot camp on standardized placement test scores of students enrolling at a community college in North Carolina. The study has a quasi-experimental non-equivalent control group design. Collected data will include participants' scores on the pretest and posttest placement test. A control group of eligible students who chose not to participate will be posttested for comparison. Instruments include ASSET® placement test and Computer-Adaptive Placement Assessment and Support System. Results showed an improvement in numerical and algebra scores but no significant change in English scores.

Descriptors: Developmental courses, college placement, remediation, boot camp

Dedication

To my wonderful family for their love and support during this journey! My husband, Michael; my daughters, Michaela, Meredith, and Mallory; our parents, Doug and Annette Harkey and Robert and Carolyn Hill; and our siblings, Traci and Keith Blackwelder, and Lisa Hill are the blessings in my life.

"Praise be to the God and Father of our Lord Jesus Christ, who has blessed us in the heavenly realms with every spiritual blessing in Christ." - Ephesians 1:3

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CHAPTER ONE: INTRODUCTION

Nationwide, students are entering college unprepared for college-level work. Recent high school graduates are being placed into developmental courses at an alarming rate. The research suggests that the factors contributing to this problem are many in number and complex in nature. At community colleges across the nation, as many as 43% of students are enrolled in at least one developmental class (NCES, 2003). At four-year colleges and universities, the number is nearly 30% nationally (Fennel, Professor, & College, 2008). The statistics are even more staggering and the state and local level. More than 70% of students at Stanly Community College are required to take at least one developmental class before being allowed to enroll in their required curriculum level course (Stanly Community College, 2010). To resolve this problem, educators must examine why a large number of high school graduates are placing into developmental courses at the college level, and look at specific strategies for high schools, colleges and universities to use to effectively decrease the number of students taking developmental courses.

Background

Community colleges offer a variety of adult education programs. They are successful in many measures of job placement, workforce training, and university transfer. A common malady continues to be low rates of completion in many different areas (Shulock & Moore, 2007). Community colleges face unique challenges due to governance by a state legislature, open-door policy, and stigma of being inferior (Cohen & Brawer, 2003; Shulock & Moore, 2007).

Developmental education at the college level has received much attention over the past decade (Tierney & Garcia, 2008). Much of the research addressing retention and completion rates compares community colleges to universities. The glaring misconception with this approach is the difference in population. Student bodies of community colleges are most likely part-time students, part-time or full-time workers, academically underprepared students, parents, and low-income individuals (Mellard & Anderson, 2007). Community college students are often first-generation college students in their families (Gibson, 2010). As a result, to determine the effectiveness of programs on student achievement on college placement tests, the focus on community college programs or initiatives that have measureable results in raising student achievement is essential.

In the state of North Carolina, placement testing became mandatory for all community college students enrolling in curriculum level courses with a developmental prerequisite (Lancaster, 2006). Community colleges must use one of the approved tests and follow the state-mandated validated test scores for placement into the corresponding courses. Acceptable placement tests include ASSET, COMPASS, and ACCUPLACER.

Problem Statement

Nationwide, students are entering college unprepared for college-level work. Recent high school graduates are placing into developmental courses at an alarming rate. Though the problem is not new, developmental education has received much attention over the past decade. The factors contributing to this problem are many in number and complex in nature. A community college in North Carolina implemented a developmental boot camp to attempt to raise placement test scores and help students

place into college-level courses.

Purpose Statement

The purpose of this study is to examine the effect of a developmental boot camp on standardized placement test scores of students enrolling at a community college in North Carolina. Due to the expense and time commitment required to operate the boot camp, the effects on students' placement test scores is an important determining factor.

Research Questions and Hypotheses

The study will attempt to answer the following questions:

Research Question 1. What effect does the developmental boot camp have on students' performance on the ASSET placement test?

Hypothesis 1. H_a: Students completing the developmental math numerical boot camp will score significantly higher on the ASSET placement test than those students not completing the developmental math numerical boot camp.

Hypothesis 2. H_a: Students completing the developmental math algebra boot camp will score significantly higher on the ASSET placement test than those students not completing the developmental math algebra boot camp.

Hypothesis 3. H_a: Student completing the developmental English boot camp will score higher on the ASSET placement test than those students not completing the developmental English boot camp.

Research Question 2. What effect does the developmental boot camp have on students' performance on the COMPASS placement test?

Hypothesis 4. H_a: Students completing the developmental math numerical boot camp will score significantly higher on the COMPASS placement test than those

students not completing the developmental math numerical boot camp.

Hypothesis 5. H_a: Students completing the developmental math algebra boot camp will score significantly higher on the COMPASS placement test than those students not completing the developmental math algebra boot camp.

Hypothesis 6. H_a: Students completing the developmental English boot camp will score significantly higher on the COMPASS placement test than those students not completing the developmental English boot camp.

In addressing the research questions, the study will support or fail to support the hypotheses.

Research Design

The study has a quantitative, quasi-experimental non-equivalent control group research design. Collected data will include participants' scores on the pretest and posttest placement test. Participation in the boot camp will be the independent variable and placement test scores will be the dependent variable. The control group will be students invited to attend who did not participate in the boot camp but did retest on the appropriate placement test. Students in both the experimental and control groups both meet the same criteria for participation based on their initial placement test scores.

Identification of Variables

The independent variable for this study is participation in the boot camp. Dependent variables are placement test scores on two standardized college placement tests, ASSET and COMPASS.

Definitions

ASSET. ASSET® is a standardized, pencil-and-paper college placement test used

nationwide to support math and English course placement and retention-service needs of colleges created and distributed by American College Testing, or ACT (ACT, 1994). Pretest and posttest scores for both the experimental and control groups will be studied, making the test scores the dependent variable of the study.

Boot camp. The developmental boot camp is a two-week intensive study session to review key concepts covered on the college placement tests, ASSET or COMPASS. Students are invited to participate based upon predetermined pretest scores. Participation is self-selected. The instruction is provided by community college instructors based upon topics common to the associated developmental course matching the range of pretest scores. The boot camp is the treatment applied to the group making participation in the boot camp the independent variable in the study.

COMPASS. The ACT Computer-Adaptive Placement Assessment and Support System (COMPASS) is an untimed, computerized, standardized placement test. The test is adaptive and measures students' performance in English and math to help colleges place students are the appropriate level of study to achieve maximum success (ACT, 2006). Pretest and posttest scores will be studied, making the test scores the dependent variable of the study.

Developmental Course. Developmental courses are defined in the North Carolina Community College System (NCCCS) as those courses covering material prerequisite to college-level work. Developmental courses, also referred to as remedial courses, are offered in math and English. Students invited to participate in this study placed into one of the following developmental courses:

ENG 095 Reading & Comp Strategies. This course is a reading and writing

course intended to help students "comprehend, analyze, and evaluate college texts and to compose essays in preparation for college writing" (CCL, 1997).

MAT 060 Essential Mathematics. This course is a numerical skills course covering topics including "decimals, fractions, percents, ratio and proportion, order of operations, geometry, measurement, and elements of algebra and statistics" (CCL, 1997).

MAT 070 Introductory Algebra. This course is a foundational algebra course covering problem solving techniques and algebraic topics including "signed numbers, exponents, order of operations, simplifying expressions, solving linear equations and inequalities, graphing, formulas, polynomials, factoring, and elements of geometry" (CCL, 1997).

Assumptions and Limitations

The study makes the assumptions that students will perform at their best on both the pretest and posttest placement test. Students will posttest on the same type of placement test, ASSET and COMPASS, as they pretested. Maturation, a common threat to external validity with pretest-posttest design, will be limited due to the short time lapse between retesting. The sample is self-selected from the population of qualified testers, limiting the amount of inferences.

A possible limitation is the lack of definition of participation in the boot camp. Students' amount of time in participating in the boot camp is not quatified. As a result, students attending for many hours may markedly improve their placement test scores while students spending very little time in the boot camp may not improve much at all.

The boot camp is one course with content available in all three areas: numeric, algebra, and English which included both reading and writing. Students may be invited

to attend one or more areas. All students participating have access to all of the content. Some students may retest in areas for which they were not officially enrolled.

CHAPTER TWO: REVIEW OF LITERATURE

This chapter reviews the literature by categorical topics. A brief history of developmental education in postsecondary institutions begins the review followed by the theoretical framework for the topic. The literature reveals some of the reasons that large numbers of high school graduates are placing into developmental, or remedial, courses at the college level, retention issues, early intervention strategies for improvement, and the benefits of developmental education.

Introduction

A college degree is correlated to the likelihood of a successful career. In a competitive era of globalization, an increasing number of high school graduates must be prepared for college-level work. The demand for an educated workforce has increased and will continue to increase (Byrd & MacDonald, 2005; Hoyt & Sorensen, 2001). Research suggests that not only are students failing to be prepared through their high school studies to meet the rigor of college courses, they are not learning the rudiments of reading writing and arithmetic (Cohen & Brawer, 2003; Donovan & Wheland, 2008; Hoyt & Sorensen, 2001; Taylor, 2008; Tierney & Garcia, 2008). Data on how many students are placing into developmental courses at the community college level suggests the magnitude of the problem. The National Center for Education Statistics (NCES) reported that developmental courses are offered at 100% of the community colleges, 80% of public senior institutions, and 59% of private senior institutions (2003). Data reveal about three-fourths, 76%, of incoming freshmen nationwide are required to take at least one developmental course resulting in over two million students (NCES, 2003; Saxon,

Sullivan, Boylan, & Forrest, 2005).

Remediation through developmental courses is the most common approach to helping students become college ready. Despite its high cost and extensive use of resources, there is little rigorous research available evaluating its effectiveness (Bailey, 2008; Levin & Calcagno, 2008). Effective strategies are needed to reverse this increasing trend toward developmental courses. Colleges and universities need to serve their current student body, not the student body they envision in the future (McCabe, 2003). Strategic intervention is required to interrupt the pattern of poor math performance and to eliminate the perception of inability to be successful in math. Students scoring close to the cut-off scores for the curriculum level course on the placement test may be successful in the curriculum course if provided with the appropriate skill review (Bailey, 2008; Boylan, 2009; Taylor, 2008). Innovative, cost-effective solutions are needed to reverse the growing trend of students placing into developmental courses.

Courses designed to teach literacy are called by several synonymous terms: developmental, remedial, compensatory, and basic skills. The choice to use either developmental or remedial education is a controversial one. The term remedial, according to Casazza, emphasizes students' deficiencies rather than their potential (1999). The term developmental is intended to reflect a more sophisticated approach to teaching and a different attitude about the students. Regardless of terminology, the goal of each is to teach basic reading, writing, and arithmetic (Casazza, 1999; Cohen & Brawer, 2003). Basic knowledge of reading, science, math, and technology are fundamental to student success (Uysal, 2007) and are the focus of developmental courses at the community college level.

History of Developmental Education

Developmental education is essential to the mission of community colleges. As early as 1937, colleges and universities were charged to "assist students in developing to the limits of his potentialities and in making his contribution to the betterment of society" (American Council on Education, 1937, reprinted by National Association of Student Personnel Administrators, 1989, p. 39.) The term developmental education refers to the development of the student's academic and personal well-being. Remedial work at the postsecondary level is beneficial to students in the long-term and provides students the prerequisite skills they are missing to be successful in college-level work (Attewell, Lavin, Comina, & Levey, 2006).

The concept of remedial or developmental education is evident in the seventeenth century when struggling Latin students were assignment tutors (Bettinger & Long, 2005). In the early 1970s, community colleges realized the need for precollege courses in math, reading, and writing when faced with students at all levels of academic preparedness (Perin, 2005). The nation's community colleges moved toward a standardized system of placement tests in the late 1970s and began restricting admissions to many courses and programs (Armstrong, 2000). More recently, states have mandated cutoff scores to place students into particular courses. Of these states, most require students to enroll into the courses in which they place before proceeding into further college courses (Olsen, 2006).

Theoretical Framework

One model of education that appropriately fits this study is Malcolm Knowles' model of andragogy. Andragogy is defined as the art and science of helping adults learn (Whiting, Guglielmino, & Burrichter, 1988). Knowles identified four basic assumptions

about adult learners: Adults become more self-directed as they mature; life experiences become learning resources; readiness to learn is closely tied to an adult's social role; and adults tend to be problem-based learners rather than subject-based (Cyr, 1999; Tennant & Pogson, 1995; Whiting et al., 1988). Traditional pedagogy is focused on a dependent learner and is predominant with child learners. In contrast, adult learners are more self-directed and motivated (Somers, 1988). This theory supports the format of new delivery method in higher education like online or hybrid courses.

Knowles' fourth assumption stresses adults tend to bring a sense of urgency to their education. Learning is more focused on problem-solving and real life applications than subject matter content (Sommers, 1988; Tennant & Pogson, 1995). Adult learners have tendencies toward being internally motivated. Learning is related to life goals. Though all individuals have some innate desire to grow and learn, the desire is more prominent as adults mature (Cyr, 1999). Adult learners prefer to focus learning in a single area rather than a myriad of topics. In addition, adults are comfortable with peer teaching and sharing, more so than child learners (Cyr, 1999; Giguere & Minotti, 2003; Somers, 1988). Another area of difference lies in experience. Adult learners use their experiences as learning resources, particularly when those experiences were active learning and not passive (Somers, 1988). Life experiences gave students self-efficacy skills, time management tools, and goal setting abilities they attribute to their college success (Byrd & MacDonald, 2005). Using the lens of andragogy, the way adults learn plays a vital part in this study of how best to help adults perform their best.

Motivation is a critical issue for adult learners. In an age of utilitarianism where students want to weigh cost versus benefit, motivation to learn is crucial to adult learners.

When learners feel in control of their learning in a student-centered environment, they are more motivated to engage in the process (Svinicki, 2004). Motivation leads to self-regulated learning. The three basic characteristics of self-regulated learning are learners having control over their environment, learners working toward a measureable goal, and learners having control over the decisions to be made (Pintrich, 1995). Students can set goals for themselves and take responsibility for their own learning. Adult learners are the population for community colleges and are the focus of this study.

Trends

The literature supporting trends in increased demand for developmental courses at the community college level are documented. Possible contributing factors include changing high school requirements, misalignment of high school requirements and college placement tests, community college challenges, and retention issues.

High School Mathematics Requirements

High school graduation requirements have adjusted over the year, and vary by state and district. However, the adjustments may not be meeting the demands of a changing climate and workplace. The Committee of Ten declared in 1893 that high schools did not exist to prepare students for college (National Education Association [NAE], 1894). At that time, many students were considered job-ready after attaining a high school diploma. A more competitive global marketplace requires more from today's students, yet the high schools have not changed as dramatically as the country's economy dictates (Strong American Schools, 2008). Among the students placing into developmental courses at the postsecondary level are high numbers of students who completed college-preparatory courses in high school (Attewell et al., 2006). In a study

of Ohio graduates, many students who had successfully completed college-preparatory math classes were placed into developmental courses based on their COMPASS or ASSET placement test scores (Deil-Amen & Rosenbaum , 2002). A 2008 study revealed that almost half of developmental students wished their high school courses had been more difficult to prepare students for the college classes (Strong American Schools).

One theory to address the decline in literacy revolves around high school mathematics requirements for graduation. States vary in the number of required math course students must take to earn their diploma. The National Mathematics Advisory Panel, while researching ways to improve mathematics achievement for all students, discovered an interesting relationship with Algebra II (Dervarics, 2005). The American Diploma Project (ADP) developed exam standards using mathematics faculty from high schools and colleges. The Algebra II exam incorporated content viewed as most important to improve math curricula and to best prepare students for math at the collegiate level (Achieve, 2009). Algebra II is a strong predictor of college success and potential job earnings. Studies show that students who successfully complete Algebra II are more than twice more likely to become college graduates than those students who are less prepared in mathematics (Dervarics, 2005; Fennel et al., 2008). Statistics show that students placing into developmental math and English courses as they enter college tend to have lower completion rates than other students. The division in content among college placement test and high school end-of-course tests occurs in the specificity of topics (Martino & Abell, 2009). A college placement test assesses a mix of topics whereas an end-of-course test assesses mastery of particular course content.

There is much debate over the appropriateness of offering high school level

algebra courses to students in middle school (Achieve, 2009; Capraro & Joffrion, 2006). Do the students have the maturity to process the complex principles and critical thinking skills necessary to master algebra at a young age? Are the courses taught at the same level of rigor for all age groups? Students at this age tend to use algebraic procedures without understanding why the procedures work (Thompson, Phillip, Thompson, & Boyd, 1994). Teachers are charged with making the concepts accessible to all levels of learning and maturation. More research is needed to better determine if maturity level affects comprehension of algebraic concepts. As of 2005, only 41% of eighth-graders were enrolled in gateway math courses, like Algebra I (Strong American Schools, 2008).

The opposite side of the debate encourages algebra in middle schools to offer students a chance to prepare for the more rigorous high school requirements. If students are presented with algebraic concepts and procedures earlier in school, they will be better prepared when presented with true algebra content later in middle school (Capraro & Joffrion, 2006). Some studies have suggested that students are able to understand word problems without truly understanding the symbolic-procedural operations (Nathan & Koedinger, 2000). Problems presented as stories or in an informal manner are easier for middle school students to solve than those presented using common algebraic symbols.

Research studies compare preparation statistics of young people in public schools to their international peers (Donovan & Wheland, 2008). The United States falls short in the mathematical preparation of its students, in most cases. A myriad of possible solutions to the problems exist and there are equally as many recipients of blame. Though many agree that change is necessary, few can agree on what changes need to occur (Achieve, 2007). The foundation of knowledge includes basic building blocks of

math and English. At the state level, policymakers are exploring options ranging from aligning high school academic standards to college entry-level course competencies to requiring all students to complete more math courses in high school (Achieve, 2008). Further discrepancies in performance are found in low-income and underrepresented students (Dervarics, 2005).

Misalignment of High School Competencies and College Placement Tests

Martino and Abell (2009) report a misalignment of college professor expectations and the competencies taught in the nation's high schools. When states adopt content standards in the public school system, the goal is to identify the skills and content mastery needed for each grade level, not specifically to prepare students for college (Shelton & Brown, 2008). Uniform standards and assessments are not bad for schools, but would be more efficient at preparing students for college if they were aligned with college placement tests. Alignment is defined as a measure of how components of a system match and indicates how well they work together (Webb, 2007).

As recently as 2005, no state had aligned high school requirements with demands of the workforce (Shelton & Brown, 2008). As of September 2009, 29 states have defined college-ready and career-ready standards in math and English (Achieve, 2009). The misalignment of competencies taught in high school versus those covered on the placement tests is one cause for low scores on college entrance exams. This is a barrier to high school graduates planning to enroll in college. High schools have state mandated competencies to cover in each of their courses (Shelton & Brown, 2008). With the No Child Left Behind Act (NCLB), schools are charged to meet minimum standards and pass rates in order to receive additional funding. As a result, the content taught must align to

the competencies on the standards based, high-stakes test. Students may perform well on the test and remain unprepared for the college level placement test (Herman, Webb, & Zuniga, 2007). Such assessments send mixed messages to teachers and educators about what teachers should teach and what students should learn.

If the competencies for high school are not aligned with the college placement test objectives, then the content taught in most high school math classes will be significantly different from what postsecondary institutions expect students to master before being placed into college level courses (Brown & Niemi, 2007; Gordon, 2006; Martino & Abell, 2009; Roueche & Waiwaiole, 2009). Alignment between the secondary and senior institutions is essential to provide consistent information to students. Proper alignment is also crucial to data collection in areas such as achievement gaps, remediation rates, and student attrition.

Hoyt and Sorensen (2001) report there are other areas where high schools fail to prepare students for college work, including grade inflation, lack of academic rigor in some areas, and not enough college preparatory courses. In an economic time where overcrowding is prevalent in high school classrooms, inadequate funding manifests itself in many ways. To address these concerns, school systems continue to change high school graduation requirements and end-of-course assessments.

An obvious fix would be to adjust the college placement test to the high school competencies. Most senior institutions require applicants to take a placement exam to take courses in math and English (Perin, 2006). As a result of mandatory testing, many students may be unable to take college-level courses their first semester (Shelton & Brown, 2008). The North Carolina community colleges are held to similar state

mandated standards. All community colleges in NC are required to give one of three standardized placement tests and are required to place students into college, or developmental, courses based upon specific cut-off scores (Lancaster, 2006). The alignment of these two groups of standards would require the joint effort at the state level of the Department of Public Instruction (DPI) and the North Carolina Community College System Office (NCCCS). Ideally, further collaboration with the North Carolina University System Office would enable alignment between high school competencies and all placement tests. Most senior institutions use their own variations of placement tests. An interconnected K-16 system with consistent goal, outcomes, and student expectations would likely increase the number of students completing their college degree (Strong American Schools, 2008). The dilemma facing all concerned parties is to find a solution without placing blame (Hoyt & Sorensen, 2001). Success will come from helping students transition from high school to college and to bridge the gap that unfortunately continues to widen. Legislatures in most states agree that the developmental education problem was inherited from the K-12 sector and little has been done to effect change (Levin & Calcagno, 2008; Tierney & Garcia, 2008).

Research also shows that placement tests alone may not be the best indicators of a student's likelihood of success in college courses. Other factors which may contribute to the success of underprepared learners include time-management, self-motivation, and the ability to self-learn (Armstrong, 2000; Byrd & MacDonald, 2005). Companion measures could be used to complement placement testing to accurately place students and might include grade point average and hours of employment. Research also indicates that using a traditional approach that focuses only on specific knowledge may not be the most

accurate measure of general knowledge and problem solving abilities (Cronbach, 1990; Gordon, 2006). Perin (2006) suggests that colleges and universities often soften assessment and placement mandates using waivers, subjective assessments, and by removing or reducing prerequisite course requirements for college level courses. The goal of course placement should be to place students into the classes where they will be most successful (Donovan & Wheland, 2008). Regardless of assessment, the solution involves collaboration between the high schools and the senior institutions.

Community College Challenges

All publicly funded community colleges offer developmental education courses (NCES, 2003). Developmental education is fundamental to the mission of the community college and is a benefit to society (McCabe, 2000). With that being said, community colleges are often criticized for offering too many developmental courses, duplicating K-12 efforts, and spending too much time and too many resources in developmental education that could be spent on university transfer (Perin, 2006; Rhoads & Valadez, 1996). Community colleges often have higher median student ages than their more traditional counterparts, the universities. A discussion of the effect time between high school graduation and college testing has on test scores bears consideration. Community colleges serve a larger percentage of students who are academically underprepared for college (George, 2010). The admissions criteria for enrolling in a community college are much less rigorous than those of a senior institution. As a result, students enter community colleges with all levels of preparation and at all stages of their lives (Armstrong, 2000). Such statistics seem to point to traditional college students being unprepared for college. While a portion of that is true, a percentage of the students

are adults returning to education after spending time in the workforce, or after an extended time away from education (Pappas Consulting Group, 2006). Students returning to college after an absence of more than ten years would understandably score lower on placement tests due to the time out of the classroom. The National Center for Developmental Education reports that students ages 22 and over account for 43% of those in developmental classrooms (NCES, 2007).

A challenge for community colleges is providing the appropriate support with declining resources. Among this non-traditional population, there are degrees of preparedness. Some students graduated before more stringent graduation requirements were in place and some have simply forgotten what they need to know (Esch, 2009; Levin & Calcagno, 2008). Other students may need repetition of the content to achieve mastery (Hoyt & Sorensen, 2001). Community colleges must find the balance between maintaining high academic standards while preparing students who are not yet college-ready.

Cost. The 21st century is a time where college degrees are necessities for social and economic success. At the same time, the economic downturn has created financial barriers to attaining degrees (Byrd & MacDonald, 2005). The vicious cycle of unemployment increasing community college enrollment while the lack of income tax may cut school budgets is a familiar lament. Community colleges find themselves doing more with less. In such an economy, college and university tuition will inevitably increase (College Board, 2006). Many senior institutions choose to send students to the local community college to complete their developmental work before fully accepting them at the college or university (Cohen & Brawer, 2003; Duranczyk & Higbee, 2006;

Horn et al., 2009; Levin & Calcagno, 2008). Providing remedial education through developmental courses is expensive for students requiring more time in college, and costly for colleges and governments (Levin & Calcagno, 2008; Strong American Schools, 2008). Remedial education is less expensive in terms of faculty salaries at the community college versus the university. Full-time faculty salaries at a public, doctoral institution are nearly 150% of the salary of faculty members at a public two-year institution (Bailey, 2008; Bettinger & Long, 2006).

A 2008 study reported the annual cost of remediation at community colleges was between $1.9 and $2.3 billion while nearly $500 million at four-year colleges and universities (Strong American Schools, 2008). States continue to move the responsibility of developmental education away from senior institutions to community colleges. Some states, including Florida, Massachusetts, and New York, have legislation that moves all developmental courses out of public senior institutions into community colleges (Horn et al., 2009; Tierney & Garcia, 2008). Many state legislatures are questioning the funding as related to developmental education. If high schools are paid to teach children basic skills in math and English, why should community colleges be funded to teach the same content to the same students? Many view this as a duplication of resources (Hoyt & Sorensen, 2001; Saxon & Boylan, 2001). Some school systems in Virginia ventured further to guarantee their graduates were college ready by offering to pay developmental course tuition for former students (Bettinger & Long, 2005)

Cost factors are being discussed at the state legislature level as using taxpayer dollars inefficiently. Some states are requiring students to pay tuition for developmental courses. Federal funding (PELL grant) may not be available for developmental education

(Brothen & Wamback, 2004). For other students, the developmental courses may be covered by financial aid, count toward class hours without earning college credit, and occupy the PELL dollars. Too many of the developmental classes could threaten eligibility or cause a shortage of money later in the program sequence for other courses that earn college credit (Bailey, 2008; Martino & Abell, 2009; Saxon & Boylan, 2001). Some states have mandated that developmental instruction not be offered in the public universities.

In perspective, the costs of developmental education statewide are usually single digit percentages, meaning less than ten percent of the education budget for the college or university. In many cases, the percentage is between 1% and 2% (Saxon & Boylan, 2001). This is a difficult number to derive since in many institutions, developmental education is blended with other departments. Regardless of percentage, the monetary cost involved is viewed as repetitious while the intrinsic value is being questioned.

In addition to the cost factors, the philosophical argument that precollege level courses (developmental) should not be offered at senior institutions (Bettinger & Long, 2005; Pulley, 2008; Tierney & Garcia, 2008). Some states have prohibited four-year universities from offering developmental education courses (Bettinger & Long, 2005). Others limit the number of courses that are offered at their institutions. By relegating developmental courses to community colleges and not offering them at senior universities, students are being denied access to the university environment. Many community college students placing into developmental courses never receive a baccalaureate degree (Boylan, 2009; Duranczyk & Higbee, 2006) In North Carolina, some universities contract with local community colleges to provide developmental

courses (Pappas Consulting Group, 2006). Students being sent from the universities to the community colleges to complete their developmental studies are likely to not return to the university, depending on how long their course sequence will last at the developmental level.

Recognizing the role community colleges play in the educating of adults and the production of college graduates, United States President Barack Obama announced an American Graduation Initiative, calling for an additional five million community college graduates by 2020 (Obama, 2010). If community colleges are effective in moving half of their developmental students through their course sequence, the overall results can be staggering (Esch, 2009). The statistics are clear in describing developmental education as fundamental to the community college. Significant alterations could drastically change the educational foundation of the colleges (Bahr, 2008). Community colleges are not expected to fix the problem alone but are expected to do their best, including trying new approaches when the old ones no longer work. Small changes and improvements at the fundamental level can have exponential effects on the number of community college graduates and the number of community college students who transfer to senior institutions.

Open access. Open access to community college is not new. The open door policy generally means that there are no minimum entrance scores on standardized tests, like ACT, SAT, COMPASS, ASSET, and other standardized tests for admission to the college. As a result, academically underprepared students who may have low scores on such tests now have access to higher education. In many states, access to higher education is the main mission for community college systems (Shelton & Brown, 2008).

Since their inception, community colleges were bound to accept students with very few restrictions. Open access admission to the community college does not imply immediate access to college level courses (Horn, et. al, 2009). The system's mission, in part, is to meet students where they are and take them as far as they can go. An intrinsic part of the community college system is to lead students to success, not failure. Is it ethical to allow an underprepared student to set himself up for failure? This often leads to the common debate of access versus success (Fonte, 1997; Hadden, 2000; Levin & Calcagno, 2008). In many states, open access is interpreted as access to the college as a student, not necessarily to any program or course a student chooses to take. As a result, many states, including North Carolina, have state-mandated placement test policies and cut scores for math and English courses (Lancaster, 2006). The mandating of common cut scores is an attempt to clarify the ambiguous term "college ready". In an effort to help students, colleges across the nation are implementing study skills course requirements and providing intense advising and counseling for students placing into developmental courses.

A 2006 report from the Secretary of Education's Commission on the Future of Higher Education called attention to the need for accountability of institution of higher education. Though there is no current federal policy requiring mandatory testing of all students, pressure increases for colleges and universities to demonstrate accountability and quality of instruction (Field, 2006). Many states have adopted a mandatory placement test, or comparable assessment such as the Scholastic Aptitude Test (SAT) or American College Test (ACT) (Foley-Peres & Poirier, 2008; NCES 2003). Hadden (2000) argues that some may view mandatory placement testing as violating the open-

door policy because mandatory placement may exclude some students or limit their freedom to choose their own path. Mandatory placement tests may not be viewed in the same light as more traditional college assessments, like SAT and ACT (Levin & Calcagno, 2008). Many students enroll in community colleges without knowing that they may have to take a placement test. Community colleges with placement test tutorials often cite underutilization of the preparatory materials (Edsource, 2008). Such statistics imply a complacent attitude regarding the placement test and its academic implications.

The nation is divided in the debate of voluntary versus mandatory enrollment in developmental courses. While the majority of senior institutions and community colleges require placement tests, the number of schools that mandate enrollment in those developmental courses is much different (Achieve, 2009; Bailey, 2008). In a national study, 99% of community colleges allowed students to take college-level courses while enrolled in developmental courses (Shults, 2000). Some of these decisions are based on the students' need to be full-time students, requiring additional courses outside of developmental requirements to meet the 12-credit-hour minimum. Many community colleges only administer placement tests for students enrolling in math and English courses. College-level courses in other areas without math or English prerequisites are not restricted in most instances (Perin, 2006). Another obstacle to preventing academically underprepared students from enrolling in college-level courses is the method of registration. Some registration systems are unable to prevent students from enrolling in courses without the necessary prerequisites.

Attitudes. One of the first experiences students have on the college campus is taking their placement test. While true that students cannot pass or fail a placement test,

the test is important in determining a student's placement into either developmental or college-level courses. Students are often unaware of the particular assessments and as a result, may not take the test seriously (Shelton & Brown, 2008). This nonchalant attitude may hamper or mask a student's true ability and performance. In a study of El Paso Community College students, providing students with an orientation to the placement test and some basic skills reviews demonstrated that many of the students were not lacking in the necessary math and English skills (Kerringan & Slater, 2010). Researchers conclude that many high school students were placing poorly due to not understanding what they would see on the test and were not reviewing content they had actually mastered in high school.

Studies over the years have shown a correlation between students' attitudes about their ability and their actual performance. Students with a positive attitude and who think that they are good math students are more successful in their math courses (Goldberger, 2008). Upper level math courses are essential for all students and should not be limited to those planning to pursue a baccalaureate degree or enter into a math-related career. All students can be successful in math courses with the appropriate provisions (Achieve, 2007). Many researchers in areas of mathematics and its learning do not believe in the innate ability to "do math". In many cultures, success at math is the expectation of all students and everyone can "do math". Such affective issues correlate with mathematics learning (Duranczyk & Higbee, 2006). By contrast, students in the United States are perceived to either have the innate ability or not. Lack of effort is dismissed as lack of a gift for "doing math" (Achieve, 2007, Duranczyk & Higbee, 2006).

Students often incorrectly believe that participation or involvement is

synonymous with success in their courses. While participation alone does not equate with success, there is a correlation between a student's motivation to learn and his or her success in developmental courses (Brothen & Wambach, 2004; George, 2010). Some students may be intrinsically motivated while others require external motivation from their instructor. George (2010) believes that instructors motivate their students in two ways: motivation by intervention and motivation by policy. The first type of motivation occurs when instructors nurture, encourage, and support students either in a group or classroom intervention or on a more personal level by individual intervention. The latter form of intervention, intervention by policy, is based on how instructors set up their courses and assign value to tasks and assessments (pp. 85-87). For example, if a course is pass/fail based on performances on a final exam, will individual homework assignments have a direct effect on grades? If the homework is not graded, then is it valuable, and are students motivated to complete the assignments? Policies that are clear and show a relationship between the expected input and course outcomes will motivate students to engage themselves and actively participate in class.

Higher-order math skills lay the foundation for college success and career-readiness. As a country, the United States must change the way mathematics is approached and emphasized if our students are expected to compete internationally (Achieve, 2007; Donovan & Wheland, 2008). Students who perceive developmental courses as a punishment for their deficiencies are less likely to be successful than those who perceive developmental courses as the first step of their academic journey (Hadden, 2000; Tierney & Garcia, 2008). Most developmental courses do not count award college credit. Students are placed into courses where they must pay tuition and successfully

finish before moving on to college credit courses (Cohen & Brawer, 2003). Students may perceive placement into developmental courses as suggesting they do not belong in college. Again, if enrolling in developmental courses is perceived as helpful to getting them started on their college journey rather than wasting time and money, students will be more successful (Bettinger & Long, 2005). This is an argument in favor of mentoring and mandatory advising for students placing into developmental courses.

Students leaving high school and enrolling in college must shift their focus from grades to learning content (Grubb & Cox, 2005). Students must also examine their often utilitarian attitudes where costs are weighed against benefits for their actions. Most community colleges do not offer credit for developmental courses so the benefit is not readily apparent to students. The Diploma to Nowhere Report reinforces this concept of focus shift. Of the students surveyed, almost all high school graduates believed they were college-ready. Finding out they were not evoked anger, surprise, and frustration (Strong American Schools, 2008).

Similarly, developmental courses at the community college should vary in instructional method from those taught in the high school. Evidence suggests that if drill-and-skill methods were unsuccessful for a group of students in high school, they will likely not be effective when repeated in community college (Levin & Calcagno, 2008). The constructivist approach to developmental education may not be the best approach. Adult students view good instruction as that which has student engagement, direct practice, and ongoing feedback and assessment (Giguere & Minotti, 2003; Knowlton & Simms, 2009). Studies show promising results for course formats that utilize both classroom sessions and computer lab components. In computer-based courses, much if

not all of the instruction occurs through the interactive software allowing the student to construct knowledge rather than receive the knowledge from an expert (Kinney, 2001; Pascarella & Terenzini, 2005; Zhao & Kun, 2004). Instructional improvement for adult learners in community colleges should concentrate on mastery learning, and student-centered, meaning-based learning (Perin, 2005). Other innovative instructional methods incorporated in developmental education programs across the nation are immersion programs, summer programs for students before they enroll in college, basic skills workshops, and tutoring programs that will help students move more quickly through their developmental math and English sequence (Ritze, 2005). There is a significant gap in the research where there has been little if any formal studies conducted on the effect of instructional methods on success.

Retention

There are many factors that influence a student's success in a community college, but being college-ready academically is clearly a central issue. According to Dr. Scott Ralls, President of the North Carolina Community College System, the leading predictor of college dropout rates is the need for developmental studies. Seventy-six percent of students needing developmental English courses do not complete an associates or bachelor's degree. Nationwide, sixty-five percent of students who do not place into developmental courses complete a degree (2008). Overall, freshmen in developmental classes are less likely to be retained for their second year than those who are not in developmental courses (Bettinger & Long, 2005). An inverse relationship exists between the number of developmental courses a student needs and his or her likelihood of completing a degree.

The United States ranks among the top five developed nations in the percentage of young people who attend college. Sadly, the United States is reported to rank 15th in the percentage of students who complete college degrees nationwide (Organisation for Economic Co-operation and Development [OECD], 2010). In North Carolina, less than half of the first-year community college students return for their second year, as compared with almost 80% of returning students at senior institutions (NC Insight, 2008). Research suggests that the leading predictor of potential for dropping out of college is the need for remedial education (Pappas Consulting Group, 2006). Community colleges face unique challenges but also have unique opportunities. The research does not distinguish between the "need for remedial education" as the failure to have the preparatory courses cause the withdrawal versus the "need for remedial education" referring to the institutions requirement that students take the remedial courses. Such a distinction would create an entirely different area of research.

Studies show that students who have a sense of community are more likely to be satisfied with and continue their higher education (Bettinger & Long, 2005; Duranczyk & Higbee, 2006). Developmental class size is often smaller than traditional university class size. Students are better able to form bonds and a sense of community with instructors and their peers.

In a case study of 15 community colleges, one specific remedial practice that decreased the number of remedial students in developmental courses was re-administering the assessment test (Perin, 2006). Other areas include lowering cut scores, overriding prerequisites, and using multiple subjective measures in addition to the objective placement test for course placement. Another successful practice is to have

floating cut-off scores for placing into developmental courses. Analysis of data has shown that for students very near the cut-off score, taking the developmental class may not have helped them in the curriculum college-level course (Bailey, 2008). A floating cut-off score would allow students in a particular range to choose to either take the developmental course, or take the college-level course. Floating cut-off scores may also balance the numbers by accounting for specific student differences. Students achieving the same score on a standardized placement test could have reached that score for different reasons: being out of school for an extended period of time, having never seen the material, or having learned the material at some point but simply forgotten. Having some flexibility with placement could more accurately place students into their courses.

Early Intervention

Interventions are proactive measures intended to address concerns and issues early and in a positive, constructive manner. The Secretary of Education's Commission on the Future of Higher Education quotes a prominent chancellor as questioning the way seniors use their senior year of high school (2006, p. 17). A national model of California State University's version of an Early Assessment Program [EAP] is highlighted for its innovation and application (p. 18). Other states are collaborating with senior institutions to solve the problem.

At the high school level, early intervention and ongoing communication are important to student success on many levels, particularly academically. Students are often unaware of the varying types of assessments and are unfamiliar with their content (Shelton & Brown, 2008). Early assessments while students are in high school provide diagnostic information in a timely manner while there is time for a solution. Several

states have implemented a program called Early Math Placement Testing [EMPT] or Early Assessment Programs [EAP] where students are evaluated in high school to see if they are meeting the competencies that will be presented on their college math placement test (Cohen & Wollack, 2006). Pretests and posttests at this point will ensure student improvement and allow time for remediation while students are still in high school. California targets rising juniors and tests them in math and English. Their scores influence their choice of math courses their remaining years in high school. These changes would make better use of a student's senior year (Cohen & Wollack, 2006; Olsen, 2006; Tierney & Garcia, 2008).

In North Carolina, East Carolina University provides the North Carolina Early Math Placement Test [NCEMPT] to participating high schools (NCEMPT, 2010). The NCEMPT offers students at participating high schools an online version of a placement test at no charge. The results are sent to the student and their school with mastered competencies and suggested study topics to better prepare students for the college placement test. The schools have the opportunity to address the areas of deficiency earlier rather than later at the community college level.

El Paso Community College [EPCC] is a recipient of the Achieving the Dream grant and is seizing the opportunity for early intervention with local high school students (Kerrigan & Slater, 2010; Roueche & Waiwaiole, 2009). High school students in the El Paso Community College service area participate in an innovative project called the "college readiness protocol." Before their high school graduation, students complete admissions applications at EPCC and the University of Texas at El Paso [UTEP]; are given an orientation about the ACCUPLACER placement test and encouraged to refresh

their math and English skills; take the ACCUPLACER test; and take the next steps to meet any deficiencies (Kerrigan & Slater, 2010). Some of the options for students needing remediation are summer intensive review programs or taking additional high school math classes their senior year. Kerrigan and Slater (2010) report fewer students entering EPCC after participating in the college readiness protocol program in need of developmental courses. Better yet, the same study reveals that even the students who are unable to place out of developmental courses place into higher levels of the developmental courses. The orientation to the placement test, or assessment tool, may be crucial to solving this problem. Deil-Amen and Rosenbaum (2002) agree that the gap between students' perceived skills and the results of their assessment can be frustrating enough for students to leave college. An orientation to the assessment early in high school could prevent this loss.

Maryland's public school system has implemented a Voluntary State Curriculum [VSC] program which aligns high school competency requirements with college placement tests, specifically the College Board's ACCUPLACER since this test is used predominantly in Maryland senior institutions. Students graduating in 2009 or later are given a High School Assessment [HSA] to assess knowledge of Algebra I and Data Analysis. Students must pass the test to graduate from high school (Martino & Abell, 2009). More research is needed to discover long-term success or failure of the VSC. Some teacher feedback has expressed concerns that students who focus on the new curriculum are neither as prepared for nor successful in Algebra II, a strong predictor of college success (Dervarics, 2005; Fennel et al., 2008).

Regardless of the assessment tool or early intervention plan, forming

collaborations and partnership between and area high schools is necessary. Two essential components of a successful partnership are administrative support from senior administration at all institutions and the creation of a blameless environment (Kerrigan & Slater, 2010). The problems have been identified. The group now needs to form a solution.

Early intervention also applies to community college students. With a growing percentage of students placing into developmental courses, mentoring, counseling, and advising is a necessary component of success and retention (Byrd & MacDonald, 2005; Goldberger, 2008). One approach to providing the necessary support is to form leaning communities of students placing into similar developmental courses. Students within a learning community receive additional counseling and advising throughout the semester and form a sense of community with their peers (Cohen & Brawer, 2003). Studies have shown a direct correlation between these factors. Ironically, studies have not shown a significant correlation between performance on placement tests and success in developmental courses (Armstrong, 2000; Cohen & Brawer, 2003).

Another often neglected population of community college students is our younger students entering community college through basic skills or adult high school programs. Students entering a community college curriculum program directly from basics skills programs have only been tracked for the past seven years (Hadden, 2000). Many community college systems offer classes for students who did not graduate from high school or completed high school through an alternate path community college literary program earning a general education degree [GED] or Adult High School diploma. Though the General Education Degree that many students take is intended as a high

school equivalency exam, the GED is not intended as an assessment of college readiness. Regardless of GED, individuals will experience differing levels of success on placement tests. Most participants in adult education programs are not considering postsecondary goals. Of the five core outcomes of an adult education, postsecondary education is just one (Quirk, 2005). To improve college readiness among this population, changes must be made in the mission, structure, and capacity of adult education programs (Mellard, et al., 2007). A starting place for this effort could be a comparison of the scope of content and variety of skills measured on the common college placement tests and the adult education assessments through literacy programs. The alignment of the two assessments would be a great advantage for the adult education students.

Overall, regardless of specific method of placement or design of the developmental program, community colleges no longer allow students to drop in and drop out at will and have moved toward a mode of mandatory assessment and placement into courses (Cohen & Brawer, 2003). The intent is to allow students access, keep them in school, and help them improve their basic skills so they can compete academically in senior institutions or the workplace.

An avenue of early intervention at the college level would be to require students to complete their developmental courses before progressing to the college-level, or curriculum, courses (Fonte, 1997; Hoyt & Sorensen, 2001). The actual practices of colleges vary in regard to mandating all developmental courses be completed before enrolling in college-level courses versus allowing students to enroll in developmental and college-level courses simultaneously. Castator and Tollefson (1996) completed a longitudinal study comparing underprepared students in both scenarios. These authors

found that there was no statistically significant difference among underprepared students who remediated first, remediated while concurrently enrolled in college-level work, and those who did not require remediation in final grades in the college-level course. There was a difference in the grades of those who were underprepared but did not remediate at all before progressing to the college-level course.

Benefits of Developmental Education

Research is divided in the area of benefits of developmental education. Proponents argue that developmental courses are preparing academically weak students for college-level work (Bettinger & Long, 2005) while opponents see no long-term gains. In separate longitudinal studies of success in college-level math, students taking developmental courses prior to entering the college-level courses were compared to those not taking the prerequisite courses first. There was no statistically significant difference in the results (Baxter & Smith, 1998; O'Connor & Morrison, 1997; Waycaster, 2001). Bettinger and Long (2005, 2009) again report positive results in the areas of retention and attrition for younger students taking developmental math courses. Another study using larger and broader samples of students found no statistically significant difference in college graduation for students taking developmental courses and those not, among college completers (Calcagno & Long, 2008). An area warranting further exploration is the relationship between the assessment placing students into the developmental course and the outcomes of the actual developmental course (Hughes & Scott-Clayton, 2010). Students take a placement test to determine which developmental course to take but are not retested on the same placement test after completing the developmental course to see if there is a significant improvement in the assessment.

Another area of concern revolves around the fact that many studies use simple comparisons between developmental students and non-developmental students and their performance and retention (Bettinger & Long, 2005). Students placing into developmental courses are not as well prepared initially and would likely not perform as well in college-level courses despite taking the prerequisite courses. The Ohio Board of Regents concluded that there were no conclusive indicators of success or failure of developmental education programs due to the extenuating circumstances (2001). Better prepared students are less likely to be placed into developmental classes and may skew the results of simple surveys. Students may not appear to perform better in college-level course after taking developmental courses when compared with those who did not take developmental courses, but the groups are dissimilar and confound the results (Bettinger & Long, 2005).

Achieving the Dream is a nationwide initiative to promote student success and improve educational outcomes for students at community colleges (Kerrigan & Slater, 2010). A study of 27 community colleges found that students who successfully completed any developmental course in their first semester of enrollment at the community college were more likely to be retained and continue on their academic path (Community College Survey of Student Engagement, 2007). The interesting part of this statistic is that students completing a developmental course their first semester had higher retention rates than students who did not place into developmental courses at all. In a similar study, researchers found completion of a developmental course to be a statistically significant predicator of retention, particularly when the developmental course was in reading (Fike & Fike, 2008).

Conclusion

In a time of economic downturn, community colleges experience growth and many adults find themselves returning to college. Many of these students fall into the previously mentioned category of having been out of school for many years. Providing every opportunity to be successful is vital to these, and all, students. Honestly, many students need to take developmental courses and are placed correctly based upon their placement test scores. Developmental education is not going away. Developmental courses are intended as a gateway to college-level courses but in many ways are becoming gatekeepers. Enrolling in a developmental course does not automatically imply success. Attrition rates are high in most developmental courses. However, this study focuses on those students who should have the tools necessary to be successful in college level math courses and do not belong in developmental courses. Many states are slashing budgets and will likely look at funding for developmental courses as duplicated funds. To the objective mind, if the competencies were covered in high school math classes but not achieved, states are paying for the student to be taught the material more than once. A balance between increasing access and maintaining standards as well as serving both baccalaureate transfers and the underprepared student is a delicate balance that community colleges must find.

Attitude plays an important role in student success. Colleges are obliged to present developmental studies in a positive light and as a stepping stone to future college success. Studies have shown that students who complete remediation in developmental courses are more successful in their subsequent college-level math and English courses than those who did not complete remediation (Cohen & Brawer, 2003). Focusing on the

mission of connecting students with opportunities will aid all students by meeting them where they are and helping them become college-ready. Students should not see developmental courses as punishment but as a gateway to their future success in college. Abiding by this mission, community colleges should aim to get students through their developmental education as quickly and effectively as possible to avoid extra cost, extended time, student frustration, and attrition.

CHAPTER 3: METHODOLOGY

Chapter three outlined the methodology used in the study beginning with participants and setting, instrumentation and design, and analysis. This chapter reexamined the research questions and revealed data collection procedures and statistical analyses used to determine the effectiveness of a developmental boot camp on student performance on standardized placement tests.

Introduction

This quantitative quasi-experimental study was designed to determine the effects of a developmental math and English boot camp on students' college placement tests. Students were pretested before participating in the boot camp and posttested at its conclusion. This chapter described the methodology and procedures that were used to measure the effectiveness of a developmental boot camp on student performance on a college placement test.

Research Design

Research suggested that placement tests alone may not be the best indicators of a student's likelihood of success in college courses. However, standardized placement test preparation and review has been shown to be effective in reducing test anxiety and may contribute to the success of underprepared learners (Armstrong, 2000; Byrd & MacDonald, 2005). If a boot camp is effective in preparing students for the test and reducing anxiety, a success for both students and institutions will be reached. This study examined the effect of a developmental boot camp on students' placement test scores on standardized placement tests. Students were pretested and posttested using the same

assessment tool, either COMPASS or ASSET. Both the experimental group and the comparison control group were compared using the pretest and posttest measures. Participation in the boot camp was self-selected removing random assignment from the study. Experimental designs require random assignment of subjects (Howell, 2008) making this study quasi-experimental.

The researcher was still obligated to include as many components of an experimental design as possible. The comparison of the experimental and control groups was established on the basis of whether or not students' chose to participate in the boot camp. Ary, Jacobs, Razavieh, and Sorensen (2006) believe the non-equivalent control group design was useful for comparing similar, defined groups. If both groups are similar in pretest measures and differ in posttest measures, researchers can make claims about the effect of the treatment with more confidence (Miller, n.d.).

As is true in many educational settings, the groups being studied were predetermined and not disrupted nor reorganized for the sake of this study. Thus the removal of random assignment made this design quasi-experimental. The subjects of both groups were given a pretest. The treatment, or boot camp, was then given to the experimental group. Both groups were given the posttest. This design was considered an alternative option to randomized experiments because the selection for treatment was based on a cutoff score of the variable, targeting participants who may benefit the most from the experiment (Ary et al., 2006).

A quasi-experimental non-equivalent control group research design was used for the study and was selected since random assignment of students to groups was not possible. Students were assigned to their groups based upon subject area (math or

English) and standardized placement test (ASSET or COMPASS). Participants were included in at least one group and may be considered for up to three groups depending on scores and participation. Students who were eligible to participate but chose not to attend the boot camp were placed into the control group and posttested on the same placement test used initially.

The study has a Quasi-experimental Design: the Nonequivalent Control Group Design. Collected data included participants' scores on the pretest and posttest placement test. Participation in the boot camp was the independent variable and placement test scores was the dependent variable.

Research Questions and Hypotheses

The study attempted to answer the following research questions and support the hypotheses.

Research Question 1. What effect does the developmental boot camp have on students' performance on the ASSET placement test?

Hypothesis 1. H_a: Students completing the developmental math numerical boot camp will score significantly higher on the ASSET placement test than those students not completing the developmental math numerical boot camp.

Hypothesis 2. H_a: Students completing the developmental math algebra boot camp will score significantly higher on the ASSET placement test than those students not completing the developmental math algebra boot camp.

Hypothesis 3. H_a: Student completing the developmental English boot camp will score higher on the ASSET placement test than those students not completing the developmental English boot camp.

Research Question 2. What effect does the developmental boot camp have on students' performance on the COMPASS placement test?

Hypothesis 4. H_a: Students completing the developmental math numerical boot camp will score significantly higher on the COMPASS placement test than those students not completing the developmental math numerical boot camp.

Hypothesis 5. H_a: Students completing the developmental math algebra boot camp will score significantly higher on the COMPASS placement test than those students not completing the developmental math algebra boot camp.

Hypothesis 6. H_a: Students completing the developmental English boot camp will score significantly higher on the COMPASS placement test than those students not completing the developmental English boot camp.

In addressing the research questions, the study supported or failed to support the hypotheses.

Students had access to on-campus computer labs during specified hours and web-access to Moodle from off-campus. The boot camp followed the teaching plan developed by the developmental math and English faculty to correspond with MAT 060, MAT 070, or ENG 095 competencies. Additional online resources were provided to students for further topical coverage outside of the Moodle boot camp.

As with any pretest posttest design, pretest sensitization was a concern and possible limitation of the study. After exposure to the pretest, participants may have responded differently to the treatment, in this study the treatment was the boot camp.

The researcher viewed deemed this an asset to the study, viewing the sensitization as a motivator for participants to benefit from the boot camp.

Participants

The population of this study was identified as students enrolled in community college curriculum programs. As a result of an admissions requirement, all participants were also high school graduates. The sample consisted of students who took one of the state approved assessments, ASSET or COMPASS. The sample was self-selected and by invitation only. English faculty at the community college convened to determine, based upon past student success rates, reasonable ranges of test scores. State-mandated placement test minimum scores for placing into curriculum level English courses were studied and the English faculty developed the following guidelines for probable success in an intensive boot camp. Similarly, math faculty at the same community college analyzed current placement test score ranges and developed the following guidelines for participation. The population consisted of students placing into ENG 095 Reading and Comprehension Strategies, the developmental class immediately preceding the freshman curriculum English course, ENG 111 Expository Writing.

The math students comprising the population of the study are those who placed into MAT 060 Essential Mathematics, a numerical mathematical skills course that serves as a prerequisite for all college level math courses or MAT 070 Elementary Algebra, the first developmental algebra course that serves as a prerequisite for all higher-order algebra-based courses. Since both standardized placement tests, ASSET and COMPASS, quantify numerical skills and algebra competencies separately, there are two groups of candidates for the MAT 060 boot camp: those who have placement test cut scores close

to the range to exit out of MAT 060 and those who placed into MAT 060 but were able to show algebra competency and place out of the first developmental algebra course, MAT 070 Introductory Algebra. In summary, students were identified as potential participants based upon the following scores and/ or criteria:

ENG 095 – Reading and Composition Strategies (NCCCS, 2010)

1. ASSET: (Students who placed into ENG 095 with these minimum scores)

Reading 39 to 40

Writing 34 to 40

Students met both requirements.

2. COMPASS (Students who placed into ENG 095 with these minimum scores on each of the two components, Reading and Writing)

Reading 74 to 79

Writing 63 to 69

Students must met both requirements.

MAT 060 – Essential Mathematics (NCCCS, 2010)

1. Any student who placed into MAT 060 Essential Mathematics, regardless of Numerical score (ASSET) or Prealgebra Score (COMPASS), but placed out of MAT 070 Introductory Algebra.

2. ASSET

Numerical scores in this range 35 – 40

3. COMPASS

Prealgebra scores in this range 35 – 46

MAT 070 – Elementary Algebra (NCCCS, 2010)

1. ASSET

Numerical scores in this range 35 – 40

2. COMPASS

Algebra scores in this range 35 – 45

Students who took their placement test between January 3, 2011 and April 26, 2011 and met the above criteria were queried by the school data manager. The boot camp coordinator sent letters to the eligible students inviting them to participate in the boot camp July 18 – 31, 2011. Follow-up phone calls and/or email invitations were sent to qualifying potential students. All students invited to participate were given the opportunity to retest on either ASSET or COMPASS during the designated posttest period. Students choosing to retest who did not participate in the boot camp comprised the control group for the study. Selection of students based upon the above criteria made participants in the experimental group and participants in the control group equivalent. Students in both groups have scored in the indicated range on their placement test. The difference in the groups was the self-selection, choosing to participate in the boot camp or not. The selection threat to internal validity was the self-selection process in the study.

Setting

The study occurred in a small community college in a rural county approximately 45 miles outside of a large metropolitan city in North Carolina. Instruction was delivered through Moodle, an online platform used in the North Carolina Community College System (NCCCS) to deliver online content. Rich media included pencasts, learning objects from the North Carolina Learning Object Repository (NCLOR), videos, and

lecture notes. Classes were available for two weeks. Students had access to the Moodle boot camp continuously during the two-week boot camp. On-campus computer lab time was available for students who chose to work independently on campus.

Instrumentation

Performance on the college placement test was the dependent variable for the study. Due to the sustainability and appropriateness of standardized testing, the current standardized tests used at the community college were deemed acceptable. Performance was measured using the Assessment of Skills for Successful Entry and Transfer (ASSET) or the computer-adaptive assessment program (COMPASS) placement test. The ASSET is a pencil-paper, timed test comprised of two versions: English (writing and reading) and math (numerical, elementary algebra, intermediate algebra). Validity is necessary to ensure that the test scores allow for meaningful and appropriate interpretations (Ary, Jacobs, & Sorensen, 2010). The ASSET has a validity of 0.50, 0.53, and 0.57 in numerical skills, reading, and writing, respectively. The ASSET test has an internal consistency reliability of 0.87, 0.86, and 0.66 using the K20 scale on writing skills, numerical skills, and elementary algebra skills, respectively (ACT, 1994).

The COMPASS is adaptive, computer-based, untimed test in reading, writing, and mathematics (numerical/pre-algebra, algebra, and higher). COMPASS is an American College Testing (ACT) standardized test nationally normed for validity and reliability (ACT, 1997). According to the COMPASS technical manual (1997), the predictive validity in writing, reading, numerical/pre-algebra, and algebra are 0.67, 0.67, 0.72, and 0.68 respectively. The standard test package covering the numerical, or prealgebra, set of questions and the elementary algebra sections has a reliability of 0.88. (p. 31).

All students invited to participate had taken one of the aforementioned placement tests. At the conclusion of the boot camp, students were retested using the same assessment. Students were only be retested on the portion of the test that corresponds to their subject participation in the boot camp in most cases. Some students in each group retested on more than one portion.

Procedures

After receiving IRB approval, data was gathered. Initial placement test scores, final placement test scores, and demographic information was collected and used for comparison. The population of students eligible to attend was collected from the data manager. Students accepting the invitation were culled from the population, placed in the experimental group, and placement test scores were collected through the college computer system. Students invited to attend who chose not to participate were placed in the control group.

Data Analysis

A one-way ANCOVA was used to analyze the data from each group to search for differences. All participants were selected from students with a specific range of scores so the ANCOVA was preferable to negate the effect of the pretest (Ary et al, 2006). The F-test of significance will be used to see if the differences between the groups are significant.

Descriptive statistics were calculated using placement test pretest and posttest for each student and included gender of both the experimental and control groups. The ANCOVA looked for differences between and within groups.

The study attempted to answer the following questions:

Research Question 1: *What effect does the developmental boot camp have on students' performance on the ASSET placement test?*

Students participating in the math and those participating in the English portions of the boot camp were allowed to retest on their ASSET placement test.

Research Question 2: *What effect does the developmental boot camp have on students' performance on the COMPASS placement test?*

Students participating in the math and those participating in the English portions of the boot camp were allowed to retest on their COMPASS placement test.

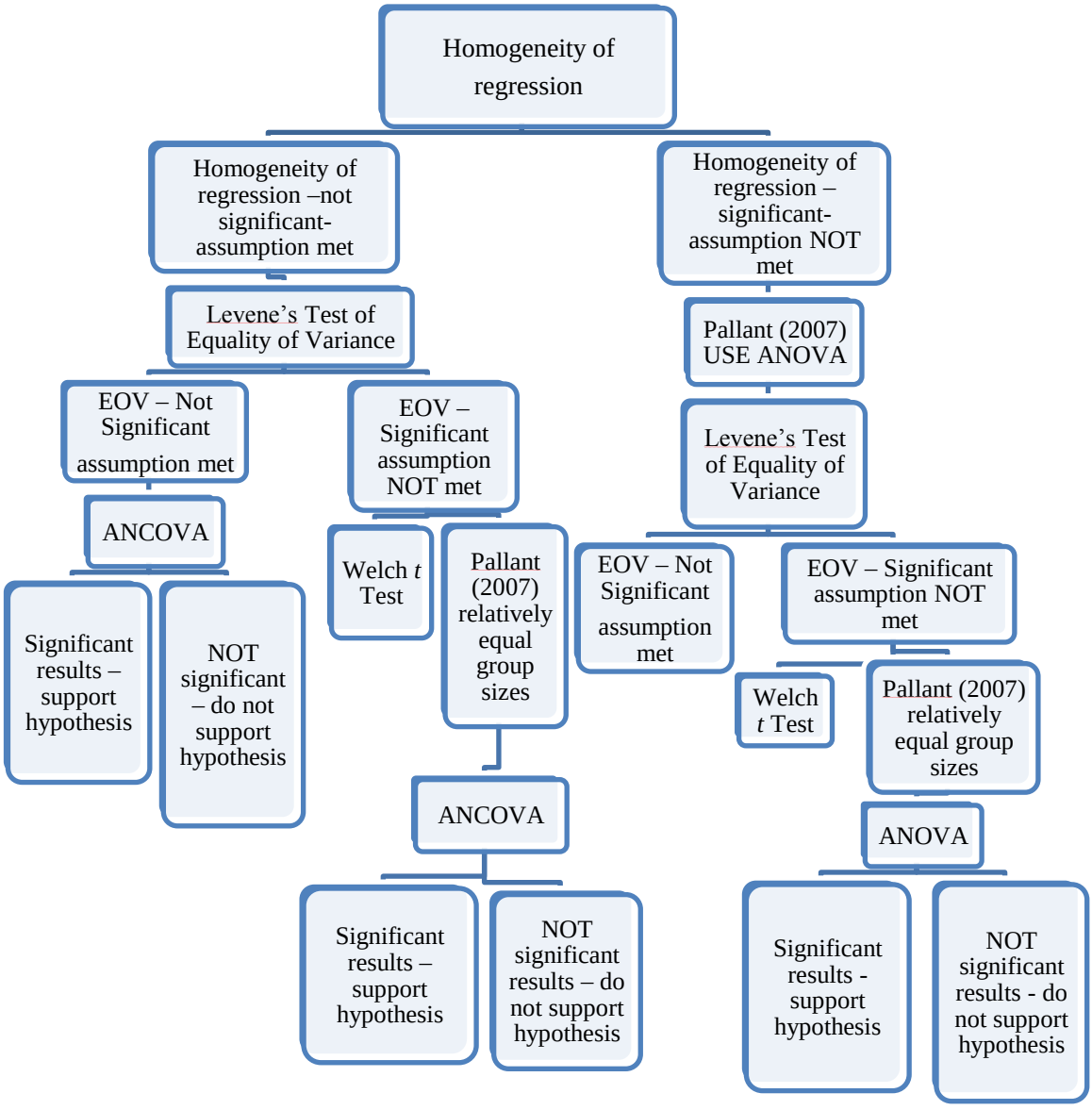
The developmental boot camp had been active for three years. Past enrollment suggested that students were interested in improving their scores but were less likely to make the time commitment. Out of approximately 250 students invited to attend in 2010, around 30 actually attended (SCC, 2010). The committee organizing the camp decided to offer the boot camp online to increase the service area and to allow participants more flexibility in their schedules. Based on past numbers, the anticipated sample size was small for each group. Normality for all scores was assessed using Kolmogorov Smirnov tests. Homogeneity of regression was assessed and determined to be significant or not in hopes of normalizing data. If the assumption of equality of variances was not met, Pallant (2007) suggested that the analysis was robust against the assumption if there are at least 30 participants for the analysis.

An $\alpha = 0.05$ level of significance provided a 95% degree of confidence in the results of the study. As a result, a p-value < 0.05 resulted in supporting the hypotheses (Kiriakidis, 2009). Sample size for each group was anticipated being no more than 40 persons per group (math and English) with an increasing percentage in the COMPASS

group rather than the ASSET group. The sample sizes met this assumption. The flowchart in Figure 1 was used to aid in the decision-making process of whether to support or fail to support the hypotheses.

Figure 1

Decision-Making Flowchart for all hypotheses.



CHAPTER FOUR: FINDINGS

Descriptive statistics including gender, mean, and standard deviation were calculated. Statistical analysis was conducted via SPSS statistical software. Six ANCOVAS were conducted; one for each hypothesis where the independent variable was group (control group/non-participant versus experimental group/participant) and the dependent variables were the post-test scores. The covariates were the pretest scores. Normality for all scores was assessed using Kolmogorov Smirnov tests. Hypotheses were supported when p-values were less than 0.05.

Descriptive Statistics

Study participants were as follows: 194 unique persons. Several participants and control group non-participants were invited pre- and post-tested in more than one area. Of the boot camp participants, 23.7% (141) were male and 76.3% (71) were female. In the control group of non-participants, 30.7% (31) were male and 69.3% (79) were female. This resulted in an overall gender demographic of 27.3% (53) male and 72.7% (141) female, as summarized in Table 1.

Table 1

Gender

	Male	Female
Experimental Group	22 (23.7%)	71 (76.3%)
Control Group	31 (30.7%)	70 (69.3%)
Total	53 (27.3%)	141 (72.7%)

The students who participated in the boot camp comprised the experimental group and the students invited to attend, chose not to attend, and posttested comprised the control group. Each of the test scores were divided by subject area: ENG 095 based on reading and writing scores, MAT 060 based on numerical scores, and MAT 070 based on algebra scores. More scores were reported from students who took the COMPASS test than the ASSET test. Five of the six experimental groups had 30 or more scores, with one group having only 28. Four of the six control groups had 30 or more scores, with the remaining two groups having 28 and 29. Each analysis has a total of 60 or more scores. The numbers of scores in each group are represented in Table 2.

Table 2.

Number of scores in each group for experimental and control groups

	Compass		Asset	
	Experimental	Control	Experimental	Control
ENG 095	58	35	28	33
MAT 060	37	30	32	28
MAT 070	31	33	32	29

Pretest scores for the MAT 060 ASSET test ranged from 26 to 42 (M = 36.27, SD = 3.56) and posttest scores ranged from 32 to 63 (M = 39.90, SD = 5.82). MAT 070 ASSET pretest scores ranged from 27 to 45 (M = 34.02, SD = 3.95) and posttest scores ranged from 29 to 51 (M = 36.80, SD = 4.66). ENG 095 ASSET pretest scores ranged from 28 to 47 (M = 36.82, SD = 4.23) and posttest scores ranged from 28 to 60 (M = 39.11, SD = 5.20). Pretest scores for the MAT 060 COMPASS test ranged from 21 to 77

(*M* = 39.15, *SD* = 7.65) and posttest scores ranged from 26 to 86 (*M* = 45.67, *SD* = 11.69). MAT 070 COMPASS pretest scores ranged from 15 to 81 (*M* = 32.89, *SD* = 11.24) and posttest scores ranged from 16 to 81 (*M* = 36.25, *SD* = 11.90). ENG 095 COMPASS pretest scores ranged from 12 to 97 (*M* = 59.81, *SD* = 19.44) and posttest scores ranged from 24 to 98 (*M* = 67.76, *SD* = 18.80). The means and standard deviations by class are presented in Table 3.

Table 3

Mean and Standard Deviation for Pre-test and Post-test Scores for all Groups

		ASSET		COMPASS	
Class		*M*	*SD*	*M*	*SD*
MAT060	Pretest	36.27	3.56	39.15	7.65
	Posttest	39.90	5.82	45.67	11.69
MAT070	Pretest	34.02	3.95	32.89	11.24
	Posttest	36.80	4.66	36.25	11.90
ENG095	Pretest	36.82	4.23	59.81	19.44
	Posttest	39.11	5.20	67.76	18.80

Research Question 1

What effect does the developmental boot camp have on students' performance on the ASSET placement test?

Normality for all scores was assessed using Kolmogorov Smirnov tests. The results of the test were all significant, violating the assumption for normality. However,

Pallant (2007) suggests that the analysis is robust against the assumption if there are at least 30 participants for the analysis (there are over 60 in each analysis).

Hypothesis One: ASSET Numerical. Ha stated: Students completing the developmental math numerical boot camp will score significantly higher on the ASSET placement test than those students not completing the developmental math numerical boot camp. Pretest scores for the MAT 060 ASSET Numerical test experimental group ranged from 26 to 42 (M = 36.1, SD = 4.03) and posttest scores ranged from 33 to 63 (M = 42.3, SD = 6.54). Pretest scores for the MAT 060 ASSET Numerical test control group ranged from 27 to 40 (M = 36.5, SD = 2.83) and posttest scores ranged from 33 to 44 (M = 37.2, SD = 2.99). The means and standard deviations for the experimental and control groups are presented in Table 4.

Table 4

Mean and Standard Deviation for Pre-test and Post-test Scores for Experimental and Control Groups for ASSET Numerical

ASSET MAT 060 Numerical	Pretest		Posttest	
	Mean	SD	Mean	SD
Experimental Group (Participants in the Boot Camp – pretested, participated in the boot camp, then posttested)	36.1	4.03	42.3	6.54
Control Group (students pretesting, not attending the boot camp, then posttesting)	36.5	2.83	37.2	2.99

For the first ANCOVA (MAT 060 posttest by group controlling for pretest), homogeneity of regression slopes was assessed by checking if there is a statistically significant interaction between the covariate and the treatment; the results were not significant, thus the assumption of homogeneity of regression slopes was met. The assumption of equality of variance was assessed with a Levene's test. The result of the test was significant, violating the assumption. Because of the violation in equality of variance, an independent sample Welch *t* test was conducted instead without controlling for pretest scores. The results for the Welch *t* test were significant, t (45) = -3.85, p < .001, suggesting there were differences in posttest scores by group. The mean for the P group (42.25) was significantly larger than the mean for the C group (37.21) thus supporting the hypothesis. The results of the first analysis are presented in Table 5.

Table 5

Welch t Test on ASSET MAT 060 by Group (C vs. P)

	C		P			
Source	*M*	*SD*	*M*	*SD*	*t* (45)	*p*
Group	37.21	3.05	42.25	6.64	-3.85	.001

Pallant (2007) suggests the analysis is robust against violations of equality of variance as long as group sizes are relatively equal (28 C vs. 32 P in this case). The results for the ANCOVA were significant, F (1, 57) = 33.82, p < .001, suggesting there were differences in posttest scores by group after controlling for pretest. Adjusted marginal means were calculated with the covariate set to its mean score of 36.27. The

adjusted marginal mean for the P group (42.44) was significantly larger than the adjusted marginal mean for the C group (37.00) thus supporting the hypothesis as indicated by the flowchart in Figure 2. The results of the first ANCOVA are presented in Table 6.

Figure 2.

Flowchart for analysis and decision for Hypothesis One: ASSET Numerical

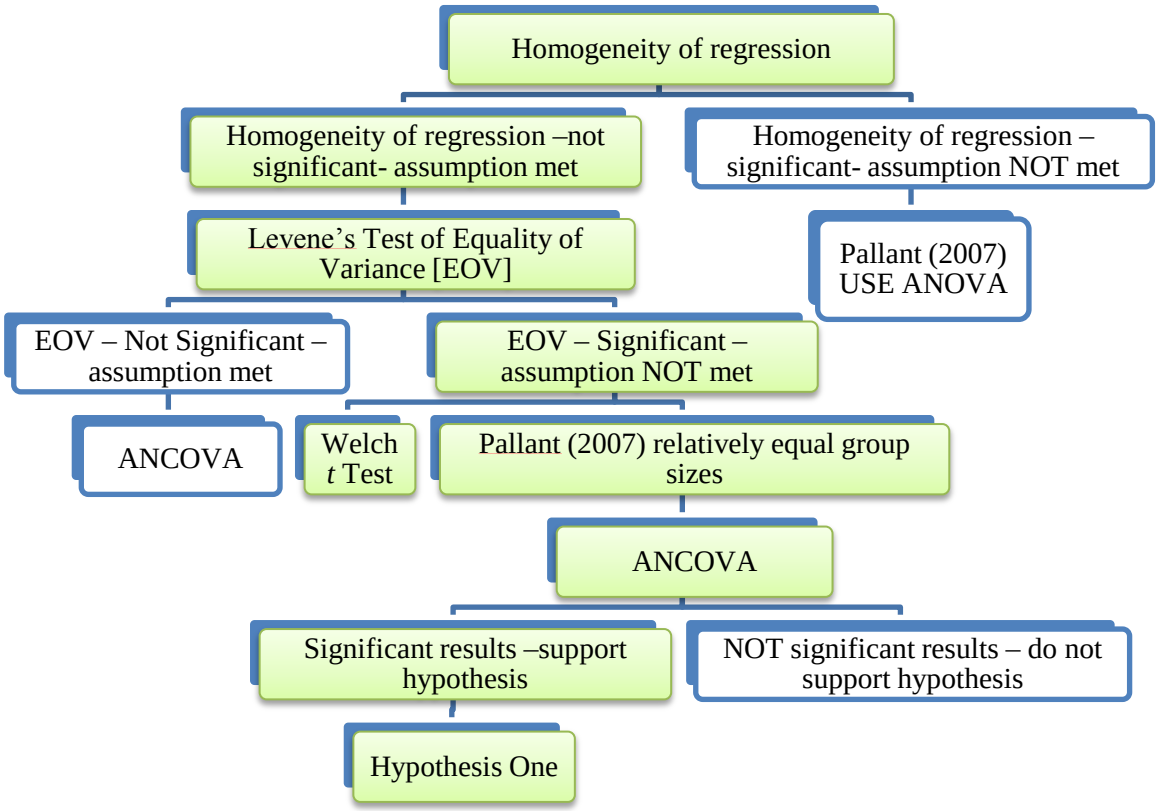


Table 6

ANCOVA on ASSET MAT 060 by Group (C vs. P) controlling for Pretest

Source	*df*	*SS*	*MS*	*F*	*p*	η^2
Pretest	1	876.531	876.53	67.32	.001	.54
Group	1	440.31	440.31	33.82	.001	.37
Error	57	742.18	13.02			

Hypothesis Two: ASSET Algebra. Ha stated: Students completing the developmental math algebra boot camp will score significantly higher on the ASSET placement test than those students not completing the developmental math algebra boot camp. Pretest scores for the MAT 070 ASSET Algebra test experimental group ranged from 27 to 45 (M = 33.8, SD = 4.15) and posttest scores ranged from 32 to 51 (M = 38.3, SD = 5.47). Pretest scores for the MAT 070 ASSET Algebra test control group ranged from 29 to 41 (M = 34.3, SD = 3.61) and posttest scores ranged from 29 to 40 (M = 35.1, SD = 2.58). The means and standard deviations for the experimental and control groups are presented in Table 7.

Table 7

Mean and Standard Deviation for Pre-test and Post-test Scores for Experimental and Control Groups for ASSET Algebra

ASSET MAT 070 Algebra	Pretest		Posttest	
	Mean	SD	Mean	SD
Experimental Group (Participants in the Boot Camp – pretested, participated in the boot camp, then posttested)	33.8	4.15	38.3	5.47
Control Group (students pretesting, not attending the boot camp, then posttesting)	34.3	3.61	35.1	2.58

For the second ANCOVA (ASSET MAT 070 posttest by group controlling for pretest), homogeneity was assessed by checking if there is interaction between the covariate and the treatment; the results were significant, violating the assumption. Pallant (2007) suggests that because homogeneity of the regression slopes was significantly different, the covariance should not be used. This is because how different the groups are depends largely on what value is chosen for the covariate (Stevens, 2002). Therefore, only an ANOVA was run.

The assumption of equality of variance was assessed with a Levene's test. The result of the test was significant, violating the assumption. Because of the violation in equality of variance, an independent sample Welch *t* test was conducted instead without controlling for pretest scores. The results of the Welch *t* test were significant, $t\ (45) = -2.90$, $p = .006$, suggesting that the P group had a significantly larger MAT 070 posttest score than the C group supporting the hypothesis as indicated by the flowchart in Figure 3. Results of the Welch *t* Test are presented in Table 8.

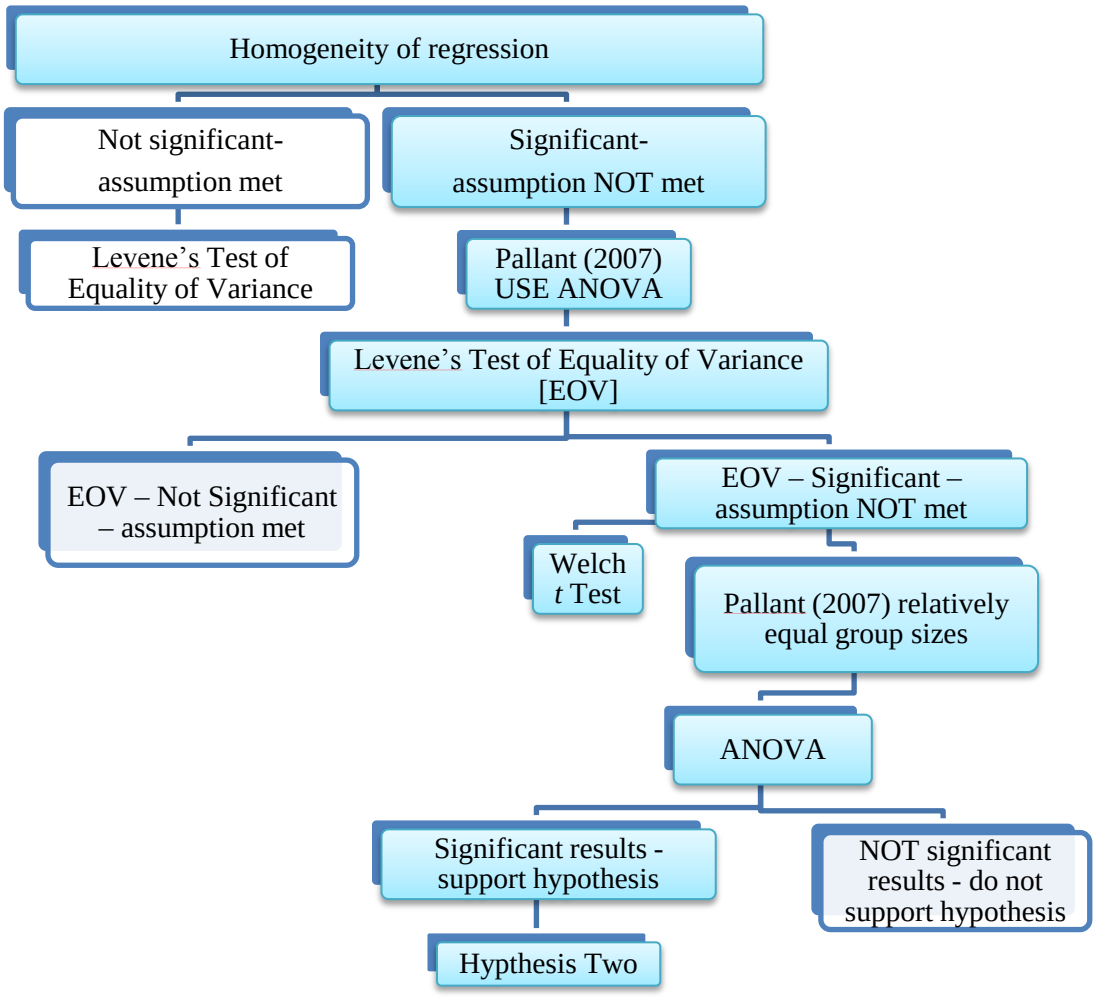
Table 8

Welch t Test on ASSET MAT 070 by Group (C vs. P)

	C		P			
Source	*M*	*SD*	*M*	*SD*	*t* (45)	*p*
Group	35.14	2.63	38.31	5.56	-2.90	.006

Figure 3.

Flowchart for analysis and decision for Hypothesis Two: ASSET Algebra



Pallant (2007) suggests the analysis is robust against violations of equality of variance as long as group sizes are relatively equal (29 C vs. 32 P in this case). The results of the ANOVA were significant, F (1, 59) = 7.86, p = .007, suggesting that the P group had a significantly larger MAT070 posttest score than the C group supporting the hypothesis as indicated by the flowchart in Figure 3. Results of the ANOVA are presented in Table 9.

Table 9

ANOVA on ASSET MAT 070 Posttest by Group (C vs. P)

Source	*df*	*SS*	*MS*	*F*	*p*	η^2
Group	1	153.32	153.32	7.86	.007	.12
Error	59	1150.32	19.50			

Hypothesis Three: ASSET English. Ha stated: Student completing the developmental English boot camp will score higher on the ASSET placement test than those students not completing the developmental English boot camp. Pretest scores for the ENG 095 ASSET English test experimental group ranged from 28 to 47 (*M* = 37.9, *SD* = 4.16) and posttest scores ranged from 34 to 60 (*M* = 40.8, *SD* = 5.50). Pretest scores for the ENG 095 ASSET English test control group ranged from 28 to 47 (*M* = 35.9, *SD* = 4.02) and posttest scores ranged from 28 to 49 (*M* = 37.7, *SD* = 4.39). The means and standard deviations for the experimental and control groups are presented in Table 10.

For the third ANCOVA (ASSET ENG095 posttest by group controlling for pretest), homogeneity was assessed by checking if there is interaction between the covariate and the treatment; the results were not significant, thus the assumption of homogeneity of regression slopes was met. The assumption of equality of variance was assessed with a Levene's test. The result of the test was not significant, meeting the assumption.

The results of the ANCOVA were not significant, F (1, 58) = 2.18, p = .145, suggesting there were no differences in ENG095 posttest scores by group after

controlling for pretest scores failing to support the hypothesis as indicated by the flowchart in Figure 4. Results of the ANCOVA are presented in Table 11.

Table 10

Mean and Standard Deviation for Pre-test and Post-test Scores for Experimental and Control Groups for ASSET English

ASSET ENG 095 English	Pretest		Posttest	
	Mean	SD	Mean	SD
Experimental Group (Participants in the Boot Camp – pretested, participated in the boot camp, then posttested)	37.9	4.16	40.8	5.50
Control Group (students pretesting, not attending the boot camp, then posttesting)	35.9	4.02	37.7	4.39

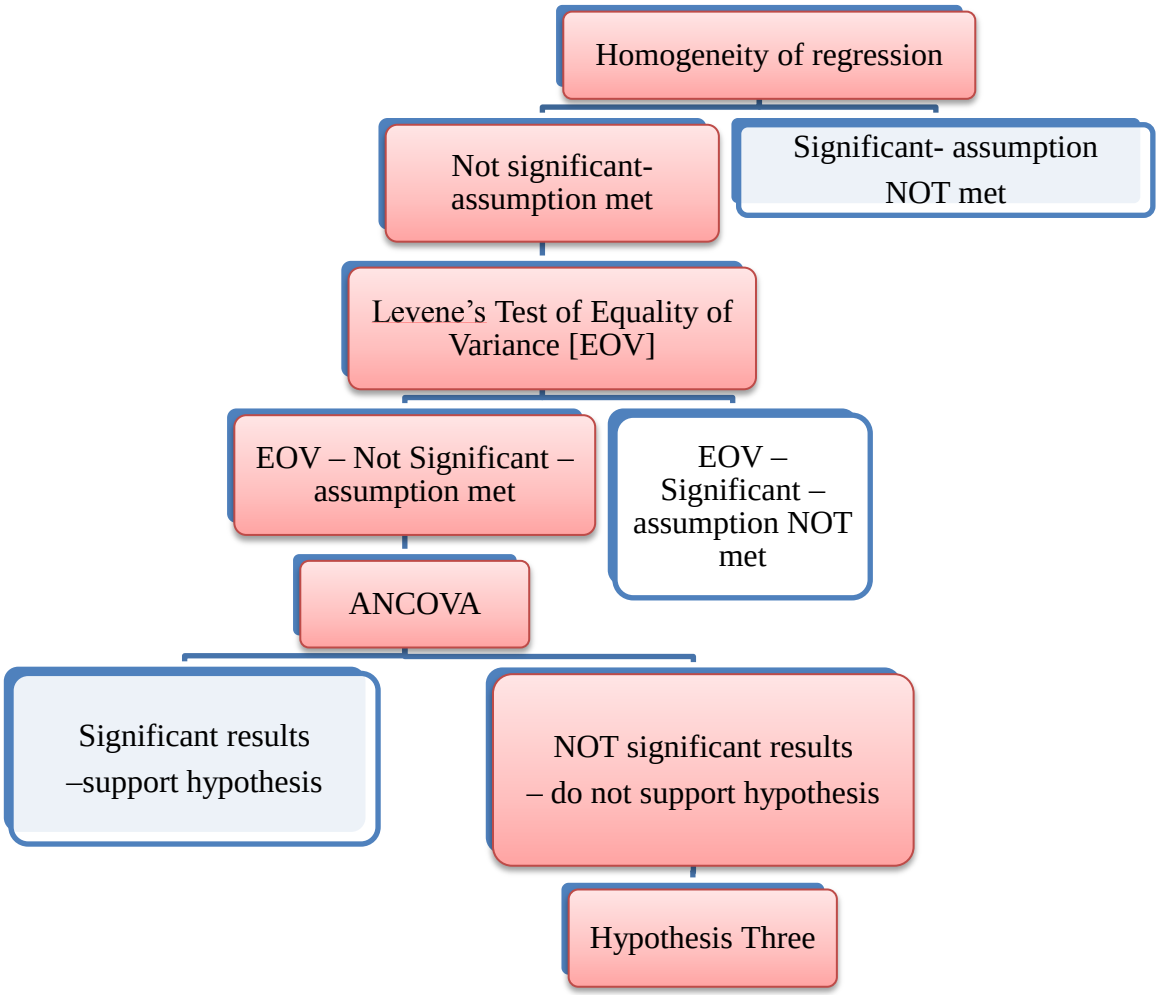
Table 11

ANCOVA on ASSET ENG095 by Group (C vs. P) Controlling for Pretest

Source	*df*	*SS*	*MS*	*F*	*p*	η^2
Pretest	1	1005.64	1005.64	122.49	.001	.68
Group	1	17.89	17.89	2.18	.145	.04
Error	58	476.16	8.21			

Figure 4.

Flowchart for analysis and decision for Hypothesis Three: ASSET English



Research Question 2

What effect does the developmental boot camp have on students' performance on the COMPASS placement test?

To assess research question two, three ANCOVAs were conducted, where the independent variable was group (Control vs. Participant) and the dependent variables were the COMPASS placement MAT060, MAT070, and ENG095 post-test scores. The covariates were the COMPASS placement MAT060, MAT070, and ENG095 pre-test

scores. Normality for all scores was assessed using Kolmogorov Smirnov (KS) tests. The results of the tests were all significant, violating the assumption for normality. However, Pallant (2007) suggests that the analysis is robust against the assumption if there are at least 30 participants for the analysis (there are over 60 in each analysis).

Hypothesis Four: COMPASS Numerical. Ha stated: Students completing the developmental math numerical boot camp will score significantly higher on the COMPASS placement test than those students not completing the developmental math numerical boot camp. Pretest scores for the MAT 060 COMPASS Numerical test experimental group ranged from 21 to 77 (M = 40.1, SD = 8.42) and posttest scores ranged from 32 to 86 (M = 51.1, SD = 12.52). Pretest scores for the MAT 060 COMPASS Numerical test control group ranged from 25 to 52 (M = 37.9, SD = 6.22) and posttest scores ranged from 26 to 49 (M = 39.0, SD = 5.08). The means and standard deviations for the experimental and control groups are presented in Table 12.

Table 12

Mean and Standard Deviation for Pre-test and Post-test Scores for Experimental and Control Groups for COMPASS Numerical

COMPASS MAT 060 Numerical	Pretest		Posttest	
	Mean	SD	Mean	SD
Experimental Group (Participants in the Boot Camp – pretested, participated in the boot camp, then posttested)	40.1	8.42	51.1	12.52
Control Group (students pretesting, not attending the boot camp, then posttesting)	37.9	6.22	39.0	5.08

For the fourth ANCOVA (COMPASS MAT060 posttest by group controlling for pretest), homogeneity was assessed by checking if there is interaction between the covariate and the treatment; the results were not significant, thus the assumption of equal variances was met. The assumption of equality of variance was assessed with a Levene's test. The result of the test was significant, violating the assumption. Because of the violation in equality of variance, an independent sample Welch *t* test was conducted instead without controlling for pretest scores. Results of the Welch *t* test were significant, t (51) = -5.27, $p < .001$, suggesting there were differences in MAT060 posttest scores by group. The mean for the P group (50.14) was significantly larger than the mean for the C group (38.97) supporting the hypothesis as indicated in the flowchart in Figure 5. Results of the Welch *t* test are presented in Table 13.

Table 13

Welch t Test on COMPASS MAT 070 by Group (C vs. P)

	C		P			
Source	*M*	*SD*	*M*	*SD*	*t* (51)	*p*
Group	38.97	5.16	50.14	11.40	-5.27	.001

Pallant (2007) suggests the analysis is robust against violations of equality of variance as long as group sizes are relatively equal (30 C vs. 35 P in this case). Results of the ANCOVA were significant, F (1, 62) = 24.87, $p < .001$, suggesting there were differences in MAT060 posttest scores by group. Adjusted marginal means were calculated with the covariate set to its mean score of 38.48. The adjusted marginal mean

for the P group (49.12) was significantly larger than the marginal mean for the C group (39.26) supporting the hypothesis as indicated in the flowchart in Figure 5. Results of the ANCOVA are presented in Table 14.

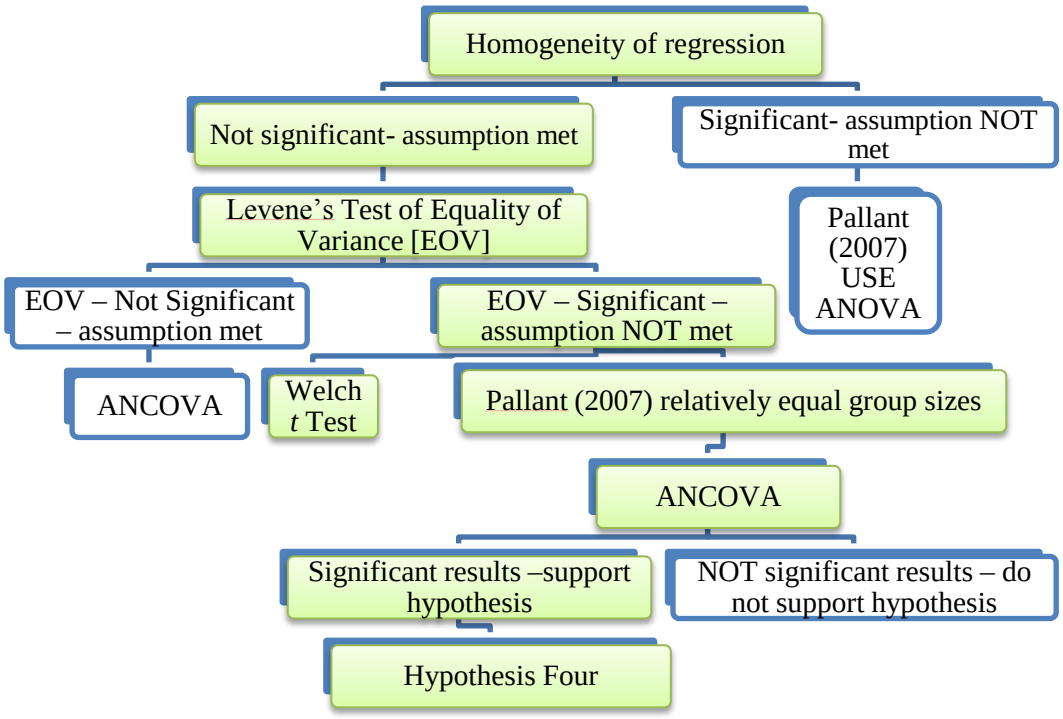
Table 14

ANCOVA on COMPASS MAT060 Posttest Scores by Group (C vs. P) Controlling for Pretest

Source	*df*	*SS*	*MS*	*F*	*p*	η^2
Pretest	1	694.15	694.15	11.08	.001	.15
Group	1	1558.38	1558.38	24.87	.001	.29
Error	62	3884.99	62.66			

Figure 5.

Flowchart for analysis and decision for Hypothesis Four: COMPASS Numerical



Hypothesis Five: COMPASS Algebra. Ha stated: Students completing the developmental math algebra boot camp will score significantly higher on the COMPASS placement test than those students not completing the developmental math algebra boot camp. Pretest scores for the MAT 070 COMPASS Algebra test experimental group ranged from 15 to 81 (M = 31.6, SD = 13.12) and posttest scores ranged from 17 to 81 (M = 38.1, SD = 13.56). Pretest scores for the MAT 070 COMPASS Algebra test control group ranged from 16 to 46 (M = 34.1, SD = 8.75) and posttest scores ranged from 16 to 45 (M = 34.5, SD = 9.57). The means and standard deviations for the experimental and control groups are presented in Table 15.

Table 15

Mean and Standard Deviation for Pre-test and Post-test Scores for Experimental and Control Groups for COMPASS Algebra

COMPASS MAT 070 Algebra	Pretest		Posttest	
	Mean	SD	Mean	SD
Experimental Group (Participants in the Boot Camp – pretested, participated in the boot camp, then posttested)	31.6	13.12	38.1	13.56
Control Group (students pretesting, not attending the boot camp, then posttesting)	34.1	8.75	34.5	9.57

For the fifth ANCOVA (COMPASS MAT070 posttest by group controlling for pretest), homogeneity was assessed by checking if there is interaction between the covariate and the treatment; the results were not significant, thus the assumption of equal variances was met. The assumption of equality of variance was assessed with a Levene's test. The result of the test was significant, violating the assumption. Because of the violation in equality of variance, an independent sample Welch *t* test was conducted instead without controlling for pretest scores. Results of the Welch *t* test were not significant, t (57) = -0.80, p = .427, suggesting there were not differences in MAT 070 posttest scores by group not supporting the hypothesis. Welch *t* test results are presented in Table 16.

Table 16

Welch t Test on COMPASS MAT 070 by Group (C vs. P)

	C		P			
Source	*M*	*SD*	*M*	*SD*	*t* (57)	*p*
Group	34.51	9.72	36.67	11.44	-0.80	.427

Pallant (2007) suggests the analysis is robust against violations of equality of variance as long as group sizes are relatively equal (33 C vs. 30 P in this case). Results of the ANCOVA were significant, F (1, 60) = 20.84, p < .001, suggesting there were differences in MAT070 posttest scores by group supporting the hypothesis as indicated in the flowchart in Figure 6. Adjusted marginal means were calculated with the covariate set to its mean score of 32.13. The adjusted marginal mean for the P group (38.76) was

significantly larger than the marginal mean for the C group (32.61). Results of the ANCOVA were significant supporting the hypothesis as indicated in the flowchart in Figure 6. ANCOVA results are presented in Table 17.

Figure 6.

Flowchart for analysis and decision for Hypothesis Five: COMPASS Algebra

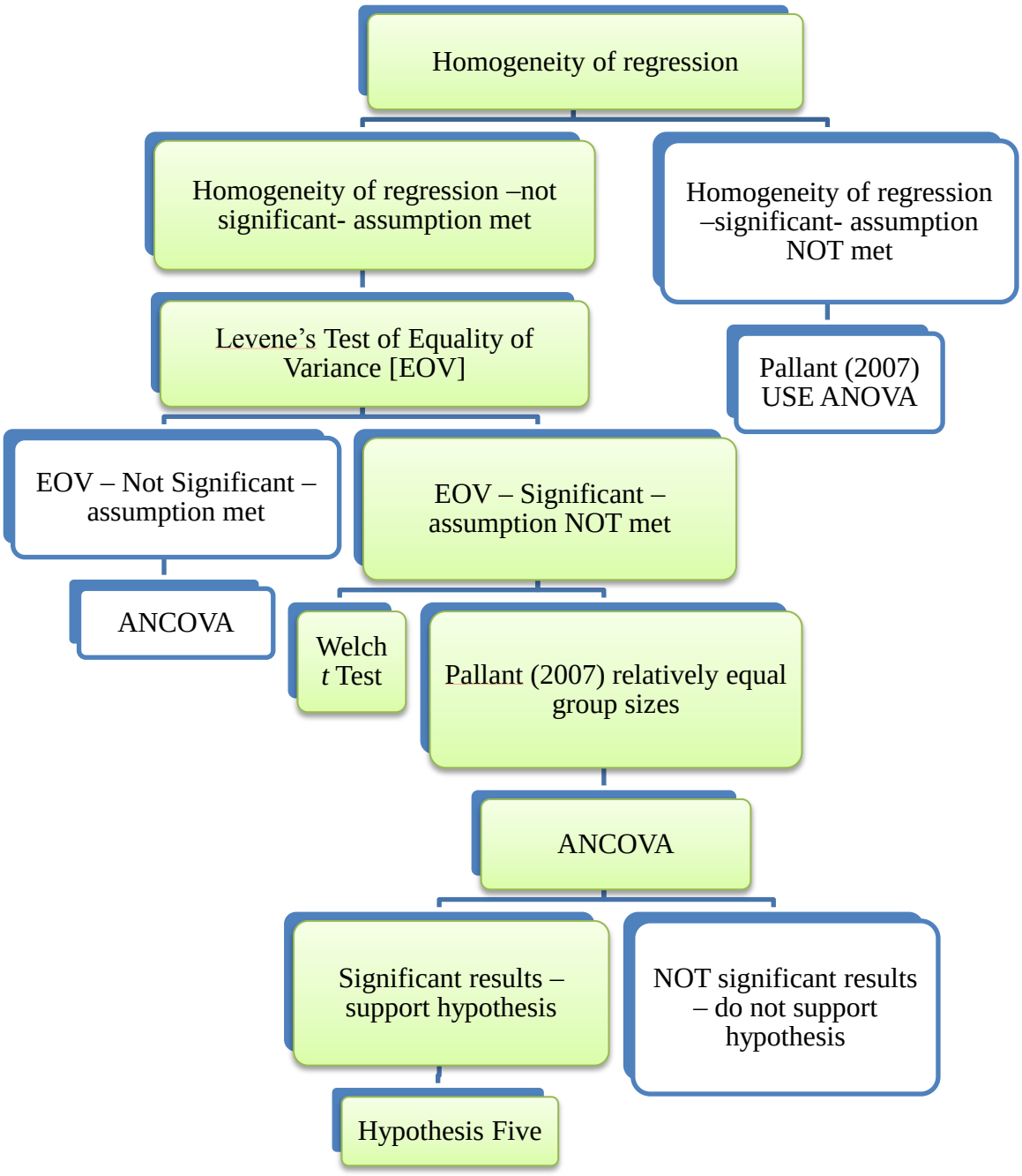


Table 17

ANCOVA on COMPASS MAT070 Posttest Scores by Group (C vs. P) Controlling for Pretest

Source	*df*	*SS*	*MS*	*F*	*p*	η^2
Pretest	1	5183.35	5183.35	190.62	.001	.76
Group	1	566.74	566.74	20.84	.001	.26
Error	60	1631.56	27.19			

Hypothesis Six: COMPASS English. Ha stated: Students completing the developmental English boot camp will score significantly higher on the COMPASS placement test than those students not completing the developmental English boot camp. Pretest scores for the ENG 095 English test experimental group ranged from 20 to 97 (*M* = 61.7, *SD* = 20.01) and posttest scores ranged from 24 to 93 (*M* = 70.8, *SD* = 18.98). Pretest scores for the ENG 095 COMPASS English test control group ranged from 12 to 82 (*M* = 56.7, *SD* = 17.75) and posttest scores ranged from 27 to 98 (*M* = 62.7, *SD* = 17.03). The means and standard deviations for the pre-test and post-test scores for both the experimental and control groups for COMPASS English are presented below in Table 18.

Table 18

Mean and Standard Deviation for Pre-test and Post-test Scores for Experimental and Control Groups for COMPASS English

COMPASS ENG 095 English	Pretest		Posttest	
	Mean	SD	Mean	SD
Experimental Group (Participants in the Boot Camp – pretested, participated in the boot camp, then posttested)	61.7	20.01	70.8	18.98
Control Group (students pretesting, not attending the boot camp, then posttesting)	56.7	17.75	62.7	17.03

For the sixth ANCOVA (COMPASS ENG095 posttest by group controlling for pretest), homogeneity was assessed by checking if there is interaction between the covariate and the treatment; the results were not significant, thus the assumption of equal variances was met. The assumption of equality of variance was assessed with a Levene's test. The result of the test was not significant, meeting the assumption.

Results of the ANCOVA were not significant, F (1, 90) = 3.04, p = .085, suggesting there were not differences in ENG095 posttest scores by group failing to support the hypothesis as indicated by the flowchart in Figure 7. Results of the ANCOVA are presented in Table 19.

Figure 7.

Flowchart for analysis and decision for Hypothesis Six: COMPASS English

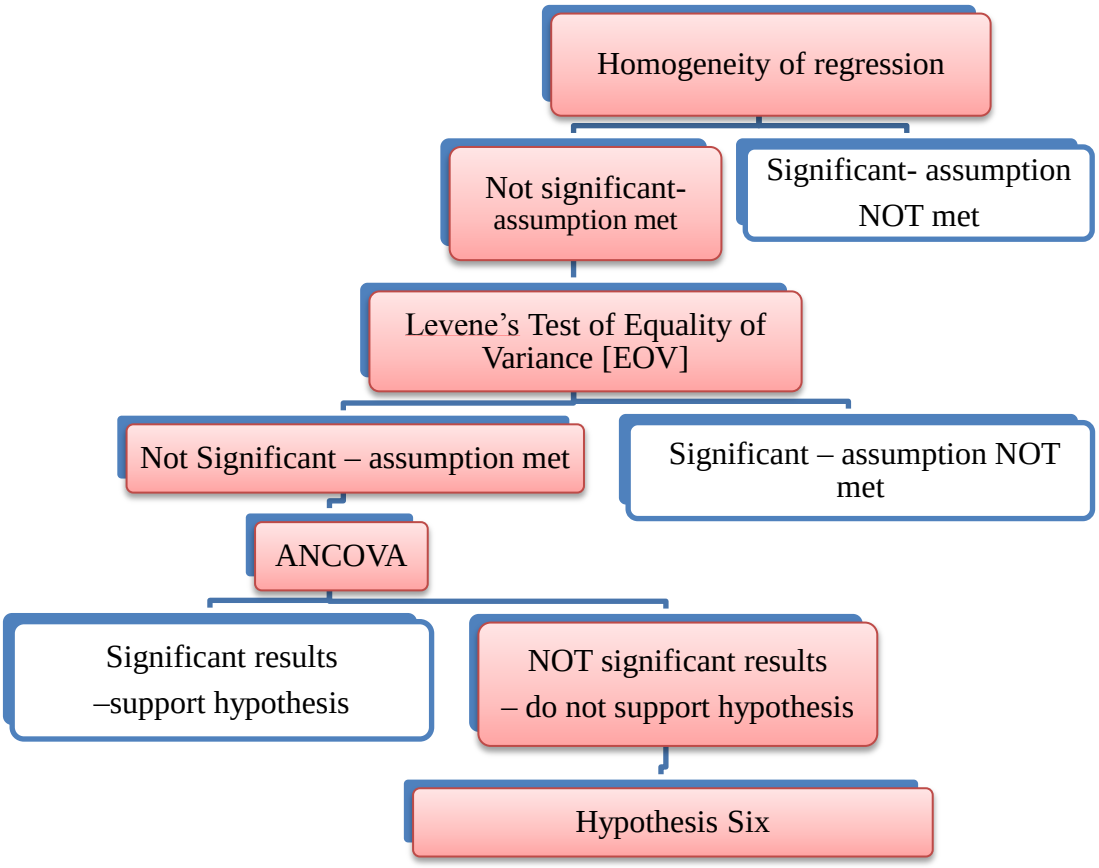


Table 19

ANCOVA on COMPASS ENG095 Posttest Scores by Group (C vs. P) Controlling for Pretest

Source	*df*	*SS*	*MS*	*F*	*p*	η^2
Pretest	1	16488.55	16488.55	101.98	.001	.53
Group	1	491.12	491.12	3.04	.085	.03
Error	90	14550.94	161.68			

Summary

The research hypotheses were tested using ANCOVA. If the homogeneity test was not significant, homogeneity was met. A Levene's test was run to test the equality of variance. If this test was significant, the assumption of homogeneity was violated. In these instances, Pallant (2007) suggests that the analysis is robust against the assumption if there are at least 30 participants for the analysis. The ANCOVA was conducted to determine if differences between the groups were significant. In the hypotheses where Levene's test of equality of variance was violated, an independent sample Welch *t* test was conducted without controlling for pretest scores. For three of the hypotheses, the differences were significant and the hypotheses were supported for ASSET Numerical, COMPASS Numerical, and COMPASS Algebra.

If the ANCOVA homogeneity test was significant, the assumption of homogeneity was violated. An assumption here would be that the score on the pretest determined the posttest score more so than participation or not in the boot camp. Without removing the covariance, an ANOVA was used. A Levene's test was run to test the equality of variance. If this test was significant, the assumption of homogeneity was violated. In these instances, Pallant (2007) suggests that the analysis is robust against the assumption if there are at least 30 participants for the analysis. When Levene's test of equality of variance was violated; an independent sample Welch *t* test was conducted without controlling for pretest scores The ANOVA was conducted to determine if differences between the groups were significant. For one of the hypotheses, the differences were significant and the hypothesis was supported for ASSET Algebra.

If the ANCOVA homogeneity test was not significant, homogeneity was met. A

Levene's test was run to test the equality of variance. If this test was not significant, the assumption of homogeneity was met. The ANCOVA was conducted to determine if differences between the groups were significant. For two of the hypotheses, the differences were not significant and the hypotheses were not supported for ASSET English and COMPASS English.

CHAPTER FIVE: DISCUSSION

The purpose of this study was to examine the effect of a developmental boot camp on standardized placement test scores of students enrolling at a community college in North Carolina. Due to the expense and time commitment required to operate the boot camp, the effects on students' placement test scores is an important determining factor. The resulting implications support the use of a boot camp such as the one used in this study to improve students' math scores on a standardized placement test but did not support the use of a boot camp to significantly improve reading and writing scores.

Hypotheses were as follows:

1. ASSET Numerical (MAT 060) – Students completing the developmental math numerical boot camp will score significantly higher on the ASSET placement test than those students not completing the developmental math numerical boot camp.

2. ASSET Algebra (MAT 070) – Students completing the developmental math algebra boot camp will score significantly higher on the ASSET placement test than those students not completing the developmental math algebra boot camp.

3. ASSET English (ENG 095) – Students completing the developmental English boot camp will score significantly higher on the ASSET placement test than those students not completing the developmental English boot camp.

4. COMPASS Numerical (MAT 060) – Students completing the developmental math numerical boot camp will score significantly higher on the COMPASS placement

test than those students not completing the developmental math numerical boot camp.

5. COMPASS Algebra (MAT 070) – Students completing the developmental math algebra boot camp will score significantly higher on the COMPASS placement test than those students not completing the developmental math algebra boot camp.

6. COMPASS English (ENG 095) – Students completing the developmental English boot camp will score significantly higher on the COMPASS placement test than those students not completing the developmental English boot camp.

Hypotheses were tested using six ANCOVAs; one for each hypothesis where the independent variable was group (control group/non-participant versus experimental group/participant) and the dependent variables were the post-test scores. The covariates were the pretest scores. Normality for all scores was assessed using Kolmogorov Smirnov tests. Hypotheses were supported when p-values were less than 0.05.

Summary of Findings

Hypothesis One: ASSET Numerical

The homogeneity test was not significant meaning the assumption of homogeneity was met. The Levene's test of equality of variance was significant, violating the assumption of homogeneity. A Welch *t* Test was conducted without controlling for the pretest covariate. Pallant's (2007) suggestion that the analysis is robust against the assumption if there are at least 30 participants for the analysis was also accepted and the ANCOVA conducted. The results for the ANCOVA were significant suggesting there were differences in posttest scores by group after controlling for pretest. Adjusted

marginal means were calculated with the covariate set to its mean score. The adjusted marginal mean for the boot camp participant group was significantly larger than the adjusted marginal mean for the C group thus supporting the hypothesis.

Hypothesis Two: ASSET Algebra

The homogeneity test was significant meaning the assumption of homogeneity was violated. Pallant (2007) suggests that because homogeneity of the regression slopes was significantly different, the covariance should not be used. This is because how different the groups are depends largely on what value is chosen for the covariate (Stevens, 2002). Therefore, only an ANOVA was run.

The Levene's test of equality of variance was significant, violating the assumption of homogeneity. A Welch *t* Test was conducted without controlling for the pretest covariate. Pallant's (2007) suggestion that the analysis is robust against the assumption if there are at least 30 participants for the analysis was also accepted and the ANOVA conducted. The results of the ANOVA were significant suggesting that the boot camp participants had a significantly larger MAT070 posttest score than the non-participants group supporting the hypothesis.

Hypothesis Three: ASSET English

The homogeneity test was not significant meaning the assumption of homogeneity was met. The Levene's test of equality of variance was not significant, meeting the assumption of homogeneity. The results for the ANCOVA were not significant suggesting there were no significant differences in posttest scores by group after

controlling for pretest failing to support the hypothesis.

Hypothesis Four: COMPASS Numerical

The homogeneity test was not significant meaning the assumption of homogeneity was met. The Levene's test of equality of variance was significant, violating the assumption of homogeneity. A Welch *t* Test was conducted without controlling for the pretest covariate. Pallant's (2007) suggestion that the analysis is robust against the assumption if there are at least 30 participants for the analysis was also accepted and the ANCOVA conducted. The results for the ANCOVA were significant suggesting there were differences in posttest scores by group after controlling for pretest. Adjusted marginal means were calculated with the covariate set to its mean score. The adjusted marginal mean for the boot camp participant group was significantly larger than the adjusted marginal mean for the C group thus supporting the hypothesis.

Hypothesis Five: COMPASS Algebra

The homogeneity test was not significant meaning the assumption of homogeneity was met. The Levene's test of equality of variance was significant, violating the assumption of homogeneity. A Welch *t* Test was conducted without controlling for the pretest covariate. Pallant's (2007) suggestion that the analysis is robust against the assumption if there are at least 30 participants for the analysis was also accepted and the ANCOVA conducted. The results for the ANCOVA were significant suggesting there were differences in posttest scores by group after controlling for pretest. Adjusted marginal means were calculated with the covariate set to its mean score. The adjusted

marginal mean for the boot camp participant group was significantly larger than the adjusted marginal mean for the C group thus supporting the hypothesis.

Hypothesis Six: COMPASS English

The homogeneity test was not significant meaning the assumption of homogeneity was met. The Levene's test of equality of variance was not significant, meeting the assumption of homogeneity. The results for the ANCOVA were not significant suggesting there were no significant differences in posttest scores by group after controlling for pretest failing to support the hypothesis.

Discussion of Findings and Implications Related to the Literature

Hypothesis One: ASSET Numerical

Research suggests that not only are students failing to be prepared through their high school studies to meet the rigor of college courses, they are not learning the rudiments of reading, writing, and arithmetic (Cohen & Brawer, 2003; Donovan & Wheland, 2008; Hoyt & Sorensen, 2001; Taylor, 2008; Tierney & Garcia, 2008). The use of calculators in elementary education has been blamed for students failing to learn basic arithmetic operations. An additional common assumption of poor performance on numeric tests was assuming students had forgotten content from years of non-use (Perin, 2005). The analysis of this hypothesis revealed that students who remediated before retesting on the placement test, in this study by participating in the numerical math boot camp, were able to significantly improve their posttest scores.

Perin (2006) argues that retesting on the same placement test should result in

higher test scores. The fact that the boot camp participants were compared with a control group of non-participants negates this argument and shows that retesting alone does not account for the statistically significant difference.

Hypothesis Two: ASSET Algebra

This study found that students who remediated in elementary algebra were able to score significantly higher on the retest using the same assessment tool. With increasing rigor and requirements for high school mathematics required for graduation, more students graduate with elementary algebra credit, and in most states, intermediate algebra credit (Dervarics, 2005). As evidenced by the results of this study, a remediation tool like the boot camp used in this study may serve as enough of a review tool to warrant higher posttest scores for students in elementary algebra.

Hypothesis Three: ASSET English

Significant predictors of success in college are reading and writing abilities (Tierney & Leys, 1984). For placement into ENG 095, students must meet minimum scores in both reading and writing. Though at a glance, scores for participants appear to have improved, the improvements were not significant and not significantly different from those of non-participants. Tierney (1984) stresses that though reading and writing are closely aligned and should be taught together, students are not likely to show vast signs of improvement in short refresher courses. Most successful pedagogy employs reading using writing strategies and writing using reading strategies over the course of an academic year. This study found that students were not able to significantly improve their

reading and writing scores after completing the two-week boot camp.

Hypothesis Four: COMPASS Numerical

This study found that students participating in the numerical math boot camp were able to score significantly higher on their COMPASS retest than students not participating in the boot camp. Perin (2006) concludes that the use of calculators in elementary school allow students to develop a dependence on them for basic arithmetic operations. The COMPASS test, unlike the ASSET, has an optional calculator tool. Having the optional calculator tool available to both participants and non-participants levels the field and shows students participating in the boot camp were able to significantly improve posttest scores.

Hypothesis Five: COMPASS Algebra

This study found students that participated in the elementary algebra boot camp were able to significantly improve posttest scores on the COMPASS placement test. In addition to studies suggesting more rigorous high school requirements expose more students to algebra in high school (Dervarics, 2005), the untimed COMPASS allows students to test in a less pressurized environment. The benefits of untimed tests allow students to perform more at their true academic level (Juhler, Rech, From, & Brogan, 1998). However, our study allowed both boot camp participant and non-participants to retest untimed on the COMPASS, negating this argument that untimed testing can account for higher test grades.

Hypothesis Six: COMPASS English

This study did not find a significant different in retest scores on the COMPASS retest for students participating in the boot camp versus those who chose not to participate. A common conclusion can be drawn that a two week time period is too short to significantly improve reading and/or writing (Tierney, 1984). Shelton and Brown (2008) suggest a strong correlation between reading and writing abilities and college performance, regardless of subject area. Students learn to read by reading and learn to write by writing. A longer remedial period could possible yield more significant results.

Study Limitations and Recommendations for Future Research

Sample

The population of this study was identified as students enrolling in community college curriculum programs. As a result of an admissions requirement, all participants are also high school graduates. The sample consists of students who took one of the state approved assessments, ASSET or COMPASS. The sample was self-selected and by invitation only. The population consists of students placing into ENG 095 Reading and Comprehension Strategies, the developmental class immediately preceding the freshman curriculum English course, ENG 111 Expository Writing.

The math students comprising the population of the study are those placing into MAT 060 Essential Mathematics, a numerical mathematical skills course that serves as a prerequisite for all college level math courses or MAT 070 Elementary Algebra, the first developmental algebra course that serves as a prerequisite for all higher-order algebra-based courses. Since both standardized placement tests, ASSET and COMPASS, quantify

numerical skills and algebra competencies separately, there are two groups of potential candidates for the MAT 060 boot camp: those who have placement test cut scores close to the range to exit out of MAT 060 and those who place into MAT 060 but were able to show algebra competency and place out of the first developmental algebra course, MAT 070 Introductory Algebra. In summary, students will be identified as potential participants based upon the following scores and/ or criteria:

ENG 095 – Reading and Composition Strategies (NCCCS, 2010)

1. ASSET: (Students who placed into ENG 095 with these minimum scores)

Reading 39 to 40

Writing 34 to 40

Students need to meet both requirements.

2. COMPASS (Students who placed into ENG 095 with these minimum scores on each of the two components, Reading and Writing)

Reading 74 to 79

Writing 63 to 69

Students must meet both requirements.

MAT 060 – Essential Mathematics (NCCCS, 2010)

1. Any student who placed into MAT 060 Essential Mathematics, regardless of Numerical score (ASSET) or Prealgebra Score (COMPASS), but placed out of MAT 070 Introductory Algebra.

2. ASSET

Numerical scores in this range 35 – 40

3. COMPASS

Prealgebra scores in this range 35 – 46

MAT 070 – Elementary Algebra (NCCCS, 2010)

1. ASSET

Numerical scores in this range 35 – 40

2. COMPASS

Algebra scores in this range 35 – 45

Students taking their placement test between January 3, 2011 and April 26, 2011 who met the above criteria were invited to participate in the boot camp July 18 – 31, 2011. All students invited to participate were given the opportunity to retest on either ASSET or COMPASS during the designated posttest period. Students who chose to retest who did not participate in the boot camp comprised the control group for the study. Selection of students based upon the above criteria made participants in the experimental group and participants in the control group equivalent. Students in both groups scored in the indicated range on their placement test. The difference in the groups was the self-selection, choosing to participate in the boot camp or not. The selection threat to internal validity is the self-selection process in the study.

Study participants were as follows: 194 unique persons. Several participants and control group non-participants were invited pre- and post-tested in more than one area. Of the boot camp participants, 23.7% (141) were male and 76.3% (71) were female. In the

control group of non-participants, 30.7% (31) were male and 69.3% (79) were female. This resulted in an overall gender demographic of 27.3% (53) male and 72.7% (141) female. Control and experimental groups by subject and test included 194 unique participants; 58 boot camp participants and 35 non-participants in ENG 095 COMPASS, 37 boot camp participants and 30 non-participants in MAT 060 COMPASS, 31 boot camp participants and 33 non-participants in MAT 070 COMPASS, 28 boot camp participants and 33 non-participants in ENG 095 ASSET, 32 boot camp participants and 28 non-participants in MAT 060 ASSET, 32 boot camp participants and 29 non-participants in MAT 070 ASSET and are presented in Table 20.

Table 20

Participants by Test and by Group

	COMPASS		ASSET	
	Experimental	Control	Experimental	Control
ENG 095	58	35	28	33
MAT 060	37	30	32	28
MAT 070	31	33	32	29

Sample size results can be tenuous. Sizes less than 30 can limit the ability to make inferences about larger populations. Pallant (2007) suggests that though the sizes are

small, they are proportional to one another so our calculations are valid.

One limit to our population that reduced sample size was that not all students retested whether they were boot camp participants or non-participants in the control group. Of the boot camp participants, some students retested on different test from the pretest resulting in removing them from the experimental group again reducing the sample size.

Instruments

Performance was measured using the Assessment of Skills for Successful Entry and Transfer (ASSET) or the computer-adaptive assessment program (COMPASS) placement test. The ASSET is a pencil-paper, timed test comprised of two versions: English (writing and reading) and math (numerical, elementary algebra, intermediate algebra). The COMPASS is adaptive, computer-based, untimed test in reading, writing, and mathematics (numerical/pre-algebra, algebra, and higher). COMPASS is an American College Testing (ACT) standardized test nationally normed for validity and reliability (ACT, 1997).

Reliability

The ASSET test has an internal consistency reliability of 0.87, 0.86, and 0.66 using the K20 scale on writing skills, numerical skills, and elementary algebra skills, respectively (ACT, 1994). According to the COMPASS technical manual (1997), The standard test package covering the numerical, or prealgebra, set of questions and the elementary algebra sections has a reliability of 0.88. (p. 31).

Threats to Internal and External Validity

Validity is necessary to ensure that the test scores allow for meaningful and appropriate interpretations (Ary et al., 2010). The ASSET has a validity of 0.50, 0.53, and 0.57 in numerical skills, reading, and writing, respectively. A common threat to internal validity for similar studies is maturation between pretest and posttest. The time between pretest and posttest ranged from four months to eight months. Though participants were exposed to remediation in the boot camp, this study did not determine if members of the control group took advantage of independent measures of remediation.

COMPASS is an American College Testing (ACT) standardized test nationally normed for validity and reliability (ACT, 1997). According to the COMPASS technical manual (1997), the predictive validity in writing, reading, numerical/pre-algebra, and algebra are 0.67, 0.67, 0.72, and 0.68 respectively. Students were remediating in two separate areas, reading and writing. Performances in both were not separated in this study.

This study has relatively small sample size in most of the subgroups. As a result, inferences can only be made to select populations resulting in a common threat to external validity. Statistical power is directly related to sample size and in this study, is not as strong as desired (Ary et al., 2006). This study did not investigate performance be students testing in more than one area. For example, did students who improved their reading scores also improve their numerical math scores? The correlation of performance by student would solidify the results and make the inferences more valid.

Analysis

Descriptive statistics were calculated using placement test pretest and posttest for each student and categorized by group. Six one-way ANCOVAs were conducted to analyze the data from each group to search for differences. After the first test of homogeneity, Levene's test was used to determine equality of variance. In most of the cases, both tests did not confirm homogeneity and Pallant's (2007) suggestion of common sample sizes was used to validate homogeneity. ANCOVAs were then used to determine if differences existed between groups after removing the covariance of the pretest. A Welch *t* Test was conducted for hypotheses where Levene's test failed to show equality of variance without controlling for pretest scores. The concern here is the effect that higher pretest scores may have on posttest scores. The design of this study worked well for five of the six hypotheses. The second hypothesis' data showed no homogeneity meaning the posttest scores were more closely correlated to pretest score than treatment. As a result, an ANOVA was a better analysis tool. Levene's test of equality of variance was still used, and the ANOVA showed a significant difference in groups.

This study did not quantify the term "participation in the boot camp". As a result, participation times varied greatly among participants. Students who spent many hours participating in the boot camp may have seen very large improvements in test scores. This resulted in outliers, or scores far beyond the mean of our data group. Such deviations caused issues with the Levene's test of equality of variance. As a result, the ANCOVA for four of the six hypotheses was based on the assumption that relatively

equal sample sizes provide a robust analysis in such instances (Pallant, 2007).

Implications

Hypotheses One and Four: Numerical

To avoid redundancy in the implications, these hypotheses will be discussed together. Most research suggests that high school graduates have most likely forgotten content rather than having never learned it. The content in the numerical assessment is covered in elementary school competencies and is considered to be content below the sixth grade academic level (ACT, 2006).

An area of consideration is the use of calculators. Student use of calculators from elementary school, middle school, and high school may have a firm grasp of the numerical content if allowed the aid of a calculator. The prohibition of calculator use on the placement test may indicate a lack of attention to detail that calculator use could provide.

Hypotheses Two and Five: Algebra

With increasing rigor in high school mathematics requirements for graduations, most students have been exposed to elementary algebra, and many to intermediate algebra. With some exceptions of student graduating before the more rigorous requirements were enforced, students in this group will likely benefit from remediation before retesting. The students in this group fall under the same umbrella as those in the numerical group of having merely forgotten content rather than having deficiencies. Perin (2005) stresses that as high school requirements increase in rigor, students will eventually

all have prior experience with algebra content. As our students age out over the years, the average student will have met the high school graduation requirement of Algebra II or higher and should not place into developmental courses (Achieve, 2007).

States vary in the number of required math course students must take to earn their diploma. The National Mathematics Advisory Panel, while researching ways to improve mathematics achievement for all students, discovered an interesting relationship with Algebra II (Dervarics, 2005). The American Diploma Project (ADP) developed exam standards using mathematics faculty from high schools and colleges. The Algebra II exam incorporated content viewed as most important to improve math curricula and to best prepare students for math at the collegiate level (Achieve, 2009). Algebra II is a strong predictor of college success and potential job earnings. Studies show that students who successfully complete Algebra II are more than twice more likely to become college graduates than those students who are less prepared in mathematics (Dervarics, 2005; Fennel et al., 2008). Statistics show that students placing into developmental math and English courses as they enter college tend to have lower completion rates than other students. The division in content among college placement test and high school end-of-course tests occurs in the specificity of topics (Martino & Abell, 2009). A college placement test assesses a mix of topics whereas an end-of-course test assesses mastery of particular course content.

Hypotheses Three and Six: English

Students scoring below college level in reading, writing, or both are not able to significantly improve their performance on the placement test by means of an intensive remediation. Reading and writing are closely related and the strength of one is

imperative for the strength of the other. Research suggests that reading and writing ability is closely tied to college-readiness, regardless of subject (Shelton & Brown, 2008). Students learn to read by reading and learn to write by writing. A two-week refresher course such as the one used in this study is not sufficient to remediate students in reading and/ or writing. Success in one without the other is not sufficient to qualify as college-ready.

Recommendations for Future Research and Practice

Recommendation One

As evidenced in the results of this study, remediation before taking a placement test can improve test scores. Students should be required to prepare before taking community college placement tests. Many are unaware of the consequences of poor performance on the assessment. Whereas high school students may spend weeks preparing for other assessments, like the SAT, community college students do not view the placement test the same way (Headden, 2011). Early intervention strategies, like the NCEMPT are solid programs with success rates for participants. The NCEMPT offers students at participating high schools an online version of a placement test at no charge. The results are sent to the student and their school with mastered competencies and suggested study topics to better prepare students for the college placement test. The schools have the opportunity to address the areas of deficiency earlier rather than later at the community college level (NCEMPT, 2010). Remediation and test preparedness have been shown to significantly improve test scores. The time when students arrive on a

college campus, in person or virtually, is too late to begin the remediation process.

Recommendation Two

Research is heavy in the area of college readiness determination. Colleges and universities use placement tests to determine if students are ready for college-level courses. An area for future research is that of determining if the developmental courses are working. Students successfully completing the prescribed developmental course should be retested on the same assessment tool to see if their success in the developmental course was sufficient to place them out of the course. The research does not support the supposition that completing the developmental course will resolve the deficiency measured on the placement test.

Further exploration into the determination of college readiness should include looking at multiple assessments, possibly including high school grade point average, other standardized assessments, or performance in high school classes (Armstrong, 2000; Byrd & MacDonald, 2005).

Recommendation Three

The Department of Public Instruction, the community college system, and the university system need to work together to define college-readiness. Once defined, high school requirements and college expectations should be aligned to offer students the best secondary education and preparedness for post-secondary education. Not having a universal definition creates a problem for high schools, colleges, as well as publishers of standardized tests. In North Carolina, the community college system and the university

system have a joint Comprehensive Articulation Agreement that provides statewide course descriptions of college courses, providing seamless transfer opportunities for students among participating institutions (Lancaster, 2006).Other states have similar arrangements, giving high school students a goal to work toward as they prepare for college.

As of September 2009, 29 states have defined college-ready and career-ready standards in math and English (Achieve, 2009). The misalignment of competencies taught in high school versus those covered on the placement tests is one cause for low scores on college entrance exams. This is a barrier to high school graduates planning to enroll in college. High schools have state mandated competencies to cover in each of their courses (Shelton & Brown, 2008). With the No Child Left Behind Act (NCLB), schools are charged to meet minimum standards and pass rates in order to receive additional funding. As a result, the content taught must align to the competencies on the standards based, high-stakes test. Students may perform well on the test and remain unprepared for the college level placement test (Herman, Webb, & Zuniga, 2007). Such assessments send mixed messages to teachers and educators about what teachers should teach and what students should learn.

If the competencies for high school are not aligned with the college placement test objectives, then the content taught in most high school math classes will be significantly different from what postsecondary institutions expect students to master before being placed into college level courses (Brown & Niemi, 2007; Gordon, 2006; Martino & Abell, 2009; Roueche & Waiwaiole, 2009). Alignment between the secondary and senior institutions is essential to provide consistent information to students. Proper alignment is

also crucial to data collection in areas such as achievement gaps, remediation rates, and student attrition.

Hoyt and Sorensen (2001) report there are other areas where high schools fail to prepare students for college work, including grade inflation, lack of academic rigor in some areas, and not enough college preparatory courses. In an economic time where overcrowding is prevalent in high school classrooms, inadequate funding manifests itself in many ways. To address these concerns, school systems continue to change high school graduation requirements and end-of-course assessments.

An obvious fix would be to adjust the college placement test to the high school competencies. Most senior institutions require applicants to take a placement exam to take courses in math and English (Perin, 2006). As a result of mandatory testing, many students may be unable to take college-level courses their first semester (Shelton & Brown, 2008). The North Carolina community colleges are held to similar state mandated standards. All community colleges in NC are required to give one of three standardized placement tests and are required to place students into college, or developmental, courses based upon specific cut-off scores (Lancaster, 2006). The alignment of these two groups of standards would require the joint effort at the state level of the Department of Public Instruction (DPI) and the North Carolina Community College System Office (NCCCS). Ideally, further collaboration with the North Carolina University System Office would enable alignment between high school competencies and all placement tests. Most senior institutions use their own variations of placement tests. An interconnected K-16 system with consistent goal, outcomes, and student expectations would likely increase the number of students completing their college degree (Strong

American Schools, 2008). The dilemma facing all concerned parties is to find a solution without placing blame (Hoyt & Sorensen, 2001). Success will come from helping students transition from high school to college and to bridge the gap that unfortunately continues to widen. Legislatures in most states agree that the developmental education problem was inherited from the K-12 sector and little has been done to effect change (Levin & Calcagno, 2008; Tierney & Garcia, 2008).

Recommendation Four

For the students who participated in the boot camp and improved their test scores but were unable to advance out of the developmental course, did they complete the course successfully? How would they rate their level of satisfaction or preparedness for the course? More longitudinal studies are recommended to determine the affective benefits of preparing students for their coursework, even for those who were not able to place out of the corresponding developmental course. A cursory review of the data shows that mean scores for participants are higher on the posttests than for non-participants, even for the two hypotheses that were not supported.

Recommendation Five

Following Malcolm Knowles' assumption that adults are self-directed, motivated learners, further research may provide evidence of the success of self-paced instruction, such as the instruction in this boot camp. Do adult learners perform better when allow to work at their own pace and to self-assess to determine mastery? Technology changes faster than pedagogy. If students are not learning or retaining what they have learned in elementary school, middle school, or high school, post-secondary institutions should not

repeat the same pedagogy and expect different results.

Evidence suggests that if drill-and-skill methods were unsuccessful for a group of students in high school, they will likely not be effective when repeated in community college (Levin & Calcagno, 2008). The constructivist approach to developmental education may not be the best approach. Adult students view good instruction as that which has student engagement, direct practice, and ongoing feedback and assessment (Giguere & Minotti, 2003; Knowlton & Simms, 2009). Studies show promising results for course formats that utilize both classroom sessions and computer lab components. In computer-based courses, much if not all of the instruction occurs through the interactive software allowing the student to construct knowledge rather than receive the knowledge from an expert (Kinney, 2001; Pascarella & Terenzini, 2005; Zhao & Kun, 2004). Instructional improvement for adult learners in community colleges should concentrate on mastery learning, and student-centered, meaning-based learning (Perin, 2005). Other innovative instructional methods incorporated in developmental education programs across the nation are immersion programs, summer programs for students before they enroll in college, basic skills workshops, and tutoring programs that will help students move more quickly through their developmental math and English sequence (Ritze, 2005). There is a significant gap in the research where there has been little if any formal studies conducted on the effect of instructional methods on success.

Conclusion

The purpose of this study was to examine the effect of a developmental boot camp on standardized placement test scores of students enrolling at a community college in North Carolina. Due to the expense and time commitment required to operate the boot

camp, the effects on students' placement test scores is an important determining factor. This study found that remediation is effective and can significantly improve placement test scores for students who choose to participate. In this study, students needing remediation in numerical and algebra skills were able to significantly increase their posttest scores on both the ASSET and COMPASS placement tests.

Studies have shown that a review course can raise scores enough on a placement test to place students out of the required developmental course (Tierney & Garcia, 2008). The issue of preparation, or lack thereof, is significantly different for standardized college placement tests, like ASSET and COMPASS, versus other tests like the Scholastic Aptitude Test [SAT]. Students often spend weeks preparing for the SAT, practicing math problems, completing review courses, and drilling vocabulary prior to attempting the test. Community college students do not view the placement test the same way. Many are unaware that the placement test will determine whether or not they must take courses that are not college-level and for which they do not receive college credit (Headden, 2011).

An area of rising concern that merits additional research is determining if developmental courses are worth the time and money. If developmental courses are mandatory versus recommended, a student's path to a credential can increase dramatically. More research needs to be collected and more longitudinal studies conducted to see if developmental courses help students perform better at the college level. Studies by Calcagno and Long (2008) have found little if any positive effect on student performance at the college level comparing students who place into

developmental courses then successfully complete the required course versus students who place into developmental courses and choose not to complete the developmental course before attempting the college-level course. Such research suggests that current remediation practices are not improving student learning outcomes.

Does placement test underestimate ability? Students placing into developmental courses but choosing to enroll in college-level courses without taking the developmental courses are successful at a rate of 71% and do not have the detriment to self-esteem nor attrition rate (Bailey, 2008). Students who are high school graduates are all college ready and are all in need of some remediation in varying degrees. College readiness then becomes a matter of degrees, not an absolute (Conley, 2007).

The number of attempts at a test differs greatly from test like the SAT and typical community college placement tests. Students are allowed to take the SAT as many times as they choose while most community colleges have strict retest policies. Placement test retest policies vary by institution and can often work against college success. This study found that students given a review opportunity and allowed to retest were able to perform better on the retest, even if the improvement was not sufficient to elevate them out of the corresponding developmental course.

The study highlights the fact that the placement test is not an accurate judge of a student's knowledge. Colleges should look toward using student achievement and work ethic as a means for determining college placement rather than judging a student's ability to learn based upon one assessment. Student performance in high school, as reflected in

overall grade point average, is based on repeated sampling over the span of several years of student classroom performance. Prior achievement and success in high school is a better predictor of future performance than an isolated placement test.

Test, like ASSET and COMPASS, are satisfactory measures of basic cognitive skills (Boylan, 2009) but may not be the only determinant of college readiness. Community colleges that use multiple measures to assess college readiness, like high school grade point average and previous college experience, may be more successful at serving students. Studies have shown that affective attributes may be as good as or better predictors of college success than placement tests (Headden, 2011). A recent study indicates that fewer than 10 percent of schools use both affective and cognitive tools to assess college readiness (Brown & Niemi, 2007).

Many placement tests use total scores to place students into developmental courses and are neither diagnostic nor prescriptive in content. Very little diagnostic information is available that relates directly to academic deficiencies. The foundation for this study was based upon determining whether or not students placing into developmental courses were not prepared to take the test, had merely forgotten the content, or had never learned the content. Existing placement test fail to answer this question.

As much of the literature suggests, a major reason students are leaving high school not college-ready is the misalignment of high school requirements and college expectations. Many high school graduation requirements are generally set at a 10^{th} grade

level (Conley, 2007). Creating college readiness standards that align with high school requirements can provide focus for a student's last two years of secondary education. The American Diploma Project is an excellent resource for state departments to use as a starting point for such an alignment (ADP, 2004). Similar work has taken place with high schools and colleges determining Advanced Placement courses and their earned credit equivalents at the college-level (Conley, Aspengren, Stout, & Veach, 2006). The merging of high school requirements and college expectations could potentially raise college placement test scores for students and eliminate the need for developmental courses.

The National Commission on the High School Senior Year (2001) suggests that students must remain academically engaged during their senior year to reap the most benefit and to prepare themselves for college work. High school credits can be accumulated during early years and seniors may find themselves with few graduation requirements during this fourth year of secondary education. A senior seminar, or possible a boot camp such as the one in this study, may provide the necessary refresher skills to aid students in placing into college-level courses. Work could be presented at a quicker pace, more like college rate. Seminars or courses could focus on the areas college deem as weakest such as critical thinking, problem solving, and analytic research (Standards for Success, 2003). Some successful programs, like the University Park Campus School partnership with Clark University and Jobs for the Future, focus on more than academic content. All seniors are required to take at least one college course during

their senior year of high school. Doing so exposes students to the faster pace, pedagogy, and assessments of college courses (Conley, 2007).

Research suggests that the longer a student's developmental path, the less likely he or she is to successfully complete the corresponding gateway curriculum level course. In the North Carolina Community College System, only 8% of student who place into three or more developmental courses will complete their first curriculum level course (DEI, 2010). To increase this percentage, community colleges must decrease the amount of time required to complete developmental courses while reducing the number of exit opportunities. Like Knowles theory of andragogy, students need instruction that is flexible, individualized, and adaptable (Casazza, 1999). Computer-adaptive instruction is one solution to this dilemma. Traditional methods of instruction for adult students in remedial courses may not allow underprepared students to reach their goal of becoming college-ready and prepare them to excel at their college studies (Russell, 2008). Offering developmental courses that are flexible in scheduling and are more individualized in instruction through computer-mediated instruction allows more time for students to work individually with the instructor as opposed to standard lecture formats. Students are able to omit content they have mastered and move forward to areas of weakness. A personalize system of instruction has been shown to be effective to achieve student success (Duranczyk & Higbee, 2006). The flexible scheduling is often self-paced and can significantly decrease a student's time in developmental courses.

Developmental courses, nationwide, cost an estimated one to three billion dollars

per year (Strong American Schools, 2008). Much debate exists over the exact cost since states vary so significantly on how the cost is calculated. Strong American Schools (2008) used nationally normed data from the Integrated Postsecondary Education Data Survey [IPEDS]. There are researchers who argue that the cost is worth the results if students persevere and receive a college credential and become job-ready (Merisotis & Phipps, 2000). Cost is definitely a consideration when evaluating developmental studies but value is an even more important one. Are the classes working? Are students able to continue their college pathway and achieve some degree of success? If so, then the remediation is working. Pairing cost effective solutions, like preparatory boot camps and placement criteria other than solo placement test scores, will help place students at the correct level of course work and prepare them to achieve their desired credential.

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APPENDIX A

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Telephone (704) 982-0121
Fax (704)982-0819

January 17, 2012

Institutional Research Board
Liberty University
1971 University Boulevard
Lynchburg VA 24502

Liberty University IRB Office:

As President of Stanly Community College, I have given Ms. Heather Hill permission to conduct her research at our college. I have spoken with Ms. Hill and understand the scope of her research and how she will collect and present her data. All information to be gathered will be done in a confidential and appropriate manner.

Should you have any questions, please feel free to contact me.

Sincerely,

Brenda S. Kays, Ed.D.
President
Stanly Community College
bkays2651@stanly.edu
(704) 991-0220