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The Relationship Between Students' ACT Math Subscores and High School Math Course Completion in Tennessee

Jacob Carver
jacob.carver@lmunet.edu

LMU | Carter & Moyers School *of* Education
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Committee Member	Joshua Bond 10/29/19 Date
Committee Member	10/29/19 Date
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The Relationship between Students' ACT Math Subscores and High School Math Course Completion in Tennessee

Dissertation

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Dedication

First, I thank God for his many blessings in my life. I am forever grateful for His help and guidance.

I dedicate this study to my parents, Joe and Debbie Carver, and my grandparents, Boyce and Norma Jones. Thank you for always believing in me and pushing me to achieve my goals.

I also dedicate this study to my wife, Carissa. Thank you for your love and support throughout the dissertation process.

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Abstract

In 2009, President Barack Obama and legislators passed the American Recovery and Reinvestment Act (ARRA), which financed the Race to the Top Fund. To receive funding from the Race to the Top, Tennessee educators and legislators implemented the Tennessee Diploma Project in 2009. The Tennessee Diploma Project increased graduation requirements for students in terms of coursework and assessments. Tennessee educators and legislators anticipated the increased graduation requirements would increase students' achievement and ACT scores (college readiness skills). In mathematics, the graduation requirement increased from three high school math courses to four high school math courses: Algebra I, Geometry, Algebra II, and an upper-level math course. The purpose of this study was to investigate if a relationship existed between students' ACT math subscores and the fourth mathematics class they completed in high school in Tennessee. In a sample of 674 students who graduated from a rural high school in Tennessee, the researcher conducted a one-way analysis of variance (ANOVA) and a Welch-Test ANOVA to analyze data from students' transcripts. The researcher determined a statistically significant relationship existed between students' ACT math subscores and the fourth mathematics class they completed in high school. The researcher acknowledged some students could have higher ACT math subscores than other students due to completing a particular fourth mathematics course in Tennessee high schools. The researcher encouraged educators to adjust their mathematics curriculum to maximize students' performance and improve students' college and career readiness skills.

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Chapter I: Introduction

Statement of the Problem

President George W. Bush and administrators of the United States Department of Education (ED) signed the No Child Left Behind Act (NCLB) in 2001. NCLB increased accountability for school administrators and teachers based on student performance on state and national assessments. In the next administration, President Barack Obama signed the American Recovery and Reinvestment Act (ARRA) in 2009, which provided $4.35 billion for the Race to the Top fund (ED, 2009). The goal of this legislation was to increase student achievement and prepare students for college and future careers.

Tennessee Department of Education (TDOE) policymakers set a goal for Tennessee students to achieve an average ACT composite score of 21 by the year 2020 (TDOE, n.d. a). As of 2018, TDOE policymakers required all public school students to complete an ACT assessment (funded by TDOE) during their eleventh grade year to measure progress toward the composite score goal of 21 (TDOE, n.d. a). In an effort to improve student achievement and ACT scores (college readiness), state legislators enacted, and education leaders implemented the Tennessee Diploma Project in 2009, to increase graduation requirements for students in terms of coursework and assessments (TDOE, n.d. a). In another effort to improve ACT scores, TDOE policymakers implemented a senior retake opportunity (funded by TDOE) for all public school students in Tennessee to retake the ACT as a senior beginning in 2016 (TDOE, 2018b).

In October 2017, TDOE policymakers reported public school students achieved an average composite score of 20.1 on the ACT (TDOE, 2017). In the same report, TDOE policymakers noted public school students achieved an average mathematics

subscore of 19.4 (TDOE, 2017). ACT researchers (2013b) suggested students need a 22 on the mathematics section of the ACT to achieve success (75% chance to earn a C or better) in college mathematics courses. From the class of 2017, only 29% of graduates met this benchmark (ACT, 2017b). Therefore, many students from Tennessee graduated from high school not prepared for mathematics courses at the university level. As mentioned earlier, in an effort to improve student achievement, TDOE officials implemented the Tennessee Diploma Project and required students to complete additional coursework to graduate from high school. In mathematics, TDOE officials required students to complete at least four (instead of the previous three) high school mathematics courses (Algebra I, Geometry, Algebra II, and another course chosen by each student) (TDOE, n.d. b). Furthermore, TDOE officials required students to complete at least one mathematics course per academic year in high school. Thus, students could not enroll in multiple mathematics courses for an academic year in an attempt to become exempt from enrolling in a mathematics course during a future academic year. TDOE officials allowed students to choose from the following options for their fourth high school mathematics course: Bridge Math, Pre-Calculus, Statistics, Applied Mathematical Concepts, and Calculus (TDOE, 2018c). TDOE officials also provided students with the option to enroll in a dual credit course for their fourth high school mathematics class. The purpose of this study was to examine if a relationship existed between students' ACT math subscores and the fourth mathematics class they completed in high school.

Research Question

The researcher utilized the following research question to guide the study:

Research question 1. Does a relationship exist between students' ACT math subscores and the fourth high school mathematics course they completed?

Theoretical Framework

For this study, the researcher applied Bandura's (1986) Social Cognitive Theory as the theoretical framework. Bandura (1989) stated, "Social cognitive theory favors a model of causation involving triadic reciprocal determinism. In this model of reciprocal causation, behavior, cognition and other personal factors, and environmental influences all operate as interacting determinants that influence each other bidirectionally" (p. 2). Bandura (1989) argued beliefs, expectations, self-perceptions, goals, intentions, physical structure, sensory systems, neural systems, environmental influences, and social influences could affect the behavior of human beings. According to Social Cognitive Theory, people "affect the nature of their experienced environment through selection and creation of situations" based on their acquired preferences and competencies (Bandura, 1989, p. 4). For this study, the researcher utilized an analysis of variance (ANOVA) within the framework of the Social Cognitive Theory to determine if a relationship existed between students' selection of their fourth mathematics course in high school and the students' ACT mathematics subscores.

Significance of the Study

By analyzing ACT math subscores and students' fourth high school mathematics courses, the researcher attempted to discover what relationship, if any, existed between Tennessee mathematics curriculum and student performance. Determining a relationship, or lack thereof, between ACT math subscores (student performance) and students' fourth high school mathematics courses in Tennessee (Tennessee mathematics curriculum)

could help ensure that all students in Tennessee had the opportunity to maximize their performance in mathematics and improve their college and career readiness skills.

Description of the Terms

ACT. The ACT referred to a national college admissions standardized examination accepted by all four-year universities and colleges in the United States (ACT, 2019b). The ACT measured students' high school competencies in four subject area tests to determine students' academic readiness for college (ACT, 2019c). ACT scores ranged from 1 to 36. The ACT consisted of the following four subject area tests: English, mathematics, reading, and science. A student's ACT composite score represented the student's average of the four subject area tests.

ACT College Readiness Benchmark. The ACT College Readiness Benchmark referred to the minimum subtest score students should achieve to have a 50% chance to earn a B or higher and a 75% change to earn a C or higher in each content area's entry-level college course (ACT, 2013b). The ACT College Readiness Benchmarks for the English, mathematics, reading, and science subtests were 18, 22, 22, and 23, respectively (ACT, 2013b).

ACT math subscore. The ACT math subscore represented a student's score, ranging from 1 to 36, on the ACT mathematics subject area test.

American Recovery and Reinvestment ACT (ARRA). President Obama signed ARRA into law on February 17, 2009 (ED, 2009). ARRA focused on stimulating the economy, supporting job creation, and investing in critical sectors such as education (ED, 2009). ARRA provided $4.35 billion to the Race to the Top Fund to support "investments in innovative strategies that are most likely to lead to improved results for

students, long-term gains in school and school system capacity, and increased productivity and effectiveness" (ED, 2009, p. 2).

Applied Mathematical Concepts. As of 2019, Applied Mathematical Concepts was an upper-level high school mathematics course in Tennessee. In this course, students focused on the following concepts: financial mathematics, linear programming, logic and Boolean algebra, problem solving, investigative logic, organizing and interpreting data, counting and combinatorial reasoning, normal probability distribution, and confidence intervals (TDOE, 2018c).

Bridge Math. As of 2019, Bridge Math was one of the courses students had the option to take as their fourth mathematics course. TDOE (2018) officials intended students to build upon concepts they learned in their previous mathematics courses. In Bridge Math, students focused on the following concepts: the real number system, quantities, the complex number system, seeing structure in expressions, arithmetic with polynomials and rational expressions, creating equations, reasoning with equations and inequalities, interpreting functions, similarity, right triangles, trigonometry, circles, geometric measurement and dimension, modeling with geometry, interpreting categorical and quantitative data, and probability (TDOE, 2018c).

Calculus. At the time of this study, Calculus was an upper-level mathematics course in Tennessee. TDOE (2018) officials claimed students interested in STEM careers could benefit from enrolling in Calculus. In Calculus, students focused on the following concepts: limits of functions, behavior of functions, continuity, derivatives, and integrals (TDOE, 2018c).

Credit. For this study, a credit was a passing score in a high score course.

Fourth mathematics class. For this study, the fourth mathematics class referred to the mathematics class students completed after Algebra I, Geometry, and Algebra II. Tennessee Department of Education officials allowed students to choose from the following options for their fourth high school mathematics course: Bridge Math, Pre-Calculus, Statistics, Applied Mathematical Concepts, and Calculus (TDOE, 2018c).

No Child Left Behind Act (NCLB). NCLB was legislation passed in 2001 as "a landmark in education reform designed to improve student achievement and change the culture of America's schools" (ED, 2002, p. 9). NCLB focused on increasing accountability of school administrators and teachers based on student results on state and national assessments. NCLB also emphasized flexibility for educators to utilize federal funds, higher-quality teachers, and researched-based teaching strategies.

PLAN. The ACT PLAN test referred to a college and career readiness assessment. Educators and students utilized this assessment to help students plan for their future educational and career goals (ACT, 2013a). Students completed the PLAN test during their sophomore year in high school to determine their readiness for the ACT test. The PLAN test was similar to the ACT assessment; however, the maximum score on the PLAN test was 32 instead of 36. Like the ACT assessment, the PLAN test included four multiple-choice tests in the following areas: English, mathematics, reading, and science.

Pre-Calculus. At the time of this study, Pre-Calculus was an upper-level mathematics course in Tennessee. Students who desired to pursue STEM careers enrolled in Pre-Calculus (TDOE, 2018c). In Pre-Calculus, students focused on the following concepts: number expressions, the complex number system, vectors and

matrix quantities, sequences and series, reasoning with equations and inequalities, parametric equations, conic sections, building functions, interpreting functions, trigonometric functions, graphing trigonometric functions, applied trigonometry, trigonometric identities, polar coordinates, and modeling with data (TDOE, 2018c). Educators in Tennessee would commonly refer to this course as Trigonometry because of the emphasis on trigonometric concepts.

Statistics. At the time of this study, Statistics was an upper-level mathematics course in Tennessee. TDOE (2018) officials explained students should learn how to collect, analyze, and draw conclusions from data. In Statistics, students focused on the following concepts: interpreting categorical and quantitative data, conditional probability and the rules of probability, using probability to make decisions, making inferences, and justifying conclusions (TDOE, 2018c).

Tennessee Diploma Project. The Tennessee Diploma Project was a state initiative to increase high school graduation requirements (TDOE, n.d. b). Tennessee state legislators authorized this initiative in 2009. Following the initiative, Tennessee high school students had to earn 22 credits, including four math credits, to graduate beginning with the graduating class of 2013 (TDOE, n.d. b).

Chapter II: Review of the Literature

The researcher organized the review of the literature into the following themes: ACT, ACT and high school courses, and high school mathematics courses in Tennessee.

Background

President Bush and President Obama influenced education in the United States by advocating for NCLB and American Recovery and Reinvestment ACT (ARRA), respectively. NCLB focused on the following key principles: "stronger accountability for results; greater flexibility for states, school districts, and schools in the use of federal funds; more choices for parents of children from disadvantaged backgrounds; and an emphasis on teaching methods that have been demonstrated to work" (ED, 2002, p. 9). In the next presidential administration, President Obama signed ARRA to provide $4.35 billion to the Race to the Top Fund (ED, 2009). ARRA focused on "innovative strategies" to improve student achievement, prepare students for college and future careers, improve graduation rates, and close achievement gaps throughout the United States (ED, 2009, p. 2). In order to obtain funds from Race to the Top, state policymakers submitted applications to the United States Department of Education. In these applications, state policymakers demonstrated a commitment to the following: developing and adopting common standards, raising student achievement, closing achievement gaps, improving teacher and principal effectiveness using a comprehensive evaluation framework (with quantitative and qualitative data), rewarding effective teachers and principals through differentiated compensation, developing and implementing common assessments, and implementing a statewide longitudinal data system to track the growth of students and educators (ED, 2009, pp. 2-3). In 2010,

TDOE received $500 million to implement the school reform plan described in the TDOE application (ED, 2010).

In the application, TDOE policymakers desired to improve student achievement by preparing students for success in college and future careers; therefore, they set a goal for students in Tennessee to achieve an average ACT composite score of 21 by 2020 to ensure Tennessee high school graduates were prepared for postsecondary coursework (TDOE, n.d. a; TDOE, 2015b). TDOE policymakers required all public school students in Tennessee to complete the ACT assessment (funded by TDOE) during their eleventh grade year (TDOE, n.d. a). Furthermore, TDOE provided funds for all public school students in Tennessee to retake the ACT assessment during their twelfth grade year (ACT, 2018). TDOE policymakers believed the ACT Senior Retake Day would provide students with an opportunity to raise their ACT scores. From the Tennessee graduating class of 2017, students who took the ACT only once had an average composite score of 17.4 (ACT, 2018). In contrast, students who took the ACT two or more times had an average composite score of 21.5 (ACT, 2018).

ACT

About the ACT

According to ACT, Inc. (2019a), University of Iowa Professor E.F. Lindquist and Registrar Ted McCarrel developed the ACT test in 1959. The purpose of the ACT test was to measure students' college and career readiness in four academic content areas (ACT, 2017). At the time of this study, the ACT test contained four subtests: English, mathematics, reading, and science (ACT, 2019c). On the English subtest, test-takers had 45 minutes to answer 75 multiple-choice questions. Similarly, test-takers had 35 minutes to answer 40 multiple-choice questions for both the reading and the science subtests. On

the mathematics subtest, test-takers had 60 minutes to answer 60 multiple-choice questions. ACT test-takers had the option to complete the ACT writing subtest; however, this subtest did not influence the test-takers' ACT composite score. To calculate students' ACT composite scores, individuals employed by ACT counted the total number of correct responses for each of the four subtests (ACT, 2019d). Next, those individuals converted students' raw scales into ACT scale scores ranging from 1 to 36 for the four subtests respectively. Finally, those individuals calculated the averages of students' subtest scores (rounded to the nearest whole number) to determine students' composite scores.

ACT Mathematics Subtest

For this study, the researcher focused on the ACT mathematics subtest. At the time of this study, the mathematics subtest contained questions over content students should have learned by the end of their 11th grade year (McNeish, Radunzel, & Sanchez, 2015). The mathematics subtest contained questions related to the following content areas: pre-algebra, elementary algebra, intermediate algebra, coordinate geometry, plane geometry, and trigonometry. ACT (2017a) researchers noted students received score reports for the following mathematical categories along with their respective ACT mathematics subscores: Number & Quantity, Algebra, Functions, Geometry, and Statistics & Probability.

ACT researchers (2017a) admitted the mathematics subtest emphasized mathematical reasoning and application over memorization and computation. ACT researchers encouraged students to utilize calculators for the mathematics subtest; however, students could complete the subtest without one. To answer all questions on the mathematics subtest, students had to perform the following: make sense of problems

and context, represent relationships mathematically, access appropriate mathematical knowledge from memory, incorporate given information, model, mathematical computations and manipulations, interpret, apply reasoning skills, justify, make decisions based on mathematics, and appropriately manage the solution process (ACT, 2017a).

ACT (2013b) researchers suggested students should achieve a score of 22 on the mathematics subtest to meet the college readiness benchmark. If students meet this benchmark, ACT researchers claimed those students have a 50% chance to earn a B or better in college algebra and a 75% chance to earn a C or better in college algebra. TDOE (2018a) researchers stated, "Many of the skills a student needs to master this benchmark is embedded in the Tennessee math standards in grades 6-8" (p. 44). TDOE researchers clarified Tennessee middle school students should learn how to understand quantities, perform operations with rational numbers, and utilize basic algebraic thinking. If students were proficient in the aforementioned mathematical skills, TDOE researchers suggested those students should possess the foundational skills needed to meet the ACT College Readiness Benchmark.

ACT as a Measure of College Readiness

Previous researchers acknowledged students' ACT scores have been an accurate predictor of collegiate success (ACT, 2013b; ACT, 2009; Brown, Halpin, & Halpin, 2015; Clough & Montgomery, 2015; Harwell, Moreno, & Post, 2016). ACT employees Clough and Montgomery (2015) explained how the designers of the ACT assessment utilized empirical research to ensure the ACT would be an appropriate tool to measure college readiness. Clough and Montgomery noted ACT researchers conducted the ACT National Curriculum Survey every three to four years since 1976. In this survey, ACT researchers identified what skills postsecondary faculty members expected their students

to acquire before entering college. Next, ACT researchers utilized this information to determine which skills the ACT should assess. Clough and Montgomery also provided information regarding the ACT College and Career Readiness Standards.

ACT (2013b) researchers set ACT College Readiness Benchmarks based on an empirical study. ACT researchers gathered students' test score data and students' first-year college grades from 214 postsecondary institutions. The data consisted of over 230,000 students' test scores and first-year college grades. ACT researchers calculated descriptive statistics to determine the subtest scores students achieved to have a 50% chance to earn a B or higher and a 75% chance to earn a C or higher in each content area's first-year college course. As mentioned earlier, if students achieve a score of 22 on the ACT mathematics subtest, ACT researchers claim those students have a 50% chance to earn a B or better in college algebra and a 75% chance to earn a C or better in college algebra. The ACT College Readiness Benchmarks for English, Reading, and Science were 18, 22, and 23, respectively.

Harwell et al. (2016) examined the relationship between students' college mathematics achievement and the ACT mathematics College Readiness Benchmark. Harwell et al. utilized a sample of 11,324 students who attended four-year postsecondary institutions after graduating from a high school in Minnesota. After gathering students' ACT mathematics scores and grades from their college mathematics courses, the researchers utilized logistic regression models to examine the relationship between students who met the college mathematics standard and students' college mathematics achievement. Harwell et al. determined students who met the ACT College Readiness Benchmark were 2.83 times as likely to make a B or higher in their first collegiate mathematics course compared to students who did not meet the benchmark.

In a study that included a sample of 2,328 students, Brown et al. (2015) investigated the relationship between high school mathematics preparation and "success in the pre-engineering curriculum at the post-secondary level" (p. 2). The authors reported the number of STEM jobs in the United States tripled during the decade of 2010, and the researchers suggested students needed to do well in mathematics while in high school to obtain a STEM job in the future. The participants of this study enrolled in a university in the southeastern United States between the fall 2000 semester and the fall 2004 semester. Brown et al. utilized these participants because they intended to major in engineering and their College Freshman Survey responses matched their grades and standardized tests scores according to the University Planning and Analysis Office. After conducting multiple regression analysis on students' demographic data, standardized test score data, and students' high school grades, Brown et al. (2015) determined that the most significant predictor of a student's GPA in a college's pre-engineering curriculum was students' adjusted ACT score in math (p. 4).

ACT (2009) researchers conducted a case study to observe how statewide administration of the ACT influenced students in Colorado and Illinois. The researchers noted education policymakers in both states mandated statewide administration of the ACT in 2001. Because of statewide administration of the ACT, the researchers reported the following improvements in either one or both states: student readiness for college, the number of students considering college, college enrollment and retention, student academic achievement, improved workforce planning, and economic benefits. The researchers also noted these improvements were similar to the nationwide improvements experienced by college bound students.

ACT and High School Courses

Laing, Engen, and Maxey (1987) stated, "Intuitively, one would expect that increased academic coursework in an area would result in increased achievement in that area" (p. 4). Several previous researchers reported students' ACT subscores increased when students enrolled in additional academic coursework related to the specific subscores (Buddin & Croft, 2014; Chenoweth, 1996; Jones, 2008; Laing et al., 1987; McLure, Sun, & Valiga, 1997; McNeish et al., 2015; Noble & Schnelker, 2007). Buddin and Croft (2014) examined the relationship between increasing high school graduation requirements in Illinois and student outcomes. In this study, student outcomes referred to additional mathematics and science course taking, student achievement, and college enrollment. In 2005, state policymakers in Illinois enacted Public Act 94-0676. Prior to this act, many school districts' graduation requirements were two mathematics courses and one science course. This legislation increased the graduation requirement to three mathematics courses and two science courses. After the researchers gathered student data from nine Illinois high school graduating classes in 2013, the researchers conducted a comparative analysis to compare the data of students enrolled in districts that increased graduation requirements because of the legislation (treated districts) to students enrolled in districts that already required students to take the additional math and science courses (untreated districts). The researchers reported students' ACT math and science subscores increased slightly for both types of school districts; however, there was not a statistically significant difference between the ACT subscores and the type of school district.

Chenoweth (1996) organized a literature review on the relationship between increasing high school coursework and ACT scores. Chenoweth claimed there was a significant positive correlation between students' SAT, ACT, and Advanced Placement

(AP) test scores and the number of academic courses students complete in high school. The author noted this is true for all students regardless of ethnicity or race. In 1992, the ACT national composite score was 20.6. In 1996, the ACT national composite score was 20.9. Chenoweth acknowledged ACT researchers attributed the improved national composite scores to students' taking an increased number of English, math, science, and social studies courses.

Laing et al. (1987) conducted an empirical study to determine if a relationship existed between the number of courses students completed in a subject and the corresponding ACT subscore for the subject. Using a sample of 31,419 students who completed the ACT assessment in October 1985, researchers utilized descriptive statistics and linear regression analyses to evaluate the data obtained from students' ACT score reports. The researchers noticed a positive correlation between the number of courses students completed in all subjects and the corresponding ACT subscores for the particular subjects. Additionally, Laing et al. reported this positive correlation was true regardless of students' racial/ethnic background, sex, class rank, or high school grade point average.

In a similar study, Noble and Schnelker (2007) investigated the relationship between students completing specific high school courses and meeting the ACT College Readiness Benchmarks. The researchers gathered PLAN (to statistically control prior achievement) and ACT test scores of 403,381 students in the 2003 graduating class from 10,792 high schools. All participants in this study completed the PLAN assessment during their sophomore year in high school to determine their readiness for the ACT. After Noble and Schnelker gathered the data, the researchers utilized hierarchical linear regression to analyze students' ACT English, mathematics, and science subscores. The researchers also utilized hierarchical logistic regression to determine the probability of

students' meeting or exceeding the ACT College Readiness Benchmarks. The researchers noted students who completed Algebra I, Algebra II, and Geometry scored 1.1 points higher (on average) on the ACT mathematics subtest than students who took less than these courses (p. 16). The researchers commented students who completed additional higher-level mathematics courses scored higher (on average) on the ACT mathematics subtest than students who did not complete these higher-level mathematics courses. Noble and Schnelker reported students who completed Algebra I, Algebra II, Geometry, Other Advanced Mathematics, Trigonometry, and Calculus scored 3.16 points higher (on average) than students who did not complete the specific sequence of courses (p. 16). After completing the hierarchical logistic regression models, the researchers noticed students who completed upper-level mathematics courses beyond Algebra I, Geometry, and Algebra II experienced "substantial increases in the odds of students meeting or exceeding the ACT Mathematics Benchmark (by 88% to 481%)" (p. 20).

McLure et al. (1997) investigated trends in students' ACT scores and the number of high school mathematics and science courses students completed from 1987 to 1996. The researchers focused on the following advanced high school math and science courses: Algebra II, Geometry, Trigonometry, Calculus, Other Advanced Mathematics, Chemistry, and Physics. After gathering students' data from the ACT Assessment Program history files, researchers utilized systematic sampling to select "10% of the ACT-tested, high school graduating class from each year, 1987 through 1996" (p. 7). The ACT-tested population ranged from 777,444 in 1987 to 945,369 in 1995. To analyze the data, researchers calculated descriptive statistics on the course-taking information and ACT score data for each graduating class of students. The researchers did not conduct any causal analyses. The number of students who took the ACT increased by 18.9%

from 1987 to 1996. The researchers stated, "The ACT Composite score increased from 20.7 in 1987 to 20.9 in 1996, and the ACT Mathematics score increased from 20.0 in 1987 to 20.3 in 1996" (p. 12). The researchers noted students with the largest increase in mathematics and science course taking also had the largest increase in ACT Mathematics subscores. The researchers posited this observation was true regardless of student demographic information (race, ethnicity, sex, etc.).

McNeish et al. (2015) analyzed the contributions of noncognitive factors on students' ACT scores. McNeish et al. utilized an online questionnaire to gather student demographic data on 6,440 college-bound students from the class of 2013. Additionally, all 6,440 participants completed the ACT assessment in either October or December 2012. McNeish et al. executed regression analyses to analyze how noncognitive factors influenced students' ACT scores. The researchers reported students who completed higher-level mathematics courses experienced an increase in both their ACT mathematics subscores and their ACT composite scores. McNeish et al. claimed students who completed mathematics courses above Algebra II scored, on average, 0.7 to 3.0 points higher on the ACT mathematics subtest.

Similarly, Jones (2008) performed a correlational study to determine if a relationship existed between students' coursework and students' ACT scores. After gathering data from 235 students' high school records, the researcher utilized multiple linear regression analysis to analyze the data. Jones reported there was a positive correlation between students' number of completed courses in a certain subject and students' ACT subscores for the same subject. For example, Jones noted there was a positive correlation of 0.172 between students' number of completed mathematics courses and students' ACT mathematics subscores. Furthermore, Jones also utilized

multiple linear regression analysis to examine the relationship between students' grades in high school courses and students' ACT subscores. Jones discovered a positive correlation between students' grades in the following mathematics courses and students' ACT mathematics subscores: Integrated Geometry (0.596), Algebra II-Trig (0.564), Pre-Calculus (0.5), and AP-Honors Calculus (0.080) (p. 70).

In similar studies, other researchers studied the relationship between high school mathematics courses and the ACT mathematics subtest (Dial, 2016; Grinstead, 2013; Phipps, 2018; Pierson, 2015). Dial (2016) investigated the relationship between students' upper-level math course completion and students' final ACT math subscores in Missouri. Dial also utilized this study to determine if an upper-level math course could help students increase their ACT mathematics subscores. Specifically, Dial examined if enrolling in a certain mathematics course would help students who had an ACT mathematics subscore below the ACT College Readiness Benchmark increase their scores. After gathering data from students' high school transcripts, Dial conducted a one-way ANCOVA to examine the relationship between upper-level math course completions and ACT math scores. Next, the researcher conducted another one-way ANCOVA to analyze if the completion of a certain upper-level math course helped students (below the ACT College Readiness Benchmark during their junior year) raise ACT math scores during their senior year. Utilizing the results of the ANCOVA, the researcher determined there was a significant relationship ($p = .011$) between students' ACT mathematics subscores and the specific upper-class mathematics courses students completed after Algebra II (p. 61). Dial reported students averaged the following ACT mathematics subscores in their upper-class mathematics courses: 18.31 in Statistics, 21.21 in College Algebra, 25 in College Calculus I, 30 in College Calculus II, and 23.17 in Honors Pre-

Calculus (p. 60). In contrast, the researcher reported students who scored below the ACT College Readiness Benchmark did not complete an upper-level mathematics course that significantly helped them raise their ACT math subscores during their senior year.

Grinstead (2013) performed a similar study in Iowa. Grinstead explored the relationship between students' enrollment in upper-level mathematics courses and students' ACT mathematics subscores. After gathering data from 15,661 students' transcripts, Grinstead utilized a general linear model to analyze students' ACT mathematics scores and students' advanced mathematics courses. Grinstead claimed there was a statistically significant relationship between all upper-level mathematics courses and ACT mathematics subscores with $p<.0001$ (p. 49). Furthermore, the researcher reported students' experienced an increase in their ACT mathematics subscores after they enrolled in the following classes: Trigonometry (by 0.6754 points), Pre-Calculus (by 0.7929 points), Calculus (by 0.5917 points), AP Statistics (0.6836 points), and AP Calculus (by 1.6568 points) (p. 48).

Pierson (2015) implemented a study in Illinois to examine the relationship between the rigor of students' mathematics courses and students' ACT mathematics subscores. Pierson listed the following mathematics courses in order of least rigorous to most rigorous: Algebra II, Advanced Algebra and Trigonometry, Honors Advanced Algebra and Trigonometry, Pre-Calculus and Trigonometry, and Honors Pre-Calculus and Trigonometry. Using a sample of 1,777 students, Pierson utilized the Spearman rank-order correlation to determine if a relationship existed between students' ACT math subscores and the rigor of students' mathematics courses. The researcher determined there was a strong positive correlation between the rigor of students' 11^{th} grade math course and students' ACT math subscore ($r=.773$) (p. 73). Pierson reported students who

took the course sequence of Honors Geometry, Honors Advanced Algebra & Trigonometry, and Honors Pre-Calculus & Trigonometry had the highest mean ACT math subscore (31.46) of students in this study (p. 93).

High School Mathematics Courses in Tennessee

Prior to 2009, students in Tennessee high schools had to complete three mathematics courses to graduate (TDOE, n.d. b). In 2009, TDOE officials implemented the Tennessee Diploma Project. The Tennessee Diploma Project increased students' mathematics requirement to four classes. TDOE officials required students to complete Algebra I, Geometry, Algebra II, and one mathematics course above Algebra II. In some instances, the Tennessee State Board of Education (TBOE) (2018) allowed students with qualifying disabilities to substitute Integrated Math I, Integrated Math II, and Integrated Math III for Algebra I, Geometry, and Algebra II, respectively. Students had the option to choose from the following courses for their fourth mathematics course: Bridge Math, Pre-Calculus, Statistics, Applied Mathematical Concepts, and Calculus (TDOE, 2018c). TBOE (2018) board members recommended students who did not score 19 or higher on the ACT mathematics subtest enroll in Bridge Math for their fourth mathematics course. TBOE suggested students who did score 19 or higher on their ACT mathematics subtest should utilize career interests or study habits to help them choose which fourth mathematics class to complete.

In 2015, TDOE officials reported the most common mathematics course sequence for students was Algebra I, Geometry, Algebra II, and Bridge Math (TDOE, 2015a). Previous researchers suggested if students completed any upper-level mathematics course, their mathematics performance should increase (Buddin & Croft, 2014; Chenoweth, 1996; Dial, 2016; Grinstead, 2013; Jones, 2008; Laing et al., 1987; McLure

et al., 1997; McNeish et al., 2015; Phipps, 2018; Pierson, 2015). Phipps (2018) conducted a quantitative study to investigate if students' ACT composite scores and mathematics subscores increased after students completed a specific upper-level mathematics course, Pre-Calculus. For this study, the participants included 208 students from five high schools in Tennessee. After gathering students' ACT scores and demographics from their permanent records, Phipps conducted a paired samples *t*-test to analyze students' ACT composite scores and mathematics subscores before and after they completed a Pre-Calculus course. Phipps reported there was a statistically significant difference in students' ACT composite scores ($t = -7.426$, $p = .001$) and students' ACT mathematics subscores ($t = -5.344$, $p = .001$) after they completed a Pre-Calculus course (pp. 59-60). Phipps acknowledged the differences in scores were statistically significant regardless of sex or socioeconomic status.

Chapter III: Methodology

For this study, the purpose was to examine a potential relationship between students' ACT mathematics subscores and the fourth mathematics course they completed in high school. The independent variable for this study was the fourth mathematics course students completed in high school. The dependent variable was students' ACT mathematics subscores.

Research Design

The researcher utilized a non-experimental quantitative research design to determine if a relationship existed between students' ACT mathematics subscores and the fourth mathematics course students completed in high school. Creswell (2014) contended a quantitative research approach was appropriate to examine the relationship among variables using numerical data and statistical procedures (p. 4). To determine if a relationship existed between the independent and dependent variables, the researcher utilized a one-way analysis of variance (ANOVA).

Sample of the Study

According to the Tennessee Diploma Project, administrators of the Tennessee Department of Education (TDOE) required graduating seniors in the class of 2013 and beyond to complete at least four mathematics courses during their high school careers (TDOE, n.d. a). The population of this study included high school graduates from the following graduating classes in a rural school district in East Tennessee: 2013, 2014, 2015, 2016, 2017, and 2018. (At the time of this study, the researcher chose not to include student data from the class of 2019 because some students from this graduating class intended to take the ACT one more time according to their school counselors.) This population included 861 students from the graduating classes of 2013 through 2018. The

researcher excluded students who did not complete at least one ACT assessment while in high school and students who did not complete Algebra I, Geometry, and Algebra II for their first three high school mathematics courses. If students did not complete the previously mentioned classes, those students did not meet the TDOE graduation requirements, and their ACT scores would negatively skew the data. Similarly, the researcher excluded data from students who completed more than four mathematics courses in high school. Previous researchers suggested if students completed any upper-level mathematics course, their mathematics performance should increase (Buddin & Croft, 2014; Chenoweth, 1996; Dial, 2016; Grinstead, 2013; Jones, 2008; Laing et al., 1987; McLure et al., 1997; McNeish et al., 2015; Phipps, 2018; Pierson, 2015). Therefore, students who completed more than four high school mathematics courses would positively skew the data in this study. After the exclusions, the participants of the study consisted of 674 students. The participants completed Bridge Math (511), Applied Mathematical Concepts (68), Pre-Calculus/Trigonometry (71), Calculus (8), College Algebra (10), or Statistics (6). The researcher only gathered data from this school district because all high school mathematics teachers in this district utilized similar teaching strategies, identical pacing guides, and identical curriculum maps.

Data Collection

After the researcher obtained approval from the director of schools at the school district and the Institutional Review Board at Lincoln Memorial University (LMU), school counselors gathered student data from students' transcripts. School counselors at the high school within the school district gathered data consisting of students' highest ACT mathematics subscores and all the mathematics courses students completed in high school for the graduating classes of 2013-2018. The school counselors gave each student

a unique identification number and entered students' data into a Microsoft Excel spreadsheet.

The researcher received the data in a Microsoft Excel file via email from the school counselors. After obtaining the data, the researcher stored the data on a password protected laptop computer. The researcher organized the data in Microsoft Excel by removing students' data if the students (a) did not complete an ACT assessment in high school, (b) did not complete Algebra I, Geometry, and Algebra II, or (c) completed more than four high school mathematics courses. Next, the researcher prepared the data for analysis by removing all data except for students' ACT mathematics subscores and the fourth mathematics course students completed in high school.

Methods of Analysis

Tanner (2012) argued it was appropriate to conduct a one-way ANOVA to analyze "the impact of multiple levels or manifestations of *one* independent variable on a dependent variable" (p. 177). For this study, there were multiple manifestations of the independent variable (students' fourth mathematics courses) and one dependent variable (students' ACT mathematics subscores). Tanner (2012) contended researchers should utilize data consisting of homogeneity of variance and normally distributed data to conduct an ANOVA. Norušis (2008) claimed the Levene test for equality of variances and the Shapiro-Wilk's test for normality were appropriate tests to determine the homogeneity of variance and the normality of data distribution, respectively.

To analyze the data, the researcher transferred the data into IBM SPSS Statistics Version 26. Using SPSS, the researcher conducted descriptive statistics, the Levene test, and the Shapiro-Wilk's test. Next, the researcher conducted a one-way ANOVA in SPSS to determine if a relationship existed between the fourth mathematics course students

completed in high school (independent variable) and students' ACT mathematics subscore (dependent variable).

To conduct the one-way ANOVA, the researcher utilized the following model:

$F = MS_{bet} \div MS_{with}$.

In this model, F represented the value of the one-way ANOVA. MS_{bet} (mean square between groups) referred to the variability between students' ACT mathematics subscores for students who completed different mathematics courses as their fourth mathematics course in high school. MS_{with} (mean square within groups) referred to the variability between students' ACT mathematics subscores for students who completed the same fourth high school mathematics course. The researcher analyzed the F-value to determine the probability of a relationship existing by chance. For this study, the researcher utilized a p-value of 0.05 as the alpha level to determine statistical significance.

Finally, the researcher conducted a Welch-Test ANOVA in SPSS. The researcher realized the data had the potential to not exhibit homogeneity of variance due to unequal sample sizes of students in each of the higher-level mathematics courses. Moder (2010) argued the Welch-Test ANOVA was an appropriate test to conduct if the data were not homogeneous. Moder (2010) claimed the Welch-Test ANOVA was a robust method of analysis "which keeps type I error rate despite heteroscedastic variances" (p. 344). Thus, the researcher analyzed the Welch statistic to determine the probability of a relationship existing by chance with a p-value of 0.05.

Reliability and Validity

The researcher utilized the ACT as an instrument for the data collection process. At the time of this study, the ACT assessment measured high school students' college

and career readiness skills (ACT, 2017a). The ACT assessment determined "how skillfully students solve problems, grasp implied meanings, draw inferences, evaluate ideas, and make judgments in subject-matter areas important to success in college" (ACT, 2017a, p. 1.1).

To ensure reliability, the ACT organization required uniform administration of the ACT "to ensure a fair and equitable testing environment for all examinees" (ACT, 2017a, p. 5.1). In an effort to determine the reliability of the ACT assessment, researchers at ACT, Inc. (2017a) conducted a study using data from five of the ACT test forms administered in the 2015-2016 academic year. In the study, the researchers calculated the scale score reliability coefficients and the standard error of measurement (SEM) for the ACT test scores to determine consistency. ACT researchers (2017a) reported the median scale score reliability coefficient for the ACT composite score was 0.97 (p. 10.2, Table 10.1). The minimum and maximum scale score reliability coefficients for the ACT composite score were 0.96 and 0.97, respectively (ACT, 2017a, p. 10.2, Table 10.1). Similarly, the median, minimum and maximum SEM for the ACT composite score were 0.93, 0.93, and 0.96, respectively (ACT, 2017a, p. 10.2, Table 10.1). The median scale score reliability coefficients for each subsection of the ACT test were as follows: English (0.92), mathematics (0.91), reading (0.87), and science (0.85) (ACT, 2017a, p. 10.2, Table 10.1). The median SEM for each subsection of the ACT test were as follows: English (1.71), mathematics (1.55), reading (2.16), and science (1.90) (ACT, 2017a, p. 10.2, Table 10.1).

Previous researchers contended students' ACT scores have been an accurate predictor of collegiate success (ACT, 2013b; ACT, 2009; Brown et al., 2015; Clough & Montgomery, 2015; Harwell et al., 2016). Therefore, at the time of this study, the ACT

was a valid assessment because the designers of the ACT assessment intended for the test to measure college readiness (ACT, 2017a). Additionally, to ensure content validity, ACT researchers conducted surveys of thousands of teachers and college instructors every few years "for the purpose of determining which skills and knowledge are currently considered essential for college and career readiness" (ACT, 2017a, p. 2.2). In another attempt to ensure content validity, ACT employees and reviewers performed at least sixteen reviews of each test item before the test items appeared on an ACT assessment (ACT, 2017a).

Limitations and Delimitations

One limitation of this study was the researcher could not obtain specific demographic information for the participants. Because of this, the researcher could not analyze the data further based on participants' demographics. Other limitations included factors other than mathematics course completion that could have influenced student performance in mathematics. For example, students could have obtained mathematics tutors, participated in ACT preparation courses, learned certain mathematics skills in science courses, or individually studied mathematical topics. In addition, not all participants in the study had the same mathematics instructors. This may have influenced students' performance in mathematics due to differing teaching strategies. Another limitation of this study was an unequal number of participants in each of the fourth mathematics courses completed by the students. For example, only a small number of students completed either College Algebra, Statistics, or Calculus as their fourth high school mathematics course. This could have impacted the results of this study.

The researcher delimited the study to include data from one rural school district because all high school mathematics teachers in this district utilized similar teaching

strategies, identical pacing guides, and identical curriculum maps. This delimitation prevented the generalizability of this study to include all school districts in Tennessee. Another delimitation was the researcher chose to gather student data from the graduating classes of 2013 through 2018. The researcher utilized this delimitation because of the passage of the Tennessee Diploma Project, which increased the graduation requirements to include completion of four mathematics courses.

Assumptions of the Study

The researcher assumed students attempted to complete the ACT assessment with their best efforts. The researcher also assumed all teachers at the high school in the selected school district taught the appropriate mathematical standards in each of their classes. Finally, the researcher assumed the data provided by the school counselors at the high school in the selected school district were accurate.

Chapter IV: Analyses and Results

Data Analysis

In 2009, President Barack Obama signed the American Recovery and Reinvestment Act (ARRA) to fund the Race to the Top initiative. ARRA focused on improving student achievement, preparing students for college and future careers, improving graduation rates, and closing achievement gaps throughout the United States. In an effort to receive funding from the Race to the Top, Tennessee state legislators enacted the Tennessee Diploma Project to increase graduation requirements for students in terms of coursework and assessments. State legislators required students to complete at least four mathematics courses to complete graduation requirements: Algebra I, Geometry, Algebra II, and a fourth mathematics course higher than Algebra II. State legislators also required students to complete an ACT assessment to graduate. The researcher investigated a potential relationship between students' ACT mathematics subscores and the fourth mathematics course students completed in high school.

Analysis of ACT Math Subscores and High School Mathematics Courses

After the researcher received students' ACT mathematics subscore data, the researcher grouped the data by the fourth mathematics course students completed in high school. In this study, the students completed one of the following mathematics courses: Bridge Math, Applied Mathematical Concepts, Pre-Calculus/Trigonometry, Calculus, College Algebra, or Statistics. Using SPSS, the researcher computed descriptive statistics of students' ACT mathematics subscores for each student grouping based upon the fourth mathematics course students completed in high school. Notably, students who completed Applied Mathematical Concepts had the lowest average ACT mathematics subscore (15.54) while students who completed College Algebra had the highest average ACT

mathematics subscore (21.50). Interestingly, Bridge Math students had the widest range of ACT math subscores (from 10 to 25); however, students who completed Bridge Math had one of the lowest standard deviations (1.970) of ACT math subscores when compared to students who completed other classes. This was likely associated with the sample size of students (511) who completed Bridge Math. The researcher recorded descriptive statistics on Table 1.

Table 1

Descriptive Statistics of ACT Math Subscores and High School Math Courses

High School Math Course	N	Mean	Std. Deviation	Std. Error	Minimum	Maximum
Bridge Math	511	15.91	1.970	.087	10	25
Applied Mathematical Concepts	68	15.54	1.501	.182	12	21
Pre-Calculus/Trigonometry	71	17.63	2.491	.296	13	25
Calculus	8	20.63	2.722	.962	17	24
College Algebra	10	21.50	2.068	.654	19	24
Statistics	6	21.00	1.673	.683	20	24
Overall	674	16.24	2.268	.087	10	25

To continue analyzing descriptive statistics, the researcher conducted the Levene test for equality of variances and the Shapiro-Wilk's test for normality. The null hypothesis for the Levene test was the data obtained for this study consisted of homogeneity of variance. Similarly, the null hypothesis for the Shapiro-Wilk's test was the students' ACT mathematics subscores obtained for this study were normally distributed. After conducting the Levene test, the researcher rejected the null hypothesis because the test resulted in a Levene Statistic of 3.495 (p-value = .004) based on the mean ACT mathematics subscores of students in their respective mathematics course groups. Likewise, the researcher rejected the null hypothesis for the Shapiro-Wilk's test

for students who completed Bridge Math, Applied Mathematical Concepts, Pre-Calculus/Trigonometry, and Statistics because the *p*-value was less than 0.05. On the other hand, the researcher failed to reject the null hypothesis for students who completed Calculus and College Algebra because the *p*-value was greater than 0.05. The researcher recorded results from the Levene test and the Shapiro-Wilk's test on Table 2 and Table 3, respectively.

Table 2

Test of Homogeneity of Variances of ACT Math Subscores Grouped by Course

ACT Mathematics Subscore		Levene Statistic	df1	df2	Sig.
	Based on Mean	3.495	5	668	.004
	Based on Median	2.659	5	668	.022
	Based on Median and with adjusted df	2.659	5	611.354	.022
	Based on trimmed mean	3.291	5	668	.006

Notably, the p-value of the Levene test was less than 0.05 regardless of which measure of central tendency the researcher utilized to describe the ACT math subscore data. Therefore, the researcher could not assume the data displayed homogeneity of variance.

Table 3

Test of Normality of ACT Math Subscores Grouped by Course

		Shapiro-Wilk's		
	Math Course	Statistic	Df	Sig.
ACT Math Subscore	Bridge Math	.936	511	.000
	Applied Mathematical Concepts	.907	68	.000
	Pre-Calculus/ Trigonometry	.907	71	.000
	Calculus	.893	8	.248
	College Algebra	.856	10	.068
	Statistics	.701	6	.006

Because the p-value of the Shapiro-Wilk's test was less than 0.05 for students who completed Bridge Math, Applied Mathematical Concepts, Pre-Calculus/Trigonometry, and Statistics, the researcher could not assume the ACT math subscore data were normally distributed for students who completed the aforementioned classes. The researcher could assume normality of data for students who completed Calculus and College Algebra; however, the researcher acknowledged a smaller sample of students completed Calculus and College Algebra compared to other upper-level mathematics courses.

Research Question

The researcher utilized the following research question to guide the study:

1. **Research question 1.** Does a relationship exist between students' ACT math subscores and the fourth high school mathematics course they completed?

H_0: A relationship does not exist between students' ACT math subscores and the fourth high school mathematics course they completed.

To test the null hypothesis, the researcher utilized a one-way ANOVA to investigate a potential relationship between students' ACT math subscores and the fourth high school mathematics course they completed (see Table 4).

Table 4

ANOVA of Students' ACT Math Subscores Grouped by 4th Math Course

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	792.961	5	158.592	39.684	.000
Within Groups	2669.581	668	3.996		
Total	3462.542	673			

Using SPSS, the researcher conducted an ANOVA to analyze the means of students' ACT math subscores grouped by the fourth high school mathematics courses. The researcher calculated an F-statistic of 39.684 after conducting an ANOVA (see Table 4). This was statistically significant with a *p*-value of .000. Because the data did not exhibit homogeneity of variance based on the Levene test, the researcher conducted a Welch-Test ANOVA. The researcher calculated a Welch statistic of 33.000. Similar to the one-way ANOVA, this was statistically significant with a *p*-value of .000 (see Table 5).

Table 5

Welch-Test ANOVA (Robust Test of Equality of Means) of ACT Math Subscores Grouped by 4th Math Course

	Statistic*	df1	df2	Sig.
Welch	33.000	5	24.952	.000

Note. *Asymptotically F distributed.

Because the data analysis revealed a statistically significant relationship between students' ACT math subscores and the fourth mathematics course students completed in high school, the researcher rejected the null hypothesis. As stated earlier, the null hypothesis contended a relationship did not exist between students' ACT math subscores and the fourth mathematics course students completed in high school.

Summary of Results

According to results from the data analysis of this study, both the one-way ANOVA and the Welch-Test ANOVA revealed a statistically significant relationship between students' ACT math subscores and the fourth mathematics course students complete in high school. The researcher did not explore which mathematics courses had

the most influence on students' ACT math subscores; however, the researcher calculated the mean ACT math subscores of students grouped by their fourth high school mathematics course. The researcher noted students who completed College Algebra had the highest average ACT math subscores followed by Statistics students, Calculus students, Pre-Calculus/Trigonometry students, Bridge Math students, and Applied Mathematical Concepts students in that order (see Figure 1).

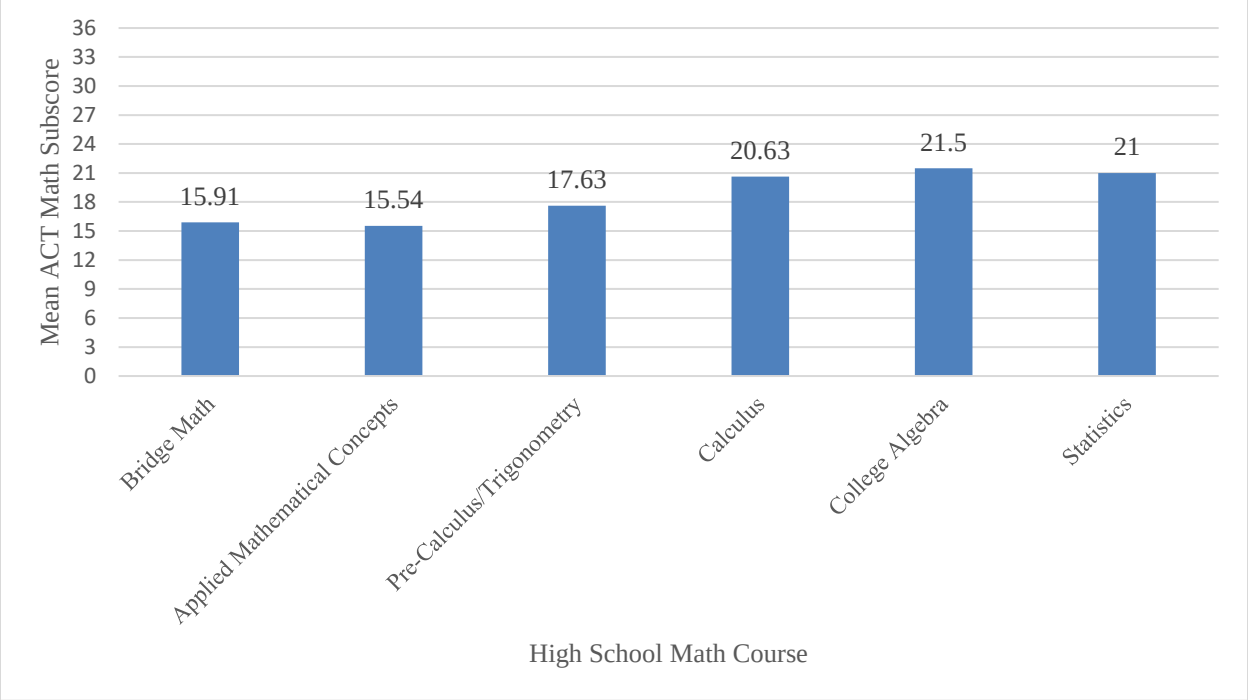

Figure 1. Mean ACT mathematics subscores of students based on the fourth high school math course they completed.

Chapter V: Conclusions and Recommendations

Conclusions of the Study

Similar to prior researchers from other states (Dial, 2016; Grinstead, 2013; Pierson, 2015), this researcher noted there was a statistically significant relationship between students' ACT math subscores and students' mathematics courses. For this study, the researcher specifically examined the relationship between students' ACT math subscores and the fourth mathematics course students completed in Tennessee. The researcher did not investigate which mathematics course had the greatest impact on students' ACT math subscores; however, the researcher determined a significant relationship existed between Tennessee students' fourth mathematics course and students' ACT math subscores. Therefore, the researcher concluded some students could have higher ACT math subscores than other students due to completing a particular fourth mathematics course in Tennessee high schools.

Implications for Practice and Research

The researcher determined educators in Tennessee should acknowledge students' fourth mathematics course in high school could influence students' ACT math subscores. The researcher challenged educators to adjust their mathematics curriculum to maximize students' performance and improve students' college and career readiness skills. The researcher suggested educators could meet this challenge by determining which Tennessee mathematics course(s) had standards similar to skills on the ACT math subtest and convincing students to complete the course(s). Additionally, the researcher posited educators should persuade students to complete a rigorous high school mathematics course for their fourth math credit. Pierson (2015) determined there was a strong positive correlation between the rigor of students' math courses and students' ACT math

subscores. Previous researchers also reported students' ACT subscores increased when students enrolled in additional academic coursework related to the specific subscores (Buddin & Croft, 2014; Chenoweth, 1996; Jones, 2008; Laing et al., 1987; McLure et al., 1997; McNeish et al., 2015; Noble & Schnelker, 2007). Thus, the researcher contended educators in Tennessee should encourage students to complete additional mathematics courses if possible, to increase students' ACT math subscores.

Recommendations for Further Research

The researcher documented the following recommendations based on the results of the study and review of the literature:

1. The researcher recommended future researchers investigate which of the higher-level mathematics courses in Tennessee had the largest impact on students' ACT math subscores. Educators and policymakers at the Tennessee Department of Education (TDOE) required all public school students to complete an ACT assessment (funded by TDOE) during their eleventh grade year to measure progress toward the composite score goal of 21 (TDOE, n.d. a). Additionally, ACT researchers (2013b) suggested students need a 22 on the mathematics section of the ACT to meet the college readiness benchmark in mathematics. Therefore, if educators and students recognized which of the higher-level mathematics courses in Tennessee had the largest impact on students' ACT math subscores, school counselors could assist students in enrolling in this particular mathematics course.
2. The researcher recommended all school districts throughout the state of Tennessee to conduct a similar study to gain larger sample sizes. A larger

sample size could improve the homogeneity and normality of the data. This would help the generalizability of the results of this study.

3. The researcher recommended future researchers explore the relationship between instructional strategies in mathematics courses and students' ACT math subscores. In this study, high school mathematics teachers in the selected school district utilized similar teaching strategies. Future researchers could determine if teachers' instructional strategies in students' fourth high school mathematics course affect students' ACT math subscores.

Researchers and educators in Tennessee should help students complete appropriate mathematics courses to improve students' ACT math subscores. If Tennessee students could improve their ACT scores, this would create a larger population of college and career ready students.

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