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Career and Technical Education on Mathematics and Reading Achievement for Students in North Central Arkansas

Kimberley Sartain

CAREER AND TECHNICAL EDUCATION ON MATHEMATICS AND READING ACHIEVEMENT FOR STUDENTS IN NORTH CENTRAL ARKANSAS

by

Kimberley Sartain

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ABSTRACT

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Kimberley Sartain
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Title: Career and Technical Education on Mathematics and Reading Achievement for Students in North Central Arkansas (Under the direction of Dr. Lynette Busceme)

The purpose of this quantitative research study was to determine the effects of gender and Career and Technical Education (CTE) participation level on the mathematics and reading achievement as measured by the ACT Aspire for 10th-grade students and ACT subtest assessments for 11th-grade students in 2 5-A high schools in North Central Arkansas. While researching the effects of gender and CTE participation level, this scholar found no statistically significant difference between gender and CTE participation level on student achievement. This researcher explored the literature relating to the mathematic and reading achievement of males and females as well as whether they participated in CTE courses. During the analysis, I examined findings concerning the influence of gender on mathematics and reading achievement of students. Some literature included physical and hormonal influences, as well as differences in brain functions. However, the literature failed to specifically address the differences in mathematics and reading achievement in relation to CTE participation.

The findings of the study indicated that CTE participation level did not have a significant effect on student achievement scores. Similarly, Jacob (2017) stated that

students who participate in CTE programs did not necessarily have strong academic outcomes. The study also revealed that gender did not have a significant effect on student achievement scores. Thus, neither variable indicated statistically significant effects. However, the results of the study do give insight into trends and potential areas for future study. Stone and Aliaga (2003) found that CTE students study more, which might lead to higher achievement levels due to increased study times. The results might indicate that students who do not participate in CTE and focus on an academic path might not be performing as well as first thought. Because the main effect of CTE participation level was not significant and because students in CTE tend to include students on a non-academic track, the CTE participating group means might indicate that students performed better when engaged in meaningful, integrated learning, regardless of their academic background. As a group, the four or more CTE courses group performed as well as the three CTE courses or fewer group, which focused on a more academic path.

In light of the trends in CTE curriculum and student achievement over the past few decades, integration of mathematics and reading into CTE coursework has become an important part of the high school educational process. Those who support integrative learning believe it can improve student engagement, motivation, and retention because higher-order thinking skills are used through problem-solving, collaboration, creativity, and innovation (Caine & Caine, 1991). This research might provide some insight into the results of this practice.

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CHAPTER I

INTRODUCTION

Educators in the United States compete with those in other countries, specifically in the area of academic achievement. Because students live in a global society, they no longer only compete with one another on state or national levels. Student achievement levels in the United States are compared globally as students from high schools or colleges enter into careers that take them across the globe. High wage, high demand careers require advanced mathematics and reading skills. While core subjects teach reading, writing, speaking, or mathematics skills, career and technical education (CTE) teaches technical skills that often incorporate academics to prepare students for specific career fields.

CTE has been a part of the United States educational system for many years, from its earliest beginnings in the 1870s as young men and women began industrial training in the use of wood-working tools and kitchen equipment. CTE has evolved over the years as course offerings have changed to meet the needs of society as well as a name change reflecting the changing direction programs were taking as a result of societal changes. As late as the 1980s, it was called vocational education. However, in the 1990s it was finally referred to as CTE among educators. The mission of CTE is to provide students with skills necessary for technical trades in the labor market, which include reading and mathematics competencies.

In addition to the change in name, CTE experienced other changes in the 1980s as the educational system underwent reforms in several areas including mathematics and reading. During the 1990s, there were several attempts to reform the educational system and improve student achievement. However, the United States high school mathematics and reading performance did not improve for three decades (Rampey, Dion, & Donahue, 2009). Furthermore, since No Child Left Behind (NCLB) legislation was passed in 2001, student achievement scores have not shown improvement in the high school or middle school levels (Center on Education Policy, 2007). There is a discrepancy between United States and international student performances in mathematics, science, reading, and problem-solving. The challenge facing educators is to find ways to help students improve academically.

The movement to find ways to improve achievement scores in core subjects continues as new initiatives such as Every Student Succeeds Act (ESSA) of 2015 and assessments such as ACT Aspire and ACT are given to high school students across America. ESSA was signed by President Obama in an effort to reinforce the Elementary and Secondary Education Act, a civil rights law signed by President Johnson in 1965. President Johnson believed providing educational opportunities was a national goal. The Elementary and Secondary Education Act provided grants to low-income students and helped with funding centers and agencies to improve the quality of educational opportunities for students. ESSA requires, for the first time, all students to be taught guided by high academic standards that will prepare them for college or careers. It holds low-performing school districts with low graduation rates and achievement levels more

accountable than ever before. It also ensures that state-wide assessments such as ACT Aspire measure student progress in achieving the new academic standards.

Arkansas began using ACT Aspire assessments in 2015-2016 to fulfill the state and federal requirements that students take a state-wide assessment. Arkansas law requires that all public school students participate in a state-wide assessment program. The Arkansas State Board of Education has chosen the ACT Aspire summative assessment. The ACT Aspire is an end-of-year summative assessment of English, reading, writing, mathematics, and science achievement used in Grades 3-10. The assessment was developed to measure skills deemed necessary for college and career readiness. According to the Arkansas Department of Education (2017), many schools across the state responded positively to the decreased amount of testing time averaging 4.5 hours compared to 12 hours in the past. In 2016-2017, Arkansas tested approximately 288,000 students in Grades 3-10 with the ACT Aspire assessment.

Although the 2016-2017 ACT Aspire assessment has only been used for a short period of time, Arkansas students made significant improvements on their test scores compared to previous years. The largest improvements occurred in sixth-and eighth-grade mathematics and writing. It showed 62.05% of sixth graders and 43.58% of eighth graders were meeting readiness benchmarks in mathematics. In writing, 59.29% of sixth graders and 37.58% of eighth graders were meeting readiness benchmarks. In high school, 24.72% of 10th graders met mathematics readiness benchmarks, and 56.75% met writing readiness benchmarks (Arkansas Department of Education, 2017). To help track the progress of their students, test scores are provided by the Arkansas Department of Education each year to give school districts feedback on student achievement.

The ACT test was developed in 1959 by E. F. Lindquist and Ted McCarrel (ACT, 2014b). It was originally developed to be an alternative to the Scholastic Aptitude Test or SAT, which had been given to students since 1901. Developers Lindquist and McCarrel discovered a shift in the college attendance patterns in the United States and desired to create a test that more accurately assessed a student's ability to succeed in college (Grabianowski, 2010). The goal was to create a more streamlined admission process so more students could apply to college. In the beginning, the ACT acronym stood for American College Testing, but in September 1996, both the company and the test was renamed to be called simply ACT (ACT, 2014b).

On November 7, 1959, the first ACT assessment was administered to 75,460 students and cost $3.00 per student. According to Niche (ACT, 2014b), the first test had four assessment areas: English, mathematics, social studies, and natural sciences. Each area was tested for 45 minutes, for a total of three hours. Today's ACT assessment is much like the first assessment given because it and is scored into four composite scores on a 1-36 scale and sub scores on a 1-18 scale. Assessed areas include English, mathematics, reading, science, and an optional writing assessment. Each test is scored in a range of 1 (low) to 36 (high). A student's composite score is calculated by averaging the scores from all four tests (ACT, 2012). However, each assessed area is assigned a score ranging from 1 to 36, with 36 considered a perfect ACT score. It has become a pivotal assessment in education and is administered several times each year. In the early 1990s as reforms called for changes in education, ACT began offering workforce development programs and other services besides just assessments. It has become the

most popular college admissions standardized test in the United States, far exceeding the SAT.

From the beginning, ACT began reporting scores directly to students as well as colleges and universities. However, students could not take the ACT more than once unless there were extenuating circumstances such as illness during the exam. Today, students are encouraged to take the ACT multiple times to earn higher scores. The cost to take the exam in the 2017-2018 academic year was $46.00 for the basic ACT and $62.50 for the ACT with the additional writing assessment. Grove (2018) reported that a typical student will spend approximately $100 on the ACT during the college admissions process. The first four score reports are free, but additional score reports require an additional fee. Student scores can be used to determine placement in college level courses. There is a minimum benchmark score provided in each subject area to indicate at least a 50% chance of earning a B or an A and a 75% chance of earning a C or higher. Benchmark scores and percentages are calculated based upon the performance of college students in corresponding courses (ACT, 2013). Within the past 2 years since the ACT Aspire test has been given, the average ACT test scores have improved. In 2015-2016, the percentage of Arkansas students ready for college-level English courses and college Algebra was 49% and 25%, respectively.

Statement of the Problem

The purposes of this study were four-fold. First, the purpose of this study was to determine the effects by gender between taking four or more CTE courses versus three or fewer on reading achievement as measured by the ACT Aspire for 10th-grade students in two 5-A high schools in North Central Arkansas. Second, the purpose of this study was to

determine the effects by gender between taking four or more CTE courses versus three or fewer on mathematics achievement as measured by the ACT Aspire for 10th-grade students in two 5-A high schools in North Central Arkansas. Third, the purpose of this study was to determine the effects by gender between taking four or more CTE courses versus three or fewer on reading achievement as measured by the ACT Reading subtest for 11th-grade students in two 5-A high schools in North Central Arkansas. Fourth, the purpose of this study was to determine the effects by gender between taking four or more CTE courses versus three or fewer on mathematics achievement as measured by the ACT Mathematics subtest for 11th-grade students in two 5-A high schools in North Central Arkansas.

Background

Research was limited when addressing the effects of gender, grade, and CTE enrollment on reading and mathematics achievement for students. Most of the studies discussed the integration of academics into CTE courses or specifically targeted student achievement in reading and mathematics with no relationship to CTE enrollment. I provided the reader with studies that encompassed several facets on the issue of student reading and mathematics achievement among students enrolled and not enrolled in CTE courses.

Conceptual Framework

A conceptual framework is different from a vision statement. Vision statements often refer to what will be or should be done, whereas, conceptual frameworks provide the schema for establishing important issues and allowing for solutions to be found. Conceptual frameworks must have the capacity to change over time and adapt to external

factors (Rojewski, 2002). Teaching CTE courses and academic courses often requires different strategies. Two educational theories, constructivist and contextual, can be found in successful CTE classrooms and serve as the conceptual framework. The work of Dewey, Piaget, and Vygotsky laid the foundation for constructivist pedagogy that focuses on cognitive development and deep understanding. Constructivist pedagogy theorists contend true learning comes from an active process developed through interactions and experiences in the social environment (Brown, 1998; Fosnot & Perry, 2005; Richardson, 2003; Von Glaserfeld, 2005). Educational trends change over time. As outdated curriculum and new programs are developed, the scope, mission, and methods of CTE adapt to the changes and modifications made to the courses offered in high schools.

The constructivist theorists believe there is a human need to make sense of one's surroundings. Students actively try to construct knowledge by adding new information and experiences to what they have previously learned (Billett, 1996). The foundations of CTE were based upon behaviorist principals. However, educational reforms have created changes that more closely follow cognitive constructivist principals. Doolittle and Camp (1999) stated that the constructivist learning theory addresses the needs of CTE because it enables educators to structure and deliver course content as they move into the future. The nature of CTE courses requires students to use learned skills from CTE courses as well as other curriculum courses to complete tasks. This theory helps teachers facilitate learning by guiding students to construct their own ideas and methods of problem solving. Being actively engaged is a key factor to the constructivist theory because it requires students to use higher order thinking skills to process and analyze activities and

concepts. A repetitive experience provides students opportunities to add to their knowledge base and reinforces the learning process.

The contextual theory is derived from the constructivist theory. Although research based on the contextual learning theory is fairly new, student engagement in contextual learning has deep roots. John Dewey introduced experiential learning at the turn of the century as the most sensible and effective way to make learning meaningful for students (Baker, Hope, & Karandjeff, 2009). As it relates to CTE, the contextual learning theory combines concepts learned with hands-on activities where students demonstrate what they have learned, and it implies students gain a deeper understanding of knowledge by putting it into practice. It generates meaning for students by linking academic skills to practical, day-to-day decisions where students understand concepts, solve problems, and think critically. Furthermore, Johnson (2002) explained how the brain structures and organizes connections to the outside environment to create meaning and transfer information. As students participate in CTE courses, academic concepts are retrieved by the brain and new connections to what is learned can be used in different ways. Being able to transfer skills can be evidenced by performance tests or by successfully mastering concepts to move to a higher level of coursework or training. From a metacognitive approach, these transferable skills indicate students have become more aware and self-directed, becoming better learners and constructing effective inquiry (Baker et al., 2009). The overall goal of contextual theory is to improve the level of learning so students gain a better understanding of solving problems and thinking creatively as they make applications to real life situations. The curriculum of CTE courses as well as the nature of

the CTE learning environment lends itself to the implementation of the contextual learning theory.

Career and Technical Education

CTE was once called vocational education. Traditionally, general education included vocational skills with each area being taught in a common curriculum to prepare students for the future. As a result of the Industrial Revolution, the late 1800s began to see the introduction of occupational content in classrooms across the United States. It was during this time the manual training movement began to shape vocational education, which also began to create the divide between academic courses and vocational courses. This divide would continue to define programs of study within high schools for the next century (Grubb, 1995). It was not until the Smith-Hughes Act of 1917 that vocational schools began to address the needs for educating students entering the industrialized labor force by focusing on job specific skills. It was the first federal investment in vocational education, even before education was compulsory in every state (Jacob, 2017). There were legislative changes in vocational education in the 1970s and 1980s, but they did not change the separation between academics and vocational education even though major educational changes were taking place elsewhere (Bragg, 1999; Castellano, Stringfield, & Stone, 2003). In the past, high schools offered two pathways of coursework for students. One pathway was college-bound, and the other was career-bound. Each pathway focused on specific courses to prepare students for life after graduating high school. However, the students participating in these pathways were often isolated from one another due to courses not overlapping.

The federal government has long provided funding for career education. By 1946, vocational education received over $29 million per year, and by 2016, Congress appropriated $1.117 billion for CTE. As CTE's funding increased, many other educational programs were cut during this time (Imperatore, 2017). Today, funding comes through the Carl Perkins Act that was passed in 1990 and continues to focus on alignment of academic and vocational skills fully integrated to provide complete preparation for the workforce.

Despite funding, CTE enrollment declined over several decades as states began increasing the number of courses required for graduation. Students enrolled in mathematics, science, social studies, and foreign languages and focused on preparation for obtaining 4-year college degrees. However, a resurgence in CTE occurred within the past decade as technical skills and precise knowledge-based jobs went unfilled. A shortage of workers to fill vacancies led to additional funding and scholarships in CTE programs. New programs are emerging to address the changing needs of society.

For many, participation in academic courses prepared students for the intellectual rigor required for success in college courses, whereas CTE courses prepared students for the workforce for which little academic skill was needed. Whether or not CTE courses have a positive effect on academic achievement continues to be debated and requires more research for conclusive evidence. As CTE courses change, the structure and integration of academics within those courses can be seen through project-based learning, cooperative learning, and problem-based learning as students use academic skills to perform critical CTE skills.

In academic education, the shift from simply reproducing knowledge to producing knowledge has changed the direction schools design instruction. Reform in mathematics called for improved reasoning and problem-solving skills through the use of activity-based learning (Jonsson & Johan, 2014). Similarly, literacy skills such as reading and writing were to be interwoven into all content areas, including CTE courses. Early on, language skills were to be learned through real-life experiences (Roberts & Kellough, 1996). The integration of core content into CTE curriculum and the use of project-based learning can reinforce the skills learned in academic courses, but one must consider if it The integration of course content would significantly influence student achievement.

Gender Achievement Gaps

The term *achievement gap* in education refers to the differences in academic performance between groups of students. Achievement gaps can appear between the grade levels, the genders, and the types of courses selected by students, as evidenced by test scores and dropout rates. There has been much debate on the issue of gender differences on student achievement. More specifically, the debate revolves around potential differences in mathematics and literacy such as reading and writing. In recent years, academic performance of both female and male students has become the center of focus as schools struggle to increase student achievement. Research continues to explore reasons why gender differences may or may not exist in subject matter as well as abilities (Linver, Davis-Kean, & Eccles, 2002). Standardized achievement tests given in the past show more females achieving higher test scores and completing high school as compared to males (Jacob, 2002). Female students have consistently out-performed male students in academic course grades in subjects such as physics and mathematics. However, males

have higher scores in ability tests in these subject areas. Female students are making improvements in subjects such as mathematics and science that previously were dominated by males.

Similarly, studies have also found females have better overall memory than males. This includes several types of memory such as episodic, spatial, short-term, visual, and specific memory (Halpern, 2000). Knowing how the human brain works, especially pertaining to gender, may help explain student achievement differences in high school. As ESSA begins to shape the nation's educational strategies, improving academic performance is at the forefront of the reform. Low mathematics and reading scores have characterized student achievement in the United States for years, especially among minorities and low-income families. On the other hand, male students are more likely to enroll in advanced mathematics courses compared to females, and the number of female students outnumbers male students participating in advanced reading courses.

CTE programs do not require enrollment in advanced mathematics or reading courses. Many students in advanced courses do not participate in CTE courses, due to limitations in course offerings, or focus on particular subject areas in preparation for college. However, as CTE programs change to meet the needs of society, females are more likely to enroll in advanced mathematics courses and be capable of competing with their male counterparts. Furthermore, the traditional stereotypes and beliefs of CTE courses and how well female and male students perform continues to be of interest. One must ask how gender affects mathematics and reading achievement in high school. Regardless of how small or how large gender gap achievement may be, any gap should be explored for causation.

Hypotheses

The initial review of the literature indicated that little data existed on how participation level in CTE courses may influence student performance on ACT Aspire and ACT subtest assessments in mathematics and reading. Therefore, the following null hypotheses were generated:

1. No significant difference will exist by gender between taking four or more CTE courses versus three or fewer on reading achievement as measured by the ACT Aspire for 10th-grade students in two 5-A high schools in North Central Arkansas.
2. No significant difference will exist by gender between taking four or more CTE courses versus three or fewer on mathematics achievement as measured by the ACT Aspire for 10th-grade students in two 5-A high schools in North Central Arkansas.
3. No significant difference will exist by gender between taking four or more CTE courses versus three or fewer on reading achievement as measured by the ACT Reading subtest for 11th-grade students in two 5-A high schools in North Central Arkansas.
4. No significant difference will exist by gender between taking four or more CTE courses versus three or fewer on mathematics achievement as measured by the ACT Mathematics subtest for 11th-grade students in two 5-A high schools in North Central Arkansas.

Description of Terms

Accountability. Accountability is a term used to describe an obligation or willingness to accept responsibility in accounting for one's actions. This obligation usually requires that teachers, schools, and states provide evidence in the form of student standardized tests that they are teaching students a common core of knowledge and skills. It is by the evidence provided whether they are judged accountable (McBrien & Brandt, 1997).

ACT. The ACT is a standardized college-ready assessment for high school achievement and college admissions in the United States that provides composite scores in English, mathematics, reading, and science. The writing assessment is optional and not averaged into the score. Only scores from the Mathematics and Reading subtests were used for this study.

ACT Aspire. The ACT Aspire is a state-wide assessment published by ACT for students Grades 3-10 in English, mathematics, reading, science, and writing. It serves as a way to predict ACT scores and college readiness and is also used by Arkansas as their accountability measure (ACT Aspire, 2016b).

Career and Technical Education Participation Level. Participation was determined by a high school transcript that contains documentation indicating an individual has successfully completed four or more CTE courses versus three or fewer CTE courses. Scores included in this study were grouped based on the degree of student enrollment in CTE courses within educational programs specializing in skilled trades, applied science such as engineering, business, agriculture, family and consumer science, technology, and career preparation.

Contextual Learning. Contextual learning is a learning pattern that connects academic content to real life and helps store short-term and long-term memory. This helps students make connections between knowledge and real life (Davtyan, 2014).

Cooperative Learning. Cooperative learning is a teaching strategy using small, heterogeneous groups of students who work together to achieve a common goal (Kagan, 1994).

Gender Gap. A gender gap is differences between women and men, especially as reflected in social, political, intellectual, cultural, or economic attainments or attitudes (Gender Gap, n.d.)

Integrated Curriculum. An integrated curriculum is holistic and is organized around real problems by exploring knowledge from various subjects relating to certain aspects of the environment (Humphreys, Post, & Ellis, 1981).

Problem-Based Learning. Problem-based learning is student-centered teaching approach which students learn about a subject by working in groups to solve an open-ended problem. It is often referred to as PBL (Cornell University, 2018).

School Size. The identified classification of schools based mainly by enrollment figures. In the 2017 cycle, 5-A schools had an enrollment from 301 to 857 students (Arkansas Activities Association, 2015).

Service Learning. Service learning is a form of experiential education where learning occurs through action and reflection as students achieve real objectives for the community and a deeper understanding and skills for themselves (Bandy, 2018).

Work-Based Learning. Work-based learning allows students to participate in a program of study that is embedded in the workplace and designed to meet the learning

needs of the employees as well as the educational institution (Lemanski, Mewis, & Overton, 2011).

Significance

Research Gap

Researchers have written a significant amount on the effects of socioeconomic status and gender on student achievement. However, after reviewing the literature, there appeared to be large gaps in research on how the integration of core content of reading and mathematics into CTE courses affected student achievement on high-stakes assessments. Furthermore, there were few connections to GPAs and graduation rates. In fact, in 2007, the United States ranked 10th in the world for high school completion (Association for Career and Technical Education, 2007). First, although many have written about integration of core subject content in CTE courses, the focus was on teaching methodology rather than enrollment status and effects on student achievement scores. Second, although many have conducted studies in other states such as Tennessee (Shadden, 2011; Sparks-Wallace, 2007), there are few data regarding Arkansas. Therefore, a study seemed necessary to examine the effects of CTE courses by gender and grade in North Central Arkansas high schools.

Possible Implications for Practice

This study's completion has the potential to assist school administrators, the Arkansas Department of Career and Technical Education, and the CTE teachers throughout the state of Arkansas by addressing a gap in literature on academics and CTE courses, which may strengthen CTE programs. This study's findings may provide additional information to the body of research on the effects of CTE courses on reading

and mathematics by providing evidence that CTE programs may contribute to student achievement, as well as prepare them for the workplace. In addition, this study can provide state departments of education additional information when making decisions concerning CTE funding, curriculum framework updates, and teacher preparation courses for higher education.

Process to Accomplish

Design

I used a quantitative, causal-comparative strategy in this study. All four hypotheses used a 2 x 2 factorial between-groups design. The independent variables for all four hypotheses were gender (female and male) and participation level in CTE courses (four or more and three or fewer). The dependent variables for the first two hypotheses were academic achievement scores in reading and mathematics for 10th-grade students as measured by the ACT Aspire reading and mathematics tests, respectively. The dependent variables for the last two hypotheses were achievement scores in reading and mathematics for 11th-grade students as measured by the ACT Reading and Mathematics subtests, respectively.

Sample

This study used 10th- and 11th-grade students' scores in two Arkansas high schools. The high schools chosen were from 5-A school districts. These schools were located in North Central Arkansas and had roughly equal numbers of males and females. Students who were designated as English language learners were removed from the sample to prevent data being skewed.

Instrumentation

I used data from two instruments in this study. First, scores from the ACT Aspire test were used to measure reading and mathematics achievement for the 10th-grade students. The Arkansas Department of Education (2017) required all schools in Arkansas to administer the ACT Aspire exam to students in Grades 3-10 each year. The norm-referenced exam consists of multiple-choice questions including constructed response, selected response, and technology-enhanced items to assess student knowledge and provide insights to student preparedness for the ACT assessment (ACT Aspire, 2016b). The 10th graders were given the English, mathematics, reading, science, and writing exams in the spring term of each year.

Second, scores from two ACT subtests were used to measure reading and mathematics achievement for the 11th-grade students. Throughout the year, high schools across the state of Arkansas offer all 11th-grade students the opportunity to take the ACT college readiness assessment. However, not all 11th-grade students take the ACT college readiness assessment due to costs, time, or desire to enter college. It is a norm-referenced assessment that serves as a curriculum-and standards-based educational and career planning tool. The ACT also assesses students' academic readiness for college. The ACT is a nationally recognized assessment in English, mathematics, reading, science, and writing (optional). It is also used as a tool in college admissions (ACT, 2017a). For the purpose of this study, scores from the Reading and Mathematics subtests were used. The ACT Reading subtest is a 40-question, 35-minute test measuring students' reading comprehension. The test requires students to read several passages and answer specific questions to demonstrate their understanding of content. The reading test can be broken

down into four categories: 25% for each social studies, natural sciences, prose fiction, and humanities. The ACT Mathematics subtest is a 60-question, 60-minute test measuring mathematical skills acquired during courses taken by the end of 11th grade. The test is made up of multiple-choice questions that require students to use reasoning skills to solve mathematical problems. The test can be broken down into six categories and percentages of test questions from each: 20-25% pre-algebra, 15-20% elementary algebra, 15-20% intermediate algebra, 15-20% coordinate geometry, 15-20% plane geometry, and 5-10% trigonometry.

Data Analysis

To address the first hypothesis, a 2 x 2 between-groups factorial analysis of variance (ANOVA) was conducted using gender and CTE participation level for 10th graders as the independent variables. The dependent variable, student reading achievement, was measured by the ACT Aspire reading test. To address the second hypothesis, a 2 x 2 between-groups factorial ANOVA was conducted using gender and CTE course participation level for 10th graders as the independent variables. The dependent variable, student mathematics achievement, was measured by the ACT Aspire mathematics test. To address the third hypothesis, a 2 x 2 between-groups factorial ANOVA was conducted using gender and CTE course participation level for 11th graders as the independent variables. The dependent variable, student reading achievement, was measured by student scores on the ACT Reading subtest. To address the fourth hypothesis, a 2 x 2 between-groups factorial analysis of variance ANOVA was conducted using gender and CTE course participation level for 11th graders as the independent variables. The dependent variable, student mathematic achievement, was measured by the

ACT Mathematics subtest. To test the null hypotheses, I used a two-tailed test with a .05 level of significance. A Bonferroni correction was used to adjust the probability value because of the increased risk of type I errors that are likely when performing multiple statistical tests (Morgan, Leech, Gloeckner, & Barrett, 2012). Therefore, because two samples were selected for analysis, the adjusted significance level was .025 (.05/2).

CHAPTER II

REVIEW OF THE RELATED LITERATURE

The beginnings of Career and Technical Education (CTE) can be traced to the founding of the United States. Its inception reflected the beginning of society's need for citizens to possess a strong knowledge base and special skillsets. As workforce needs changed, so did the direction of CTE. After World War I, CTE expanded and is now found in most high schools across the nation. With federal funding used to support CTE programs, the question of whether it plays an important role in student achievement has been asked. Does CTE improve student achievement in mathematics, reading, or other core academics when these core areas are integrated into the CTE curriculum? Mathematics and reading scores have been low across the nation and the state of Arkansas in recent years. With integration strategies, CTE students use skills learned in core subjects in other types of classrooms. The purpose of CTE has often been thought to prepare less academically inclined students for the workforce, and not for college (National Association of State Directors of Career Technical Education Consortium, 2010). However, the direction of CTE has changed with more course offerings and diversity in students participating in them, and as integration continues to be used in CTE classrooms, CTE's effectiveness is often measured by assessments.

State assessments such as the ACT and ACT Aspire help determine student achievement each year. The results from the assessments enable educators to track

student progress by subject, grade level, and gender among other demographics. However, there is little research on how students who participate in CTE courses score on these assessments since the integration of mathematics and English Language Arts content into the CTE curriculum has become a popular teaching strategy. The question remains whether there is a connection between participating in CTE and student achievement, especially in mathematics and reading.

Career and Technical Education: Early Beginnings

Historical Background

As the population and industry changed during the late 1800s, so did the curriculum and direction of CTE programs. As it relates to CTE, curriculum began when apprentices trained with experts in specific vocations during the 1700s and 1800s (Louisiana State University, 2017). The master craftsman decided what the apprentice most needed to know to take over the work at a future time. Gordon (2003) indicated that during the 1800s, United States schools were divided by social class where those individuals viewed as belonging to the lower class were trained in manual labor and those associated with a higher class received academic schooling. Many of those considered as being of lower class were trained as apprentices, which was the most rudimentary form of CTE training. Their training was not considered a part of the academic curriculum, and it was the only educational opportunity many of them had. In the early 1900s, the educational system focused more on agricultural training because society relied heavily upon farming. Finch and Crunkilton (1999) found that by 1900, a strong public support for CTE had developed. Rural America questioned traditional education and wanted agricultural education to be integrated into public schools. National organizations were

created to support CTE programs and secure federal funding. This created much debate: some believed public schools were to teach liberal arts studies, and others believed CTE should be formally incorporated into the school curriculum.

Several factors affected the development of CTE. According to Gordon (2003), education reform, prominent political leaders, war, presidential study panels, and the American Vocational Association all had major influences in the early development of CTE programs. Two prominent educational philosophers emerged during the early 20th century, Charles Prosser and John Dewey. On the one hand, Prosser supported social efficiency where schools could be reformed to meet the needs of society (Gordon, 2003). He believed students should be trained in areas where they would excel in learning environments similar to the actual workplace. He also believed that practice and theory should go hand in hand. On the other hand, Dewey supported an educational system where science, technology, and democracy would complement each other (Wirth, 1972). However, Gordon (2003) stated that Dewey did believe vocational education could foster change to improve education because occupations were central to educational activities. These philosophies informed CTE reform movements.

The war affected the development of CTE as women began to fill male-dominated positions to support war-time efforts. Many inexperienced people received on the job training that required problem-solving and hands-on training not offered in high school. Presidential influences also affected CTE development as study panels and committees were established to look at the needs of society and the overall condition of the United States educational system. It was from these panels and committees that several organizations were formed (Wang, 2009). One was The American Vocational

Association, now called the Association for Career and Technical Education, whose members established a mission to provide educational leadership in a competitive workforce.

When the Smith-Hughes Act of 1917 was passed, Prosser's educational philosophy prevailed, and the landmark legislation set the stage for CTE being separate and distinct from academic education. In fact, Gordon (2003) referred to the Smith-Hughes Act as a contributing factor to the isolation CTE had, in relation to the academic programs, by separating curricula and establishing state vocational boards to manage the program. Although CTE has long been considered a part of the educational system, its curriculum has distinguishing characteristics that set it apart from the purely academic settings. At the turn of the 20th century, CTE saw changes in its direction as school reform began to separate education tracks. Raizen (1989) stated separate tracks were established for agricultural and industry training for students who were considering dropping out of school because they felt academic curriculum was not relevant to their lives. This shift in educational tracks was the inception to different programs offered through CTE.

CTE could be identified by the types of programs offered to specific groups of students as well as facilities and equipment. A distinct difference between CTE courses and academic courses began to take shape as well as society's view of what the CTE classroom looked like. It also brought much debate over funding the different programs being offered in high schools across America.

Funding and Legislative Reform

Funding for education is costly, and in the United States, the Constitution leaves the responsibility for funding public K-12 education to each state. However, to ensure states provide a quality education, the government offers assistance to supplement, not supplant, the costs to educate students within each state. The government has had an interest in education for more than 100 years. Federal, state, and local governments contribute to educational funding, but the share of funding from each of these has changed over the years. However, the budgetary foundation for CTE programs and their funding began with the Morrill Act of 1862. This Act was replaced by multiple legislative efforts, continually focusing on the needs of America's workforce. The number of legislative revisions is an indication of the importance it has not only to students, but to the economy and society as a whole.

The Smith-Hughes Act of 1917 set aside funding specifically for CTE and was developed to prepare students for jobs, providing them with an alternative course of study compared to the traditional general education curriculum (Lynch, 2000). According to Moore (2017), the Act was named after Hoke Smith and Dudley Hughes. Although Smith and Hughes did not conceive the idea of vocational education, their political influence helped pass legislation for the Smith-Hughes Act on February 23, 1917. In 1984, another Act was passed called the Carl D. Perkins Vocational Education Act (Moore, 2017). This Act focused on the alignment of standards and integration of academics into the vocational programs as well as establishing a reserve fund for state authorization. This reserve would ensure at least 85% of funding would be allocated to local agencies.

In the late 1990s, educators began to realize the United States' educational system was faltering and a new focus on school reform in both academic and vocational education began. McKenna, Robinson, and Miller (1990) found that the advocates of literacy programs, which included reading, writing, listening, and speaking, also developed a set of teaching methodologies linked to meaningful contexts. Just a decade before, the 1983 report called *A Nation at Risk* was considered a landmark reform movement in education. It focused on a universal education by increasing academic rigor as a means of improving student achievement. It promoted more academic courses and limited students' choices in elective courses, which included CTE (Lee & Ready, 2009). A more centralized focus on academic courses was thought to be necessary in order to increase student achievement. Restructuring took place in mathematics that changed the content, teaching, and assessments used to evaluate student understanding (National Council of Teachers of Mathematics, 2000). This was done to increase rigor and student achievement and bring the existing standards to a higher level.

With the educational movement of the 1990s and the NCLB Act of 2001, the Bush administration wanted greater accountability through the federal government to ensure students were achieving. Students were required to meet specific benchmarks on assessments. Often resources were allocated to those schools meeting mandated benchmarks, and schools that did not meet benchmarks were sanctioned. As the reforms of the Reagan and Bush administrations created a clearer focus on the direction of the nation's educational system, they unknowingly created a divide between academics and CTE. This divide compartmentalized student achievement to academic performances and created challenges for curriculum integration in CTE as well as the role technical

programs have for students (United States Department of Education, 2011). The educational reforms of the Bush administration continued until the Obama administration began looking for ways to improve the direction America's educational system was going.

After several reauthorizations over the years, the goal of Perkins is to enhance academic, career, and technical skills of secondary and post-secondary students interested in CTE programs. The 2006 Act reauthorizes five programs that include Basic State Grants, the Tech Prep Grant program, the Tribally Controlled Postsecondary Career and Technical Institutions Grant program, various National Programs centered on research and development, and the Occupational and Employment Information program (Perkins Collaborative Resource Network, n.d.). As Perkins reauthorizations began to change CTE programs, there were changes in educational reform taking shape. After President Bush's term, President Obama initiated a new reform called Every Student Succeeds Act (ESSA).

ESSA was signed into law by President Obama on December 10, 2015. It was developed from the 50-year old Elementary and Secondary Education Act, which committed to providing equal opportunity for all students. The Elementary and Secondary Education Act, as it is known, was implemented by President Johnson's administration in 1965. President Johnson believed full educational opportunities for all students should be the goal of the nation. The Act provided grants for low-income districts, grants for textbooks, and funding for special education centers. Low-income college students could qualify for scholarships to help pay tuition and fees. ESSA requires all students in the United States be taught to high academic standards that

prepare them for college and/or career readiness. The tenets of the Act hold all schools accountable, especially those low-performing schools where students do not make progress (United States Department of Education, n.d.). Providing students with a high-quality education that meets today's educational standards and workplace needs ensures all students have the same opportunities.

Although ESSA gives states more freedom in educational decisions, it still provides specific goals requiring evidence of student achievement. It is the first federal law to define the term *evidence-based*. West (2016) described ESSA as an evidence-based system rather than an evidence-based program, which contrasted the difference between NCLB and ESSA. ESSA allows states to align proven practices with existing standards as long as evidence of success with practices used in the classroom can be shown. Because states have more flexibility in reaching ESSA's goals, they must document a system of strong educational practices that have proven successes in the classroom.

According to Career and Technical Education (2017), ESSA will provide opportunities for CTE to expand. This is specifically cited in the Act as a *well-rounded education*. ESSA requires states to align academic standards to relevant CTE standards. It increases Title I funding to qualifying high schools in order to support high-quality CTE programs aligned to state standards, work-based programs, and those linked to industry recognized credentials. Title II funds allow states to provide professional development that can be used to learn how to integrate academics into CTE lessons. The term well-rounded education is clarified in Title VII and includes courses, programs, and activities associated with CTE.

Funding has declined over the years. In the fiscal year of 2011, Perkins funding was cut by $140.2 million, which brought the total appropriations for the Act to $1.1 billion. This action is counter-intuitive. As far back as the 1990s, Finch and Crunkilton (1999) noted that the cost of maintaining a CTE program was considerably more than that required for academic-based counterparts. Operating costs depend upon particular areas of instruction that see differences in equipment, consumable materials, travel, and basic operational costs for larger square footage in facilities. As the United States recovers from an economic downfall, the challenge to keep CTE funding will continue. Without adequate funding, CTE providers cannot equip students with technical skills necessary to fill the job openings and needs of the economy.

According to The State of Arkansas Bureau of Legislative Research (2018) staff, the Arkansas General Assembly members appropriated $20.1 million to the Arkansas Department of Career Education. This amount includes some of the Carl Perkins funding Arkansas receives. This money is then distributed into two parts. The first part goes to school districts across the state, which is approximately $8.9 million. The second part of the funding, approximately $11.3 million, goes to Secondary Area Career Centers across the state. The State of Arkansas Bureau of Legislative Research staff calculated about 75% of funds go to secondary education, and the remaining 25% goes toward postsecondary education. During the 2016-2017 school year, districts were allocated about $6.6 million in Perkins funding to support Arkansas CTE programs. This equates to $47.50 per CTE student. Thus, funding plays an important part in the success of programs and the students they serve.

The State of Arkansas Bureau of Legislative Research (2018) staff also stated that because Arkansas receives funding from the Perkins Act, administrators must report how many students are participating in CTE and their academic performance in particular subject areas such as mathematics and literacy. For instance, in the 2015-2016 school year, 75.87% of CTE students were proficient in the Geometry end of course exam.

Arkansas Career and Technical Education

When the Smith-Hughes Act of 1917 was passed, it marked the beginning of vocational education in the state of Arkansas. The staff of Arkansas Department of Higher Education (2006) noted that the Arkansas legislature was in session when the Act was passed and accepted the provisions at that time. In addition, the state board approved a plan to be submitted to the federal government in March of that year. There were 497 secondary and adult students being enrolled in trades and industrial, agriculture, and home economics courses during the 1917-1918 school year. In contrast, by 2006, there were 192,245 students in secondary and postsecondary programs. Student participation numbers in CTE continue to change. According to Advance CTE (2018), there are 202,705 secondary and postsecondary students enrolled in Arkansas CTE courses. Enrollment has continued to increase since ESSA was enacted.

The Arkansas Department of Career Education staff are responsible for approving, overseeing, and regulating the state's CTE programs. The Carl D. Perkins Act of 2006 identifies 16 industry-based areas often referred to as the 16 career clusters. Many high school CTE programs use these clusters to organize courses designed to provide students with hands-on learning experiences. These sequenced sets of CTE courses are called programs of study or career pathways (Sass et al., 2011). Researchers

for the State of Arkansas Bureau of Legislative Research (2018) stated that under the regulations of the Arkansas Department of Career Education, Arkansas high schools serving Grades 9-12 are required to teach 9 units of CTE. Of these 9 courses, a minimum of 3 out of 16 occupational areas must be represented. These 16 occupational areas include (a) Agriculture, Food, and Natural Resources; (b) Architecture and Construction; (c) Arts, A/V Technology, and Communications; (d) Business, Management, and Administration; (e) Education and Training; (f) Finance; (g) Government and Public Administration; (h) Health Science; (i) Hospitality and Tourism; (j) Human Services; (k) Information Technology; (l) Law, Public Safety, Corrections, and Security; (m) Manufacturing; (n) Marketing, Sales, and Service; (o) Science, Technology, Engineering, and Mathematics; and (p) Transportation, Distribution, and Logistics.

During the 2016-2017 school year, districts across Arkansas offered a total of 58 programs of study, although districts typically only offer a select number of those programs. The staff of the State of Arkansas Bureau of Legislative Research (2018) stated that the top three programs of study and the percentage of schools across the state offering them were Family and Consumer Sciences (86%), Agricultural Power (71%), and Medical Professions (65%). There were 601 separate courses offered within the state's CTE programs. Of these courses, the three most popular for the 2016-2017 school year were Computerized Business Applications with 15,947 students, Family and Consumer Science with 13,300 students, and Food and Nutrition with 8,683 students. The report also identified gender differences in CTE participation and the types of courses in which students were interested. Computerized Business Applications was the most popular course for males and females. For male students in Arkansas, two of the most

popular CTE courses included Survey of Agriculture Systems, as well as Family and Consumer Sciences. For female students in Arkansas, Family and Consumer Sciences and Child Development were among the most popular courses. Dougherty (2016) examined the CTE courses and outcomes of Arkansas students. They found that on average, students in Arkansas enrolled in 4.9 CTE courses during their high school careers, and 89% took at least one CTE course. In addition, in the State of Arkansas Bureau of Legislative Research Report (2018), researchers stated that Arkansas students participating in at least three CTE courses were 21% more likely to graduate from high school, be employed, enrolled in a 2-year college, and have higher wages than those students whose secondary school experience did not have a CTE focus.

Arkansas graduation requirements also encompasses six Career Focus units, which includes CTE courses. To graduate, students must take six Career Focus units. Career Focus units and CTE courses are similar in concept, but students can receive Career Focus units by taking courses not considered to be within CTE programs such as foreign language, mathematics, or any other course that help students progress toward their work aspirations (State of Arkansas Bureau of Legislative Research, 2018). Students who create a Career Focus plan enroll in specific courses that better prepare them for future careers. In addition to the Career Focus plan, students in Arkansas have the option to participate in three units of high school CTE credit to earn the status of CTE completer. Graduating seniors who have successfully completed three units in one particular CTE program are considered completers for that respective area. Researchers from the State of Arkansas Bureau of Legislative Research (2018) reported completers make up 40% of all 12th-grade students and 42% of all graduates. In the 2012-2013

school year, Arkansas had 12,056 completers with an increase to 12,855 reported in the 2016-2017 school year. However, this level of participation was not always evident across the United States. Statisticians from the National Center for Education Statistics (2013) pointed out that between 1990 and 2009, the number of CTE credits earned by United States high school students dropped 14% due in part to more emphasis in academic courses associated with the implementation of the NCLB legislation.

After schools across the United States implemented NCLB, the new educational reform known as ESSA was created to better prepare students for college and careers. The Arkansas Department of Education (2018c) reported the state's ESSA plan was approved by the United States Department of Education on January 16, 2018. This plan will be fully implemented in the 2018-2019 school year. Indicators in the plan focus on students' success while preparing them for college and careers through rigorous academic standards. In addition, the plan will focus on reading proficiency, science, and expanded learning opportunities. According to Bradley (2016), ESSA supported CTE programs by allowing states to use federal funds for professional development in dual enrollment programs and integration of academics into CTE courses. It also allowed states to use Title I funds for student services that include CTE courses leading to industry-recognized certifications. As ESSA is implemented into schools across the nation, the implications for CTE are far reaching and include the opportunity to demonstrate how these programs and activities can contribute to overall student success.

Although ESSA supports the integration of academics into CTE courses, the Arkansas Department of Education develops curriculum standards for both academic and CTE programs. The administrators within the Arkansas Department of Education (2018a,

2018b) described the Arkansas English language arts and mathematics standards as the collective work of educators from across the state. The standards document reflects the expectations of what all students should know and be able to do (curriculum) as well as help teachers implement the standards with fidelity (pedagogy). The curricula found in mathematics, reading, and CTE classrooms continue to evolve as new educational reforms are set by policymakers; authentic instructional practices should be employed to help meet new learning goals. School administrators, counselors, and teachers work to ensure state requirements are met as well as the integration of academics into the CTE classroom.

In Arkansas, school district administrators can provide CTE instruction in two ways. First, courses may be offered face to face on district campuses or virtually in online classes. The second option is sending students to Secondary Area Career Centers located across the state. The programs of study most frequently offered among Arkansas school districts are Family and Consumer Science, Agriculture Power, Structural and Technical Systems, and Digital Communications. For those districts that send students to Secondary Area Career Centers, the most frequently offered programs of study include Medical Professions, Welding, and Automotive Service Technology (The State of Arkansas Bureau of Legislative Research, 2018). With an increase in student participation, CTE course offerings have become mainstreamed into contemporary education provided by high schools.

Perceptions of Career and Technical Education

CTE can be found world-wide. European countries have well-established programs, but in the United States, there seems to be a stigma attached to taking CTE

courses. The stigma suggests CTE courses are for under-achieving students who do not plan to attend college or for those students who struggle in traditional classrooms. However, CTE has been reintroduced into the mainstream educational system where high schools are beginning programs focused on vocational skills that include rigor associated with academic success and assessment in the classroom (Schloss & Gunter, 2011). Thus, CTE has gained more popularity in recent years. Aliaga, Kotamraju, and Stone (2012) reported between 2002 and 2012, CTE has seen a 151% increase in enrollment with almost 96% of students nationwide taking at least one CTE course (see also Castellano, Sundell, Overman, & Aliaga, 2012; Hollenbeck, 2011; Levesque et al., 2008; United States Department of Education, 2009). Of these students, Aliaga et al. (2012) reported that 27% have taken three or more CTE courses during high school. Therefore, they noted that participation in CTE programs is on the rise again.

As more focus has been placed on funding CTE courses to meet the demands of today's workforce, more focus has also emerged on the effectiveness of CTE programs and courses. Students taking a mixture of CTE courses and academic courses are less likely to drop out of high school and have higher academic scores than those who enroll mostly in CTE courses (Bozick & Dalton, 2013). The United States Department of Education (1992) stated high school graduates participating in more CTE courses were less likely to meet academic standards compared to those students who did not participate in as many courses. Almost 20 years later, Yettick, Cline, and Young (2012) studied the effects of dual enrollment coursework, and while doing so, the researchers made some observations regarding those students enrolled in career-readiness courses as opposed to college-readiness offerings. They found students participating in several CTE courses

tend to have lower academic scores than those who participate in more academic-focused courses.

Dual enrollment is a program or course that allows students to earn both high school and postsecondary credit. Dual credit research conducted by Levesque, Wun, and Green (2011) indicated less than 4% of America's 2.7 million 2005 high school graduates completed dual credit coursework. Bozick and Dalton (2013) stated students who struggled academically were more likely to be placed in CTE courses. The research results helped solidify the negative perception that CTE courses are for less academically-able students (Aliaga, Kotamraju, & Stone, 2014; Haag, 2015). For 20 years, evidence seemed to support the idea that participation in CTE courses translated to low achievement.

Perceptions matter in education. Lynch (2000) stated that high school CTE programs are at a critical point in their success. There are two realities affecting the view of CTE. First, some programs have adapted to the demands of industry and academic accountability by staying up to date by integrating rigorous academics to help equip students with knowledge and skills necessary for success after high school. However, the second reality lies in programs that have failed to stay relevant and simply have relied on special populations to maintain participation numbers. Unfortunately, according to Lynch, it is these programs that the public thinks of when CTE is discussed. CTE is often referred to as vo-tech, shop class, or an elective course. Public perception often views CTE courses for students who are not college bound or who cannot afford college. Public opinion on relevancy and rigor has impacted the reputation of CTE programs.

Despite the reputation of CTE participation as being a track for lower-achieving students, the pathways found within it offer real world learning opportunities that engage and motivate them through rigorous academic applications. New reforms such as ESSA and a renewed focus of academic content integration have brought CTE back into the spotlight. As the United States' educational system continues to work with limited funding, policymakers are looking toward programs that work. The Career and Technical Education (2013) revealed that some CTE programs are struggling, but overall, policymakers have recognized the role these programs play in preparing highly-skilled workers for the job market.

Learning Theories and Career and Technical Education

Learning theories provide a framework of how knowledge is processed. There are several learning theories in education, and each one is important because it provides a deeper understanding of the learning needs of students. Curriculum planning and understanding the theory behind the method of instruction help teachers organize concepts and principles. Resnick and Klopfer (1989) asserted that the organization of curriculum is critical in helping students see connections between what has been learned and what is currently being learned. Mugisha and Mugimu (2015) noted that learning theories play an important role in the implementation of curriculum. There are many different views of putting curriculum theory into practice. Due to the nature of CTE courses, instructional strategies may differ greatly from those employed in academic courses. Two popular theories associated with CTE are the constructivist and contextual learning theories. Deeply rooted in allowing students to problem-solve and make

connections between concepts, the two theories offer insight to the fundamental curricula of CTE programs.

Constructivist Theory

With roots in the philosophy of pragmatism, the constructivist learning theory has led to significant findings in education. Researchers have long studied the human brain and how information is processed and demonstrated. Since the late 1800s, constructivism has been one of the main learning theories in education. It has provided much explanation and insight to the nature of learning and gaining knowledge (Mayer, 1992). At the core of constructivism is the theory that learners actively learn to construct knowledge and meaning from their experiences (Fosnot, 1996; Steffe & Gale, 1995). It is associated with information processing and the process of cognition. The building of knowledge comes from creating mental pictures of what has been learned. Anderson (1995) and Bruning, Schraw, and Ronning (1999) found creating mental pictures created significant relationships with learning, memory, and cognition. It was important in a student's working memory and in neurological models of the brain. There are three basic types of constructivist principles, which include social, cognitive, and radical. Of the three principles, cognitive constructivism is most closely related to the practices of CTE courses because knowledge and meaning are built through student experiences. As educational standards change to incorporate higher-order thinking and problem-solving skills, constructivism may have important implications in the future (Doolittle & Camp, 1999). Although education and CTE are changing, there are still important factors of the constructivist theory that provide students with opportunities to learn by being involved.

Doolittle and Camp (1999) described several factors essential to the constructivist pedagogy. One factor is that learning should take place in authentic and real-world environments where experiences are the primary catalyst for learning. Learning is enhanced when experiences are more authentic. Within CTE, the classroom settings include project-based learning opportunities in which students actively work alone or with other students to solve a real-world problem with applications to what has already been learned. Another factor includes social negotiation and mediation in learning. Socially relevant skills and knowledge such as greetings, gender relations, and dress can be enhanced. According to Spivey (1997), language is one of the most important components of constructivism because it is the medium in which knowledge and understanding are shared. CTE coursework assumes that specific language skills are in place.

Creating learning opportunities that are relevant to students is a third factor. The staff of the Career and Technical Education Center of New York (2012) suggested that fostering rigorous and relevant instruction provides all students with the knowledge and skills needed for success in today's complex, technologically-oriented society. The center's staff also suggested students benefit most from rigorous learning environments that create a culture of learning that is orderly, meaningful, and successful. At the beginning of the 20th century, legislators who promoted the Smith-Hughes Act of 1917 called for real-world applications within all CTE courses where instruction is relevant to applications used in real life. Constructivist researcher Vygotsky (1978) stressed the importance of reading and writing, "Teaching should be organized in such a way that reading and writing are necessary for something…writing must be relevant to life" (pp.

117-118). Practical application is at the heart of CTE coursework. Other factors noted by Doolittle and Camp (1999) include assessing students formally to structure future learning experiences, encouraging students to become self-regulatory, and creating content and skills that can be understood using prior knowledge. Teachers should be facilitators in learning who encourage multiple perspectives. These factors create a link between theory and practice.

Implementing constructivist-based learning theories into the CTE classroom can be achieved in project-based learning, cooperative learning groups, and within service learning and problem-solving activities. Providing students with opportunities to examine complex problems can promote integration of core subjects (Barell, 2007). In order for authentic constructivist learning opportunities to be provided to students, integration of other disciplines must be included in lesson plans and activities.

Contextual Theory

The contextual teaching and learning theory is derived from the theory of behaviorism and then constructivism. The foundation of the contextual learning theory is rooted in both theories. Contextual learning theory involves making connections with learned concepts to the real world. Davtyan (2014) stated that contextual learning is a system that ties brain actions to patterns and meaning by connecting academic content to the context of real life. Davtyan argued that it is important because it helps students store short-term memory and also helps long-term memory that can be associated with application processes. It draws upon student skills, interests, experiences, and cultures in vocational contexts and engages students in interactive and collaborative activities that help make meaningful connections. It also encourages students to become self-regulated

learners as they complete projects in the classroom as well as preparing them for successful career endeavors (Purdue University, n.d.). Not all people learn best abstractly. In fact, most people learn best through informal, contextual experiences (Caine & Caine, 1991; Gardner, 1983; Kolb, 1984). Therefore, the new educational reform ESSA will require teachers to attend to more rigorous academic standards that meet the needs of their students and increase student achievement not only in core classes but CTE classes as well.

There are seven components of contextual learning. Each is an integral part in the application of the theory within the classroom. Wijarwadi (2008) identified them as using authentic materials, reflection upon what was learned, modeling, working in learning communities, questioning, inquiry, and constructing knowledge. The parameters require students to use critical thinking and problem-solving skills. They also involve students thinking about what was learned and having access to authentic assessments that demonstrate their task performance levels. Furthermore, Johnson (2002) outlined eight elements essential to the theory. These include developing meaningful connections between materials, doing significant work, being self-regulated, collaborating with others, using critical thinking, providing individual nurturing to motivate, setting high standards, and incorporating the use of authentic materials. Both Johnson (2002) and Wijarwadi (2008) found the use of authentic assessments as key elements of contextual learning. CTE coursework employs each element of the theory on a regular basis.

Schraw and Olafson (2002) stated contextual learning practice changes over time to be authentic to student needs, which include teaching and learning strategies such as problem solving, project-based learning, cooperative learning groups, self-exploration,

and learning from each other. In a contextual classroom, teachers are simply instructional facilitators who assist students in exploring and sharing ideas. Assessments are often created at the local school level and use criterion-based or portfolio evaluations. Schraw and Olafson also stated the purpose of employing the theory is for students to self-regulate their learning, relate knowledge learned, and apply the principles to their lives.

The integration of standards-based mathematics and literacy into CTE programs encourages the application of constructivist and contextual theories to authentic learning experiences. Those leading successful CTE programs incorporate rigorous academic standards that apply skills needed for successful careers. Teachers use contextual learning to help students make connections between what is learned and life goals.

Pedagogy and Career and Technical Education

The methods of teaching employed for one subject area may vary greatly from those used with other content. *Pedagogy* refers to the interactions between teachers and students and includes the learning environment as well as the types of tasks used to help students learn concepts (Hall, Murphy, Soler, 2008). There is a broad spectrum of approaches ranging from teacher-centered to learner-centered. Teacher-centered pedagogy is useful when new material is presented, and a student-centered approach allows students to explore ideas and develop a deeper understanding. Craig, Kraft, and Du Plessis (1998) stated that effective pedagogy can increase student achievement, social development, and technical skills. The type of classroom and student demographics also play a role in determining the best type of teaching method.

Deciding what type of pedagogy to use is usually dictated by the subject matter coupled with the teaching style of individual teachers. Craig et al. (1998) indicated the

use of proper and effective pedagogy can improve student achievement, technical, and academic skills. National assessments such as the ACT or ACT Aspire and curriculum standards established by each state influence teacher pedagogy. When educational leaders examine the types of pedagogy used, they must also examine ways to align policies and practices in order to encourage teachers to use higher-order thinking skills (Vavrus & Bartlett, 2013). Pedagogy is different from curriculum because it determines how content is taught. Curriculum, on the other hand, is what content is taught in the classroom. Curriculum standards are revised by each state and contain specific content to be taught in each course. Pedagogy can reach across academic and CTE courses, whereas curriculum is unique to each course taught. However, CTE coursework may provide a vehicle for the practical application of academic standards.

Integration Initiatives

With the passage of ESSA, a shift in the direction of the nation's educational system will give states more control over standards, interventions, and funding. To better understand the effects of reform and academics on CTE, the concept of integration must be examined. Integration was designed to make concepts more meaningful for students, to improve student engagement, and to integrate academic content into CTE courses. Researchers and scholars have developed many definitions and theories of what integration really is, and the variety of definitions have made it difficult to have one characterization that encompasses its purpose (Etim, 2005; Vars, 1997). According to Beane (1995), integration is the process of organizing learning and life skills to help students make connections between subject matter that focuses on the blending of

curriculum and relationships by encouraging inquiry in a contextual manner. CTE courses may provide the contexts for these connections.

By integrating academics and technical skills of CTE, students have opportunities to master concepts of mathematics, reading, and science skills along with those skills specific to a profession. The Association for Career and Technical Education (2006) revealed teaching core academics within CTE courses helps students make necessary connections to achieve success in both academic and technical classrooms. Students need opportunities to gain critical mathematics and reading skills in a relevant context. Integration also helps students learn how to use inquiry and exploration to learn concepts of academics within other curricula. This, in turn, helps them make connections between what has been learned and what they are currently learning.

Mathematics has been identified as an important core subject that can be integrated into many curriculum areas. This content has gained much attention because concept connections can be made across two or more courses or discipline areas, which means mathematics can be found between similar subjects or across different discipline areas such as between mathematics and clothing construction. Stone, Alfeld, Pearson, Lewis, and Jensen (2006), in a study by the National Research Center for Career and Technical Education titled *Building Academic Skills In Context: Testing the Value of Enhanced Math Learning in CTE*, revealed when teachers combine professional development with pedagogic framework to teach mathematics that is rooted in CTE curriculum, students who received the enhanced instruction scored significantly higher on standardized mathematics tests than those who received regular curriculum. In addition, Partin (2016) revealed that in Arizona where academic content is deeply embedded

within CTE courses and teachers use instruction aligned with the state's academic standards, CTE students outperformed the general high school population on the high-stakes academic test called the Arizona Instrument to Measure Standards test. As integration of academics in CTE classrooms continues, more teachers are developing methods of instruction that show students the connections between CTE and academic courses such as mathematics and reading as well as other subjects.

Despite strong integration efforts, Conley (2005) suggested there remains a gap in mathematics achievement that could be addressed by creating activities requiring students to master content and high-order thinking skills while working with their high school teacher as well as a post-secondary faculty member. By linking the two levels of mathematics applications, students can begin to bridge the gap between attaining basic concepts and using the skills necessary to complete tasks. In their report, *Rigor and Relevance*, Stone, Alfeld, Pearson, Lewis, and Jensen (2007) identified the need to improve mathematics scores and discussed how CTE courses can create more rigorous and relevant mathematics skills though applied learning. Yet, Ota St. Clair and Gardner (n.d.) contended high schools and community colleges are not producing competent CTE graduates for the workforce. They reported the National Association of Manufacturers stated 80% of manufacturers have difficulty finding qualified employees and rejected 50% of applicants due to the lack of basic skills. Therefore, there is much work remaining. Emphasizing standards-based mathematics skills in CTE coursework may be beneficial on many fronts. By the beginning of the 21st century, Crowson, Wong, and Aypay (2000) suggested that even though efforts to integrate academics into CTE curriculum has gained greater emphasis, the movement is only a decade old. Educators

are approaching two decades since integration was first seriously employed; the momentum to integrate and create higher standards in education continues to grow as teachers look for ways to link academic skills into CTE courses.

As schools continue to integrate mathematics in order to prepare students for success in high school and the workforce, reading is another important subject that has been a focal point for integration. Literacy includes reading skills and links those skills with listening, speaking, and writing in the CTE curriculum. Integrating components such as reading, writing, and speaking is called whole language instruction. Pressley, Mohan, Fingeret, Reffitt, and Raphael-Bogaert (2007) identified effective literacy instruction as having a combination of skill-based and whole language teaching in an environment that is motivating and supportive to students. The Association for Career and Technical Education (2009) reported that fourth-grade students in the United States have some of the world's best reading and writing levels. However, by high school, students are performing at much lower levels. The reading levels have steadily declined over the past two decades with only 35% of the United States 12th graders reading at proficient levels.

Several studies (Goodman, 1989a, 1989b; Penn, 1992) found that by incorporating reading skills into CTE curriculum, students develop comprehensive reading skills that build on what has already been learned in English or language arts courses. An essential element of literacy integration is reinforcing reading, writing, comprehension, presentation, and speaking in a contextual way through CTE course content. The Association for Career and Technical Education (2009) argued that leaders in CTE have been at the forefront of integration efforts in reading by using content area reading and writing strategies to promote student learning and help them apply higher-

level literacy skills. They also reported that research has shown one of the best ways to help students gain literacy skills is to motivate and engage them in content related to their interests. The unique combination of content and rigor that CTE courses offer can motivate students to read, write, and apply skills in authentic situations that can prepare them the workforce.

Student Achievement: Measuring Success

As educational reform creates change in accountability for schools, it also creates a call for more rigorous academic programs by educators and policymakers who want in-depth content taught in the classroom. Schools face outcome-based accountability and cannot ignore the importance of student achievement. Many school faculties choose interventions or enhanced teaching strategies to teach complex content and help students use higher-order thinking skills. The United States spends approximately $620 billion per year on K-12 education, and after NCLB, a resurgence in research on the effects of teachers on student achievement has taken place (Kane, 2017). As schools seek effective strategies to improve student achievement, academic content and CTE should be considered.

Academic Assessments

Several seminal pieces of educational legislation were passed that brought monumental changes to education, especially in student achievement and how it is measured. These education-based laws were designed to increase student achievement and create more accountability not only for students but school districts as well. When NCLB was put into place, a strong emphasis was placed on academic courses that could better prepare students for college. There was no mention of CTE in NCLB, but the

influence of NCLB legislation has affected its programs (Wallace, 2012). NCLB placed the responsibility of student progress upon the school as tests in reading, mathematics, and language arts were given each year. These test results carried a great deal of weight with the state and federal government; therefore, many teachers were encouraged to teach only content found on the tests. Since the focus of teaching shifted to specific content, a reduction in the number of elective courses began to occur. According to Wallace (2012), the notion developed that CTE courses were less demanding and lacked the rigor required in academic courses. The academic standards of NCLB provided students with opportunities to develop skills necessary for college. However, the policymakers had failed to consider the number of students who would not attend college or seek certifications within their chosen line of work. The influence of NCLB on CTE became evident, and leaders in CTE began to question whether or not districts would continue offering CTE programs due to low student participation.

According to Long (2016), ESSA still requires annual tests in reading, language arts, and mathematics in Grades 3-8 as well as in high school. However, this is a reduction in the amount of standardized testing that had been expected in the past. ESSA will allow school districts to use different nationally recognized assessments instead of just one, limit the amount of time students spend taking tests, eliminate duplicate or unnecessary assessments, and create assessments that are driven by teaching and learning alone. The researchers from the American Institutes of Research (2016) contended that ESSA will provide an opportunity for CTE to demonstrate how career related programs and activities can contribute to student success. In an effort to increase student achievement, ESSA now includes several references to career preparation and focuses on

integrating CTE into academic content areas. In fact, CTE can be included on state report cards, thus showing the effectiveness of programs and achievement levels of students who participate in those programs.

ACT

ACT and SAT are the two major college entrance exams used by high schools and higher education to determine college readiness. The ACT is more commonly given in the Midwestern states, whereas the SAT is more popular on the east and west coasts (Grinstead, 2013). Of the students graduating from high school in 2016-2017, 60% took the assessment with 82% of them aspiring to go to postsecondary school (ACT, 2017b). The number of students taking the ACT has increased, and the emphasis on earning higher scores has increased as well. The higher the scores, the more opportunities a student has for entrance into postsecondary schools.

With an emphasis on student achievement and career readiness, the educational reforms ESSA brings to education will be seen in the use of ACT test scores. In high schools across the nation, ESSA allows ACT or SAT scores to be used in lieu of a state-developed assessment. Student data collected from these assessment tools have been researched for many years. Earlier researchers indicated the best predictors of ACT performance were those measuring achievement in high school such as course work and grades (Noble, Crouse, Sawyer, & Gillespie, 1992; Noble, Davenport, Schiel, & Pommerich, 1999; Noble & McNabb, 1989). Student participation in extracurricular and education-related activities also showed an influence on their academic achievement (Noble, Davenport, & Sawyer, 2001; Stricker, Rock, & Burton, 1992; Viadero, 1998). This combination of courses taken and participation in activities where students connect

concepts learned in class can influence their performance on the ACT. The relationship between courses and ACT performance continues to be carefully analyzed by educators and researchers.

Mathematics scores, in particular, continue to be of great concern for educators. In a study by Wang and Pennington (n.d.) of the Iowa Department of Education, student achievement in mathematics courses and their performance on the ACT mathematics sub-test were compared. Their study discovered taking higher level mathematics courses has a positive influence on ACT mathematics scores. Both female and male students benefitted from taking higher-level mathematics courses because their ACT scores were higher than those who did not. Lower-achieving students also saw gains in achievement levels when combined with rigorous coursework. The study did not specifically address ACT performance related to CTE course participation.

However, data indicate that it is important for students to go beyond minimum requirements in order to positively affect ACT results. The Arkansas Department of Education (2016) indicated that 57% of students in 2016-2017 took courses considered to be core or more. This means students took at least 3 years of mathematics and 4 years of English courses, which would include reading skills. ACT scores provided in the report indicated mathematics scores were lower, 16.9 for students taking less than core courses, as opposed to students taking the core or more who had an average ACT score of 19.5. In reading, similar results indicated students taking fewer core courses scored lower on the ACT reading subtest with an average score of 16.8, whereas students who took the core or more had an average score of 20.3. Reading also showed similar results with students taking less than core English classes having an average ACT reading score of 19.3 and

those who took core or more having an average of 22.6. ACT scores reflect the effectiveness of instruction and a student's preparedness for college but will also provide valuable data to educators as ESSA is implemented. With ESSA, schools must have challenging academic standards in reading, mathematics, and science, while preparing students to succeed in college or careers. States may choose to use assessments such as the ACT to monitor student achievement.

Arkansas has used the ACT assessment for many years. Each year the Arkansas Department of Education provides a report for student achievement. ACT also provides national results each year to help measure student achievement in all areas tested. The Arkansas Department of Education (2016) provided ACT data showing the number of 11th-grade students tested in the state has increased exponentially since 2012-2013 from 7,170 students to 31,110 in 2016-2017. Edwards (2017) reported Arkansas as 1 of 17 states with 100% participation in giving the ACT test, which is typically given during the 11th grade. This means that Arkansas and other states have made the ACT a mandatory part of the statewide assessments. She also reported that in 2017, Arkansas' average mathematics score was 19.0 and reading was 19.7, with an overall composite score of 19.4. The national average composite score was 21. States that require the ACT test tend to have lower composite scores than those who do not.

With increased numbers, the percentage of students meeting benchmark scores (determined based on national data each year) in mathematics and reading has decreased (ACT, 2017c). In 2012-2013, 27% of students met mathematics benchmarks and 36% met reading benchmarks. Still, in 2016-2017 only 24% met mathematics benchmarks and 30% met reading benchmarks. The mean mathematics ACT score for Arkansas students

has dropped from 19 to 18.5, and mean reading score has seen a small gain from 18.8 to 18.9. These results correlate with research conducted by Wang and Pennington (n.d.). Although changes in benchmarks have been small, they are, indeed, changes in ACT performance from Arkansas students. Overall, Arkansas falls below the national average on ACT scores. According to ACT (2017b), the average national score in 2017 was 21.0 overall, 20.7 in mathematics and 21.4 in reading. In Arkansas, the overall average was 19.4, with students scoring 19.0 in mathematics and 19.7 in reading. There is a need to improve the scores of Arkansas students.

ACT Aspire

ACT Aspire was developed by the ACT organization and released in 2014. The assessment is designed to be administered to students in Grades 3-10 as a way to measure student achievement toward college and career readiness. It measures student achievement in English, reading, writing, mathematics, and science. These scores can provide longitudinal data to show growth in several subject areas and measure a student's progress toward achieving college and career readiness skills. Many states, including Arkansas, now use ACT Aspire to monitor student growth over the course of several years.

All 10th-grade students in Arkansas general education classes take the Reading and Mathematics ACT Aspire assessments. The Arkansas Department of Education (2017) published details of 10th-grade student scores for the 2016-2017 school year. In mathematics, 24.72% of 10th-grade students met the benchmark, and 36.38% of 10th graders met readiness benchmarks for reading. Results also indicated an increase in the number of students who are meeting readiness benchmarks in those subject areas.

Mathematics saw a gain of 3.20% and reading also gained 1.77%. The ACT Aspire (2017) staff reported that the national percentage of students meeting or exceeding the benchmarks for mathematics was 32% and 38% for reading. For mathematics and reading, the state saw an increase in students at or above the benchmark scores from the 2015-2016 assessment and the 2016-2017 assessment. In 2015-2016, 21.5% of students scored at or above the benchmark in mathematics, and in 2016-2017, 24.7% scored at or above the benchmark. In reading, the 2015-2016 scores revealed 34.6% scored at or above the benchmark, and in 2016-2017, 36.4% of students scored at or above the benchmark. Although the state saw increases, 10th-grade students in both mathematics and reading failed to score at or above the national average.

Although the ACT Aspire assigns student scores to help assess a student's readiness for college or career skills, it is considered a new assessment, and many states are just recently at the point of collecting enough data to see if the ACT score predictions correlate with actual student ACT scores. Mathematics and reading scores continue to be low not only across Arkansas but the nation as well. The data gained from ACT Aspire over time will provide evidence of its effectiveness and reliability as a measure of student achievement.

Gender and CTE

CTE courses are unique because they contain content that attracts both male and female students. However, this was not always true due to stereotypes and societal expectations. Before the 1970s, it was common for female students not to enroll in woodworking or auto mechanics courses because of gender bias. By the same token, male students were often discouraged from enrolling in family and consumer science

courses. A clear distinction of CTE courses by gender has been in place for decades with particular courses attracting more males and others attracting more females (Lufkin et al., 2007). For example, Cashen (2012) found male-dominated courses included computer science, agribusiness, construction trades, mechanics, and repairs or precision products. In contrast, female-dominated courses included family and consumer sciences, allied health and health sciences, and business courses. However, today's CTE administrators and school counselors encourage more gender diversity than ever before.

As more males and females participate in CTE, levels of student achievement need to be carefully examined. Although many studies have addressed gender and achievement without the CTE association, there is little research in regard to gender relative to CTE and student achievement. Researchers have associated gender with CTE, but it often related to course choices and not achievement levels. However, Stone and Aliaga (2003) found students who do participate in CTE study more, which may improve achievement levels by devoting more time to coursework. In addition, the National Association of Vocational Education (2004) also indicated that 12th-grade students who participated in CTE and took the National Assessment of Educational Progress exam scored 11 scale points higher in mathematics and 4 scale points higher in reading than those who took little or no CTE coursework.

Differences in academic performance and which gender is more academically inclined has been the subject of much research. Halpern (2000) suggested there are no significant differences in academic intelligence, but there are some gender-related cognitive ability differences that are consistently found. Many stereotypes exist portraying that males perform better in mathematics and science, and females perform

better in English courses. Banaji, Greenwald, and Nosek (2002) noted that stereotypes regarding females in mathematics and science are well known. Some believe these stereotypes affect performance, which is often referred to as stereotype threat. O'Connor (2015) reported researchers have discovered females taking mathematics tests under stereotype threat actually show particular areas of the brain processing the negative social information. In short, this means anxiety as a result of stereotyping can have an influence on performance levels. Although stereotypes may have an influence on student achievement, achievement levels may also be influenced by physiological differences in the brain.

Some argued the gender gap is due to biological differences in male and female brain structure and exposure to sex hormones. The exposure to these hormones and structural variations between male and female brain hemispheres appear to influence gender-specific skills (Cahill, 2005; Halpern, 2000). Further research by Burman, Booth, and Bitan (2008) revealed specific areas of the brain associated with language operate differently in females than in males during language tasks. Also, females and males rely on different parts of their brains while performing these types of tasks. Halpern (2000) found that female students performed better than males on tests of mathematical sentences and reasoning, and males performed better than females in geometry, measurement, probability, and statistics. In addition, females excelled in language production, synonym generation, word fluency, and memory. Research continues to examine how societal and physiological factors affect male and female student achievement not only in the courses taken but also on national assessments such as the ACT.

As high schools continue to use testing as a way to assess student achievement levels with ACT tests for those desiring to enter college, test taking skills can reveal gender differences. Hedges and Nowell (1995) found male cognitive abilities are more variable than females, with wide variations of high and low scores on the scoring scale. They noted that females score higher on written assessments than they do on multiple-choice questions, and the reverse appears to be true for males. Perhaps, this is why male and female students show a difference on ACT scores where nationally, males outperform females on the mathematics subtest. According to ACT (2014a), females score higher in English and social sciences, and males score higher in mathematics and science. In 2017, the national average ACT score for males in mathematics was 21.2 and 20.4 for females. In reading, the average reading score was 21.2 for males and 21.8 for females (ACT, 2017a). The difference between male and female student scores on the ACT is less consistent than the differences shown in high school grades. Grades reflect the day to day performance in school course work, and ACT scores reflect a point in time assessment. When analyzing national averages, it is also important to consider state averages in subject areas as well as other demographics such as gender.

The Arkansas Department of Education (2016) provided the ACT profile report for the state that indicates 26% of males and 30% of females met mathematics benchmarks. In reading, 24% of males and 32% of females met benchmarks. Nationally, 44% of males and 39% females met mathematics benchmarks on the ACT. For reading, 46% males and 49% females met established benchmarks (ACT, 2017a). Student achievement in academic courses such as mathematics and reading continues to be an

important indicator of learning, but achievement in CTE courses may be just as important.

Career and Technical Education Achievement

The evolution of CTE has made it more popular and viable for students with all levels of abilities. In the United States, CTE can be found at both the secondary and postsecondary levels. According to United States Department of Education (2014), the National Assessment of Career and Technical Education's final report to Congress found in 2009, 85% of public high school students had completed one or more occupational CTE courses, and 76% had earned at least one full credit of CTE coursework. Of these students, 19% were CTE concentrators who earned at least three credits in one CTE field. Just a few years earlier, the National Center for Education Statistics (2011) reported that 90% of high school graduates have earned some CTE credit. The participation rate in CTE is high, and those districts that offer high quality programs also have lower dropout rates and more students earning dual enrollment credits. Students also earn more industry-endorsed certificates, which encourage students to continue in postsecondary education (Plank, DeLuca, & Estacion, 2005). CTE courses offer students a skill-based education designed to help them enter the workforce with transferable skills that lead to careers.

The demographics of students enrolled in CTE courses are also changing, thus increasing the diversity of students participating in programs. In addition to the percentage of students completing course work, the United States Department of Education (2014a) also showed more male graduates are CTE concentrators than are female graduates (21% versus 17%). With changes in society, the workforce, and

education, the performance of students is not the only thing being analyzed. Due to requirements and standards set forth by Perkins, each state receiving Perkins funding is carefully analyzed to determine whether it is performing.

Each state must submit performance data to the United States Department of Education for all Perkins funding indicators, which includes target indicators in mathematics and reading. Based on the data collected for mathematics, the report showed CTE concentrators scored lower than non-CTE concentrators in mathematics proficiency levels in 2005 and 2009. In addition, the report also noted a Philadelphia study by Neild, Boccanfuso, and Byrnes (2013) who discovered CTE course-taking had no effect upon achievement in mathematics or reading comprehension among students in Grades 8-11.

According to the United States Department of Education's (2016) Consolidated Annual Report, the reading performance of Arkansas' students is declining. As educators look for ways to improve student achievement, the application of literacy and reading skills into other non-academic classrooms becomes more relevant than ever. Rice (n.d.) stated CTE is not emphasizing rigorous technical reading and writing skills. Technical literacy includes the ability to read, understand, and communicate the language of specific CTE fields. She added that not enough students are being asked to read and write in their CTE assignments and only one-third say they have prepared a written report or research paper. Fewer than half (46%) were asked to read a CTE article containing technical reading at least once or twice a month. This may indicate that integration opportunities are not being optimized and academic growth is not nurtured. In relation to mathematic achievement, researchers Stone et al. (2006) from The National Research Center for Career and Technical Education found students who participated in CTE

courses with integrated mathematics performed significantly higher on standardized mathematics tests and community college mathematics placement tests than those who were in regular CTE courses. They also improved their mathematics skills without losing technical skills. It is important to note that the study used naturally occurring mathematics in CTE courses where instructors did not replace what they were already teaching with mathematics standards for instruction.

The balance between CTE and academic courses can be challenging as students must choose required courses to graduate as well as courses that are of interest to them. CTE courses offer a wide variety of courses that are of interest to students but also provide insight to potential career fields. In a 2005 report by Plank et al., it was noted students entering high school at a normal or younger age were less likely to drop out if they participated in CTE courses. They proposed the mixture of academic and CTE courses helps balance classroom experiences that help students identify pathways leading to their individual successes. High school CTE programs are typically offered in three settings: comprehensive high schools, full-time CTE schools, or area CTE centers. Most high school programs focus on student academic achievement but offer CTE courses as electives as students work toward graduation (United States Department of Education, 2014). The popularity of CTE programs continues to grow as students look for more diversity in coursework.

After analyzing over 2 million transcripts in 2010, The National Research Center for Career and Technical Education discovered students who participated in three or more CTE courses were four times more likely to take advanced mathematics (Aliaga et al., 2012). The United States Department of Education (2014) reported CTE concentrators

accounted for 14% of students completing a higher-level mathematics course in ninth grade compared to 24% having completed a lower-level course or no mathematics course at all. Hudson and Hurst (1999) described a study that analyzed students who participated in a mixture of CTE and academic courses as well as those who took only academic courses. There was no difference in test scores of either group of students. Conversely, a significant difference was found in those students who focused mainly on CTE courses.

Much like the study Hudson and Hurst (1999) described, there are other studies centered on improving reading and writing scores. In Florida, the Content Area Technical Area Education Reading program has been used in CTE classrooms as a way to increase reading proficiency (Florida Department of Education, 2010). The program focuses on a continual effort by both student and teacher to read a wide variety of materials to improve reading skills and is just one initiative used to improve student achievement. It has shown some improvements in reading and writing skills for those students who are in classrooms using enhanced reading strategies. On the other hand, when students were tested after a semester of the Content Area Technical Area Education Reading program, no statistically significant results were found (Florida Department of Education, 2010). Efforts to incorporate more mathematics and reading into the curricula and explore the influence CTE courses have on student achievement will continue. Educators, undoubtedly, will continue to refine curriculum as society, student needs, and the direction of CTE continues to change.

Summary

The birth of CTE came from the need to supply the workforce with skilled workers. As programs became implemented into schools, funding became necessary for

supplies and equipment. The first major funding came with the Smith-Hughes Act of 1917, which provided an alternative course of study compared to traditional education (Lynch, 2000). Today's CTE classroom looks much different than the early classrooms, but two learning theories remain closely connected to instruction—constructivism and contextualism—where students actively learn from experiences and make connections to the real world (Barell, 2007; Fosnot, 1996; Steffe & Gale, 1995). These connections to real world applications also integrate core academics into the CTE curriculum. Mathematics and reading skills, in particular, are applied as students complete assignments relating to specific CTE courses in which they are participating. By integrating academics with the technical skills of CTE, students may improve academic skills as well as specific skills of a given profession.

Another factor that continues to be researched is gender differences. Researchers continue to identify differences in academic achievement. Although the influence of CTE on student achievement in mathematics and reading was the primary focus of the examined research, there was limited research on how CTE influences ACT performance and none found on the effects on ACT Aspire scores. Whether one focuses on mathematics or reading, research confirms integration is important in the education of students. I maintained a focus on CTE participation and student achievement on the ACT and ACT Aspire tests, but gender was also added as a factor that might affect achievement.

Advocates for CTE programs and those who advocate for academic programs may be at odds. Lynch (2000) stated high school CTE programs are at a critical point in their success due to perceptions of the public. Although the quality of CTE programs and

the ability levels of students have some bearing on mathematics and reading achievement, the question must be asked: to what degree does participation level in the CTE program influence student achievement? Research on gender differences and achievement continues as educators continue to analyze assessments such as the ACT and ACT Aspire to determine whether students demonstrate growth in achievement levels.

CHAPTER III

METHODOLOGY

The literature review indicated that there were little data on how participation level in CTE courses may influence student performance on ACT Aspire and ACT assessments in mathematics and reading. However, much research existed on the integration of academics such as mathematics and reading into the CTE classroom. Additional research was also found on gender differences in student achievement related to the ACT assessment. In the present casual-comparative study, I examined the effects of participation level in CTE courses on student performance on the ACT Aspire and ACT subtest assessments in mathematics and reading. Assessments were administered during the 2017-2018 school year in two 5-A public schools in North Central Arkansas. Scores from the ACT Aspire assessment for 10th graders and the ACT assessment scores for 11th graders were accessed by the schools' representatives and forwarded to me for statistical analysis. For this study, I generated the following null hypotheses:

1. No significant difference will exist by gender between taking four or more CTE courses versus three or fewer on reading achievement as measured by the ACT Aspire for 10th-grade students in two 5-A high schools in North Central Arkansas.
2. No significant difference will exist by gender between taking four or more CTE courses versus three or fewer on mathematics achievement as measured

by the ACT Aspire for 10th-grade students in two 5-A high schools in North Central Arkansas.

3. No significant difference will exist by gender between taking four or more CTE courses versus three or fewer on reading achievement as measured by the ACT Reading subtest for 11th-grade students in two 5-A high schools in North Central Arkansas.
4. No significant difference will exist by gender between taking four or more CTE courses versus three or fewer on mathematics achievement as measured by the ACT Mathematics subtest for 11th-grade students in two 5-A high schools in North Central Arkansas.

This chapter includes an explanation of the research design, sample, instrumentation, data collection procedures, and analytical methods. A summary of the limitations is also presented.

Research Design

A causal-comparative, non-experimental design was used for this research. The data for this study included ACT Aspire assessment scores for 10th-grade students and ACT assessment scores for 11th-grade students in two 5-A school districts in North Central Arkansas. Assessments were taken during the 2017-2018 school year. Since the assessments were already employed in the school and because no manipulation of the main independent variables was possible, I chose a causal-comparative approach for this study. As stated by Johnson and Christensen (2008), causal-comparative research is suitable when quantitative data such as achievement data is used, and the researcher does not randomly assign the population to any particular group or influence the independent

variable(s). For this research, a 2 x 2 factorial ANOVA between-groups design was used to test the four hypotheses in this study. The independent variables for all hypotheses were gender (male versus female) and CTE participation level (participation in four or more CTE courses versus participation in three or fewer CTE courses). The dependent variables for the first two hypotheses were mathematics and reading achievement measured by the ACT Aspire test for the 10th-grade students, respectively. The dependent variables for the last two hypotheses were mathematics and reading achievement measured by the ACT subtests for the 11th-grade students, respectively.

Sample

The accessible populations from which the samples were drawn consisted of 10th- and 11th-grade students' scores in two North Central Arkansas high schools. School A had an average enrollment of 749 students in the high school, and School B had an average enrollment of 949 students in the high school (Arkansas Department of Education, 2018d, 2018e). Arkansas Activities Association (2015) categorized both high schools as 5-A schools, and both had roughly equal numbers of males and females. All the 10th and 11th grade scores were compiled by the schools' representatives and forwarded to me. After scores were recorded, each student's transcript was reviewed and the number of CTE courses each student had taken was documented. To protect the identities of students receiving special education services, these students were not identified in the data provided by the school districts and were included with the student data.

Before the samples were chosen, all students who were designated as English language learners were removed to prevent data being skewed due to language

acquisition deficits. Next, 10th-grade students who did not have mathematics *and* reading ACT Aspire scores from the 2017-2018 school year administration and all 11th-grade students who did not have mathematics *and* reading ACT subtest score were also excluded. This resulted in only two samples, one of 10th-grade ACT Aspire scores and one of 11th-grade ACT scores. Finally, scores below 409 on the ACT Aspire and 10 on the ACT assessments, both of which are considered low scores by their respective organizations, were eliminated based on an assumption of lack of effort or cognitive ability at the time the assessment was administered.

The 10th-grade data were coded by grade, school, CTE participation level, gender, ACT Aspire mathematics score, and ACT Aspire reading score. To safeguard privacy, I gathered no information that would isolate or identify students individually. First, four accessible populations of students' scores were identified from the 10th-grade scores: males who participated in four or more CTE courses, females who participated in four or more CTE courses, males who participated in three or fewer CTE courses, and females who participated in three or fewer CTE courses. From these accessible populations, equal numbers of scores were drawn for the four samples. In accordance with Johnson and Christensen (2008), having an equal number of students included in each group to be assessed is significant when using ANOVA models.

The 11th-grade data were coded by grade, school, CTE participation level, gender, ACT mathematics subtest score, and ACT reading subtest score. To safeguard privacy, I gathered no information that would isolate or identify students individually. First, four accessible populations of students' scores were identified from the 11th-grade scores: males who participated in four or more CTE courses, females who participated in

four or more CTE courses, males who participated in three or fewer CTE courses, and females who participated in three or fewer CTE courses. From these accessible populations, equal numbers of scores were drawn for the four samples. In accordance with Johnson and Christensen (2008), having an equal number of students included in each group to be assessed is significant when using ANOVA models. Although students may have taken the ACT assessment more than once, only the initial test score was used for this study. This was done to eliminate the effects of practice in taking the test more than once.

Instrumentation

I used data from two instruments in this study, the ACT Aspire and the ACT. First, in the spring, Arkansas 10th-grade students take the ACT Aspire test. The Arkansas Department of Education (2017) requires all schools in Arkansas to administer the ACT Aspire exam to students in Grades 3-10 each year. The norm-referenced exam consists of questions including constructed response, selected response, and technology-enhanced items to assess student knowledge and provide insights into student preparedness for the ACT assessment (ACT Aspire, 2016b). In Arkansas, 10th graders are given the English, mathematics, reading, science, and writing exams in the spring of each year. Although the ACT Aspire is typically taken online, students requiring special modifications in testing can take the assessment by paper and pencil.

According to ACT Aspire (2016a), the ACT Aspire assessment is the first longitudinal assessment to fully connect student performance with readiness benchmarks and the only system to directly connect to the ACT exam, which is commonly used for college entrance. Within the assessed subject areas, the ACT Aspire provides a single

scale that can monitor and track performance and progress through each grade. The raw scores can range from 400 and up, depending upon the grade level and subject matter. Scores are computed using the sum of points earned between the multiple-choice, technology-enhanced, and constructed response items. In assessing ACT Aspire scores, 10th-grade students in this study must also meet benchmark scores much like the ACT. The benchmark score for mathematics is 432 and 428 for reading (ACT Aspire, 2016c).

Associated with benchmark scores, there are four ACT readiness levels used to classify student performances. These are Exceeding, Ready, Close, and Needs Support. Score ranges and benchmark scores for mathematics and reading are provided by the state of Arkansas for each readiness level. Students whose scores fall in the Ready category are expected to be at least 50% more capable compared to other students of succeeding in a college class. Those scoring Close are below the benchmark, but near, and those in need of support score substantially below the ACT readiness benchmark (ACT Aspire, 2016d). Students achieving higher scores than established benchmark scores for each subject area are considered well prepared for the ACT assessment. The score ranges for each readiness level for mathematics include Exceeding (438-460), Ready (432-437), Close (426-431), and Needs Support (400-425). For reading, the ranges include Exceeding (434-442), Ready (428-433), Close (422-427), and Needs Support (400-421) (ACT Aspire, 2017). Each level of performance provides educators with specific knowledge and skills students can demonstrate within different subjects. The levels can also provide a foundation for improvement strategies to help the student perform at higher levels. For this study, however, scale scores were used for analysis.

Second, I used the ACT assessment. The ACT is a nationally recognized assessment that includes subtests in English, mathematics, reading, science, and writing (optional). Like the ACT Aspire, the ACT is a norm-referenced assessment that serves as a curriculum- and standards-based educational and career planning tool, and it also assesses students' academic readiness for college. The ACT assessment is used by many universities as a tool in college admissions (ACT, 2017a). Unlike the ACT Aspire, it can be taken both online or by paper and pencil. Throughout the year, high schools across the state of Arkansas offer all 11th-grade students the opportunity to take the ACT college readiness assessment.

For this study, scores from the mathematics and reading subtests were used. The ACT mathematics subtest is a 60-question, 60-minute test measuring mathematical skills acquired during courses taken by the end of 11th-grade. The test is made up of multiple-choice questions that require students to use reasoning skills to solve mathematical problems. According to ACT (2017c), the test can be broken down into the following categories: 57-60% preparing for higher mathematics that includes number and quantity, algebra, functions, geometry, as well as statistics and probability; 40-43% integrating essential skills that includes skills typically learned before the 8th grade; and less than 25% modeling that measures usage of modeling skills across mathematical topics. The ACT Reading subtest is a 40-question, 35-minute test measuring students' reading comprehension. The test requires students to read several passages and answer specific questions to demonstrate their understanding of content. The reading test can be broken down into the following categories: 55-60% key ideas and details that includes interpreting key ideas and themes, 25-30% craft and structure that includes analysis of

word and phrase meanings, and 13-18% integration of knowledge and ideas in which the student demonstrates an understanding of claims and connections between texts. Each category of the mathematics and reading test measure student knowledge and skill sets that have been learned over a period.

In assessing high school student ACT scores, the ACT benchmark scores are based on actual performance of college students. ACT (2013) explained that extensive data are collected from 214 institutions and over 230,000 students. These data are used to provide an overall measure of success during the first year of college. ACT benchmarks are defined as the necessary knowledge and skills a student needs to enroll and succeed in college, trade schools, or technical schools without the need for remediation. The scoring criteria for the ACT have an established system where students earn one point for each correct answer, but do not lose or gain points for omitted or incorrect answers. A raw score for each is calculated by the number of questions answered correctly in that section. The raw scores are then converted into a scaled score, which ranges between 1 and 36. Only scale scores were employed for this research. The overall composite ACT score is the average of the scale scores for each section of the test. The writing test, which is optional, is scored a bit differently.

Students earning high ACT scores can typically get into more selective colleges and universities. According to McCammon (2018), in elite institutions such as the University of Chicago or Princeton, a score of at least 30 will be needed. Smaller state and local schools may accept lower ACT scores. She discussed how students can work to earn the middle 50%, which is a statistic many schools provide to give test score ranges from the 25th to 75th percentile and is considered a reliable way to determine scoring

thresholds. In addition to college and university acceptance, many students receive scholarship money based upon ACT scores. ACT (2017a) noted that the benchmark for the ACT mathematics subtest is 22. The score ranges and number of questions answered correctly for each quartile for the mathematics subtest include 28-36 (45-60 questions), 19-27 (29-44 questions), 10-18 (4-28 questions), and 1-9 (0-3 questions). The benchmark for the ACT reading subtest is 22. The score ranges and number of questions answered correctly for each quartile for the mathematics subtest include 28-36 (31-40 questions), 19-27 (19-30 questions), 10-18 (6-18), and 1-9 (0-5).

Data Collection Procedures

After receiving Institutional Review Board approval, I obtained existing data from the district offices of the schools in the summer of 2018. The Arkansas Department of Education emailed ACT Aspire test results to each district who then provided them to me. ACT scores were sent to each district by the organization and then shared with me. Names were replaced with numbers to maintain confidentiality. Excel spreadsheets were created for the data collected. These data included school location, grade level, gender, and participation level in CTE courses, ACT Aspire mathematics and reading scores (10th grade), and ACT mathematics and reading subtest scores (11th grade). Samples were then randomly drawn from each stratified grouping for equal-sized samples.

Analytical Methods

IBM Statistical Packages for the Social Sciences Version 22 was used for data analysis. Data collected for the hypotheses were coded, and the four hypotheses were analyzed using the following statistical analysis. A pre-analysis of the data included verifying the number of participants by grade level, school classification, gender, and

CTE participation level to ensure the correct number for the samples. A second analysis was conducted to check for outliers. Additionally, the homogeneity of variances was checked using the Levene's statistic. To address the first hypothesis, a 2 x 2 between-groups factorial ANOVA was conducted using gender and CTE course participation level for 10th graders as the independent variables. The dependent variable, student mathematics achievement, was measured by the ACT Aspire mathematics test. To address the second hypothesis, a 2 x 2 between-groups factorial ANOVA was conducted using gender and CTE course participation level for 10th-graders as the independent variables. The dependent variable, student reading achievement, was measured by the ACT Aspire reading test. To address the third hypothesis, a 2 x 2 between-groups factorial ANOVA was conducted using gender and CTE course participation level for 11th-graders as the independent variables. The dependent variable, student mathematics achievement, was measured by student scores on the ACT Mathematics subtest. To address the fourth hypothesis, a 2 x 2 between-groups factorial ANOVA was conducted using gender and CTE course participation level for 11th graders as the independent variables. The dependent variable, student reading achievement, was measured by the ACT Reading subtest. To test the null hypotheses, I used a two-tailed test with a .05 level of significance. A Bonferroni correction was used to adjust the probability value because of the increased risk of type I errors that are likely when performing multiple statistical tests (Morgan et al., 2012). Therefore, because two samples were selected for analysis, the adjusted significance level was .025 (.05/2).

Limitations

As with most research studies, limitations need to be noted to help the reader determine how to interpret the results of the studies. First, I employed a causal-comparative strategy rather than an experimental approach. This research design, therefore, was a limitation in itself. I was unable to manipulate the independent variables or randomly assign participants to a treatment condition. This produced less conclusive evidence. However, this did not exceed usual circumstances encountered in using student data for research purposes.

Second, this study was conducted with a limited number of 10th- and 11th-grade scores in only two school districts in North Central Arkansas. The research was confined to students who had taken both the ACT Aspire mathematics and reading tests or the ACT mathematics and reading subtests in the two 5-A school districts. Therefore, the quantitative sample was limited, and generalizations were restrictive and could not be applied to all schools and situations.

Third, testing may have affected internal validity. For the 10th graders, the students had previously taken the ACT Aspire standardized test before and may have recognized some items or types of items from the previous years even though formatting may have changed. However, there was one full calendar year between the tests, and it was not considered to be a major limitation.

Fourth, student apathy towards testing may have affected scores. According to Ahmad (2017), most high school students struggle with low engagement. Although assessments such as the ACT or ACT Aspire provide a snap shot of student achievement at a given moment, students with poor test-taking skills or low motivation often have

lower scores compared to their actual achievement. Many students who are not college bound do not see the value of testing or the analyzed scores. In addition, Benders (2011) discussed how apathy among American students has risen due to the lack of motivation, interest, goals, and determination to succeed. American students rank 11th among 14 major countries who have similar educational levels. He also discussed how 29% of American teachers rank apathy as a serious problem in a 2008 survey of public high school teachers. Apathy continues to pose a serious risk to educators as testing continues to be one of the most popular methods of assessment and may become skewed due to a students' motivation rather than their skill or knowledge.

Fifth, students receiving special education services were included in this study. With a greater push for inclusion in regular classroom settings, more students who receive special education services are placed in CTE courses. In fact, Peterson and Mahadevan (2008) noted that in Texas, over 25% of the 500,000 students receiving special services or students with disabilities participate in CTE courses every year. They also stated many students receiving special services or students with disabilities are placed in CTE classes to give them the best opportunity to gain employment or advancing to higher education after high school. Samuels (2017) noted students with disabilities who spend 80% of the school day in regular education classes have higher rates of graduation, college attendance, and employment compared to those who spend less time in regular education courses. Inclusion provides students with special needs with the opportunity to be mainstreamed into the regular student population. However, because some learning disabilities, particularly those specific to mathematics and reading may affect test-taking skills, a skewing of data may have resulted.

Sixth, 10th-grade students who did not have mathematics *and* reading ACT Aspire scores from the 2017-2018 school year administration and all 11th-grade students who did not have mathematics *and* reading ACT subtest scores were also excluded. Finally, scores below 409 on the ACT Aspire and 10 on the ACT assessments, both of which are considered low scores by their respective organizations, were eliminated based on an assumption of lack of effort or cognitive ability at the time the assessment was administered.

Although this study had limitations, I proposed that the results of this study might be used to inform decisions regarding the participation in CTE programs and gender and how they affect mathematics and reading achievement of students on the ACT and ACT Aspire tests. Results of this study might be beneficial to schools and districts throughout Arkansas similar to the 5-A schools as they work toward providing quality education in both academic and CTE programs.

CHAPTER IV

RESULTS

The purpose of this quantitative research study was to determine the effects of gender and CTE participation level on the mathematics and reading achievement as measured by the ACT Aspire for 10th-grade students and ACT scores for 11th-grade students in two 5-A high schools in North Central Arkansas. Using IBM SPSS Version 22, a 2 x 2 between-groups factorial ANOVA was run for the four hypotheses using a significance level of .025. Prior to running the statistical analyses, assumptions of normality and homogeneity of variances were checked. In addition, descriptive statistics and inferential results were reported.

Hypothesis 1

Hypothesis 1 stated that no significant difference will exist by gender between taking four or more CTE courses versus three or fewer on reading achievement as measured by the ACT Aspire for 10th-grade students in two 5-A high schools in North Central Arkansas. To test this hypothesis, a 2 x 2 factorial ANOVA was conducted. Before conducting ANOVA, I screened the data for outliers and examined the data for the assumptions of independence of observations, normality, and homogeneity of variances. Table 1 displays the group means and standard deviations for gender and CTE participation level on reading achievement.

Table 1

Descriptive Statistics for Gender by CTE Participation on Reading Achievement Measured by ACT Aspire for 10th-Grade Students

Gender	Program Participation	*M*	*SD*	*N*
Female	CTE Part 4 or more	426.40	7.70	30
	CTE Part 3 or fewer	426.30	6.20	30
	Total	426.35	6.93	60
Male	CTE Part 4 or more	422.83	7.63	30
	CTE Part 3 or fewer	424.73	7.69	30
	Total	423.78	7.66	60
Total	CTE Part 4 or more	424.62	7.81	60
	CTE Part 3 or fewer	425.52	6.97	60
	Total	425.07	7.38	120

To test the assumption of normality, histograms as well as Shapiro-Wilk statistics were examined for each group with $p < .05$ for each group, indicating that the data were normally distributed for both male and female participating in three or fewer CTE courses. However, the data were not normally distributed for both male and female participating in four or more CTE courses. Despite the violations of normality, analysis of data using ANOVA was deemed appropriate as ANOVA is considered robust to mild violations of the assumption of normality (Field, 2005; Leech, Barrett, Morgan, & Leech, 2011). Furthermore, results of Levene's test revealed no violation of homogeneity of variances among the groups for reading achievement, $F(3, 116) = 1.01$, $p = .391$. The results of the ANOVA are displayed in Table 2.

Table 2

Factorial ANOVA Results from Reading Achievement

Source	*SS*	*df*	*MS*	*F*	*p*	*ES*
Gender	197.63	1	197.63	3.67	.058	0.031
CTE Participation	24.30	1	24.30	0.45	.503	0.004
Gender*CTE Part.	30.00	1	30.00	0.56	.457	0.005
Error	6239.53	116	53.79			
Total	21688292.00	120				

The interaction between gender and CTE participation level was not significant, $F(1, 116) = 0.56$, $p = .457$, $ES = 0.005$. Therefore, there was no evidence to reject the null hypothesis for the interaction between gender and CTE participation level. Because there was no significant interaction, a simple effects analysis was not conducted. According to Cohen (1988), this is a small effect size. Figure 1 displays the means for reading achievement as a function of gender.

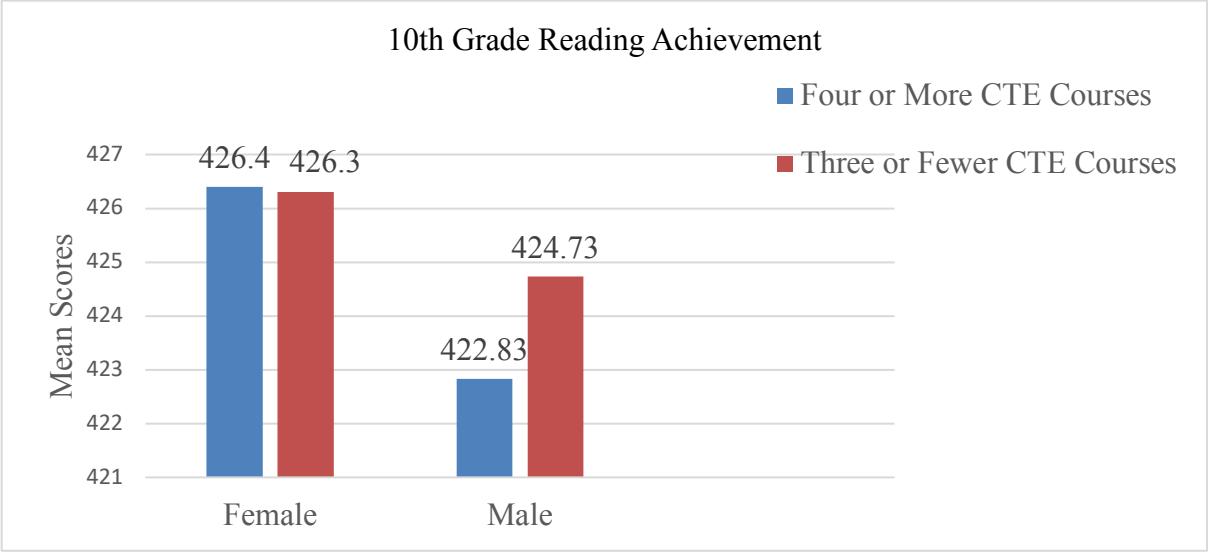

Figure 1. Means for reading achievement as a function of gender by CTE participation level.

Given there was no significant interaction between the variables of gender and CTE participation level, the main effect of each variable was examined separately. There was not a statistically significant main effect for gender, $F(1, 116) = 3.67$, $p = .058$, $ES = 0.031$; the mean of the reading scores for males ($M = 423.78$, $SD = 7.66$) was not significantly different from the mean of the scores for females ($M = 426.35$, $SD = 6.93$). There was also no statistically significant main effect for CTE participation level, $F(1, 116) = 0.45$, $p = .503$, $ES = 0.004$. The mean of the reading scores for CTE participating in four or more CTE courses ($M = 424.62$, $SD = 7.81$) was not significantly different from the mean of the scores for those participating in three or fewer courses ($M = 425.52$, $SD = 6.97$).

Hypothesis 2

Hypothesis 2 stated that no significant difference will exist by gender between taking four or more CTE courses versus three or fewer on mathematics achievement as

measured by the ACT Aspire for 10th-grade students in two 5-A high schools in North Central Arkansas. To test this hypothesis, a 2 x 2 between-groups factorial ANOVA was conducted. Before conducting ANOVA, I screened the data for outliers and examined the data for the assumptions of independence of observations, normality, and homogeneity of variances. Table 3 displays the group means and standard deviations for gender and CTE participation level on mathematics achievement.

Table 3

Descriptive Statistics for Gender by CTE Participation on Mathematics Achievement Measured by ACT Aspire for 10th-Grade Students

Gender	Program Participation	*M*	*SD*	*N*
Female	CTE Part 4 or more	427.33	7.84	30
	CTE Part 3 or fewer	428.47	7.40	30
	Total	427.90	7.58	60
Male	CTE Part 4 or more	427.67	8.23	30
	CTE Part 3 or fewer	426.83	8.89	30
	Total	427.25	8.50	60
Total	CTE Part 4 or more	427.50	7.97	60
	CTE Part 3 or fewer	427.65	8.15	60
	Total	427.58	8.03	120

To test the assumption of normality, histograms as well as Shapiro-Wilk statistics were examined for each group with $p < .05$ for each group, indicating that the data were normally distributed for both male and female participating in four or more CTE courses.

Furthermore, data were normally distributed for males participating in three or fewer CTE courses, but not for females. Despite the violation of normality, analysis of data using ANOVA was deemed appropriate as ANOVA is considered robust to mild violations of the assumption of normality (Field, 2005; Leech et al., 2011). Furthermore, results of Levene's test revealed no violation of homogeneity of variances among the groups for reading achievement, $F(3, 116) = 0.66$, $p = .579$. The results of the ANOVA are displayed in Table 4.

Table 4

Factorial ANOVA Results from Mathematics Achievement

Source	*SS*	*df*	*MS*	*F*	*p*	*ES*
Gender	12.68	1	12.68	0.19	.661	0.002
CTE Participation	0.68	1	0.68	0.01	.919	0.000
Gender*CTE Part.	29.01	1	29.01	0.44	.508	0.004
Error	7620.98	116	65.70			
Total	21946109.00	120				

The interaction between gender and CTE participation level was significant, $F(1, 116) = 0.44$, $p = .508$, $ES = 0.004$. Therefore, there was no evidence to reject the null hypothesis an interaction between gender and CTE participation level. Because there was no significant interaction, a simple effects analysis was not conducted. According to

Cohen (1988), this is a small effect size. Figure 2 displays the means for mathematics achievement as a function of gender and CTE Participation level.

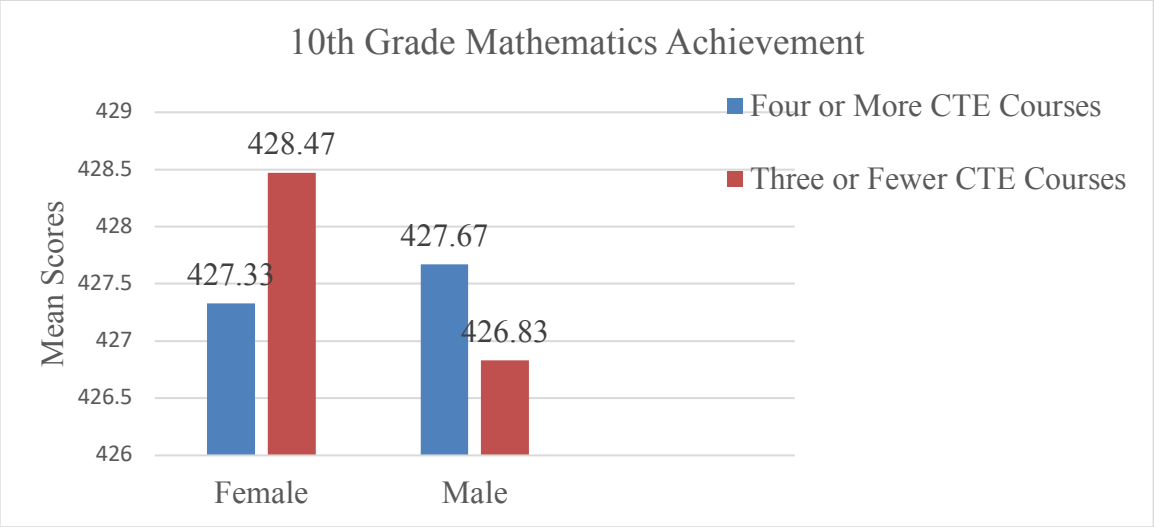

Figure 2. Means for mathematics achievement as a function of gender by CTE participation level.

Given there was no significant interaction between the variables of gender and CTE participation level, the main effect of each variable was examined separately. There was not a statistically significant main effect for gender, $F(1, 116) = 0.19$, $p = .661$, $ES = 0.002$; the mean of the mathematics scores for males ($M = 427.25$, $SD = 8.50$) was not significantly different from the mean of the scores for females ($M = 427.90$, $SD = 7.58$). There was also no statistically significant main effect for CTE participation level, $F(1, 116) = 0.01$, $p = .919$, $ES = 0.000$. The mean of the mathematics scores for those participating in four or more CTE courses ($M = 427.50$, $SD = 7.97$) was not significantly different from the mean of the scores for those participating in three or fewer CTE courses ($M = 427.65$, $SD = 8.15$).

Hypothesis 3

Hypothesis 3 stated that no significant difference will exist by gender between taking four or more CTE courses versus three or fewer on reading achievement as measured by the ACT Reading subtest for 11th-grade students in two 5-A high schools in North Central Arkansas. To test this hypothesis, a 2 x 2 factorial between-groups ANOVA was conducted. Before conducting ANOVA, I screened the data for outliers and examined the data for the assumptions of independence of observations, normality, and homogeneity of variances. Table 5 displays the group means and standard deviations for gender and CTE participation level on reading achievement.

Table 5

Descriptive Statistics for Gender by CTE Participation on Reading Achievement Measured by ACT Reading Subtest for 11th-Grade Students

Gender	Program Participation	*M*	*SD*	*N*
Female	CTE Part 4 or more	19.77	4.05	30
	CTE Part 3 or fewer	21.10	6.28	30
	Total	20.43	5.28	60
Male	CTE Part 4 or more	19.37	5.72	30
	CTE Part 3 or fewer	17.60	5.79	30
	Total	18.48	5.77	60
Total	CTE Part 4 or more	19.57	4.92	60
	CTE Part 3 or fewer	19.35	6.24	60
	Total	19.46	5.60	120

To test the assumption of normality, histograms as well as Shapiro-Wilk statistics were examined for each group with $p < .05$ for each group, indicating that the data were normally distributed for both females participating in four or more and three or fewer CTE courses. However, the data were not normally distributed for both males participating in four or more and three or fewer CTE course. Despite the violations of normality, analysis of data using ANOVA was deemed appropriate as ANOVA is considered robust to mild violations of the assumption of normality (Field, 2005; Leech et al., 2011). Furthermore, results of Levene's test revealed no violation of homogeneity of variances among the groups for reading achievement, F (3, 116) = 1.90, p = .134. The results of the ANOVA are displayed in Table 6.

Table 6

Factorial ANOVA Results from Reading Achievement

Source	*SS*	*df*	*MS*	*F*	*p*	*ES*
Gender	114.08	1	114.08	3.74	.056	0.031
CTE Participation	1.41	1	1.41	0.05	.830	0.000
Gender*CTE Part.	72.08	1	72.08	2.36	.127	0.020
Error	3538.23	116	30.50			
Total	49161.00	120				

The interaction between gender and CTE participation level was not significant, F (1, 116) = 2.36, p = .127, ES = .020. Therefore, there was no evidence to reject the null hypothesis of an interaction between gender and CTE participation level. Because there was no significant interaction, a simple effects analysis was not conducted. According to Cohen (1988), this is a small effect size. Figure 3 displays the means for reading achievement as a function of gender and CTE Participation level.

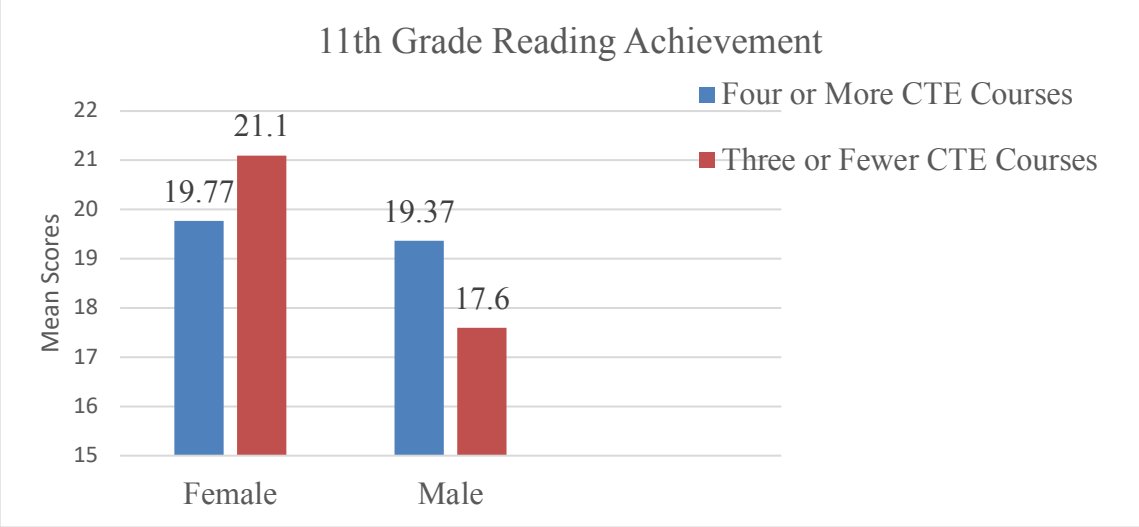

Figure 3. Means for reading achievement as a function of gender by CTE participation level.

Given there was no significant interaction between the variables of gender and CTE participation level, the main effect of each variable was examined separately. There was not a statistically significant main effect for gender, F(1, 116) = 3.74, p = .056, ES = 0.031; the mean of the reading scores for males (M = 18.48, SD = 5.77) was not significantly different from the mean of the scores for females (M = 20.43, SD = 5.28). There was also no statistically significant main effect for CTE participation level, F(1,

116) = 0.05, p = .830, ES = 0.000. The mean of the reading scores for those participating in four or more CTE courses (M = 19.57, SD = 4.92) was not significantly different from the mean of the scores for those participating in three or fewer CTE courses (M = 19.35, SD = 6.24).

Hypothesis 4

Hypothesis 4 stated that no significant difference will exist by gender between taking four or more CTE courses versus three or fewer on mathematics achievement as measured by the ACT Mathematics subtest for 11th-grade students in two 5-A high schools in North Central Arkansas. To test this hypothesis, a 2 x 2 factorial between-groups ANOVA was conducted. Before conducting ANOVA, I screened the data for outliers and examined the data for the assumptions of independence of observations, normality, and homogeneity of variances. Table 7 displays the group means and standard deviations for gender and CTE participation level on mathematics achievement.

Table 7

Descriptive Statistics for Gender by CTE Participation on Mathematics Achievement Measured by ACT Mathematics Subtest for 11th-Grade Students

Gender	Program Participation	*M*	*SD*	*N*
Female	CTE Part 4 or more	17.00	2.46	30
	CTE Part 3 or fewer	18.23	3.69	30
	Total	17.62	3.17	60
Male	CTE Part 4 or more	19.27	4.41	30
	CTE Part 3 or fewer	18.10	3.75	30
	Total	18.68	4.10	60
Total	CTE Part 4 or more	18.13	3.72	60
	CTE Part 3 or fewer	18.17	3.69	60
	Total	18.15	3.69	120

To test the assumption of normality, histograms as well as Shapiro-Wilk statistics were examined for each group with $p < .05$ for each group, indicating that the data were not normally distributed across all groups. Results of the Shapiro-Wilkes test revealed significant deviation from a normal distribution of scores for all groups. In reflection of this violation, the histograms for each group were skewed to the left. Despite this violation, analysis of data using ANOVA was deemed appropriate because ANOVA is considered robust to mild violations of the assumption of normality (Field, 2005; Leech et al., 2011). Furthermore, results of Levene's test did reveal a violation of homogeneity of variances among the groups for reading achievement, $F(3, 116) = 3.44$, $p = .019$. The results of the ANOVA are displayed in Table 8.

Table 8

Factorial ANOVA Results from Mathematics Achievement

Source	*SS*	*df*	*MS*	*F*	*p*	*ES*
Gender	34.13	1	34.13	2.57	.112	0.022
CTE Participation	0.03	1	0.03	0.00	.960	0.000
Gender*CTE Part.	43.20	1	43.20	3.25	.074	0.027
Error	1543.93	116	13.31			
Total	41152.00	120				

The interaction between gender and CTE participation level was not significant, $F(1, 116) = 3.25$, $p = .074$, $ES = 0.027$. Therefore, there was no evidence to reject the null hypothesis of the interaction between gender and CTE participation level. Because there was no significant interaction, a simple effects analysis was not conducted. According to Cohen (1988), this is a small effect size. Figure 4 shows the means for mathematics achievement as a function of gender and CTE Participation level.

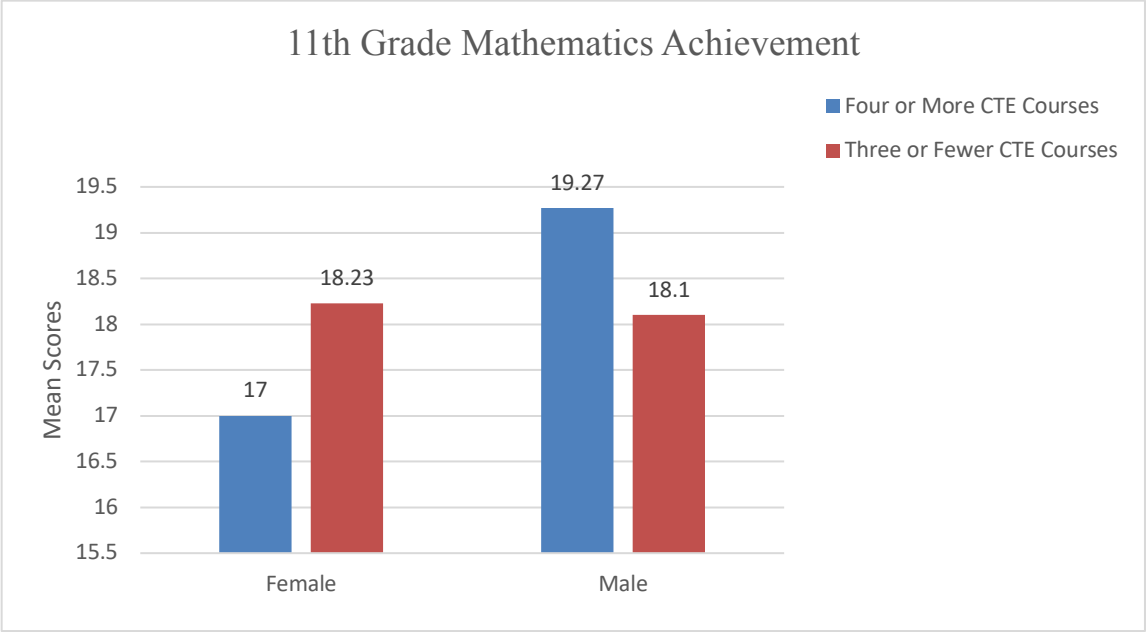

Figure 4. Means for mathematics achievement as a function of gender by CTE participation level.

Given there was no significant interaction between the variables of gender and CTE participation level, the main effect of each variable was examined separately. There was not a statistically significant main effect for gender, $F(1, 116) = 2.57$, $p = .112$, $ES = 0.022$; the mean of the mathematics scores for males ($M = 18.68$, $SD = 4.10$) was not significantly different from the mean of the scores for females ($M = 17.62$, $SD = 3.17$). There was also no statistically significant main effect for CTE participation level, $F(1, 116) = 0.00$, $p = .960$, $ES = 0.000$. The mean of the reading scores for those participating in four or more CTE courses ($M = 18.13$, $SD = 3.72$) was not significantly different from the mean of the scores for those participating in three or fewer CTE courses ($M = 18.17$, $SD = 3.69$).

Summary

The purpose of this study was to determine the effects of gender and CTE participation level on reading and mathematics achievement for 10th- and 11th-grade students in two 5-A high schools in North Central Arkansas. For the four hypotheses, none displayed a significant interaction between gender and CTE participation level. See Table 9 for results of significance for interaction and main effect of variables.

Table 9

Summary of Statistically Significant of Results by Hypotheses 1-4

	p			
Variable	H1	H2	H3	H4
Gender*CTE Part.	.457	.508	.127	.074
Gender	.058	.661	.056	.112
CTE Participation	.503	.919	.830	.960

Note: Significance = $p \leq .05$

Additionally, the main effect for CTE participation level was not significant for the four hypotheses related to reading and mathematics achievement. Similarly, the main effect for gender was not significant for the four hypotheses. However, the two hypotheses related to reading achievement yielded results that were close to statistical significance. For the 10th-grade students, females, in general, scored higher compared to the male students. For the 11th-grade students, again, females, in general, scored higher compared to their male counterparts.

CHAPTER V

DISCUSSION

The purpose of this study was to explore the effects by gender between CTE participation level on mathematics and reading achievement as measured by the ACT Aspire for 10th-grade students and the ACT for 11th-grade students in two 5-A high schools in North Central Arkansas. The results of the study indicated that CTE participation level did not have a significant effect on student achievement scores. The study data also revealed that gender did not have a significant effect on student achievement scores, regardless of participation level. Thus, neither variable indicated statistically significant effects. However, the results of the study do give insight into trends and potential areas for future study. This chapter includes a summary of the conclusions and potential influences for the state of Arkansas. Recommendations for educational change and suggestions for future research are provided.

In light of the trends in CTE curriculum and student achievement over the past few decades, integration of mathematics and reading into CTE coursework has become an important part of the high school educational process. Those who support integrative learning believe it can improve student engagement, motivation, and retention because higher-order thinking skills are used through problem-solving, collaboration, creativity, and innovation (Caine & Caine, 1991). This research may provide some insight into the results of this practice.

Conclusions

All four hypotheses proposed in this study were tested by conducting a 2 x 2 between-groups factorial ANOVA. The data sets provided for Grades 10 and 11 were analyzed from two North Central Arkansas high schools. The independent variables were gender and CTE participation level. The dependent variable was student achievement measured by scores from the 10th-grade ACT Aspire mathematics and reading assessments and scores from the 11th-grade ACT mathematics and reading tests. Analysis of the hypotheses included an examination for the effects of the independent variables. The findings of this research indicated that CTE participation level was not a significant factor in the mathematics and reading achievement of 10th-grade students or 11th-grade students, nor was gender. However, there was near significance regarding gender in reading achievement.

Hypothesis 1

The first hypothesis stated that no significant difference will exist by gender between taking four or more CTE courses versus three or fewer on reading achievement as measured by the ACT Aspire for 10th-grade students in two 5-A high schools in North Central Arkansas. An analysis of this hypothesis revealed no statistically significant interaction between independent variables, gender and CTE participation level, on student reading achievement. When comparing the four means, the mean of the females who participated in four or more CTE courses was the highest, followed closely by the mean of the females who participated in three or fewer CTE courses. The mean for the males who participated in three or fewer CTE courses was the third highest, and the mean for the males that participated in four or more CTE classes was the lowest. However, no

pairing met the significance level. Thus, the null hypothesis for the interaction effect was not rejected. Turning to the main effects, the main effect for gender on reading achievement was not significant, even though the mean for females was higher compared to the mean of the males. These findings indicated that males, regardless of CTE participation level, performed lower than the females. Similarly, even though the mean for those participating in four or more CTE courses, regardless of gender, was lower than those participating in three or fewer CTE courses, findings were not statistically significant. Therefore, both the main effect hypotheses for gender and for CTE participation level were retained when considering the reading achievement of 10th-grade students taking the ACT Aspire assessment.

Hypothesis 2

The second hypothesis stated that no significant difference will exist by gender between taking four or more CTE courses versus three or fewer on mathematics achievement as measured by the ACT Aspire for 10th-grade students in two 5-A high schools in North Central Arkansas. An analysis of this hypothesis revealed no statistically significant interaction between independent variables, gender and CTE participation level, on student mathematics achievement. When comparing the four means, the highest mean of the four groups was the mean of the females who participated in three or fewer CTE courses. The next two highest means were males participating in four or more CTE courses and females also participating in four or more CTE courses, respectively. Males who participated in three or fewer CTE courses performed lowest on their mathematics achievement. However, no pairing was statistically significant. Thus, the null hypothesis for the interaction effect was not rejected. When analyzing the results for the main

effects, the main effect for gender on mathematics achievement, regardless of CTE participation level, was not significant. Even though the female mean was higher than the male mean, the difference was not significant. Similarly, although the mean of those participating in three or fewer CTE courses was just slightly higher than those participating in four or more CTE courses, the difference was not significant. Therefore, both the main effect hypotheses for gender and for CTE participation level were retained when considering the mathematics achievement of 10th-grade students taking the ACT Aspire assessment.

Hypothesis 3

The third hypothesis stated that no significant difference will exist by gender between taking four or more CTE courses versus three or fewer on reading achievement as measured by the ACT Reading subtest for 11th-grade students in two 5-A high schools in North Central Arkansas. An analysis of this hypothesis revealed no statistically significant interaction between independent variables, gender and CTE participation level, on student reading achievement. When comparing the four means for the 11th-grade students' reading achievement, the the of the females who participated in three or fewer CTE courses had the highest mean, followed by the females who participated in four or more CTE courses. For the males, those participating in four or more CTE courses scored higher than those who participated in three or fewer CTE courses. However, no pairing met the level of significance. Thus, the null hypothesis for the interaction effect was not rejected**.** When examining the main effects of gender, even though the mean for females, regardless of CTE participation level, was higher compared to the mean for the males, no statistical significance was found. Further, the mean for

those participating in four or more CTE courses was higher compared to the mean of those participating in three or fewer CTE courses, but the difference was not significant. Therefore, both the main effect hypotheses for gender and for CTE participation level were retained when considering the reading achievement of 11th-grade students taking the ACT Reading assessment.

Hypothesis 4

The fourth hypothesis stated that no significant difference will exist by gender between taking four or more CTE courses versus three or fewer on mathematics achievement as measured by the ACT Mathematics subtest for 11th-grade students in two 5-A high schools in North Central Arkansas. An analysis of this hypothesis revealed no statistically significant interaction between independent variables, gender and CTE participation level, on student mathematics achievement. When comparing the four means, males who participated in four or more CTE courses scored the highest, followed by females who participated in three or fewer CTE courses. The third and fourth highest means were from the males who participate in three or fewer CTE courses and the females who participated in four or more CTE courses, respectively. The differences between the different pairings did not meet statistical significance. Thus, the null hypothesis for the interaction effect was not rejected. Turning to the main effect of gender, regardless of CTE participation level, the mean for males was higher compared to the mean of the females. However, the difference was not significant. Furthermore, the two means for the CTE participation level were almost identical. Therefore, both the main effect hypotheses for gender and for CTE participation level were retained when

considering the mathematics achievement of 11th-grade students taking the ACT Mathematics assessment.

Implications

The results of this study shed light on a concern of those leading high schools in Arkansas—student achievement. There are three fundamental areas of implications to be considered. The areas are reading and mathematics achievement, the effects of CTE participation level on these subject areas, and the effects of gender on these areas. The findings in this study have meaningful implications for educators, educational administrators, and policymakers. Each of these areas is discussed relative to the connection of this research to prior studies.

First and foremost, these findings provide data for schools across Arkansas regarding the ACT and ACT Aspire assessments given each year. By analyzing data from these assessments, educators can gain insight into student achievement by identifying strengths and weaknesses in curriculum, instruction, and assessment. For this study, mathematics and reading were of particular interest to since students in Arkansas have consistently scored low on standardized assessments in both areas. With regard to the ACT, mean scores from the two North Central Arkansas high schools were below the 5-year national average for both mathematics and reading scores. These findings were consistent with Edwards (2017) who noted that students from states that require the ACT as a high-stakes assessment often have lower composite scores than those who do not. According to the Arkansas Department of Education (2016), the number of Arkansas students taking the ACT has increased significantly since 2016 when it became the required exit assessment for 11th-grade students at all Arkansas high schools. However,

the mean scores for those in these high schools were also lower than the published average ACT scores for Arkansas in 2017 (ACT, 2017c). This tread indicated that there may be an even greater need at these schools for total instructional alignment to ACT learning targets.

Relative to the ACT Aspire, student means for all groups in this study reached the Close benchmark, below the level of Ready or Exceeding scores. These results are aligned to national results indicating that less than half of all U.S. students scored in the Ready or Exceeding benchmark range, though there was a significant number who did meet these levels. These findings are important to consider because it may indicate that neither the ACT nor the ACT Aspire is well aligned to standards.

Another important implication of this study is whether or not the placement of students in CTE courses enhances their achievement and their preparation for careers. Results indicate that CTE placement neither helped nor harmed achievement scores for students in these two high schools. Partin (2016) revealed that in Arizona where academic content is deeply embedded within CTE courses and teachers use instruction aligned with the state's academic standards, CTE students outperformed the general high school population on the high-stakes academic test called the Arizona Instrument to Measure Standards test. However, Yettick et al. (2012) found that students participating in CTE courses tend to have lower academic scores than those who participate in more academic-focused courses. The results of this study were contrary to these findings. In addition, Peterson and Mahadevan (2008) stated that up to 25% of students in Texas who received special education services, some with learning disabilities, might not be college-bound but might need CTE courses to better prepare them for careers after high school.

Since those receiving special education services were not identified in either group, it may be assumed that students who are participating in four or more CTE are performing at least as well as those participating in three or fewer CTE courses. Jacob (2017) stated that students who participate in CTE programs do not necessarily have strong academic outcomes. However, Stone and Aliaga (2003) found that CTE students study more, which may lead to higher achievement levels due to increased study times. Because results were mixed in the literature, it might indicate that students who do not participate in CTE and focus on an academic path may not be performing as well as first thought. Based on the results of this study, the mean of those participating in four or more CTE courses might indicate that students perform better when engaged in meaningful, integrated learning, regardless of their academic background. As a group, they performed just as well as their peers who participated in three or fewer CTE courses and focused on a more academic path.

A third implication of this study addresses gender and CTE participation level. When analyzing reading scores, this researcher found that the mean of the females who participated in three or fewer CTE courses performed better compared to all the other groups on both the ACT Aspire and the ACT. In fact, scores associated with reading achievement yielded results that were close to statistical significance. When analyzing mathematics scores, the mean of the females who participated in three or fewer CTE courses was highest on the ACT Aspire, but on the ACT, the mean for males participating in four or more CTE courses was the highest.

These findings imply that gender differences may exist in mathematics and reading, but these differences did not reach significance. There is much literature on

gender differences in mathematics and reading. Halpern (2000) suggested that there are no real significant differences consistently found but does suggest that males and females may simply perform better in different subject areas than others. This study provides consistent results with Halpern where he revealed differences in male and female brain structure might enhance gender-specific skills such as reading, word fluency, and memory. This may reflect why reading was the only assessment where females consistently performed higher than males.

Another consideration in relation to gender is the fact that some courses may attract more males than females. Lufkin et al. (2007) discussed how specific CTE courses can attract specific genders. Differences in courses might have an effect on gender performance because specific courses might use mathematics or reading skills more than others. Based on mixed results relative to gender among other studies, females demonstrated higher overall reading achievement than males. With regard to the ACT Aspire, results showed female students, regardless of CTE participation level, performed better than males in mathematics and reading. Nonetheless, this research contributes to the body of knowledge regarding gender and the achievement of high school students in North Central Arkansas.

Recommendations

Potential for Practice/Policy

I found neither gender nor CTE participation level had statistically significant effects on 10th- and 11th-grade mathematics and reading achievement. However, based on the findings, there are some suggestions on which practitioners might reflect. The following recommendations are considerations for influencing educational practices and

policies due to the findings in this study. Though the sample was small, there may be inferences for practices and policies in schools across Arkansas.

First, school administrators must determine whether the use of ACT and ACT Aspire assessments are effective tools in measuring student achievement. Since neither assessment is directly aligned with Arkansas standards, students might have low scores due to a gap between what is assessed and what is being taught. Should the practice of administering the ACT and ACT Aspire continue, teachers must become better acquainted with exactly what concepts are being assessed and how they are being assessed. Determining strengths and weaknesses in instructional practices can help districts build more robust instruction into existing courses. To identify strengths and weaknesses, districts should provide professional development in analysis and integration of specific mathematics and reading concepts in all courses. To ensure students score at or above the national average on the ACT and attain Ready or Exceeding ratings relative to benchmarks on the ACT Aspire, teachers must align instruction and formative assessments to increase the chance of success on these standardized assessments. Educators must couple this understanding with fostering a learning environment rich in differentiated instruction, conceptual learning, and experiential learning. Building a more rigorous, integrated curriculum should help districts strengthen instruction and better prepare students for criterion-based assessments like the ACT and ACT Aspire.

The mean scores for all groups studied were below those of their national peers. A second recommendation is to improve engagement of low-achieving and unmotivated students through enrollment in CTE courses. Findings from the literature (Jacob, 2017; Peterson & Mahadevan, 2008) indicated that those who were less academically focused

and those who may be receiving educational support services were frequently enrolled in CTE courses. Hence, one might conclude that those in the three or fewer CTE courses' group might have a greater propensity for academics. If this is true, engaging students in CTE coursework, at a minimum, ensures that the participating group academically keeps up with their peers. Participation in CTE courses or integrated academic courses can provide a more authentic learning environment that encourages student engagement and achievement. When students are engaged and see a meaningful purpose in courses taken, they are more motivated to learn. Darling-Hammond et al. (2012) discussed how gains in student achievement might be influenced by several factors that include class sizes, curriculum materials, instructional time, resources for learning (books, computers, science labs), individual student needs and abilities, and prior teachers and schooling. By focusing on courses that are most relevant to each student, administrators and teachers can provide struggling students with the opportunity to be successful.

Though none were significant, results were mixed relative to how CTE participation level might affect achievement. CTE participation might provide a more authentic learning experience, specifically in the area of higher mathematics concepts. Enrolling students in a mixture of courses, both academic and CTE, could provide a more diverse learning experience where concepts and applications can be implemented. This study indicated participating in a more academic track does not guarantee higher student achievement. In fact, it might indicate CTE courses are performing better than many believe. Stone and Aliaga (2003) found that CTE students study more leading to higher achievement levels due to increased study times. If district administrators, counselors, and teachers analyze long-term data, they might see a trend in scores of students being

higher when they take more CTE courses due to the use of applications and equipment in authentic learning experiences. This authentic learning is rooted in the contextual instructional theory. Davtyan (2014) stated the theory ties brain actions to patterns and meaning by connecting academic content to the context of real life. In order for teachers to have engaging, integrated lessons that improve mathematics achievement, more rigorous integration must be supported. This might also be accomplished by collaborative teaching across subjects and professional development in teaching strategies.

Finally, school administrators and educators need to consider gender differences and how they might affect student achievement. Gender gaps in CTE course selection may be narrowing as trends in education change, but efforts should be made to engage both male and female students, in all classes, even those often dominated by one gender. Lufkin et al. (2007) found there was a clear distinction of CTE courses by gender, with some courses attracting more males than females. Based on the observation that male participants out-scored all others on the ACT in the area of mathematics, engaging females in those courses that are traditionally male-associated might improve achievement in mathematics for female students. High school guidance counselors should develop a plan that encourages students to participate in gender-dominated courses and begin eliminating gender barriers.

Changes in gender participation might require changes in future efforts to engage both male and female students in the classroom. There are social implications that will take time and education to solve. The attitudes of education, even from an early age, will have to be improved in order to break down preexisting stereotypical attitudes about the importance of academic performance. O'Connor (2015) reported researchers discovered

females taking mathematics tests under stereotype threat showed particular areas of the brain processing the negative social information. For example, encouraging females to enroll in a higher level mathematics course or males in more literacy and reading courses could not only provide new learning opportunities but may improve student achievement. Districts should reflect on current practices to encourage equal, unbiased access to courses. To address equal and unbiased participation in high school courses, school counselors, administrators, and teachers need to encourage students to consider enrolling in courses despite stereotypical attitudes of a society or the school. School systems should consider that male and female students are, indeed, different but create learning opportunities where males and females work collaboratively in the classroom, thus building confidence for both genders.

Future Research Considerations

In considering how this study can be replicated or extended by way of future research, several suggestions may be considered. For example, because this study was conducted in North Central Arkansas, a predominately rural area, the same study could be conducted in other states or even a more metropolitan area of Arkansas. Doing so would create an opportunity to compare student scores from a rural setting with those from an urban population where more diversity exists. Inner-city schools might also have less gender-influenced CTE course selection, which might have affected the outcomes of this study. Second, because schools used for this study were 5-A rural schools located in a state considered to be fundamentally agricultural, another consideration for future studies might include using larger school settings where a broader selection of CTE course offerings are available to students.

A third study could include other assessment instruments or avenues to measure student achievement such as student GPAs or other tests instead of using the ACT and ACT Aspire assessments. Because these assessments are not aligned to state standards, using GPA might provide a clearer picture because it is more closely aligned to classroom instruction and state standards. Additionally, GPA might provide more long-term cumulative data in comparison to the one time per year format of the ACT Aspire. A drawback to using GPA would be that it is a non-standardized measure of academic achievement, and standardized tests allow researchers to compare across classrooms and states. Another drawback to using GPA would be the possibility of grade inflation by teachers. Whether the decision is made to continue using the ACT and ACT Aspire assessments, begin using GPA to measure student achievement, or search for another type of assessment that better aligns with standards, the Arkansas Department of Education should consider the most effective tool in measuring student achievement.

More gender studies relative to student achievement should be considered. Even though there was not a significant difference between male and female means, there was a trend that females did, indeed, score better in the area of reading than males. These results align with research from Halpern (2000). Further exploration should take place to investigate what is happening across classrooms that might encourage girls and discourage boys, from an early age, relative to reading achievement, or whether gender-based brain-development plays a role.

Finally, a comparison of students with disabilities who participated in four or more CTE courses to students with disabilities who participated in three or fewer CTE courses should be considered. This may include more research into the benefits of CTE

programs for students with disabilities, since CTE helps to bridge the gap between academics and real-world applications. This may be accomplished by gathering scores from this population of students to determine the effectiveness or ineffectiveness of CTE programs.

Based on the findings in the present study, it is important to remember that education continually changes. Academic and CTE courses will continue to evolve to meet the needs of society and the students they serve. The results of this study might affect educational practice through a better understanding of male and female student achievement as well as reading and mathematics achievement of those who participate or not in CTE courses. What *is* imperative is that those in school systems take a closer look at curriculum, instruction, and assessment, in all courses, to better prepare students for post-secondary opportunities, whether college or the workforce.

REFERENCES

ACT. (2012). *ACT and statewide testing*. Retrieved from http://www.act.org/stateservices/

ACT. (2013). *What are the ACT college readiness benchmarks*? Retrieved from http://www.act.org/content/dam/act/unsecured/documents/benchmarks.pdf

ACT. (2014a). *Gender gaps in high school GPA and ACT scores*. (Information Brief No. 2014-12). Retrieved from https://www.act.org/content/dam/act/unsecured/documents/Infor-Brief-2014-12.pdf

ACT. (2014b). *The ACT: A history*. Retrieved from https://ink.niche.com/the-act-a-history/

ACT. (2017a). *ACT technical manual*. Retrieved from http://www.act.org/content/dam/act/unsecured/documents/ACT_Technical_Manual.pdf _Technical_Manual.pdf

ACT. (2017b). *Average ACT scores by state graduating class 2017*. Retrieved from https://www.act.org/content/dam/act/unsecured/documents/cccr2017/ACT_2017-Average _Scores_by_State.pdf

ACT. (2017c). *The condition of college and career readiness 2017: National profile report graduating class 2017.* Retrieved from http:///www.act.org/content/act/en/college-and-career-readiness/standards/html

ACT Aspire. (2016a). *Interpretive guide for ACT aspire summative reports*. Retrieved from https://www.arkansased.gov/public/userfiles/Learning_Services /Student%20Assessment/2016/Aspire_Summative_Guide.pdf

ACT Aspire. (2016b). *Score scale*. Retrieved from https://www.discoveractaspire.org/assessments/score-scale/

ACT Aspire. (2016c). *Six good reasons to take ACT Aspire*. Retrieved from https//www.discoveractaspire.org/assessments/

ACT Aspire. (2016d). *State assessment solutions*. Retrieved from http://www.discoveractaspire.org

ACT Aspire. (2017). *Interpretive guide for ACT aspire summative reports*. Retrieved from https://www.arkansased.gov/public/uerfiles/Learning_Services/Student %20Assessment/2017/Interpretive_Guide_For_ACT_Aspire_Summative_Reports _2017.pdf

Advance CTE. (2018). *Arkansas*. Retrieved from https://careertech.org/arkansas

Ahmad, F. (2017). *How to overcome apathy and disillusionment when standardized tests fail kids.* Retrieved from https://www.edsurge.com/news/2017-10-31-how-to-overcome-apathy-and-disillusionment-when-standardized-tests-fail-kids

Aliaga, O., Kotamraju, P., & Stone, J. R., III. (2012). *A typology for understanding the career and technical education credit-taking experience of high school students*. Louisville, KY: National Research Center for Career and Technical Education, University of Louisville.

Aliaga, O., Kotamraju, P., & Stone, J. R., III. (2014). Understanding participation in secondary career and technical education in the 21st century: Implications for

policy and practice. *High School Journal, 97*(3), 128-158. doi:10.1353/hsj.2014.0002

American Institutes of Research. (2016, June 2). *CTE and ESSA: The start of a beautiful friendship* [web log post]. Retrieved from https://www.air.org/resource/cte-and-essa-start-beautiful-friendship

Anderson, J. R. (1995). *Cognitive psychology and its implications*. New York, NY: Worth Publishers. Retrieved from https://elmirmohammedmemorypsy.files.Wordpress.com/2014/12/cognitive-psychology-and-its-implications-john-r-anderson.pdf

Arkansas Activities Association. (2015). *Reclassification of 2016-2018.* Retrieved from http://www.ahsaa.org

Arkansas Department of Education. (2016). *The ACT profile report-state.* Retrieved from https:///arkansased.gov/pubic/userfiles/Learning_Services/Student%20Assessement/2017/2016-2017_ACT_Profile_Report.pdf

Arkansas Department of Education. (2017). *Arkansas' ACT aspire preliminary scores reflect several significant increases.* Retrieved from http://www.arkansased.gov/public/userfiles/news/2017/Press_Release_Arkansas_ACT_Aspire_Preliminary_Scores_Reflect_Significant_Increases.pdf

Arkansas Department of Education. (2018a). *English language arts*. Retrieved from https://www.arkansased.gov/divisions/learning-services/curriculum-and-instruction/curriculum-framework-documents/english-language-arts

Arkansas Department of Education. (2018b). *Mathematics*. Retrieved from https://www.arkansased.gov/divisions/learning-services/curriculum-and-instruction/curriculum-framework-documents/mathematics

Arkansas Department of Education. (2018c). *U.S. Department of Education approves Arkansas' Every Student Succeeds Act plan*. Retrieved from https://www.arkansased.gov/public/userfiles/news/2018/USDE_Approves_Arkansas_ESSA_Plan.pdf

Arkansas Department of Education. (2018d). *Statewide information system reports: Enrollment count by school.* Retrieved from https://www.adedata.arkansas.gov/statewide/Schools/EnrollmentCount.aspx?year=28&search=beebe%20high%20school&pagesize=10

Arkansas Department of Education. (2018e). *Statewide information system reports:Enrollment count by school.* Retrieved from https://www.adedata.Arkansas.gov/statewide/Schools/EnrollmentCount.aspx?year=28&search=vilonia%20school&pagesize=10

Arkansas Department of Higher Education. (2006). *Perkins coordinator handbook*. Retrieved from www.adheperkins.com/handbook/PerkinsHandbook.pdf

Association for Career and Technical Education. (2006). *Career and technical education's role in American competitiveness* [Issue Brief]. Alexandria, VA: Author. Retrieved from https://competitiveness.org/effective-strategies/#

Association for Career and Technical Education. (2007). *Issue brief*: *Career and technical education's role in dropout prevention and recovery.* Retrieved from

http://www.acteonline.org/uploadedFiles/Publications_and_Online_Media/files/Dropouts.pdf

Association for Career and Technical Education. (2009). *Issue brief: CTE's role in adolescent literacy.* Retrieved from https://www.acteonline.org/WorkArea/DownloadAsset.aspx?id=2102

Baker, E. L., Hope, L., & Karandjeff, K. (2009). *Contextualized teaching and learning: A faculty primer.* Retrieved from http://www.cccbsi.org/Websites/basicskills/Images/CTL.pdf

Banaji, M. R., Greenwald, A. G., & Nosek, B. A. (2002). Math = male, me = female, therefore math = me. *Journal of Personality and Social Psychology, 83*, 44-59.

Bandy, J. (2018). *What is service learning or community engagement?* Retrieved from http://cft.vanderbilt.edu/guides-sub-pages/teaching-through-community-engagement/

Barell, J. (2007). *Problem-based learning: An inquiry approach*. Thousand Oaks, CA: Sage.

Beane, J. A. (1995). Curriculum integration and the disciplines of knowledge. *The Phi Delta Kappan, 76*(8), 616-622.

Benders, D. (2011). *Student apathy: The downfall of education*. Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1968613

Billett, S. (1996). Towards a model of workplace learning: The learning curriculum. *Studies in Continuing Education*, *18*(1), 43-58.

Bozick, R., & Dalton, B. (2013). Balancing career and technical education with academic coursework: The consequences for mathematics achievement in high school.

Educational Evaluation and Policy Analysis, *35*(2), 123-138. doi:10.3102/0162373712453870

Bradley, S. (2016). *The role of career and technical education in college and career readiness.* Retrieved from https://all4ed.org/the-role-of-career-and-technical-education-in-college-and-career-readiness/

Bragg, D. D. (1999). Reclaiming a lost legacy: Integration of academic and vocational education. In A. J. Pautler (Ed.), *Workforce education: Issues for the new century* (pp. 181-196). Ann Arbor, MI: Prakken Publications.

Brown, B. L. (1998). *Applying constructivism in vocational and career education*. Retrieved from ERIC database. (ED428298)

Bruning, R., Schraw, G., & Ronning, R. (1999). *Cognitive psychology and instruction*. Upper Saddle River, NJ: Prentice Hall.

Burman, A. B., Booth, J. R., & Bitan, T. (2008). Sex differences in neural processing of language among children. *Neuropsychologia*, *46*(5), 1349-1382. Retrieved from https://www.ncbi.nim.nih.gov/pm/articles/PMC2478638/

Cahill, L. (2005). His brain, her brain*. Scientific American, 292*(5), 40-47.

Caine, R. N., & Caine, G. (1991). *Making connections: Teaching the human brain.* Retrieved from ERIC database. (ED335141)

Career and Technical Education. (2013). *A look inside: A synopsis of CTE trends.* Retrieved from https://careertech.org/sites/default/files/.SynopsisofCTETrends-Funding-2012.pdf

Career and Technical Education. (2017). *How ESSA and new federal funding rules will impact career and technical education.* Retrieved from https://storage.pardot.com/168722/20561/ESSA_White_Paper_FINAL.pdf

Career and Technical Education Center of New York. (2012). *Career and technical education: A driving force in school improvement*. Retrieved from https://nyctecenter.org/images/files/Publications/CTE-A-Driving-Force-in-School-Improvement.pdf

Cashen, M. (2012). The impacts of gender and income on career and technical education. *Policy Brief for Center for Poverty Research*, *2*(5), 1-2. Retrieved from https://poverty.ucdavis.edu/sites/main/files/file-attachments/policy_brief-cashen_cte_0.pdf

Castellano, M., Stringfield, S., & Stone, J. (2003). Secondary career and technical education and comprehensive school reform: Implications for research and practice. *Review of Educational Research*, *73*(2), 231-272.

Castellano, M., Sundell, K., Overman, L., & Aliaga, O. (2012). Do career and technical education programs of study improve student achievement? Preliminary analyses from a rigorous longitudinal study. *International Journal of Educational Reform, 21*(2), 98-118.

Center on Education Policy. (2007). *Answering the question that matters most: Has student achievement increased since No Child Left Behind?* Retrieved from http://www.cep-dc.org

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, N.J.: Lawrence Erlbaum.

Conley, D. T. (2005). *College knowledge: What it really takes for students to succeed and what we can do to get them ready*. San Francisco, CA: Jossey-Bass.

Cornell University. (2018). *Problem-based learning*. Retrieved from http://www.cte.cornell.edu/teaching-ideas/engaging-students/problem-based-learning.html

Craig, H., Kraft, R., & Du Plessis, J. (1998). *Teacher development: Making an impact*. Retrieved from https://sitersources.worldbank.org/EDUCATION/Resources/278200-1099079877269/547664-1099080063795/Teacher development_making_impact_En98.pdf

Crowson, R. L., Wong, K. K., & Aypay, A. (2000). The quiet reform in American education: Policy issues and conceptual challenges in the school-to-work transition. *Educational Policy, 14*(2), 241-259.

Darling-Hammond, L., Amrein-Beardsley, A., Haertel, E., & Rothstein, J. (2012). Evaluating teacher evaluation. *The Phi Delta Kappan, 93*(6), 8-15.

Davtyan, R. (2014). *Contextual learning* [Abstract]. Bridgeport, CT: University of Bridgeport. Retrieved from http://www.asee.org/documents/zones/zone1/2014/Student/PDFs/56.pdf

Doolittle, P. E., & Camp, W. G. (1999). Constructivism: The career and technical education perspective. *Journal of Vocational and Technical Education*, *16*(1). Retrieved from http://scholar.lib.vt.edu/ejournals/JVTE

Dougherty, S. M. (2016). *Career and technical education in high school: Does it improve student outcomes?* Retrieved from ERIC database. (ED570132)

Edwards, H. (2017, August 9). *Average ACT scores by state* [Web log post]. Retrieved from https://blog.prepscholar.com/act-scores-by-state-averages-highs-and-lows

Etim, J. S. (Ed.). (2005). *Curriculum integration K-12: Theory and practice*. Lanham, MD: University Press of America.

Field, A. P. (2005). *Discovering statistics using IBM SPSS statistics*. London, England: Sage.

Finch, C. R., & Crunkilton, J. R. (1999). *Curriculum development in career and technical education: Planning, content, and implementation* (5th ed.). Retrieved from ERIC database. (ED427251)

Florida Department of Education. (2010). Just read, Florida! *Career and Technical Reading*, *1-2*.

Fosnot, C. T. (1996). Constructivism: A psychological theory of learning. In C. T. Fosnot (Ed.), *Constructivism: Theory, perspectives, and practice* (pp. 8-33). New York, NY: Teachers College Press.

Fosnot, C. T., & Perry, R. S. (2005). Constructivism: A psychological theory of learning. In C. T. Fosnot (Ed.), *Constructivism: Theory, perspectives, and practice* (2nd ed.) (pp. 8-38). New York, NY: Teachers College Press.

Gardner, H. (1983). *Frames of mind: The theory of multiple intelligences*. New York, NY: Basic Books.

Gender gap. (n.d.). Retrieved from http://www.dictionary.com /browse/gender-gap

Goodman, K. (1989a). Access to literacy: Basals and other barriers. *Theory into Practice, 28*(4), 274-281. doi:10.1080/00405848909543421

Goodman, K. (1989b). Whole-language research: Foundations and development. *The Elementary School Journal, 90*(2), 207-221. doi:10.1086/461613

Gordon, H. R. D. (2003). *History and growth of vocational education in America*. Prospect Heights, IL: Waveland Press. Retrieved from https://www.ux1.edu/~cfjac3 /HistoryandGrowthofCTE.ppt

Grabianowski, E. (2010). *How the ACT works*. Retrieved from https://money.howstuffworks.com/personal-finances/college-planning/act.htm

Grinstead, M. L. (2013). *Which advanced mathematics courses influence ACT score? A state level analysis of the Iowa class of 2012* (Doctoral dissertation, Iowa State University). Retrieved from http://lib.dr.iastate.edu/etd/.13622/

Grove, A. (2018). *2017 ACT costs, fees and waivers*. Retrieved from https://www.thoughtco.com/act-costs-fees-and-waivers-4122131

Grubb, W. N. (1995). The cunning hand the cultured mind: Sources of support for curriculum integration. In W. N. Grubb (Ed.), *Education through occupations in American high schools* (pp. 11-25). New York, NY: Teacher College Press.

Haag, P. W. (2015). The challenges of career and technical education concurrent enrollment: An administrative perspective. *New Directions for Community Colleges, 2015*(169), 51-58. doi:10.1002/cc.20132

Hall, K., Murphy, P., & Soler, J. (2008). *Pedagogy and practice: Culture and identities*. Los Angeles, CA: Sage.

Halpern, D. F. (2000). *Sex differences in cognitive ability* (3rd ed.). Mahwah, NJ: Lawrence Erlbaum Associates.

Hedges, L., & Nowell, A. (1995). Sex differences in mental test scores, variability, and number of high-scoring individuals. *Science, 269*, 41-45.

Hollenbeck, K. M. (2011). *Conducting return on investment analysis for secondary and postsecondary CTE: A framework*. Louisville, KY: National Research Center for Career and Technical Education, University of Louisville.

Hudson, L., & Hurst, D. (1999). *Students who prepare for college and a vocation* [Issue Brief No. NCES-1999-072]. Washington, DC: National Statistics for Educational Statistics.

Humphreys, A, Post, T., & Ellis, A. (1981). *Interdisciplinary methods—A thematic approach*. Minneapolis, MN: Goodyear Publishing, Scott Foresman & Company.

Imperatore, C. (2017). A brief history of CTE. *Techniques Connecting Education and Careers, 92*(2), 32-33. Retrieved from https://www.acteonline.org/techniques

Jacob, B. A. (2002). Where the boys aren't: Non-cognitive skills, returns to school and the gender gap in higher education. *Economics of Education Review, 21*(6), 589–598.

Jacob, B. A. (2017). *What we know about career and technical education in high school*. Cambridge, MA: Hoover Institution, Leland Stanford Junior University. Retrieved from http://educationnext.org/know-career-technical-education-high-school/

Johnson, E. B. (2002). *Contextual teaching and learning: What it is and why it's here to stay.* Thousand Oaks, CA: Sage.

Johnson, R. B., & Christensen, L. B. (2008). *Educational research: Quantitative, qualitative, and mixed approaches* (3rd ed.). Thousand Oaks, CA: Sage.

Jonsson, B., & Johan, L. (2014). Learning mathematics through algorithemetic and creative reasoning. *The Journal of Mathematical Behavior, 36*(12), 20-32.

Kagan, S. (1994). *Cooperative learning*. San Clemente, CA: Kagan Publishing.

Kane, T. (2017). Making evidence locally: Rethinking education research under the Every Student Succeeds Act. *Education Next, 17*(2), 52-58. Retrieved from https://educationnext.org/making-evidence-locally-education-research-every-student-succeeds-act/

Kolb, D. A. (1984). *Experimental learning: Experience as the source of learning and development*. Englewood Cliffs, NJ: Prentice-Hall.

Lee, V. E., & Ready, D. D. (2009). U.S. high school curriculum: Three phases of contemporary research and reform. *The Future of Children, 19(1)*, 135-156. Retrieved from https://www.jstor.org/stable/27795038

Leech, N. L., Barrett, K. C., Morgan, G. A., & Leech, N. L. (2011). *IBM SPSS for intermediate statistics: Use and interpretation*. New York, NY: Routledge.

Lemanski, T., Mewis, R., & Overton, T. (2011), *An introduction to work-based learning*: *A physical sciences practice guide*. Retrieved from http://www.heacademy.ac.uk/physsci

Levesque, K., Laird, J., Hensley, E., Choy, S. P., Cataldi, E. F., & Hudson, L. (2008). *Career and technical education in the United States: 1990 to 2005. Statistical analysis report. NCES 2008-035*. Washington, DC: National Center for Education Statistics, U.S. Department of Education.

Levesque, K., Wun, J., & Green, C. (2011). *Statistics in brief: Science achievement and occupational career/technical education course taking in high school: The class*

of 2005 (NCES Report No. 2010-021). Retrieved from ERIC database. (ED509777)

Linver, M. R., Davis-Kean, P., & Eccles, J. E. (2002, April). *Influences of gender on academic achievement.* Paper presented at the biennial meetings of the Society of Research on Adolescence, New Orleans, LA.

Long, C. (2016). *Six ways ESSA will improve assessments*. Retrieved from https://neatoday.org/2016/03/10/essa-assessments/

Louisiana State University. (2017). *A brief history of curriculum development in the U.S.* Retrieved from https://online.lsus.edu/articles/education/brief-history-curriculum-development.aspx

Lufkin, M. E., Wiberg, M.M., Jenkins, C.R., Berardi, S.L.L., Boyer, T., Eardley, E., & Huss, J. (2007). *Gender equity in career and technical education. Handbook for achieving gender equity through education*. Retrieved from https://www.napequity.org/nape-content/uploads/ch20_9000_Klein_LEA.pdf

Lynch, R. L. (2000). *New directions for high school career and technical education in the 21st century*. Retrieved from ERIC database. (ED444037)

Mayer, R. E. (1992). Cognition and instruction: Their historic meeting within educational psychology. *Journal of Educational Psychology, 84,*405-412.

McBrien, J. L., & Brandt, R. S. (1997). *The language of learning: A guide to education terms.* Alexandria, VA: Association for Supervision and Curriculum Development.

McCammon, E. (2018, July 12). *What is the minimum ACT score for college?* [web log post]. Retrieved from https://blog.prepscholar.com/minimum-act-score-for-college

McKenna, M. C., Robinson, R. D., & Miller, J. W. (1990). Whole language: A research agenda for the nineties. *Educational Researcher, 19*(8), 3-6. doi:10.3102/003189X019008003

Moore, G. (2017). *The Smith-Hughes Act: The road to it and what it accomplished*. Retrieved from https://digital.graphcompubs.com/publication/?i=377016&article_id=2688541&view=articleBrowswer&ver=html5

Morgan, G. A., Leech, N. L., Gloeckner, G. W., & Barrett, K. C. (2012). *IBM SPSS for introductory statistics: Use and interpretation*. New York, NY: Routledge.

Mugisha, W. R., & Mugimu, C. (2015). Application of learning theories in curriculum development and implementation of the MLT diploma programme in Uganda. *British Journal of Education, Society and Behavioural Science, 5*(3), 256-275. Retrieved from https://www.journalrepositoryorg/media/journals/BJESBS_21/2014/Nov/Mugisha532014BJESBS11603_1.pdf

National Association of State Directors of Career Technical Education Consortium. (2010). *Already at the top: CTE programs show positive impact on student achievement*. Retrieved from https://www.nrccte.org/sites/default/files/idea-center-files/suburban.final.pdf

National Association of Vocational Education. (2004). *National assessment of vocational education: Final report to congress*. Washington, DC: U.S. Department of Education.

National Center for Education Statistics. (2011). *Postsecondary and labor force transitions among public high school career and technical education participants.* Retrieved from https://nces.ed.gov/pubs2011/2011234.pdf

National Center for Education Statistics. (2013). *Data point: Trends in CTE course taking* (NCES 2014-901). Retrieved from https://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2014901

National Council of Teachers of Mathematics. (2000). *Principals and standards for school mathematics.* Retrieved from https://www.pearsonhigheredu.com/assets/samplechapter/0/1/3/2/0132612267.pdf

Neild, R., Boccanfuso, C., & Byrnes, V. (2013). *The academic impacts of career and technical schools: A case study of a large urban school district*. Baltimore, MD: Center for Social Organization of Schools, Johns Hopkins University. Retrieved from https://new.every1graduates.org/wp-content/uploads/2013/02/The-Academic-Impacts-of-Career-and-Technical-Schools.pdf

Noble, J., Crouse, J., Sawyer, R., & Gillespie, M. (1992, October). *Ethnic/gender bias and the differential preparation hypothesis: Implications for performance on the ACT Assessment.* A paper presented at the annual meeting of the American Educational Research Association, San Francisco, CA.

Noble, J., Davenport, M., & Sawyer, R. (2001, July). *Relationships between noncognitive characteristics, high school course work and grade, and performance on a*

college admissions test. A paper presented at the annual meeting of the American Education Research Association, Seattle, WA. Retrieved from ERIC database. (ED434917)

Noble, J., Davenport, M., Schiel, J. & Pommerich, M. (1999). *Relationships between the noncognitive characteristics, high school course work and grades, and test scores of ACT-tested students* (ACT Research Report No. 99-4). Iowa City, IA: ACT.

Noble, J., & McNabb, T. (1989). *Differential course work and grades in high school: Implications for performance on the ACT Assessment* (ACT Research Report No. 89-5). Iowa City, IA: ACT.

O'Connor, C. (2015, February 3). *Are women worse in math? It's time to stop asking*. [Blog post]. Retrieved from https://m.huffpost.com/us/entry/6573074

Ota St. Clair, S., & Gardner, D. (n.d.). *An innovative and collaborative community college and high school algebra project: Contextualizing career and technical education (CTE) in math*. Pass, OR: Rogue Community College. Retrieved from http://go.roguecc.edu/sites/go.roguecc.edu/files/users/DGardner/EDULEARN%20FINAL%20%20St%20Clair%20Gardner.pdf/

Partin, M. S. (2016). *The influence of enrollment in career and technical education courses on the achievement of high school special education students* (Doctoral dissertation, Louisiana State University and Agricultural and Mechanical College). Retrieved from https://digitalcommons.lsu.edu/gradschool_ dissertations

Penn, A. (1992). *Integrating high school English and vocational education through teacher collaboration, cross-curricular activities, and applied communications*

database (Doctoral dissertation, Nova University). Retrieved from ERIC database. (ED350396)

Perkins Collaborative Resource Network. (n.d.). *Perkins Act.* Washington, DC: United States Department of Career, Technical, and Adult Education. Retrieved from https://cte.ed.gov/legislation/about-perkins-iv

Peterson, R., & Mahadevan, L. (2008). *CTE teachers and special populations* [Power Point slides]. Retrieved from https://ctsp.tamu.edu/documents/Special%20Populations%20CTE%20Houson%20Conf.ppt

Plank, S., DeLuca, S., & Estacion, A. (2005). *Dropping out of high school and the place of career and technical education: A survival analysis of surviving high school*. Retrieved from http://nces.ed.gov

Pressley, M., Mohan, L., Fingeret, L., Reffitt, K., & Raphael-Bogaert, L. (2007). Writing instruction in reading and effective elementary settings. In S. Graham, C. A. MacAurthur & J. Fitzgerald (Eds.), *Best practices in writing instruction* (pp. 13-27). New York, NY: Guillford Press.

Purdue University. (n.d.). *Contextual teaching and learning: What is it?* Retrieved from https://www.ydae.purdue.edu/.lct/HBCU/documents/.ContextualTeachingandLearning.pdf

Raizen, S. (1989). *Reforming education for work: A cognitive science perspective.* Berkeley, CA: National Center for Research in Vocational Education. Retrieved from ERIC database. (ED314642)

Rampey, B. D., Dion, G. S., & Donahue, P. L. (2009). *NAEP 2008 trends in academic progress* (NCES 2009-479). Retrieved from http://nces.ed.gov

Resnick, L. B., & Klopfer, L. E. (1989). *Toward the thinking curriculum: Current cognitive research*. Alexandria, VA: Association for Supervision and Curriculum Development Yearbook.

Rice, C. (n.d.). *Creative strategies for CTE teachers: A tool box of creative strategies for career and technical education teachers*. Charlotte, NC: North Carolina CTE Comprehensive Support Model. Retrieved from https://www.alsde.edu/sec/cte/General %20Agriscience/Teaching-Stratgies-creative-strategies-handbook.pdf

Richardson, V. (2003). Constructivist pedagogy. *Teachers College Record*, *105*(9), 1623-1640. Retrieved from http://people.umass.edu

Roberts, P. L., & Kellough, R. D. (1996). *A guide for developing interdisciplinary thematic units* (4th ed.). Upper Saddle River, NY: Merrill Prentice-Hall.

Rojewski, J. W. (2002). Preparing the workforce of tomorrow: A conceptual framework for career and technical education. *Journal of Vocational and Technical Education*, *27*(1). Retrieved from http://scholar.lib.vit.edu/ejournals/JVTE

Samuels, C. (2017, June 12). *Inclusion, career and technical education help students with disabilities* [web log post]. Retrieved from www.EdWeek.org

Sass, H., Bottoms, G., Pritz, S., Kelley, P., Foster, J., Hodes, C., & Lewis, M. (2011). *Improving secondary career and technical education through professional development: Alternative certification and use of technical assessment data.* Louisville, KY: National Research Center for Career and Technical Education, University of Louisville.

Schloss, M., & Gunter, P. (2011). Career and technical education. In J. M. Kauffman & D. P. Hallahan (Eds.), *Handbook of special education* (pp. 470-481). New York, NY: Routledge.

Schraw, G., & Olafson, L. (2002). Teachers' epistemological world views and educational practices. *Issues in Education, 8*(2), 99-148.

Shadden, R. E. (2011). The graduation rates of career and technical education (CTE) concentrators in Tennessee (Doctoral dissertation, East Tennessee State University). Retrieved from https://dc.etsu.edu/etd/1243

Sparks-Wallace, O. (2007). *A study of gender differences in academic performance in a rural county in Tennessee* (Master's thesis, East Tennessee State University). Retrieved from https://dc.etsu.edu/etd/2101

Spivey, N. N. (1997). *The constructivist metaphor: Reading, writing, and the making of meaning.* San Diego, CA: Academic Press.

State of Arkansas Bureau of Legislative Research. (2018). *Career and technical education in Arkansas's k-12 schools.* Little Rock, AR: House Interim Committee on Education and the Senate Interim Committee on Education.

Steffe, L. P., & Gale, J. E. (1995). *Constructivism in education.* Mahwah, NJ. Lawrence Erlbaum Associates.

Stone, J. R., & Aliaga, O. (2003). *Career and technical education, career pathways and work-based learning: Changes in participation 1997-1999.* St. Paul, MN: National Center for Career and Technical Education.

Stone, J. R., III, Alfeld, C. Pearson, D., Lewis, M., & Jensen, S. (2006). *Building academic skills in context: Testing the value of enhanced math learning in CTE*

[Final study]. St. Paul, MN: National Research Center for Career and Technical Education, University of Minnesota.

Stone, J. R., III, Alfeld, C., Pearson, D., Lewis, M., & Jensen, S. (2007). *Rigor and relevance: A model of enhanced math learning in career and technical education*. St. Paul, MN: National Research Center for Career and Technical Education, University of Minnesota.

Stricker, L. J., Rock, D. A., & Burton, N. W. (1992). *Sex differences in SAT predictions of college grades.* New York, NY: The College Board.

United States Department of Education. (1992). *Vocational education in the united states: The early 1990s*. Retrieved from https://nces.ed.gov/pubs95/95024.pdf

United States Department of Education. (2009). *New indicators of high school career/technical education course taking: Class of 2005* (NCES 2009-038). Retrieved from https://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2009038

United States Department of Education. (2011). *Schools not making adequate yearly progress.* Retrieved from https://www.ed.gov

United States Department of Education. (2014). *National assessment of career and technical education: Final report.* Retrieved from https:///www2.ed.gov/rschstat /eval/sectech/nacte/career-technical-education/final-rerport.pdf

United States Department of Education. (2016). *United States Department of Education consolidated annual report*. Retrieved from https://perkins.ed.gov/pims/DataExplorer/Performance

United States Department of Education. (n.d.). *Every Student Succeeds Act (ESSA).* Retrieved from https://www.ed.gov/esea

Vars, G. F. (1997). Effects of integrative curriculum and instruction. In J. L. Irvin (Ed.), *What current research says to the middle level practitioner* (pp. 179-186). Columbus, OH: National Middle School Association.

Vavrus, F., & Bartlett, L. (Eds.). (2013). *Teaching in tension: International pedagogies, national policies, and teachers' practices in Tanzania*. Boston, MA: Sense Publishers.

Viadero, D. (1998). Work vs. homework? *Education Week*, *17*(39), 25-29.

Von Glasersfeld, E. V. (2005). Introduction: Aspects of constructivism. In C. T. Fosnot (Ed.), *Constructivism: Theories, perspectives, and practice* (2nd ed.) (pp. 3-7). New York, NY: Teachers College Press.

Vygotsky, L. (1978). Interaction between learning and development. In M. Gauvain & M. Cole (Eds.). *Readings on the Development of Children* (pp. 34-40). New York, NY: Scientific American Books.

Wallace, T. K. (2012). *Implications of the no child left behind legislation on career and technical education*. (Doctoral dissertation, University of Southern Mississippi). Retrieved from https://aquila.usm.edu /cgi/viewcontent.cgi?article=1435& context=dissertatio

Wang, V. (2009). *Definitive readings in the history, philosophy, practice and theories of career and technical education*. Retrieved from ERIC database. (ED512468)

Wang, X., & Pennington, J. (n.d.). *Impact of high school students' coursework on their ACT scores.* Retrieved from https://www.educateiowa.gov/documents/newsroom/ 2014/12/impact-high-school-students-coursework-their-act-scores

West, M. (2016). *From evidence-based programs to an evidence-based system: Opportunities under the Every Student Succeeds Act.* Retrieved from https://www.brookings.edu/research/from-evidence-based-programs-to-an-evidence-based-system-opportunities-under-the-every-student-succeeds-act/

Wijarwadi, W. (2008, November). *The effectiveness of contextual teaching and learning in teaching speaking: An experimental study at the first grade students of SMAN 1 Ciputat academic year 2007/2008*. A paper presented at the Syarif Hidayatullah State Islamic University Jakarta. Retrieved from https://www.scribd.com/doc/60137628/Rc18-The-Effectiveness-of-Contextual-Teaching-and-Learning-in-Teaching-Speaking

Wirth, A. G. (1972). John Dewey's philosophical opposition to Smith-Hughes type vocational education. *Educational Theory, 22*(1), 69-77. doi:10.1111/j.1741.5446.1972.tb00545.x

Yettick, H., Cline, F., & Young, J. (2012). Dual goals: The academic achievement of college prep students with career majors. *Journal of Career and Technical Education, 27*(2), 120-142. Retrieved from https://ejournals.lib.vt.edu/index.php/JCTE/article/view/559/584

APPENDIX A

Status of Request for Exemption from IRB Review

(For Board Use Only)

Date: 4.12.18

Proposal Number: 2018-031

Title of Project: Career and Technical Education on Mathematics and Literacy Achievement for Students in North Central Arkansas

Principal Investigator(s) and Co-Investigator(s): Kimberley Sartain kim.sartain@concordschools.org 501-206-1071

■ Research exempted from IRB review.

☐ Research requires IRB review.

☐ More information is needed before a determination can be made. (See attachment.)

I have reviewed the proposal referenced above and have rendered the decision noted above.
This study has been found to fall under the following exemption(s):

1 ☐ 2 ☐ 3 ■ 4 ☐ 5 ☐ 6 ☐

In the event that, after this exemption is granted, this research proposal is changed, it may require a review by the full IRB. In such case, a ***Request for Amendment to Approved Research*** form must be completed and submitted.

This exemption is granted for one year from the date of this letter. Renewals will need to be reviewed and granted before expiration.

The IRB reserves the right to observe, review and evaluate this study and its procedures during the course of the study.

Rebecca O. Weaver

Chair
Harding University Institutional Review Board