The Effects of Mathematics Remediation on Entering High School Freshmen after Participating in a Remedial Mathematics Summer Camp

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The Effects of Mathematics Remediation on Entering High School Freshmen after Participating in a Remedial Mathematics Summer Camp

A Field Study

Presented to

The College of Graduate Studies

Austin Peay State University

In Partial Fulfillment

Of the Requirements for the Degree

Of Education Specialist

Glenda Lee Sullivan

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We are hereby submitting a Field Study written by Glenda Lee Sullivan entitled "The Effects of Mathematics Remediation on Entering High School Freshmen after Participating in a Remedial Mathematics Summer Camp" (Under the direction of DR. J. GARY STEWART). We have examined the final copy of this Field Study for form and content. We recommend that it be accepted in partial fulfillment of the requirements for the degree of Education Specialist in School Administration and Leadership.

Dr. J. Gary Stewart, Research Committee Chairperson

Dr. John R. McConnell, Committee Member

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DEDICATION

This field study is dedicated to my husband, Randy Sullivan, whose encouragement and support have helped me to complete this study. Without his love and patience, my journey through a new role in administration and the completion of this degree would have been much more difficult.

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ABSTRACT

GLENDA LEE SULLIVAN. "The Effects of Mathematics Remediation on Entering High School Freshmen after Participating in a Remedial Mathematics Summer Camp" (Under the direction of DR. J. GARY STEWART).

This study analyzed the effectiveness of a remedial mathematics summer camp on student achievement in mathematics for rising ninth graders in a rural Tennessee school district in Middle Tennessee. The researcher examined the subjects in terms of the categories of gender, ethnicity, socioeconomic status, and camp completion rates. The academic gains at the camp were measured by pretests and posttests, while the effectiveness of the camp in improving student achievement in mathematics were measured by Algebra I End-Of-Course (EOC) Test Scores as well as the Pass/Fail rate for camp attendees in Algebra I compared to those who did not attend the camp. The researcher also examined the categories of gender, ethnicity, socioeconomic status, and camp completion rates to determine which of those variables, if any, might be a greater predictor of proficiency on the Algebra I End-Of-Course (EOC) Test than the others.

The research questions this study proposed to answer were:

1. Does student achievement in mathematics improve after remedial mathematics summer camp participation?
2. Is camp completion a stronger indicator of future success in Algebra I proficiency on the End-Of-Course (EOC) Test than gender, ethnicity, or socioeconomic status?

The data analysis compared the scores of the campers on the camp's pretest and posttest scores. An *F*-Max test was conducted to check the assumption of homogeneity of variances between measurements. Although the two measures exhibited unequal variances, a paired sample *t*-test was used due to its robustness against the violation of this assumption when sample sizes are equal. Another *t*-test, using the scores of students who completed camp, Algebra I, and the 2010 End-of-Course Test and the scores of students who completed Algebra I and the 2010 End-of-Course Test, but who did not attend the camp, though invited to attend, compared achievement levels on the 2010 End-of-Course Test between the two groups, following an *F*-Max test of homogeneity. A *Chi*-Square test of homogeneity followed by a Fisher's Exact test compared Algebra I course pass/fail rates between these two groups of students. Finally, the researcher used a multinomial logistic regression to determine which of the variables of gender, ethnicity, socioeconomic status, and camp completion rates, if any, might be a greater predictor of proficiency on the Algebra I End Of Course Test than the others. The Null Hypotheses were tested and analyzed at the alpha level of significance, $p<.05$.

Results of this study indicated a statistically significant difference in the pre-test and post-test scores of the students who attended camp. The results of the study indicated that students who attended camp did not exhibit statistically significant achievement in proficiency on the Algebra I End-Of-Course test or in passing Algebra I when compared to the students who, though invited, did not attend camp. Lastly, none of the variables of gender, ethnicity, socioeconomic status, and camp completion rates were statistically significant as a greater predictor of proficiency on the Algebra I End-Of-Course Test than the others.

CHAPTER I

INTRODUCTION

Statement of the Problem

Students who do not acquire necessary academic skills in middle school may become a part of the Southern Regional Education Board's (SREB) statistics which indicate that, as recently as 2009, twenty-five percent of rising freshmen in the SREB area did not successfully complete high school requirements and failed to receive diplomas with their classmates (SREB, 2009). The report also noted that less than half of these incoming freshmen would enter college by their nineteenth birthday (SREB, 2009).

According to the National Center for Education Statistics (2012) over half of the eighth grade students tested on the 2011 National Assessment of Educational Progress (NAEP) lack necessary Mathematics skills with thirty-five percent scoring at or above proficient and eight percent scoring in the advanced category. While this is an improvement over past years back to 1990, it still indicates a lack of preparedness for fifty-seven percent of the rising ninth graders in the tested population.

In 2009, a NAEP assessment of 49,000 of the nation's twelfth-graders from both public and private schools were tested in mathematics (Alliance for Excellent Education, 2010). Arne Duncan, United States Secretary of Education, remarked that the report indicated that the seniors' scores in Mathematics, while rising slowly, aren't advancing quickly "enough to prepare them for college and careers" (Alliance for Excellent Education, 2010).

Students who are unprepared for high school may become a part of the over one million dropouts each year which cost the United States "approximately 260,000 dollars

in lost earnings, taxes, and productivity" (Amos, 2008, p.2, par.3, bullet 1). Other costs associated with high school dropouts include increased rates of arrests or incarceration, Medicaid and other costs resulting from being uninsured, and lower family incomes (Amos, 2008).

Le, Rogers, and Santos (2011) showed that such unprepared students may get through high school and continue on to college where they will require remedial or developmental studies, which is true for nearly sixty percent of incoming community college students. Boser and Burd (2009) reported that approximately one-third of entering college freshmen enroll in remedial programs. The annual costs cited for remediation vary from study to study, with Russell (2008) citing $1.4 billion per annum for community college students, according to the estimates of the Alliance for Excellent Education (2010). Greene (2000) cited that 222 million dollars per annum were required for remediation of basic skills by businesses, and public post-secondary schools ranging from 2.31 to 2.8 billion dollars during the 2004-2005 academic school year (Strong American Schools, 2008). Amos (2008) placed the nation's loss at more than 3.7 billion dollars per annum for costs tied to college remediation.

Faced with the problems of educating the unprepared and the underprepared, school districts have developed a number of programs aimed at addressing the needs of these students (Cuddapah, Masci, Smallwood, & Holland, 2008; Terzian, Moore, & Hamilton, 2009; & Jacob & Lefgren 2004). Because of "summer achievement gaps" (Entwisle & Alexander,1992; Alexander, Entwisle, & Olson, 2001), many of these interventions have been addressed in summer school programs, which have a long history

in the United States (Dougherty, 1981; Gold, 2002; Zweiefelhofer, 2008). Today some of the programs focus on the transition from middle school to high school while others focus more on Mathematics skills (Cuddapah, et al., 2008; Portland Schools Foundation, 2011; Hallberg, Swanlund, & Hoogstra, 2011; Edwards, Kahn, & Brenton, 2001; & Cleaver, 2010).

Purpose of the Study

The purpose of the study was to ascertain the effects of a remedial Mathematics Summer Camp on student achievement in Mathematics of rising ninth graders. The study examined the subjects in terms of the categories of gender, ethnicity, socioeconomic status, and camp completion rates. The academic gains at the camp were measured by pre-tests and post-tests, while the effectiveness of the camp in improving student achievement in mathematics was measured by Algebra I End-of-Course (EOC) Test Scores. The study also investigated the Pass/Fail rate for camp attendees in Algebra I compared to those who did not attend.

Significance of the Study

This study will benefit educators in the small rural district in which it takes place who are interested in improving student Mathematics achievement, particularly in Algebra I. The study will benefit administrators in the district who are interested in professional development for mathematics teachers in order to raise district test scores on standardized tests. The study will also add to prior research of educational institutions and school systems by analyzing a program used for one school district.

Research questions

The following research questions were used to guide this study, the second of which is based on a study by Cleaver (2010):

a. Does student achievement in Mathematics improve after remedial Mathematics Summer Camp participation?

b. Is camp participation a stronger predictor of success in Algebra I than other variables (for example, gender, ethnicity, or socioeconomic status)?

Limitations

This study was subject to the following limitations:

1. The number of students involved in the study was small; therefore, results may not be extrapolated to other situations.

2. Because the Mathematics Summer Camp was a short summer program, and because many different learning experiences may affect outcomes, results cannot solely be attributed to the camp.

Definitions

For the purpose of this study, the following definitions were used:

***Rising ninth graders*:** Students enrolled in the ninth grade in the academic year immediately following the camp.

***Algebra I EOC – Algebra I End-of-Couse tests*:** State mandated tests given to Algebra I students.

***Summer remediation camp*:** A camp designed to remediate rising ninth graders.

***Socioeconomic status*:** The designation used to indicate if a student is receiving free and reduced lunch.

CHAPTER II

REVIEW OF RELATED LITERATURE

Introduction

This chapter begins with an examination of the history of summer school programs in the United States as a precursor to modern day remedial summer programs, followed by an examination of how learning gaps are widened without summer programs. This review of summer programs and summer achievement gaps is followed by a discussion of the significance of the need for effective remediation and how that need is addressed at the university and K-12 levels, leading to a consideration of summer education programs within a camp setting. The chapter concludes with an examination of mathematics summer camp programs for students entering high school.

Historical Developments of Summer Schooling in the United States

Dougherty (1981) outlined the history of summer school in order to initiate a consideration of how summer school could be utilized in a variety of ways, including viable alternatives to retention, enrichment opportunities for talented and gifted students, early graduation, and basic skills building. Dougherty's history began with the nine month school calendar with three summer months of vacation, a plan which the researcher noted was originally based in our agricultural traditions. With the movement from the rural areas to the cities, the need for the calendars to reflect those agrarian considerations changed, according to Dougherty (2010); however, the calendars still remained the same. This led to two outcomes in managing student populations in the

summer months. These were a growth of recreational facilities and an emphasis on remediation for less able students. Dougherty noted that there were school districts on an eleven month plan as early as 1811, and one district had a twelve month plan as early as 1901, but these were the exceptions to the commonly accepted scheduling.

Dougherty (1981) devoted a chapter to remediating students in summer months. The researcher added that the teachers in a summer program should focus on what the student's standardized test scores indicated to be an area of weakness and/or what teacher evaluation indicated was needed to remediate the student. Dougherty recommended other programs to provide enrichment for ambitious and gifted students and to allow for early completion of graduation requirements. Dougherty concluded by considering year-round school options and urged that an administrator be positioned to supervise the planning and execution of the summer school program so that staffing, financing, record keeping, public relations, and related issues would be given the same attention as the regular school program.

Gold (2002) also studied the history of summer education programs. In contrast to Dougherty, Gold's study indicated that the agrarian traditions had some influence on the school calendar, but that these traditions had little effect on the three months of summer break that many schools still experience today. Instead, he pointed out that many schools were, in fact, in session in summer months and closed in times of harvesting and planting, autumn and spring, respectively (p. 8). Gold found that, as early as the mid-1800s, new ideas on childhood development, together with questions about a lack of retention of academic skills, were causing districts to reconsider the calendars they used. Gold

reported that not all schools were affected by these arguments. Another idea emerged which caused urban schools to provide summer vacations. One was the idea that too much schooling led students to function poorly because their studies interrupted normal sleeping and eating cycles.

Gold (2002) contended that scholars of the mid-nineteenth century promoted the idea that students and their teachers would find balance through participation in outdoor activities for their physical and mental health, and summer provided the greatest number of days for students and educators to get outdoors; thus, the three month summer vacation became popular. Finally, Gold added that many states experience severe heat in the summer months, and buildings were poorly ventilated. Schools closed during the summer months to avoid exposing students to oppressive conditions.

Gold's research then turned to educational programs that began to emerge in summer months in what was called vacation schools, originally started by community organizations and business leaders. The children targeted in these schools were those whose socioeconomic status prevented them from enjoying enrichment opportunities offered to students of wealthy families. A goal of the vacation schools was to provide social and moral training and to keep students off the streets and out of trouble. Eventually, public schools began to absorb these programs. As state departments of education got involved, core academic areas began to be added, and students could now repeat failed courses, and others could complete higher level courses that might allow early high school graduation (Gold, 2002).

Unlike Dougherty's (1981) study, Gold's (2002) study moved from a chronology of summer school programs and turned to specifics as the researcher pointed out a number of historically significant occurrences that caused the evolution of summer school programs in the twentieth century. "In 1933," Gold explained, "the Roosevelt White House convened the Conference on Child Health and Protection" (p. 211). He noted the recommendations of the Subcommittee on Summer Vacation Activities of the School Child, which encouraged greater use of summer school educational programs, but the effects of the Great Depression meant that cash-strapped federal programs caused summer schools to be abandoned. Yet, the reform programs started by Roosevelt led to a plethora of government-sponsored work programs that revealed the need for increased school opportunities around the nation in order to have a better prepared work force. During World War II, the U.S. Office of Education replaced "its biweekly publication, *School Life*, with *Education for Victory*," and schools expanded summer programs in order to help mothers provide child care while they went to work in the factories when their husbands were fighting overseas (Gold, 2002, pp. 213-214). Summer school offerings included job training and academic studies both for students and for their mothers as part of the war effort (Gold, 2002).

Gold (2002) noted that the next major historical event that changed educational programs, including those in the summer months, was the Soviet Union's 1957 Sputnik launch. This led to increased emphasis on Mathematics and Science, particularly the National Defense Education Act, which promoted accelerated Mathematics, Science, and Language offerings supported by federal funds (Gold, 2002). The summer schools

continued to offer remediation, but there was new emphasis on advanced students learning in summer school in courses like "Russian, rapid reading, and calculus" (Gold, 2002, p. 217).

Gold (2002) reported that mandates "from the Vocational Education Act of 1963 to the Elementary and Secondary Education Act of 1965 provided financial and technical assistance for communities to initiate summer schools, and many did" start such programs (p. 210). The 1964 declaration of President Lyndon Johnson's "War on Poverty" speech, his inaugural address, was the next historical event that Gold recorded. A number of educational programs grew out of Johnson's efforts to decrease the learning gap that separated the poor from the middle class: federally funded school lunch programs, Title I, The Extended School Program, Head Start, and others. Many of these efforts started out as summer education programs (Gold, 2002, p. 219).

Gold (2002) recognized the development of The National Commission on Excellence in Education in 1981 and noted the impact of its 1983 report, *A Nation at Risk: The Imperative for Educational Reform*, which attributed the low performance of American students when compared to other industrialized countries to the practice of social promotion. In order to abolish this practice, legislatures began to insist on the need for students to meet state standards as a measurement of successful grade/course completion. Summer schools began to focus on credit recovery and to provide remediation to help ensure that students meet these standards (Gold, 2002). Gold also mentioned the Goals 2000 initiative as a part of the standard-driven approach to summer school.

Zweiefelhofer (2008) began a study of the effects of summer school programs with a review of literature on summer school before examining three types and purposes of summer school programs, namely remedial programs, enrichment programs, and extended year programs. Crediting one of the reasons for the increase in summer school programs to the implementation of The No Child Left Behind Act of 2001, Zweiefelhofer pointed out the requirement that all states and districts have to ascertain that all students are performing proficiently in English and Mathematics. Zweiefelhofer explained that this has increased state focus on remediation for underperforming students and that summer school programs have increased because of the demand for students to make annual yearly progress.

Summer Learning Gaps

Entwisle and Alexander (1992) completed a thorough examination of the ways annual yearly progress for at-risk students is endangered by summer breaks. The phenomenon of widening achievement gaps during time away from schools, known as "summer setback," was attributed to the lack of learning support among the families of economically disadvantaged children. The researchers noted that prior research indicated ineffectiveness of summer programs, but advised, "Unless the likelihood of a summer loss is taken into account, programs that produce no gains look ineffective, yet a summer program that kept poor children from losing ground could be exceedingly valuable" (Entwisle and Alexander, 1992, p. 83).

Alexander, Entwisle, and Olson (2001) determined through a longitudinal study of a random sample of public school students in the Baltimore City Schools that the

cumulative effects of time away from school for disadvantaged youth amounted to a growing gap in achievement when compared to their more affluent counterparts. The research revealed that the loss in summer months is most significant for at-risk students; therefore, summer education becomes paramount for closing the gap.

Addressing Post-Secondary Need for Effective Remediation

Greene (2000) examined the financial impacts of remediation in the state of Michigan and estimated that monetary cost to be between 311 million dollars and 1.15 billion dollars in annual deficits using a conservative estimation from five different calculation strategies in determining the cost. The average of the five was 601 million dollars per year in 2000. By extrapolation, Greene estimated that the entire United States loses 16.6 billion dollars annually. This was much higher than earlier studies and would exceed the majority of later studies as well. The main difference in these varying totals was created by the way in which figures were determined. The earlier studies only included the costs paid by the government for remedial, sometimes called developmental, college programs. Greene (2000) also included the amounts paid by remedial students for their college educations, costs paid by private schools, costs incurred by employers to teach basic skills to employees, technology purchases made by employers to compensate for employees' lack of basic skills, lost productivity related to inadequate basic skills, and government costs related to various problems, such as welfare and criminal justice costs, which have been created by a lack of basic skills. More recently, Mary Fulton, Policy Analyst with the Education Commission of the States (2010), provided estimates from state and post-secondary reports on a state-by-state analysis and described the total as

more than 2 billion dollars annually according to a variety of national estimates (Fulton, 2010).

Levin and Calcagno (2008) pointed out that "the main statistical problem in estimating the effectiveness of remedial courses is that it is difficult to identify a causal relationship between remediation and educational attainment" (p. 190). The authors recommended evaluation using experimental designs based on random assignment as the "gold standard" (p. 194). Levin and Calcagno (2008) also suggested that all researchers should utilize a regression-discontinuity design to compare two students observed to be alike, "who differ only in that one scored just below the cutoff score and the other just above it" (p. 195). Finally, Levin and Calcagno (2008) determined that evaluations of remedial programs would benefit from the establishment of shared resources at the state level in order for colleges and their faculty to create appropriate evaluations and to replicate successful interventions (p. 202).

Bahr (2008) examined over 85,894 entering freshmen in 107 community colleges during the 1995 fall semester in California. The purpose of the study was to assess the effectiveness of remedial Mathematics programs among the state's community college students.

Because the California legislature had mandated collection of data from the state's "112 community colleges and affiliated adult education centers" (Bahr, 2008, p. 425), Bahr had a vast resource which formed the population of the study. The data received from the Chancellor's Office of California Community Colleges included:

> Transcripts, demographics, financial aid awards, matriculation records, degree/certificate awards and more cross-referenced periodically against the enrollment records of all California public 4-year postsecondary institutions and the National Student Clearinghouse database in order to identify students who transferred to public and private 4-year institutions, both in-state and out-of-state. (p. 425)

Bahr reduced the study to 107 community colleges that were semester-based and reduced the population to those students who enrolled in "at least one substantive, non-vocational math course" and students who had the demographic and identification data necessary to track them across colleges and for whom valid records of course enrollment were accessible over a period of six years. This brought the original population of 202,484 down to 85,894 (pp. 425-426).

Bahr (2008) searched for "long-term academic attainment," which the researcher defined as "the award of a credential and transfer to a 4-year institution" (p. 426). Bahr derived from this "five mutually exclusive attainment outcomes," examining the highest level achieved and if transfer occurred or not.

For the purposes of analysis, Bahr (2008) divided the students into four groups: "completer" and "non-completer" remedial mathematics students and "completer" and "non-completer" college mathematics students. Those who were deemed completers had a grade of A, B, C, D, or Credit in their college Mathematics course enrollment (p. 427).

Bahr's (2008) control variables at the student level included: "sex, race/ethnicity, age, three proxies of socioeconomic status (SES), three measures of enrollment patterns,

academic goal, grade in first math course, English competency at college entry, and two measures of interaction with academic advising services" (p. 427). The researcher further controlled for college-level variables, including: "college size, Mathematics competency levels of entering students and college goal orientation" (p. 431).

Bahr (2008) concluded that the students who remediate successfully "experience comparable outcomes" with the "students who achieve college-level Mathematics skills," but who have never received remedial education. This indicated that the remedial Mathematics programs had been "highly successful at resolving skill deficiencies" (p. 445). The study indicates only that mathematics remediation in college is only successful for students who remediate successfully. In other words, those who criticize the continuation of remedial mathematics programs in college could argue from the study that a large number of students do not gain long-term accomplishments in degree attainment or transferring to other schools, and, for those students, these critics could claim that the study indicates a waste of valuable resources. However, as Bahr (2008) explained, the purpose of the study was to examine the effects of the remedial mathematics programs and not to advocate or support policy decisions (p. 445).

Boatman and Long (2011) examined "the impact of remedial or developmental courses on students with a range of levels of preparedness" (p. 1). Using the student-level longitudinal data from the Tennessee Higher Education Commission (THEC) and the Tennessee Board of Regents (TBR), Boatman and Long studied undergraduate students at thirteen two-year and eleven four-year public higher education institutions in the state of Tennessee through each term, starting in the fall semester of 2000 to the spring of

2003 with an extension later granted to track students for an additional three years for a total of six years (Boatman & Long, 2011, p. 1).

According to a presentation by Boatman and Long at the 2010 Conference of the Institute for Educational Studies (Boatman & Long, 2010, slides 8-14), the students had been placed into varying levels of Mathematics, Reading, and Writing courses based on the American College test (ACT) and the Scholastic Aptitude Test (SAT) scores first, which then indicated need for further testing. The lowest scorers on the ACT/SAT had to take the COMPASS Arithmetic Exam (COMPASS exams are also created by ACT) which placed them either into Remedial Arithmetic (score of 0-29) or Developmental Algebra I (score of 30-100). The lower scorers on the ACT/SAT took the COMPASS Algebra exam to determine placement in Developmental Algebra I (score of 0-27), Developmental Algebra II (score of 28-49), or college-level courses (score of 50-100). The highest scorers on the ACT/SAT were placed into college-level courses. The same was true for reading and writing students who took either college-level, developmental, or remedial classes. The higher ACT/SAT students went directly into college-level courses. The others took the COMPASS English or Reading test. Remedial writing and reading students had scored 0-27 in the COMPASS English or Reading. Developmental writing students had scored 28-67 in the COMPASS English or Reading. College-level writing (composition) students had scored 68-100 in the COMPASS English or Reading.

Boatman & Long looked for causal effects from being placed into the remedial or developmental courses. The researchers used "a regression discontinuity (RD) research design" which "compare[d] outcomes for students whose COMPASS scores fall just

above and below the cutoff for placement" (Boatman & Long, 2011, p. 2). The researchers made the assumption that students in these two areas share equal expectations and compared "the enrollment patterns of students assigned to remedial or developmental courses with those assigned to the next level course" (Boatman & Long, 2011, p. 2).

Donnell (2010) described a report released by The National Center for Public Policy and the Southern Regional Education Board (SREB, 2009) and cited officials of the Southern Regional Education Board as reporting that awareness of parents and students regarding college preparation needs to begin early. Joe Pickens, a former chair of the Florida House Appropriations Committee and president at a community college in the state, indicated that an awareness of what constituted college readiness is needed as early as eighth grade. His community college hosted orientation sessions for that age group to help them realize what would be expected of them after four years of high school. The report urged states to require student-mastery of higher-level skills in vital courses (Donnell, 2010, p.10).

Addressing K-12 Need for Effective Remediation

Jacob and Lefgren (2004) examined summer school programs in Chicago Public Schools from "students who were in the third and sixth grades from the 1993-1994 school year to the 1998-1999 school year; a total of 402,924 observations" (p. 228). After eliminating students for missing demographic data or test scores and students who were receiving bilingual education and special education programs, as well as those who were placed in self-contained classes and those who left the system, the researchers retained 293,295 students in the study (p. 228).

Jacob and Lefgren (2004) reported that the Chicago Public Schools had mandated a new policy in 1996 that linked summer school attendance and grade promotions to standardized test scores. The policy meant that in the two academic years following the implementation of the policy, over 30,000 third-grade students and over 21,000 sixth-grade students were forced to attend a remedial summer school program, with approximately 10% to 20% of the students not promoted to the next grade (p. 227).

Using a regression-discontinuity analysis, in which the effects of the independent variable (intervention of summer school instruction) are measured by the value of an observed variable (pretest scores) and its relation to the posttest score, Jacob and Lefgren (2004) found that summer school did improve academic achievement in Mathematics and Reading, and that students experienced similar positive effects for at least two years after completing the Chicago program. A finding that the researchers noted was that "even under very pessimistic assumptions, summer school improves performance in mathematics" (p. 241).

Flores and Roberts (2008) examined productive strategies for improving student achievement in Algebra. The researchers indicated the pressure faced by schools to prepare students for the demands of increasing technologies and global competition as a factor in the growing interest in improving Algebra instruction. The study differed from other studies in that it focused on two principals who desired to improve Algebra scores. After professional development for the teachers, scores did improve a bit. This led the two administrators to visit successful schools with high student academic achievement in Algebra to find what factors contributed to the success. They selected three high schools

with similar demographics to their own: that is, large schools in urban settings with a large population of Latino students and a high number of students on free and reduced lunch – students who were categorized as being low socioeconomic status compared to their counterparts who were not participating on a free/reduced lunch program. Qualifying for the free and/or reduced lunch program is based entirely on parent income and the size of the family.

The methodology Flores and Roberts (2008) used involved visiting the school, talking to administrators, observing classes, and talking to teachers. Their observations were directed by three main goals: to determine what primary singular characteristics set those high schools on a path that led to success, to reveal what curriculum and instructional choices made them successful, and to determine what the schools' leaders had done to improve the students' achievement scores.

After visiting the schools, Flores and Roberts (2008) concluded that every school can achieve in Mathematics at increased levels without major restructuring by attending to particular structures and techniques at the building level. The first of these involved the structure of leadership at the school, with particular attention on school administrators and department chairs and professional development at the building level to focus on collaborative learning in shared planning periods and instructional strategies that work. Flores and Roberts emphasized that teachers not be categorized as teachers of higher level students or of lower level students. The second area of focus was on teacher collaboration using common course content and on classroom instruction with emphasis on high teacher content knowledge and a thorough knowledge of curriculum standards.

Textbooks were to be used "as a resource and not as the primary instructional guide in Algebra classes" (Flores & Roberts, 2008, p. 314). The researchers' last area of emphasis and observational analysis involved the cultural aspects of the schools; particularly a culture that promoted learning, assessing, instructing, and intervening throughout the day. This included before and after school and during lunch and on weekends when students and teachers worked together individually and in groups. The researchers also noted the schools held students accountable for what happened during their class periods only. Homework varied in the way it was utilized, with some teachers factoring it in the grading process while others did not. Flores and Roberts (2008) reported that the visiting process was a much needed process for educators and that they began to recognize common elements and patterns that helped shape their questions as they completed the visits. The final conclusion of the study was that developing strong teacher leaders and supporting them while allowing them freedom to discover the best means to solve difficult learning problems was the ultimate goal of administration.

Wang (2011) explored the use of web-based assessment in facilitating junior high school students to learn Mathematics. Based on findings in the review of the related literature, the study indicated that previous research on teaching and learning had clearly indicated that appropriate assessment improves student learning effectiveness. Other research in the review had shown that effective feedback is the key to providing positive gains. Further research indicated that such feedback must be delivered in a timely manner and on a continual basis to be deemed effective. Informing students what they should do and how to strengthen skills in learning and thinking, such feedback has the potential to

help students find value in the process and opportunity to revise work. Teachers with a number of demands on their time may find such feedback difficult to provide as they assess student learning.

Noting the related literature on feedback, the author set about to develop a type of computer-aided feedback that would provide students with appropriate feedback without increasing demands on teacher time. The use of computers to assess student learning had already been established, so the researcher was able to build on the previous advancements in the technology. Wang (2011), referring to previous work on "dynamic assessment," discussed the differences in two styles, "sandwich format" and "cake format," which have been used in helping students. In the normal "sandwich format," teachers use a pretest and a posttest with instruction in the middle. In the "cake format," also known as "Graduated Prompted Assessment," the assessment is more layered and individualized. The researcher elected to use a web-based remedial assessment design program utilizing a "cake format" for junior high Mathematics learners. The researcher attempted to address two key questions: How efficacious is the feedback method designed by the researcher in helping junior high students learn? How does that method compare to other web-based tests and pencil and paper assessment in remediating junior high mathematics students?

Wang (2011) selected three classes of one junior high mathematics teacher to take part in the research. There were ninety-six (96) seventh graders in the study, divided by classes, which were comparable in size and gender distribution. Two classes involved thirty-one (31) students, both having a population of sixteen (16) boys and fifteen (15)

girls, and the third class had thirty-four (34) students, having a population of seventeen (17) girls and seventeen (17) boys. The first group of thirty-one (31) experienced normal ("sandwich format") web-based assessment, the other group of thirty-one (31) used pencil and paper tests, and the final group had the "cake format" web-based assessment. At the onset, the researcher found no significant differences in the learning conditions of the groups (Wang, 2011, p. 1064).

The topics taught to all three groups were "positive and negative numbers," "number line," "additive inverse," "absolute value," "addition and subtraction of integers," and "multiplication and division of integers" (Wang, 2011, p. 1064). The skills needed for the attainment of the knowledge of these topics were identified in five types:" linguistic knowledge, semantics knowledge, schematic knowledge, strategic knowledge, and procedural knowledge.

Summer Learning Programs in Camp Settings

Terzian, Moore, and Hamilton (2009) examined programs across the United States in a white paper for the Wallace Foundation. Based on an extensive evaluation of 43 summer programs aimed at finding ways to close the gap faced by economically disadvantaged students, their research focused on programs serving low-income urban student populations. The main finding from their study was that although well-documented research clearly recognizes the gap in achievement between students from privileged backgrounds and students considered to be at-risk because of their socio-economic status, little research has been completed on how best to close the gap.

Terzian, Moore, and Hamilton (2009) recorded that in order to determine who attended summer programs, the research team ran a multivariate regression in order to ascertain the significant differences between the students who attended summer programs and those who do not attend summer camps. The "[c]ovariates include[d] gender, race, poverty, and family structure," and when the researchers controlled for covariates, then socioeconomic differences were the only [statistically significant ($p < .001$)] differences that remained" (pp. 7-8). The researchers divided the programs into groups: "educational/cognitive" groups, "career development" groups, and "multi-element" groups. The researchers examined whether the programs were "experimental or non-experimental," and they further divided the experimental groups into "quasi-experimental, pre-experimental, qualitative, and other" (p. 34).

Terzian, Moore, and Hamilton (2009) discovered that:

> Effective experimentally-evaluated programs with at least one positive impact covered a number of goals, among them improving literacy skills, enhancing educational and occupational potential for low-income students, cultivating academic performance, self-concept, and social skills, helping prepare disadvantaged students for college, and improving academic achievement, career maturity, intent to graduate, and discouraging dropping out of school. (pp. 35-36)

According to Terzian, Moore, and Hamilton (2009) still other programs were experimentally-evaluated with:

> Mixed or null findings: programs which attempted to promote summer learning loss and promote academic achievement, to demonstrate the importance of

> academic success to achieve career success, to improve reading achievement scores, to minimize academic loss and to prevent high school dropout and pregnancy. (pp. 37-38)

Terzian, Moore, and Hamilton (2009) further contend that there are three important trademarks for effective summer learning programs which they examined in their study. First, the effective programs were affordable and accessible with most of the programs free of charge to the participants, and many of them lasted 6 to 8 hours a day which made them more attractive as they lessened the parents' need for child care service. They also often included meals and transportation. Next, the most effective programs involved parents in some way, whether as volunteers or as decision makers or as support for emphasizing program goals at home. Finally, the most effective programs involved the community in a number of ways: decision-making, volunteering, providing matching funds or primary funding, promoting awareness about the program, and/or offering facilities (p. 21).

Terzian, Moore, and Hamilton (2009) discovered that, among the outside-of-school time programs, there was little information on how young people develop as learners and as participants in social situations. Terzian et al. (2009) identified a few characteristics that seemed to promote youth development. Among adolescents, these characteristics included encouraging skills needed to live life independent of their parents and developing positive relations with caring adults and pro-social peers. In these ways, students seemed more likely to stay the course, finish the program, and make practical applications.

Terzian, Moore, and Hamilton (2009) reported that the non-experimental studies had less positive associations than the experimental groups (p. 20). The research team concluded that an understanding of the best manner in which to target low-income children and adolescents would produce a higher number of positive outcome associations. The length of the programs, the daily schedule of the programs, and adaptations made for ethnicity and gender subgroups might have an impact, but not enough research had been completed in those areas to determine any significance. There were too few studies conducted in each of the fields to determine the effectiveness of any program (p. 25).

Dave, Blasko, Holliday, Darr, Kremer, Edwards, Ford, and Hido (2010) examined a program, which was held in 2008-2009 at Penn State Erie, The Behrend College (PSB), to encourage girls entering the ninth and the tenth grades to increase enrollment in Mathematics and Science courses in preparation for college and thus to further increase the likelihood that these girls would pursue college majors in Science, Technology, Engineering, and Mathematics, which have become recognized as the STEM disciplines. The study based its urgency on a National Science Board report in 2008, which forecasted increased needs for a STEM-ready workforce by 2013 and based upon a 2008 prediction from the U.S. Department of Education Institute of Education Sciences that the United States would fall short of the demand by as much as fifty percent based upon previously noted. By paying attention to the lack of female students pursuing these fields, the camp hoped to address the issue as well as the aforementioned problem of women being underrepresented in certain fields.

The program constructed its main project on previous research that indicated that females want careers that they feel will most benefit society. The girls in the Penn State Behrend (PSB) study under consideration were asked to design a bag made from used blue jeans and then to produce two bags, one for themselves and one to benefit a shelter for women. In this way, the girls were creating an environmentally-friendly product that would benefit others (Dave et al., p. 37).

Rather than simply launching into the project, the program went through a number of sessions. The first session introduced the girls to the idea of engineering as a teamwork concept by asking them to create a helicopter using KNEX inter-connectable building toys. The girls were first shown a helicopter model, and then they were allowed to work on the project as part of a group. The girls were each allowed to look at the model individually behind a partition and then suggest changes to the group product to improve its likeness to the model. The products were scored on similarity to the model. Counselors asked the girls questions, including whether they thought that using these toys was disadvantageous because KNEX have traditionally been considered boys' toys (Dave et al., p. 37).

Next, the girls were introduced to various types of engineering fields. They were also introduced to collaborative problem-solving as an essential aspect of Science. Mathematics Camp faculty consisted of female professors in the STEM areas, Science, Technology, Engineering, and Mathematics, and a number of female STEM major university students served as counselors. The girls were surrounded by these women in order to provide positive role models in the STEM areas (Dave et al., p. 38).

Finally, the campers began designing the bags using various parameters given to them by the camp staff. The bags had to be ergonomically designed with specific weight-bearing capabilities. Throughout the Mathematics summer camp, the girls continued using various engineering principles to complete their bags. Mechanical engineering, plastics engineering, and electrical engineering workshops gave the girls hands-on opportunities with various skills. The girls constructed business models that calculated costs of making the bags. Discussion regarding starting a business and making it profitable ended the workshops. One bag from each of the girls was donated to SafeNet, a domestic violence organization in Erie, Pennsylvania. A wrap-up session and parent reception closed the program (Dave et al., pp. 38-41).

Dave et al. (2010) noted that before and after the entire program, the girls completed computerized surveys. Both times the girls were given the same statements with a scale of 1 = strongly disagree to 5 = strongly agree. Questionnaires completed by the girls after each session were used to assess each workshop during the Mathematics summer camp. The first analysis considered the overall satisfaction with the program. Responses to the questionnaires from the thirteen students in 2008 were analyzed. The 2009 results examined fifteen students' responses. The data compared in the first analysis, which utilized independent sample *t*-tests because of the two small groups of participants (N=13 and N=15) together with the single variable (satisfaction with the program), discovered that there was no statistical significance between the groups ($p > .05$). Then the results of both the 2008 and 2009 Mathematics summer camps together were analyzed (N=28), and the results indicated that the workshops garnered

very positive reactions from the girls, indicating their overall enjoyment with the sessions. Measurements examined understanding of the information presented in the workshops as well.

Dave, Blasko, Holliday-Darr, Kremer, Edwards, Ford, and Hido (2010) concluded that the Mathematics summer camp was a success for all groups of girls. For the girls who came to Mathematics summer camp with an established interest in STEM-related career paths, the camp gave these students a wider range of knowledge of the various STEM fields, Science, Technology, Engineering, and Mathematics. For girls who were ambivalent, the camp encouraged them to keep an open mind toward STEM-related careers. The Mathematics summer camp confronted gender-bias for the students who had held negative presuppositions about women in STEM disciplines and careers. The campers also offered ideas for improving the program. Since most of the respondents indicated that they would have made the camp longer, and the researchers concluded that the camp was a positive experience.

Mathematics Summer Camp Programs for Rising 9th Graders

Cuddapah, Masci, Smallwood, & Holland (2008) conducted research of an Extended Summer Learning Program (ESLP) for rising ninth grade students who were selected because of their middle school records that indicated a history of low grades, poor adjustment skills, and low performance in testing. This at-risk population was teamed up with teachers from a university's teacher preparation cohort from the Professional Development School (PDS). Twelve second-year pre-service teacher candidates planned and implemented the three weeks of the Mathematics summer

program to address the literacy needs of the students who were advancing to high school. They, along with sixteen first-year candidates carried out the program which served seventeen ninth graders. The program used graphic novels to teach "note-taking, outlining, summarizing, predicting, inferring, questioning, evaluating, writing, and grammar" (p. 268). The students practiced these skills on the district's assigned summer reading.

Cuddapah, Masci, Smallwood, & Holland (2008) collected data throughout the following year on the students who had participated. Attendance rates were slightly higher than the entering freshmen from the previous academic school year. Students accumulated grades that averaged a 2.33 grade point average (GPA) with five (5) of the seventeen (17) rating a 3.0 or higher. Student performance ratings awarded by their English teachers for class work ranked "1.9 on a 3.0 scale (with 2.0 being the expected ninth grade average), indicating that the students performed nearly as well as other ninth graders" (p. 272).

Portland Schools Foundation (2011) published its report on student outcomes of its Ninth Grade Counts program, an initiative which examined the various ways to make a significant difference for youngsters in the summer between their eighth and ninth grade school years. The success of the program, outlined in the report as a "Summer Youth Connect" continuum, was a collaborative effort between the Portland Schools Foundation and the City of Portland to encourage at-risk students throughout their high school years (p. 4). In 2010, 1063 students participated in summer transition programs in six school districts. In 2009, 2866 students participated, with 399 of them labeled as

Academic Priority (AP), or at-risk, students. These students completed the program successfully, showing significant gains in reading scores, mathematics scores, and higher attendance rates compared to Academic Priority nonparticipants (p. 34). Other positive outcomes included higher credit attainments at the end of ninth grade when compared to Academic Priority nonparticipants (p. 35). The summer programs worked on getting students prepared by improving Reading, Writing, and Mathematics skills, and students were able to make connections and build self-confidence through various summer program activities. Students worked on volunteer projects such as Habitat for Humanities, took enrichment classes in dance, art, and film, and they visited colleges and universities.

Hallberg et al. (2011) researched the Texas Ninth Grade Transition and Intervention grant program, which included a summer transition program for 3,013 students in school districts with larger populations of disadvantaged students. The study used a quasi-experimental design to evaluate the effects of participation in the summer program. After creating a comparison group, the researchers compared the outcomes of the scores on the Texas (Ninth Grade) Assessment of Knowledge and Skills, together with ninth grade attendance records, of students who participated with the comparison group (who did not participate). Sixty-five percent of ninth graders tested met the standards on all tests.

Edwards, et al. (2001) described a program initiated at Wayne State University (WSU) in Detroit to provide summer Mathematics intervention for middle and high school students of primarily African-American descent. This program, Math Corps

Summer Camp, was started in 1991 by the mathematics department faculty as an after school tutoring program for middle school students in the Detroit Public System. These were converted to summer camps in 1992 and 1993 with "40 middle school students and 20 high school students" (Edwards et al., p. 412). The following summer there was no camp, but the program was revised and expanded during the following two school years. The camp was serving 120 students at the time of the study, an equal number of seventh, eighth, and ninth graders. In 2000, the program added a three week transitional program for participants entering their freshmen year of high school.

Edwards et al. (2001) determined that the make-up of the camp was 90% to 95% African-American participants throughout the years, equally distributed by gender. Middle school students were divided into teams, led by one college student serving as a teaching assistant and assisted by five high school teaching assistants. The middle school students were also instructed by university professors and public school teachers. The high school students served as paid teaching assistants in morning sessions, and they themselves received instruction by university faculty and college students in the afternoon. Students were required to keep journals which were reviewed by three teacher supervisors who recorded responses to the journals for student review.

Edwards et al. (2001) reported that the election of students to the Mathematics summer camp was based on written application essays so Mathematics achievement was not a factor. Students ranged from those who scored below average to above average. The researchers indicated that selection was based entirely upon evidence from the student

essays which focused on the student's desire to succeed in Mathematics and their ability and willingness to work hard and succeed.

The Mathematics summer camp program had as one of its core philosophies that their program would not provide remediation; rather, the researchers claimed that the program was intended to challenge the students and to make connections to higher Mathematics. Thus, the students were expected to move to higher academic skills (Edwards et al., 2001).

Edwards et al. (2001) cited the work of Cruickshank's (1990) identification of forty-five factors positively associated with effective schools. They noted that their program involved at least eight of those factors: an atmosphere favorable to learning, high expectations for participants, attention to rigorous standards and student goal attainment, recurrent/ concentrated homework, regular and vigilant observing of student progress, tutoring, and high rates of attendance.

Edwards et al. (2001) described the methods used to assess students in the middle school level as "individually administered pre [tests] and posttests covering skills and concepts inherent to the Mathematics content they studied" (Edwards et al., p. 422). The students took the pretest on the first day of summer camp and completed the posttests during the last days of summer camp. The researchers used a *t*-test to measure the gains, finding statistical significance at the level of $p < 0.001$ on a consistent basis. They indicated that "these results are suggestive of a positive effect of Math Corps Summer Camp nevertheless they must be regarded as very preliminary" (p. 423). The researchers

noted that the hesitancy to claim a positive effect was based on the lack of "potential comparison as to what gains could be expected in the absence of summer camp" (p. 423).

Edwards et al. (2001) indicated that the other evidence about camp success was anecdotal in nature. The journals kept by the middle school students indicated satisfaction with the camp as fun, educational, social, nourishing, and immediate. The journals kept by the older students indicated positive effects as well. High school students expressed enjoyment of their experience in the Mathematics Corps Summer Camp. Many of the college students who were working as assistants pursued teaching certificates because of their satisfaction with the experience.

Cleaver (2010) studied the impact of summer instruction in Mathematics on student attitudes toward and achievement in Algebra I in a summer program called SMART and its follow-up program called THRIVE. SMART, Summer Mathematics Advanced Readiness Training, was a summer camp program for rising eighth and ninth graders which was designed to prepare them for the study of Algebra I. Cleaver explained that the program was not remedial, but a preparedness program. THRIVE was a follow-up Saturday school program for Algebra I students that met throughout the academic year. Using archival data from achievement tests, surveys, and student records, Cleaver determined student attitudes toward Algebra I and their accompanying achievement in the subject.

Cleaver (2010) used quantitative measures to investigate the differences in student attitudes toward Mathematics and their subsequent achievement in Mathematics. According to Cleaver (2010) there were four groups involved in the study:

> (a) a treatment group … of Algebra I students who participated in SMART or THRIVE or both programs [in the previous year]; (b) a comparison group of a representative sample of Algebra I students who had not participated in [either program]; (c) a focus group of recent SMART participants; and (d) a focus group of parents of recent SMART participants. (p. 12)

Cleaver (2010) indicated that data from two tests and a survey were used to evaluate the efficacy of the programs and the attitudes of the participating students. Pretest and posttest scores from 10 SMART 2009 students' tests, selected using a random number generator, determined the focus discussion group. Their parents were invited to participate in the parent group. This process of random selection continued until the researcher had parental consent and participant assent forms from ten students (2010, p. 13). All 2008 SMART students were invited to take part in a survey. The Mathematics Attitude Inventory was administered to assess attitudes prior to SMART participation. Pretests were given on Day One and posttests and surveys were administered after completion of the program. Scores from posttests increased from pretests.

Cleaver (2010) used a logistic regression analysis to compare the treatment and the comparison group to determine what variable was the stronger predictor of the outcome variable. Descriptive and inferential analyses were carried out on the data. *T*-tests produced statistically significant results.

Summary

The history of using summer school to ameliorate education, as shown in Dougherty (1981), Gold (2002), and Zweiefelhofer (2008), has been investigated as a

way to close learning gaps by Entwisle and Alexander (1992) and Alexander, Entwisle, and Olson (2001). Greene (2000) found that the need for remedial education at the college level was quite costly, and though his estimated cost was quite high, more conservative estimates are still in the billions of dollars, such as the finding of the Education Commission of the States (2010). This has led researchers to examine the efficacy of remediation at the college and K-12 levels.

CHAPTER III

METHODOLOGY

Research Questions

The following research questions this study sought to answer were:

1. Does student achievement in Mathematics improve after remedial Mathematics summer camp participation?

2. Is camp participation a stronger predictor of success on the End-of-Course Exam (EOC) in Algebra I than other variables (gender, ethnicity, or socioeconomic status)?

The study examined the subjects in terms of the categories of gender, ethnicity, socioeconomic status, and camp completion. The academic gains at the camp were measured by pretests and posttests, while the effectiveness of the camp in improving student achievement in Mathematics was measured by Algebra I End-of-Course (EOC) Exam Test Scores and Algebra I pass/fail rates. This was determined by comparing the achievement scores of camp participants with those who did not participate.

As an indicator of possible effectiveness, the study used a quantitative research design to examine data available for students who participated in the camp (dependent variable) compared to the data available for those who, even though they were targeted for Mathematics summer camp in the same graduating class, did not participate in the Summer Mathematics Camp. The study examined the data from the subjects in terms of the categories of gender, ethnicity, and socioeconomic status (independent variables). Academic gains at the camp were measured by pretests and posttests, while the

effectiveness of the camp in improving student achievement in Mathematics was measured by Algebra I End-of-Course (EOC) test results (dependent variable) in terms of the students' proficiency or non-proficiency record and Algebra I pass/fail rates.

Participants

This study examined one school district's remedial Summer Mathematics Camp program. The district, a rural school system in Middle Tennessee, offers two high schools and three middle schools that feed into them. In 2009, the district began targeting ninth grade students at risk of failing Algebra and approaching them and their parents about enrolling the students at Algebra Summer Camp for twenty days over a five week period during the summer break. The Annual Mathematics Summer Camp continued through the summer of 2011. Data collection involved the class of 2013 (approximately 140 targeted students). The data that track the class of 2013 students as well as their End-of-Course (EOC) scores had already been archived by the district. Anonymity was assured by removing identifiers such as names and student numbers.

The Mathematics Summer Remediation Camp in this study was held in 2009. Rising ninth graders were identified as at-risk of failing Algebra. These students were identified by their seventh grade scores on the Mathematics portion of the Tennessee Comprehensive Assessment Program (TCAP) test, their eighth grade scores on the EXPLORE test (the 8th grade preliminary to the American College Test, ACT), and their most recent ThinkLink test (one of a series of tests used to predict student achievement on state-wide assessments available for districts to use in grades 2 through 8).

Using these criteria, the school district targeted a total of 140 students, approaching the students and their parents about attending an Algebra Boot Camp for twenty days over a five week period. One hundred students expressed interest and were certified, but only seventy-nine started the camp on the first day. Sixty-nine students completed the Mathematics Summer Camp.

Data collection involved students targeted for math camp from the class of 2013 who did not attend the 2009 camp and the class of 2013 participants of the 2009 camp. The entire Algebra Summer Boot Camp cohort was used and a random sample of the targeted students with similar characteristics was selected for the students who did not attend the Algebra Summer Boot Camp. Students without End-of-Course (EOC) scores in the county were excluded. Students who did not enroll in Algebra I during the 2009-2010 school year were likewise excluded.

Instrumentation

The study utilized two instruments, namely Algebra Summer Boot Camp pretests and posttests, to measure Mathematics achievement at the conclusion of the summer boot camp. The study also used End of Course (EOC) Algebra tests and Algebra I pass/fail rates to compare students who did participate in the Algebra Summer Boot Camp to the students who did not participate in the attend the Algebra Summer Boot Camp, even though they had been invited. Upon approval of the Austin Peay State University Institutional Review Board (IRB) and the school district school board to conduct the research previously described, the researcher obtained the data from the school district

for the Tennessee Algebra I End of Course (EOC) test scores for the 2009 Algebra Summer Boot Camp cohort.

According to the Tennessee Department of Education (2010) annual Secondary Assessment and Evaluation:

> The results of these examinations will be factored into the student's grade at a percentage determined by the State Board of Education in accordance with T.C.A. §49-1-302; (2). The End-of-Course test grade will count 20% of the second semester grade for the 2009/2010 and the 2010/2011 school years and 25% of the second semester grade in subsequent school years. Students will not be required to pass any one examination, but instead students must achieve a passing score for the course in accordance with the State Board of Education's uniform grading policy. (p. 3)

The purpose of Tennessee's End-of-Course (EOC) exam for Algebra I is to determine the proficiency level of students who have almost completed the course. The Algebra I End-of-Course (EOC) is a criterion-referenced test with items aligned with the Tennessee State Curriculum Goals for Algebra I. Beginning in the 2011/2012 school year, 25% of students' second semester grade is determined by the test (up from 20% for the previous two years).

Data Collection Procedures

Having received preliminary permission from the director of schools (pending Austin Peay State University IRB approval), the researcher completed the required Collaborative Institutional Training Initiative (CITI) training and submitted the IRB

approval forms to conduct research. After receiving the necessary IRB approval, the researcher began to collect data with student identifiers removed.

Next steps were:

1. The researcher pulled data for the group that did not participate in the Algebra I Boot Camp to reflect same deficits, gender, and other categorical values.
2. The researcher pulled data for the group that did participated in the Algebra I Summer Boot Camp to reflect same deficits, gender, and other categorical values.
3. The researcher coded and entered into computer spreadsheets the pretest and posttest scores. Indicator Variables were entered into a spreadsheet for the logistic regression, coded as 1=Free/Reduced Lunch, 0 = Ineligible; 1=Female, 0=Male; Camp Completion 1=yes, 0=no; EOC proficient 1=yes, 0=no; 1=non-white, 0=white.
4. The researcher determine the Mean scores for the groups.
5. Using a paired sample *t*-test, the researcher analyzed the pretest and posttest data to determine if the first null hypothesis should be retained.
6. Using a two sample *t*-test assuming unequal variances, the researcher analyzed the End-of-Course (EOC) test data to determine if the second null hypothesis should be retained.
7. Using a *Chi*-square test of homogeneity, followed by a Fisher's exact test, the researcher analyzed the pass/fail rates in Algebra I to compare the success of the students who participated in the Algebra I Summer Boot Camp with the scores for

the students who did not participate in the Algebra I Summer Boot Camp even though they had been invited to participate.

8. The researcher performed a logistic regression to determine greatest indicator of future success among the variables of camp-participation, gender, ethnicity, and socioeconomic status.
9. When results were computed, a *Chi*-square test was performed to determine if the logistic regression fits the model in place of the absence of R^2 to gauge variance.
10. The researcher saved all data on a USB drive and secured the USB in a fire-proof and secure file cabinet with limited and authorized access to the file cabinet and the data file.

Null Hypotheses

The following Null Hypotheses were tested in this study:

- **Null Hypothesis 1 (H_{01})**

  The students who attended the camp will not have statistically significantly higher scores on their posttests than on their pretests.

- **Null Hypothesis 2 (H_{02})**

  There will be no statistically significant differences between EOC achievement levels of students who attended the camp those who, though invited, did not attend the camp.

- **Null Hypothesis 3 ($H_{\theta 3}$)**

  The students who attended the camp will not have a statistically significantly higher rate of successful completion of Algebra I than those who, though invited, did not attend the camp.

- **Null Hypothesis 4 ($H_{\theta 4}$)**

  Camp completion will not be a significantly stronger indicator of future success on Algebra I EOC tests than other variables (gender, ethnicity, or socioeconomic status)?

Analyzing the Data

The researcher performed a paired samples *t*-test for Null Hypothesis 1 ($H_{\theta 1}$), a two sample *t*-test assuming unequal variances for Null Hypothesis 2 ($H_{\theta 2}$), and a *Chi-Square* test of homogeneity, followed by a Fisher's exact test, for Null Hypothesis 3 ($H_{\theta 3}$). Additionally, a logistic regression analysis was performed for Null Hypothesis 4 ($H_{\theta 4}$), and a *Chi-Square* test was then administered following the other tests as a measure for reliability.

Limitations

The following limitations are included as pertaining to this particular study:

1. The number of students involved in the study is small; therefore, results may not be extrapolated to other situations.
2. Because the camp is a short summer program, and because many different learning experiences may affect outcomes, results cannot solely be attributed to the camp.

3. The school system that was used is a rural Middle Tennessee school district; therefore, the results from the study should not be necessarily extrapolated to all school systems.

Summary

The data collection procedures for this study involved obtaining archival pre-test and post-test scores from students' tests at the beginning and end of camp, nominal variables such as ethnicity, gender, socioeconomic status, camp completion, and dependent variables such as proficiency outcomes on End-of-Course (EOC) Algebra I tests and Algebra I pass/fail results.

CHAPTER IV

DATA AND RESULTS

Introduction

The purpose of this study was to determine the impact of a Mathematics Summer Remediation Boot Camp program for rising ninth graders aimed at improving student achievement in Algebra I. The researcher investigated the differences, if any, in student performance before and after participation in the Mathematics Summer Boot Camp. Likewise, the researcher also examined the data to determine if participation in the Mathematics Summer Boot Camp program was a stronger predictor of proficiency on the Algebra I End-of-Course (EOC) examination than the other variables, such as gender, socioeconomic status, and ethnicity.

Data Analysis

Chapter three described the collection of data presented in this chapter. Four types of statistical analyses were used for this quantitative study: *t*- tests, a *Chi-Square* test of homogeneity, *Fisher's* exact test, and a Multinomial Logistic Regression analysis. The researcher performed a paired samples *t*-test using Microsoft Excel for Null Hypothesis 1 ($H_{\Theta 1}$) and Two Sample *t*-tests for Means assuming unequal variances using the statistical programs in Microsoft Excel for Null Hypothesis 2 ($H_{\Theta 2}$) and a *Chi-Square* test of homogeneity for Null Hypothesis 3 ($H_{\Theta 3}$). Additionally, a Multinomial Logistic Regression Analysis was performed using the SPSS statistical software package for Null Hypothesis 4 ($H_{\Theta 4}$), and a *Chi-Square* test was utilized as a measure for reliability. Results are reported for each research question.

Demographics

The population for this field study consisted of the 140 rising ninth grade students who had been targeted for the Algebra I Remedial Mathematics Summer Boot Camp for two rural high schools in the same in Middle Tennessee. Seventy-nine (79) students started the camp, and sixty-nine (69) completed the camp. Sixty-five (65) students completed both the pretest and posttest during the boot camp experience. Sixty-one (61) students did not attend the Algebra I Remedial Mathematics Summer Boot Camp even though they had been invited to participate. Among those students, thirty (30) students enrolled in Algebra I in their ninth grade year in the school district during the fall of 2009 and took the 2010 End-Of-Course (EOC) Algebra I test. The remaining students either enrolled outside of the two high schools in the district or took Algebra I over a two year period in the district schools and then took the 2011 End-Of-Course (EOC) Algebra I test. Students without the experience of taking Algebra I in the district's two high schools and those without 2010 End-Of-Course scores were not considered in the analyses for this study.

Purpose of the Study

The purpose of the study was to ascertain the effects of a Remedial Mathematics Summer Boot Camp on student achievement in Mathematics (Algebra 1) for students who were scheduled to start the ninth grader in the fall of 2009. The study compared the archival pretest and posttest scores from participating students' tests at the beginning and end of Remedial Mathematics Summer Boot Camp, and then examined End-of-Course (EOC) test scores and Algebra I pass/fail records, gender, ethnicity, and socioeconomic

status for students who participated in the Mathematics Boot Camp compared to the same scores for the students who elected not to participate in the Remedial Mathematics Boot Camp during the summer of 2009 even though they had been invited to participate. To determine the greatest predictor of success on Algebra I End-of-Course (EOC) testing, nominal variables such as ethnicity, gender, socioeconomic status, camp completion, and dependent variables such as proficiency outcomes on EOC Algebra I test scores and pass/fail outcomes in high school Algebra I were analyzed. This chapter presents the analyses of the research questions that provided the framework for this study.

Research Question #1

Does student achievement in Mathematics improve after Remedial Mathematics Summer Camp participation?

Testing of the Null Hypothesis 1 (H_{01})

The students who attended the camp will not have statistically significantly higher scores on their posttest than on their pretest.

To answer this question, pretest and posttest scores of students who attended the Remedial Mathematics Summer Camp were examined. Of the sixty-nine (69) students who completed the camp, sixty-five (65) students had both pretest and posttest scores. Of the sixty-five (65) camp completers with both pretest and posttest scores, twenty-five (25) were female, and forty (40) were male.

The first data collected consisted of the sixty-five (65) students' pretest and posttest scores (N=65). The Mean score for the students' posttest scores was 82.86 (M=82.86, SD =11.325, N=65) which was greater than the Mean score for the students' pretest scores, which was 51.14 (M=51.14, SD =14.979, N=65). Table 4.1 provides the comparison data from the pretests and posttests of the Remedial Mathematics Summer Camp participants.

Table 4.1

Comparison of Pretest and Posttest Data for Student Participants in Remedial Mathematics Summer Camp

	Count	**Sum**	**Arithmetic Mean**	**Variance**	**Standard Deviation**	**Low Test Score**	**High Test Score**
Pretest	65	3324	51.14	224.371	14.979	10	82
Posttest	65	5386	82.86	128.246.	11.325	48	100

As shown in Table 4.1, the Mean of scores from the test increased from the pretest to the posttest. An F-Max test was conducted to check the assumption of homogeneity of variances between measurements. Although the two measurements exhibited unequal variances, $F(64) = .830$, $p < .05$, a paired t-test was considered appropriate to use due to its robustness against the violation of this assumption when sample sizes are equal. The results of the Two Sample Paired t-test for Means are displayed in Table 4.2.

TABLE 4.2

Results of t-Test: Paired Two Sample for Means in Microsoft Excel

Count	*r*	*df*	*t*	*p*
65	.584	64	-20.582	≤.05 *

*$p \leq .05$ * Indicates Statistical Significance*

Findings from the *t*-test indicated the scores of students who completed camp and had both pretest and posttest scores displayed a positive linear relationship ($r = .584$). Posttest scores were significantly higher (t (-20.582), $p \leq .05$); therefore, the researcher rejected the Null Hypothesis 1 ($H_{\theta 1}$): The students who attended the camp will not have statistically significant higher scores on their posttests than on their pretests.

Research Question #1

Does student achievement in mathematics improve after remedial mathematics summer camp participation?

Testing of the Null Hypothesis 2 ($H_{\theta 2}$)

There will be no statistical difference between End-of-Course (EOC) achievement levels of students who had attended the camp and those who, though invited, did not attend the camp.

To analyze this question, the researcher looked at the data from two groups of students who were invited to attend the camp and compared the data of those who did to the data

of those who did not attend the camp. Fifty-seven (57) students completed both the camp and the 2010 End-of-Course (EOC) Algebra I test, having completed Algebra I in their ninth grade year. Sixty-one (61) students did not attend the camp. Among those students, thirty (30) students enrolled in Algebra I in their ninth grade year in Dickson County Schools and took the 2010 End-of-Course (EOC) Algebra I test.

The first data collected consisted of the camp's fifty-seven (57) students' Algebra I End-of-Course (EOC) test scores (N=57). The Mean for the students' scores was 71.47 (M=71.47, SD =12.543, N=57). The Mean for the non-camp students' scores was 73.57 (M=73.57, SD =8.054, N=30).

Table 4.3

Comparison of Algebra I EOC Scores for Camp Participants and Non-participants

	Count	**Sum**	**Arithmetic Mean**	**Variance**	**Standard Deviation**	**Low EOC Score**	**High EOC Score**
Control (No-camp)	30	2207	73.57	64.875	8.054	50	90
Treatment (Campers)	57	4074	71.47	157.325	12.543	27	94

An F-Max test was conducted to check the assumption of homogeneity of variances between measurements. Although the two measurements exhibited unequal variances, $F(56) = 2.425$, $p < .05$, a Two Sample t-test assuming unequal variances was considered

appropriate to use due to its robustness against the violation of this assumption when sample sizes are equal. The results of the Two Sample Paired *t*-test are displayed in Table 4. 4.

TABLE 4.4

Results of t-Test: Two Sample for Means Assuming Unequal Variances in Microsoft Excel

	df	*t*	*p*
	82	-0.943	>.05

$p \leq .05$ * *Indicates Statistical Significance*

Findings from the *t*-test indicated the scores of students who completed the Remedial Mathematics Summer Camp and Algebra I and the 2010 End-of-Course (EOC) Test were not significantly higher (t (0.943), $p>.05$); therefore, the researcher retained the null hypothesis two: There was no statistical difference between EOC achievement levels of students who attended the camp those who, though invited, did not attend the camp.

Research Question #1

Does student achievement in mathematics improve after remedial mathematics summer camp participation?

Testing of the Null Hypothesis 3 (H_{03})

The students who attended the camp will not have a statistically significantly higher rate of successful completion of Algebra I than those who, though invited, did not attend the camp.

To analyze this question, the researcher looked at the data from the same two groups of students who were invited to attend the Remedial Mathematics Summer Boot Camp compared those who did attend the camp to those who did not attend the Mathematics Summer Boot Camp. Fifty-seven (57) students completed both the camp and the 2010 End-of-Course (EOC) Algebra I test, having completed Algebra I in their ninth grade year. Sixty-one (61) students did not attend the camp. Among those students, thirty (30) students enrolled in Algebra I in their ninth grade year in the two high schools and took the 2010 Algebra I End-of-Course (EOC) test (See Table 4.5)

TABLE 4.5

Comparison of Algebra I Pass/Fail Data for Camp Participants and Non-participants

	Count	Sum	Arithmetic Mean	Variance	Standard Deviation
Control (No-camp)	30	30	1	0	0
Treatment (Campers)	57	54	0.93	0.066	0.258

The first data collected consisted of the camp's fifty-seven (57) students' Algebra I class pass/fail rates (N=57). Successful completion of the course meant students passed the course. A passing grade was coded as a 1, and a failing grade as 0. Fifty-four (54) students passed, and three (3) student failed. The Mean for the students' scores was 0.93

(M=0.93, SD =.0258, N=57). All thirty (30) students who did not attend camp passed Algebra 1. The Mean for the non-camp students' scores was 1 (M=1, SD =0, N=30). The data for reflecting this data and the relationships among the groups are located in Table 4.5 above.

The researcher performed a *Chi-Square* test of homogeneity to test whether the pass/fail rate was the same for campers and non-campers. The results are shown in Table 4.6.

TABLE 4.6

Results of Chi-Square Test of Homogeneity to Test the Pass/Fail Rate for Campers and Non-Campers

	df	***t***	***p***
	1	.943	0.13741

*$p \geq .05$ * Indicates Statistical Significance*

A *Chi-Square* test of homogeneity between groups was conducted to check for differences in successful completion of Algebra I between the students who participated in the Remedial Mathematics Summer Boot Camp and the students who elected not to participate in the summer camp but who had received an invitation to attend just the same. There was not a statistically significant difference between groups, X^2 (1, N = 87) = 2.21, p = .13741 (see Table 4.6 above). Because there were two cells in the contingency table without adequate cell counts, Fisher's exact test was also conducted. As in the

previous analysis, the researcher failed to reject the Null Hypothesis 3 (H_{O3}), with a Fisher's exact probability of .18. Accordingly, students who attended the camp did not have a statistically significantly higher rate of successful completion of Algebra I than those who, though invited, did not attend the camp.

Research Question #2

Is camp participation a stronger predictor of success in Algebra I than other variables (gender, ethnicity, or socioeconomic status)?

Testing of the Null Hypothesis 4 (H_{O4})

Camp completion will not be a significantly stronger indicator of future success in Algebra I End-of-Course (EOC) tests than gender, ethnicity, or socioeconomic status.

Success was measured in terms of passing or failing the Algebra I End-of-Course (EOC) test. A Logistic Regression was used to predict proficiency on the Algebra I End-of-Course (EOC) test from gender, ethnicity, and camp completion. The Null Hypothesis 4 (H_{O4}) that camp completion will not be a stronger indicator than other predictor effects was examined using the Statistical Package for the Social Sciences (SPSS), version 23. Data had to meet six assumptions in order for a Multinomial Logistic Regression to yield a valid result:

(1) The dependent variable had to be measured at the nominal level;

(2) One or more independent variables are continuous, ordinal or nominal, including dichotomous variables;

(3) There should be an independence of observations, and the dependent variable should have mutually exclusive and exhaustive categories;

(4) There must not be a problem with multicollinearity;

(5) There needs to be a linear relationship between any continuous independent variables and the logit transformation of the dependent variable; and

(6) There should be no outliers, high leverage values or highly influential points.

Nominal dependent variables. The success rate on the Algebra I End-of-Course (EOC) test was measured on a pass/fail basis where pass was a rating of proficient or advanced and fail was a rating of basic or below basic. Though scores from 0 to 100 are possible on the End-of-Course (EOC) test, the main goal is for student performance levels to be at least proficient. On the 2010 test, proficiency began at a score of 83 or above. The score for proficiency may change from year-to-year and differs by subject area. Students who were not proficient (labeled as basic or below basic) were coded as 0, and proficient (labeled as proficient or advanced) were coded as 1.

Continuous independent variables. Independent variables were coded in dichotomous forms. Gender was coded with males as 0, and females as 1. Ethnicity was coded as white and non-white, with white coded as 0 and non-white coded as 1. Students who completed camp were coded as 1, and non-completers as 0. Socioeconomic status

was determined by free and reduced lunch eligibility with free and reduced lunch eligible students coded as 1, and non-eligible students coded as 0.

Independent observations with dependent variable with mutually exclusive, exhaustive categories. None of the independent variables (ethnicity, gender, socioeconomic status or camp completion) are measured more than once for any individual, and none of these variables change the other. The dependent variable of proficient and non-proficient status on the Algebra I End-of-Course (EOC) test is both mutually exclusive (a student is either proficient or not) and exhaustive.

Absence of multicollinearity. Because all of the independent variables are categorical, multicollinearity will not pose a problem in this regression.

Linear relationship. Since none of the independent variables are continuous, examining the model for linear relationships was irrelevant. The researcher did not test for this assumption.

Adequate cell count. The assumption is that enough data are present so that all cells are represented. There are five (20.8%) cells (i.e., dependent variables by subpopulations) with zero frequencies. In other words, 79.2% of all combinations of independent variables are present in the study.

Results

Overall Model

To test the set of predictor variables' impact on the End-of-Course (EOC) outcomes, a Multinomial Logistic Regression was conducted using the SPSS statistical

software package. The summary of observed distributions implied that, of the data used (N=64), over fifty percent (50%) made scores on the End-of-Course (EOC) test that were not proficient. Table 4.7 contains the observed distributions in case processing in testing the set of predictor variables and their impact on the End-of-Course (EOC) outcomes.

Table 4.7

Observed Distributions in Case Processing Summary in Testing the Set of Predictor Variables' Impact on EOC Outcomes

Variable	***N***	**Marginal Percentage**
EOC Not-Proficient	51	79.7
EOC Proficient	13	20.3
No Camp	6	9.4
Camp	58	90.6
Ethnicity – White	43	67.2
Ethnicity – Non White	21	32.6
Gender Male	38	59.4
Gender Female	26	40.6
Ineligible Free/Reduced Lunch	18	28.1
Eligible Free/Reduced Lunch	46	71.9
Valid	64	100.0%
Missing	0	
Total	64	

Both goodness of fit measures indicated good model fit; the observed significance levels were 6.658 (Pearson) and 8.907 (Deviance), $p>0.10$. The model fitting information also produced a p value ($p=.683$), which indicates that the full model statistically significantly predicts the dependent variable better than the intercept-only model alone.

Table 4.8

Likelihood Ratio Test Table Indicating the Effect of Predictor Variables on EOC Outcomes

	Model Fitting Criteria			
Effect	-2 Log Likelihood of Reduced Model	*Chi Square*	*df*	*Significance*
Intercept	23.280[3]	.000	0	
Camp A	23.970	.690	1	.406
Ethnicity	24.813	1.533	1	.216
Gender	23.327	.047	1	.829
Free/Reduced Lunch	23.385	.105	1	.746

Individual Variables

Decision to Retain or Reject

More important are the results in the Likelihood Ratio Tests Table (Table 4.8) above. This table indicates the overall effect of a nominal variable. In this case, none of

the predictors showed a statistically significant effect on Algebra I End-of-Course (EOC) outcomes. Further, in the two lowest outcomes in significance levels, camp completion had a higher *p* value (p=.406) than did ethnicity (p=.216) though neither value was significant. Thus, the researcher retained the Null Hypothesis 4 ($H_{\Theta 4}$): Camp completion will not be a significantly stronger indicator of future success in Algebra I than other variables (gender, ethnicity, or socioeconomic status).

Effect Size

In Linear Regression, R^2 is the proportion of the complete variance in the criterion variable described by the set of predictor variables. The residual variance is unexplained and can be considered "error" variance. Thus, inasmuch as is possible, accounting for this variance improves an understanding of whether the camp completion was the greatest predictor of success or not. Nagelkerke's pseudo R^2 is analogous to R^2 and indicative of the degree to which the set of predictor variables improves upon the prediction of the null model for a logistic regression. The value of Nagelkerke's pseudo R^2 for this model =.055. Based on the Linear Regression (R^2) and Nagelkerke's pseudo R^2, the researcher must accept that the results are not conclusive.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

This study analyzed and evaluated the effects of a Remedial Mathematics Summer Boot Camp on student achievement in Mathematics for students who were preparing to enter their ninth grade year in a rural Middle Tennessee school system. The study compared the archival pretest and posttest scores from participating students' tests at the beginning and end of the Remedial Mathematics Summer Boot Camp, and then examined their End-of-Course (EOC) test scores, Algebra I pass/fail records, gender, ethnicity, and socioeconomic status for students who participates in the summer Mathematics camp and those students who did not participate in the camp but had received an invitation to attend prior to the summer term. To determine the greatest predictor of success on Algebra I End-of-Course (EOC) testing, nominal variables such as ethnicity, gender, socioeconomic status, camp completion, and dependent variables such as proficiency outcomes on Algebra I End-of-Course (EOC) test scores and pass/fail outcomes in high school Algebra I were considered. This chapter is a discussion of the field study and the research findings. The chapter also presents conclusions that could be drawn from the study, implications for educational practice, and recommendations for future research.

Students who participated in the Remedial Mathematics Summer Boot Camp were part of a group of students identified by a rural Middle Tennessee school system as

students at-risk of underperforming in Algebra I. Data used to determine which students should and would be invited to participate in the summer camp included student scores from the 2007 Normal Curve Equivalency (NCE), 2008 Normal Curve Equivalency (NCE), 8th Grade Explorer test, 8th grade Think Link scores, together with free and reduced lunch data and eligibility data for Student Support Services (SSS).

Using these criteria, the school district targeted a total of 140 students, approaching the students and their parents about attending an Algebra summer camp (Remedial Mathematics Summer Boot Camp) for twenty days over a five week period in the summer of 2009. One hundred (100) students expressed interest and were certified, but only seventy-nine (79) students started the camp on the first day. Students who participated in the camp were given a pretest and posttest. Sixty-nine (69) students completed the camp. Of the Sixty-nine (69) students who completed the camp, sixty-five (65) students had completed both the pretest and posttest scores.

Conclusions

The researcher investigated the differences, if any, in student performance before and after participation in the Remedial Mathematics Summer Boot Camp. The researcher further examined the difference in camp participants' pretests and posttest scores based on the administration of a paired samples *t*-test and utilizing the Microsoft Excel statistical software package. In order to compare the treatment group of remedial campers to the control group of students who were eligible for camp, but who elected to not participate in the summer camp, the researcher used a sample *t*-test for Means assuming unequal variances, again utilizing the Microsoft Excel statistical software package with a

goal of determining whether the Remedial Mathematics Summer Boot Camp participants performed differently from the nonparticipants on the Algebra I End-of-Course (EOC) test in statistically significant ways. The researcher compared the treatment group of summer camp participants to the control group (nonparticipants) for those students who were eligible for camp, who were invited to attend and participate in the summer remedial camp, but who elected not to attend or participate using a *Chi-Square* test of homogeneity and a Fisher's exact test to determine whether the summer camp participants performed differently from the nonparticipants in statistically significant ways in terms of passing or failing Algebra I. The researcher also evaluated whether participation in the Remedial Mathematics Summer Boot Camp program was a stronger predictor of proficiency on the Algebra I End-of-Course (EOC) examination than other variables (gender, socioeconomic status, and ethnicity), using a Multinomial Logistic Regression using SPSS software, version 23. All analyses tested the null hypotheses at the alpha level of significance which was set at $p \leq .05$ for this study.

The results of this study were that there was no statistically significant difference in scores made by Remedial Mathematics Summer Boot Camp participants on the Algebra I End-of-Course (EOC) tests or on the pass/fail scores in Algebra I when compared to the scores of those eligible for camp but elected to be nonparticipants and completed both Algebra I and the Algebra I End-of-Course (EOC) tests in 2010. The analysis of the increase in the summer camp participants' scores on the posttest when compared to the pretest yielded a statistically significant *p*-value.

Because the Remedial Mathematics Summer Boot Camp is a short summer program, and because many different learning experiences may affect outcomes, results cannot solely be attributed to the summer camp. However, it is possible that student outcomes on the camp participants' posttests were enhanced by this intensive approach to Mathematics education more than during a regular class. During the regular school day, learning in Mathematics is typically delivered in shorter periods of class time. Also, there are three other classes in the academic core during the day: Science, Social Studies, and English. During the summer camp, there were some lessons in English, but no others, and the instruction was delivered in longer chunks of time. Because of the way that students were selected, it is fair to say that all students had similar deficits. This may have made it easier to plan instruction that could address a majority of student deficits than in a regular classroom. Also, student outcomes on the pretest and posttest covered a relatively short period of time, merely five weeks. Other assessments in a regular classroom cover either a semester or a year's worth of learning: final exams, End-of-Course (EOC) tests, and midterm exams.

When comparing the camp participants to the students who, though eligible to attend and were invited to attend but elected to be nonparticipants, it is important to note that: 1) fifty-seven (57) camp participants completed the End-of-Course (EOC) Algebra I test and completed Algebra I in the 2009-2010 school year; 2) thirty (30) summer camp nonparticipants completed the End-of-Course (EOC) Algebra I test and completed Algebra I in the 2009-2010 school year; and 3) sixteen (16) camp nonparticipants (who had been invited) took Algebra I over a two year period and completed the Algebra I

End-of-Course (EOC) in 2011 or later. The other thirty-seven (37) did not have complete data in one of the two high schools in the district, indicating their withdrawal or alternative placement. This may have skewed the results since only a dozen camp participants were not included in the data pool, but nonparticipants who seemed unlikely to succeed had a longer time to study the subject and took a different End-of-Course (EOC) Algebra I test.

Unfortunately, concrete findings based on the results of the study remain inconclusive. Research indicates that summer remedial programs provide students with a variety of opportunities to hone new skills, prevent learning loss, and fill deficits, but it can be difficult to show that these effects are achieved.

Recommendations

Based on the literature review and findings of this field study, the researcher proposes the following recommendations:

1. In order to produce a more thorough understanding of the effects of a summer remedial Mathematics camp, it would be beneficial to include more than two rural high schools in the study. Using a larger school system with a summer remedial Mathematics program would broaden the sample size and allow for greater accuracy in the results.
2. As the Remedial Mathematics Summer Boot Camp is continued in this county, data might be examined in a longitudinal study to see if camp effectiveness in other groups of campers and non-campers increased over time.

3. Tracking camp participants as they move through Mathematics instruction in high school could provide insight on any long-term impacts on the students' progress in upper level Mathematics. This could provide school administrators and Mathematics teachers the data that might help in determining if a need exists for further Mathematics interventions as students continue to take math throughout their high school years.
4. Future studies might examine optimal time periods for delivery of Mathematics instruction comparing longer class periods of intensive instruction to shorter class periods of math instruction.
5. It would be interesting to examine the ability grouping presented by the camp structure and how ability grouping affects planning instruction.
6. The camp posttest results raise questions about how outcomes from assessments that cover longer periods of time differ from assessments that cover shorter periods of time. A study comparing assessment timing might have impacts on classroom instruction and on test preparation.

REFERENCES

Alexander, K. Entwisle, D. & Olson, L. (2001). Schools, achievement, and inequality: A seasonal perspective. *Educational Evaluation and Policy Analysis*, *23*(2), 171-191.

Alliance for Excellent Education (2010). Straight A's: Public education policy and progress. *Public Education Policy and Progress*, *10*(22) Retrieved from http://www.all4ed.org/files/Volume10No22.pdf

Amos, J. (2008). Dropouts, diplomas, and dollars: U.S. high schools and the nation's economy [Electronic version]. Retrieved July 17, 2012, from http://www.all4ed.org/publication_material/reports/Econ2008

Bahr, P.R. (2008). Does mathematics remediation work? A comparative analysis of academic attainment among community college students. *Research in Higher Education, 49*, 420-450. doi:10.1007/s11162-008-9089-4

Boatman, A. & Long, B.T. (2011, August). *Does remediation work for all students? How the effects of postsecondary remedial and developmental courses vary by level of academic preparation (NCPR Brief).* New York, NY: National Center for Postsecondary Research.

Boatman, A. & Long, B.T. (2010). *Does remediation help all students? How the effects of postsecondary developmental courses vary by background and ability* [PowerPoint slides]. Retrieved from http://ies.ed.gov/director/conferences/10ies_conference/ppt/long.ppt

Boser, U. & Burd, S. (2009). *Bridging the gap: How to strengthen the Pk-16 pipeline to improve college readiness*. Retrieved from http://www.newamerica.net/files/NAF%20Bridging%20the%20Gap.pdf

Cleaver, V. E. (2010). *A SMART approach to THRIVE in mathematics: A study of the relationship of attitude and achievement* (Doctoral Dissertation). Available from ProQuest Dissertation and Theses Database. (UMI 3465683)

Cruickshank, D.R. (1990). *Research that informs teachers and teacher educators*. Bloomington, IN: Phi Delta Kappa Educational Foundation.

Cuddapah, J. L., Masci, F.J., Smallwood, J.E., & Holland,J. (2008). A professional development school-sponsored summer program for at-risk secondary students. *NASSP Bulletin*, *92*(4), 261-275. Retrieved from http://bul.sagepub.com/content/92/4/261.refs.html

Dave, V., Blasko, D., Holliday-Darr, K., Kremer, J., Edwards, R., Ford, M., & Hido, B. (2010). Re-enJEANeering STEM education: Math options summer camp. *Journal of Technology Studies*, *36*(1), 35-45.

Donnell, A. G. (2010). Report: States can improve college readiness. *Diverse Issues in Higher Education*. *27*(13), 10.

Dougherty, J.W. (1981). *Summer school: A new look*. Bloomington, IN: Phi Delta Kappa.

Edwards, T., Kahn S., & Brenton, L. (2001). Math corps summer camp: An inner city intervention program. *Journal of Education for Students Placed at Risk*, *6*(4), 411-426.

Entwisle, D.R. & Alexander, K.L. (1992). Summer setback: Race, poverty, school composition, and mathematics achievement in the first two years of school. *American Sociological Review, 57*(1), 72-84.

Flores, R. and Roberts, W. (2008). Productive strategies for raising student achievement in algebra: A personal view from two high school principals. *NASSP Bulletin. 92*(4), 305-315. doi: 10.1177/0192636508329853

Fulton, M. (2010). *State reports on the cost of remedial education.* Education Commission of the States.

Gold, K.M. (2002). *School's in: The history of summer education in American public schools*. New York: Peter Lang Publishing, Inc.

Greene, J.P. (2000). *The cost of remedial education: How much Michigan pays when students fail to learn basic skills*. Midland, MI: Mackinac Center for Public Policy.

Hallberg, K., Swanlund, A., & Hoogstra, L. (2011, March). Supports for high school success: An evaluation of the Texas ninth grade transition and intervention grant program. Paper presented at the Society for Research on Educational Effectiveness Conference, Washington, DC. Abstract retrieved from ERIC database. (ED519146)

Jacob, B.A. & Lefgren, L. (2004). Remedial education and student achievement: A regression-discontinuity analysis. *The Review of Economics and Statistics, 86*(1), 226-244.

Le, C. Rogers, K.R., & Santos, J. (2011, April). *Innovations in developmental math: Community colleges enhance support for nontraditional students*. Retrieved from Jobs for the Future website: http://www.jff.otg/sites/default/files/MetLife-DevMath-040711.pdf.

Levin, H.M. & Calcagno, J.C. (2008, January). Remediation in the community college: An evaluator's perspective. *Community College Review, 35*(3), 181-207.

National Center for Education Statistics (Apr.2012). The nation's report card: Mathematics 2011. Retrieved from http://nces.ed.gov/nationsreportcard/pdf/main2011/2012458.pdf

Portland Schools Foundation (2011, April). *Ninth grade counts: Student data report – outcomes and participation for summer 2010.* Portland, OR: Northwest Evaluation Association.

Russell, A. (2008). Enhancing college student success through developmental education. Retrieved from http://www.aascu.org/uploadedfiles/aascu/content/root/policyandadvocacy/policypublications/pmaug08.pdf

Southern Regional Education Board (2009). *The next generation of school accountability: A blueprint for raising high school achievement and graduation rates in SREB states.* Atlanta, GA: Southern Regional Education Board.

Strong American Schools (2008). Diploma to nowhere. Retrieved from http://www.deltacostproject.org/resources/pdf/DiplomaToNowhere.pdf

Tennessee Department of Education. *Assessment and evaluation: Secondary assessment.* Retrieved from: http://www.tn.gov/education/assessment/secondary.shtml

Terzian, M., Moore, K, Hamilton, K (2009). Effective and promising summer learning programs and approaches for economically disadvantaged children and youth: A White Paper for the Wallace Foundation. *Child Trends*, July 10, 2009. (revised 2010). Retrieved from http://www.childtrends.org/Files/Child_Trends2009_06_17_FR_SummerLearning.pdf

Wang, T. H. (2011). Implementation of web-based dynamic assessment in facilitating junior high school students to learn mathematics. *Computers & Education*, *56*(4), 1062–1071. doi:10.1016/j.compedu.2010.09.014

Zweiefelhofer, C. (2008). *An Analysis of the Effects of Summer School Programs.* Retrieved from http://www2.uwstout.edu/content/lib/thesis/2008/2008zwiefelhoferc.pdf

APPENDICES

APPENDIX A

LETTER REQUESTING PERMISSION TO CONDUCT REASEARCH IN THE DICKSON COUNTY SCHOOL SYSTEM

560 Grindstone Hollow Rd.
Dickson, TN 37055

March 28, 2012

Mr. Johnny Chandler, Director of Schools
Dickson County Board of Education
817 N. Charlotte Street
Dickson, TN 37055

Dear Mr. Chandler:

As a student at Austin Peay State University pursuing the degree of Education Specialist , I am requesting permission to collect , analyze, and report data pertinent to Dickson County Schools for the completion of my field study in Educational Leadership at Austin Peay state University.

The purpose of my study, pending Institutional Review Board approval, is to determine the effectiveness of mathematics remediation for entering freshmen high school students after participating in a remedial summer camp prior to the start of their freshman year. My study will involve analyzing data (End of Course tests and other pertinent data) from the graduating class of 2014, particularly the students who attended the summer remedial program in Dickson County as well as a random sample of county students of the same class who did not attend. As the principal investigator, I will have sole access to all data. Data will be numerically coded to ensure anonymity.

I respectfully request your approval in writing on official letterhead.

Thank you for your assistance.

Sincerely,

Glenda L. Sullivan
Graduate Student, Austin Peay State University

APPENDIX B

DICKSON COUNTY SCHOOL SYSTEM

DIRECTOR OF SCHOOLS APPROVAL

DICKSON COUNTY BOARD OF EDUCATION
Johnny Chandler
Director of Schools
817 North Charlotte Street
Dickson, TN 37055
Phone 615-446-7571 – Fax 615-441-1375

March 28, 2012

To Whom It May Concern:

As Director of the Dickson County School System, I grant permission for Glenda Sullivan to collect archival data on students in the class of 2014 in Dickson County for the purpose of her research.

I understand that the purpose of the study, pending Institutional Review Board approval, is to determine the effectiveness of mathematics remediation for entering freshman high school students after participating in a remedial summer camp prior to the start of their freshman year. The study will involve analyzing data (End of Course tests and other pertinent data) from the graduating class of 2014, particularly the students who attended the summer remedial program in Dickson County as well as a random sample of county students of the same class who did not attend.

I understand that the records of this study will be kept confidential. Any published report will present information in such a manner so as not to give the identities of any of the students.

If you have any questions concerning this letter, you may contact me at jchandler@dcbe.org.

Sincerely,

Johnny Chandler
Director of Schools

APPENDIX C

AUSTIN PEAY STATE UNIVERSITY

INSTITUTIONAL REVIEW BOARD APPROVAL

May 5, 2012

RE: Your application regarding study number 12-036: The Effects of Participation in a Remedial Mathematics Summer Camp on Entering High School Freshmen Mathematics Achievement.

Dear Ms. Sullivan

Thank you for your recent submission. We appreciate your cooperation with the human research review process. This type of study qualifies for expedited review under FDA and NIH (Office for Protection from Research Risks) regulations.

Congratulations! This is to confirm that your application has been approved through one calendar year. This approval is subject to APSU Policies and Procedures governing human subject research. The full IRB may still review this protocol and reserves the right to withdraw expedited approval if unresolved issues are raised during their review.

You are granted permission to conduct your study as described in your application effective immediately. The study is subject to continuing review on or before May 20, 2013, unless closed before that date. The forms to report when your study has been completed or the form to request an annual review of a continuing study are on the IRB website. Please submit the appropriate form prior to May 20, 2013.

Please not that any changes to the study must be promptly reported and approved. Some changes may be approved by expedited review; others require full board review. If you have any questions or require further information, you can contact me by phone (931-221-7467) or email (davenportd@apsu.edu).

Again, thank you for your cooperation with the APSU IRB and the human research review process. Best wishes for a successful study!

Sincerely,

Doris Davenport

Doris Davenport, Chair
Austin Peay Institutional Review Board

Cc: Dr. Tammy Shutt, Faculty Supervisor

TABLES

Table 4.1

Comparison of Pretest and Posttest Data for Student Participants in Remedial Mathematics Summer Camp

	Count	Sum	Arithmetic Mean	Variance	Standard Deviation	Low Test Score	High Test Score
Pretest	65	3324	51.14	224.371	14.979	10	82
Posttest	65	5386	82.86	128.246.	11.325	48	100

TABLE 4.2

Results of t-Test: Paired Two Sample for Means in Microsoft Excel

Count	*r*	*df*	*t*	*p*
65	.584	64	-20.582	≤.05 *

***Significance at p≤.05**

Table 4.3

Comparison of Algebra I EOC Scores for Camp Participants and Non-participants

	Count	Sum	Arithmetic Mean	Variance	Standard Deviation	Low EOC Score	High EOC Score
Control	30	2207	73.57	64.875	8.054	50	90
Treatment	57	4074	71.47	157.325	12.543	27	94

TABLE 4.4

Results of t-Test: Two Sample for Means Assuming Unequal Variances in Microsoft Excel

	df	*t*	*p*
	82	-0.943	>.05

TABLE 4.5

Comparison of Algebra I Pass/Fail Data for Camp Participants and Non-participants

	Count	Sum	Arithmetic Mean	Variance	Standard Deviation
Control	30	30	1	0	0
Treatment	57	54	0.93	0.066	0.258

TABLE 4.6

Results of Chi-square Test of Homogeneity to Test the Pass/Fail Rate for Campers and Non-campers

	df	***t***	***p***
	1	.943	0.13741

Table 4.7

Observed Distributions in Case Processing Summary in Testing the Set of Predictor Variables' Impact on EOC Outcomes

Variable	*N*	Marginal Percentage
EOC Not-Proficient	51	79.7
EOC Proficient	13	20.3
No Camp	6	9.4
Camp	58	90.6
Ethnicity – White	43	67.2
Ethnicity – Non White	21	32.6
Gender Male	38	59.4
Gender Female	26	40.6
Ineligible Free/Reduced Lunch	18	28.1
Eligible Free/Reduced Lunch	46	71.9
Valid	64	100.0%
Missing	0	
Total	64	

Table 4.8

Likelihood Ratio Test Table Indicating the Effect of Predictor Variables on EOC Outcomes

	Model Fitting Criteria			
Effect	-2 Log Likelihood of Reduced Model	*Chi* Square	*df*	*Sig*
Intercept	23.280[3]	.000	0	
Camp_A	23.970	.690	1	.406
Ethnicity	24.813	1.533	1	.216
Gender	23.327	.047	1	.829
Free/Reduced Lunch	23.385	.105	1	.746