

The Impact of Career and Technical Education (CTE) on Student Academic Achievement and
Graduation Rates in the Commonwealth of Virginia

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ABSTRACT

The No Child Left Behind (NCLB) Act of 2001 required that states set clear standards for what all students should learn, and hold schools accountable for student progress in the areas of language arts, reading, and mathematics to assess their abilities (USDOE, 2002). However, while NCLB emphasizes the core academic subjects (i.e., English, reading/language arts, mathematics science, foreign languages, civics and government, economics, arts, history, and geography), it neglected to address Career and Technical Education (CTE) (i.e., agriculture; business and information technology; family and consumer sciences; marketing; health and medical sciences; technology; or trade and industry) in any part of the legislation. The purpose of this study was to compare the academic performance of CTE completers and non-CTE completers in the Commonwealth of Virginia on the Standards of Learning (SOL) Reading and mathematics assessments, and graduation rates. This study was modeled after and was an extension of a previous study by Blowe (2011), and represented a quantitative, quasi-experimental, correlational evaluation of ex post facto data to determine the effects of being a CTE completer on student academic success in high school. The findings show that the mean pass rate for CTE completers was higher than the mean pass rate for non-CTE completers for both the EOC Reading and EOC Algebra II SOLs, and that the mean graduation rate for CTE completers was higher than the mean graduation rate for non-CTE completers for each of the graduation cohorts years included in the study. An additional finding was the discovery of reporting discrepancies in division-reported data published by the VDOE. The findings in this study provided the researcher with valuable insight into the potential role of CTE in an improving schools model, including the utilization of a rigorous CTE curriculum as a strategy for improving SOL scores and graduation rates for all students. Additionally, this information may prove beneficial to educational and legislative leaders in developing policies governing CTE curriculum throughout the Commonwealth of Virginia.

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I dedicate this work to my two beautiful daughters, Kiersten and Kayla. They have been my greatest blessings and I pray that they will persist to strive for excellence through education. I am extremely proud of their achievements, to date, and am continually inspired by their developing character and growing maturity.

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CHAPTER 1

INTRODUCTION

History of Vocational Education

With the advent of the Elementary and Secondary Education Act of 1965 (ESEA), the federal government sought to improve the educational system through standards-based educational reform. The purpose of the ESEA bill was “to ensure that all children have a fair, equal, and significant opportunity to obtain a high-quality education and reach, at a minimum, proficiency on challenging State academic achievement standards and state academic assessments” (United States Department of Education, 2002). Over the years, Congress has reauthorized the ESEA several times to include five titles, the most important of which is arguably Title I, which provides funding guidelines for the education of children deemed to be “educationally disadvantaged” (Brown-Nagin, 2004). The enactment of the ESEA signaled a shift toward greater federal involvement in education, creating policies that were previously left almost exclusively to state and local governments (Brown-Nagin, 2004).

What began as part of President Johnson’s “War on Poverty” (Brown-Nagin, 2004), has evolved into what is now known as the No Child Left Behind Act of 2001 (NCLB), the overarching theme of which is “to close the achievement gap through accountability, flexibility, and choice, so that no child is left behind” (USDOE, 2002). Since the passing of the original ESEA, the educational system in the United States has focused on standards-based educational reform aimed at increasing the level of achievement in students by holding state and local educational organizations accountable for students’ academic success. According to Hanson, et al (2006):

NCLB has evolved considerably since its inception and will continue to evolve to meet its aims. However, the one piece of the Act that has remained constant is that of a level of accountability for student achievement. In the past several years there has been a marked increase in the collection of data used to measure performance. NCLB requires reports on individual schools that are a part of annual district report cards, also known as local report cards. Each school district must prepare and disseminate annual local report cards that include information on how students in the district and in each school performed on state assessments. The report cards must state student performance in terms

of various levels of proficiency in the areas of: basic, proficient, and advanced. Achievement data must be disaggregated, or broken out, by the nine previously mentioned student subgroups (p. 17).

While NCLB is the latest in a sequence of laws that seek to close the achievement gap among students, it has reached further than previous legislative acts in expanding the role of the federal government's aim of improving the educational outcomes of disadvantaged students (Brown-Nagin, 2004). NCLB, however, makes no mention of career and technical education, except to reference the Carl D. Perkins Vocational and Technical Education Act of 1998 in Section 1111, as part of those Acts that state educational agencies include as part of their state plans.

Vocational education, more recently referred to as career and technical education, evolved along with the birth and growth of the United States and found its legislative beginnings in the Massachusetts Bay Colony with the Old Deluder Satan Act – the first education law passed in America. This new law required masters to teach their apprentices not only vocational skills, but academic skills as well. By the mid to late 1800s, as apprenticeships declined, the youth of the nation were provided opportunities to acquire vocational, job-training skills through industrial education programs as a way of providing skilled laborers for American Industry (Gordon, Daggett, McCaslin, Parks & Castro, 2002).

After the civil war, former slaves found opportunities in the new South to learn meaningful vocational skills through such institutions as Samuel Chapman Armstrong's Hampton Institute. Armstrong believed in vocational education as a means to develop social and economic relations for African-Americans by preparing them to become good, subservient laborers. Booker T. Washington, one of Armstrong's students, further fostered the need for vocational education for African-Americans (Gordon et al., 2002). However, this view of vocational education was strongly opposed by W.E.B. Du Bois, who advocated for a more academically intellectual curriculum that would prepare African-Americans to be equal to their white counterparts (Miller, 2006).

Also, in the mid to late 1800s and early 1900s, the United States Congress passed several acts that supported vocation education. These legislative acts included the Morrill Acts of 1862 and 1890, which provided aid to land-grant colleges, "the Hatch Act of 1887 and the Adams Act of 1906 [which] allocated aid to agricultural experimental stations, and the Smith-Lever Act of

1914 [which] provided support for agricultural and home economics extension programs” (California Adult Literacy Professional Research Organization, 1999, p. 7).

Federal support for vocational education had its formal beginnings in public education with the passage of the Smith Hughes Act of 1917, which was created as a means to provide students with the specific occupational skills necessary to obtain entry-level jobs without the benefit of a college degree (Gordon et al., 2002). In 1914, the Commission on National Aid to Vocational Education was devised and pushed to include vocational education in the high school curriculum (Friedel, 2011). The Smith Hughes Act provided federal funding for alternative vocational institutions focusing on agriculture, trades and industry, and home economics and for teacher training throughout the country to meet the needs of the children of working class families who were not expected to attend college (CALPRO, 1999). Another outcome of Smith Hughes was that it created a Federal Board for Vocational Education and required that states create their own separate board (Gordon et al., 2002).

Statement of the Problem

The NCLB Act of 2001, signed into law by President George W. Bush, required that states set clear standards for what all students should learn and held schools accountable for student progress. As a result of the act, students are required to be tested regularly in the areas of language arts, reading, and mathematics to assess their abilities. The goals of this legislation were:

- increased accountability for results from states, school districts, and schools;
- more flexibility for states and local educational agencies in how federal education funding is used;
- proven teaching methods; and
- more choices for parents and students attending low-performing schools (Chadd & Drage, 2006).

NCLB emphasized the core academic subjects (i.e., English, reading/language arts, mathematics science, foreign languages, civics and government, economics, arts, history, and geography); however, it fails to make mention of career and technical education. In fact, no area of CTE (i.e.,

agriculture; business and information technology; family and consumer sciences; marketing; health and medical sciences; technology; or trade and industry) is mentioned in the legislation.

According to one author, the NCLB legislation was an attempt by the Bush administration “to zero out federal funds to career and technical education” (Friedel, 2011, p. 48) for its apparent failure to improve the academic achievement of high school students. The administration further recommended that federal funding from the Carl D. Perkins Career and Technical Education Act of 1998 be used to support Pell grants for college students in an effort to boost academic achievement for high school students and maximize the number of rigorous academic courses taken in preparation for college (Freidel, 2011).

On the state level, the Commonwealth of Virginia has enacted several performance standards aimed at improving student performance. Virginia uses the 16 career clusters to provide opportunities for students to explore career interests and develop plans to further their career goals. Students may also investigate career pathways within the career clusters in order to acquire “a common set of skills and knowledge, including academic, technical, and career readiness skills that lead to credentials necessary to pursue a full range of career opportunities from entry level to management, including technical and professional specialties” (VDOE, 2013, p.1). Additionally, CTE works with business and industry partners to produce programs that offer leadership development for students. Some of the recently recorded outcomes include:

- Participation in the Workplace Readiness Skills for the Commonwealth examination increased significantly from 3,693 in 2010-11 to 34,798 in 2012-13. Sixty-four percent (22,127) of those who attempted the exam earned the credential.
- Eighty-seven percent of CTE students (868 of 1,001) earned the Virginia Career Readiness Certificate.
- Eighty-one percent of CTE students (11,821 of 14,647) passed the W!SE (Working in Support of Education) test and earned the financial literacy credential.
- During the 2012-13 school year, 31,149 secondary students (including CTE program completers) earned dual enrollment credits.
- During the 2012-13 school year, 643 secondary students (including CTE program completers) earned community college certificates or degrees at or before high school graduation (VDOE Accountability and Virginia Public Schools, 2013, p. 1).

The Virginia Board of Education (VBOE), through the Virginia Department of Education (VDOE), has enacted several legislative policies that guarantee opportunities for student participation in a rigorous CTE program. The Standards of Accreditation (SOA) sets forth the requirements for the Standard, Advanced Studies, and Modified Standard Diplomas. Those requirements specify which level of courses and/or subject area disciplines students must complete to earn either a standard or verified unit of credit in the areas of mathematics, laboratory science, and history and social science, as well as the credit requirements in other content disciplines. The regulations also specify that the Board of Education shall approve courses (other than those specifically named in the standards) to satisfy the requirements in those areas (VDOE, 2013, p. 1).

- Effective with the entering ninth grade class of 2011-2012, Economics and Personal Finance is a required course for graduation in the Commonwealth (VDOE, 2013, p. 7).
- Effective with the entering ninth grade class of 2013-2014, students must earn a career and technical education credential approved by the Board of Education in order to earn a Standard Diploma. This credential could include, but is not limited to, an industry certification, a state licensure examination, a national occupational competency assessment, or the Virginia workplace readiness assessment (VDOE, 2013, p. 7).
- Effective with the entering ninth grade class of 2013-2014, students must complete one virtual course, which may be a noncredit-bearing course or a required or elective credit-bearing course that is offered online (VDOE, 2013, p. 7).

Each of these legislative policies represents the Commonwealth's dedication to preserving the CTE curriculum as part of the educational requirements for Virginia graduates.

Purpose of the Study

The purpose of the study was to compare the academic performance of CTE completers and non-CTE completers in the Commonwealth of Virginia on the Standards of Learning (SOL) Reading and mathematics assessments, and graduation rates. This study provided longitudinal research in examining subsequent years' data modeled after a previous study published in 2012

by Blowe entitled *The Impact of Career and Technical Education on Student Academic Achievement and Graduation Rates of Students in the Commonwealth of Virginia*.

Blowe concluded in her study of students in the Commonwealth of Virginia from 2008 to 2010 that: 1) CTE Completers experienced higher pass rates than non-CTE completers with regard to the Grade 11 Reading SOL; 2) CTE completers experienced higher pass rates than non-CTE completers with regard to mathematics SOLs; and 3) CTE completers experienced higher cohort graduation rates than non-CTE completers (Blowe, 2011). One important change to the data from the previous study by Blowe, is the implementation of new assessments based on the 2009 Mathematics SOL in 2011-2012 (VDOE, 2009). The new 2009 mathematics SOL standards for increased rigor was “intended to support the following five goals for students: becoming mathematical problem solvers, communicating mathematically, reasoning mathematically, making mathematical connections, and using mathematical representations to model and interpret practical situations” (VDOE, 2009, p. iv). In modeling the Blowe study, and looking at the subsequent three years of data for graduates of the 2011, 2012, and 2013 school years within the Commonwealth of Virginia, further insight can be gained in answering the proposed three research questions.

Research Questions

- 1) What, if any, difference is there between CTE enrollment status (CTE completer vs. non-CTE completer) and student achievement as measured by Grade 11 Reading SOL pass rates?
- 2) What, if any, difference is there between CTE enrollment status (CTE completer vs. non-CTE completer) and student achievement as measured by SOL mathematics pass rates for Algebra II?
- 3) What, if any, difference is there between CTE enrollment status (CTE completer vs. non-CTE completer) and the graduation rates of students?

Hypotheses

Following the research questions, a null and alternative hypothesis will be presented in order to assess the objective of this study using a quantitative approach. The hypotheses for this study are as follows:

H₀: There is no difference between CTE enrollment status (CTE completer vs. non-CTE completer) and student achievement and graduation rates.

H₁: There is a difference between CTE enrollment status (CTE completer vs. non-CTE completer) and student achievement and graduation rates.

Significance of the Study

Due to the increased scrutiny placed upon schools and divisions to improve student performance under the current NCLB legislation, it is increasingly important to examine the impact of students' participation in CTE upon their academic achievement and success in completing high school. The need for such studies is underscored by the fact that in an examination of published articles in Career and Technical Education Research (CTER) dating from 2001 to 2005, only 6% used quasi-experimental designs, and none of the articles published during this period utilized a truly experimental design (Gemici & Rojewski, 2007). Although Gemici's and Rojewski's (2007) study was delimited by the exclusive review of only one publication, it still holds true that in order to deliver improved evidence to the contributions provided by a CTE curriculum, it is imperative that quantifiable, scientifically-based research be conducted within the CTE field.

Definitions of Terms

The purpose of the definition of terms is to reduce ambiguity. The following terms are operationally defined for this purpose.

Career and Technical Education (CTE): Previously known as vocational education, CTE offers a sequence of coherent and rigorous courses aligned with challenging academic standards and relevant technical knowledge and skills needed to prepare for further education and careers in current or emerging professions. CTE provides technical skill proficiency, an industry-recognized credential, and may include prerequisite courses incorporating competency-based applied learning that contributes to the academic knowledge, higher-order reasoning and problem-solving skills, work attitudes, general employability skills, technical skills, and occupation-specific skills and

knowledge of all aspects of an industry, including entrepreneurship (U.S. Department of Education, 2006)

Carl D. Perkins CTE Improvement Act of 2006 (Perkins IV): Signed into law on August 12, 2006, this reauthorization of the previous Act, named for Carl D. Perkins, provides approximately \$1.3 billion in federal funding to states with “an increased focus on the academic achievement of career and technical education students, strengthen[s] connections between secondary and postsecondary education, and improves state and local accountability” (U.S. Department of Education, 2006).

CTE Completer: A CTE completer is a student who has met the requirements for a CTE concentration and all requirements for high school graduation, or an approved alternative education program. Students may take additional CTE courses that will enhance their career pathway goals (Virginia Department of Education, 2012).

Non-CTE Completer: A non-CTE completer is a student who has met all the requirements for high graduation, or an approved alternative education program, but has not met the requirements for a CTE concentration.

Graduation Rate: NCLB defines the "four-year adjusted cohort graduation rate" as the number of students who graduate in four years with a regular high school diploma divided by the number of students who entered high school four years earlier. This rate allows for adjustments based on transfers in and out, émigrés and deceased students (U.S. Dept. of Education, 2002).

High-Stakes Test: Also referred to as Minimum Competency Examinations (MCEs), these assessments measure students against a standard of learning, typically in mathematics and reading – and in some states writing, science, and social sciences – based on a specific cut score which all high school graduates are required to pass (Bishop & Mane, 2005). In Virginia, the MCE is referred to as the Standard of Learning (SOL) assessments.

Limitations and Delimitations

The following are limitations of this study, which will be further discussed in Chapter 4:

- VDOE reporting data are subject to the suppression rule, and some division data counts are not reported to protect the privacy of individuals.
- The ex post facto data are not primary data, but secondary data collected from school divisions throughout the Commonwealth of Virginia and are subject to reporting error.

The following are delimitations of this study:

- The population represent the Commonwealth of Virginia and may not be representative of other state CTE curriculum, programming, or course offerings.
- The study only focused on the end-of-course (EOC) Reading and Algebra II SOL assessments as measures of comparison between CTE completers and non-CTE completers and did not represent all core academic content areas.

Theoretical Framework

Contextual Learning Theory

Educators strive to ensure that all students learn the content through the use of reliable instructional strategies. Proponents of the contextual learning theory highlight the struggle of balancing the ability to teach students curriculum and to select the most appropriate instructional approach. According to the Center for Occupational Research and Development (1999), contextual learning allows students access to multiple aspects of any learning environment: classroom, laboratory, a worksite, a computer lab, or wheat field (Center for Occupational Research and Development (CORD), 1999). Instructors of contextual learning expose students to various forms of experiences, such as, cultural, social, psychological, and physical with the outcome being the desired learning outcome (CORD), 1999). Perin (2011) referenced Mazzeo, Rab and Alssid (2003) in defining contextualization as “a diverse family of instructional strategies designed to more seamlessly link the learning of foundational skills and academic or occupational content by focusing teaching and learning squarely on concrete applications in a

specific context that is of interest to the student” (p. 269). Perin (2011) further identified two distinct forms of contextualization: contextualized and integrated instruction.

In examining both forms of contextualization, “contextualized basic skills instruction involves the teaching of reading, writing, or mathematics skills against a backdrop of specific subject matter such as philosophy, statistical process control, allied health, business, history, and science” (Perin, 2011, p. 271). Although students may implicitly learn content through contextualized basic skills instruction, that is not the true objective; rather it is to systematically teach the academic skills necessary to successfully acquire the content. And, whereas contextualized skills instruction can occur outside of the content area, “integrated basic skills instruction occurs in content area classrooms” (Perin, 2011, p. 271); the goal of which is “to teach the disciplinary content, not basic skills; however, teaching basic skills is a necessary step toward critical thinking about the content area” (p. 272).

CORD (1999) emphasized that learning occurs when students process new information in such a way that it makes sense to them in their own frames of reference in the real-world. The following self-reflection questions allow for teachers to identify their alignment with the contextual learning theory teaching strategies:

- Are new concepts presented in real-life (outside the classroom) situations and experiences that are familiar to the student?
- Are concepts in examples and student exercises presented in the context of their use?
- Are new concepts presented in the context of what the student already knows?
- Do examples and student exercises include many real, believable problem-solving situations?
- Do examples and student exercises cultivate an attitude that says, "I need to learn this?"
- Do students gather and analyze their own data as they are guided in the discovery of important concepts?
- Are opportunities presented for students to gather and analyze their own data for enrichment and extension?

- Do lessons and activities encourage students to apply concepts and information in useful contexts, projecting students into imagined futures (e.g., possible careers) and unfamiliar locations (e.g., workplaces)?
- Are students expected to participate regularly in interactive groups where sharing, communicating, and responding to the important concepts and decision-making occur?
- Do lessons, exercises, and labs improve students; reading and other communication skills in addition to mathematical reasoning and achievement? (CORD, 1999, p. 2)

CORD (1999) compiled five strategies from mathematics and science teachers who motivated and engaged their students in the learning process: Relating, Experiencing, Applying, Cooperating, and Transferring (REACH). Relating refers to teachers' ability to link a new concept to what students already know to the content. Teachers must provide the environment for student to activate memories or prior knowledge and recognize the relevance of the information they are relating (CORD, 1999). The question then becomes, how do teachers know the student's prior knowledge? CORD (1999) offered three primary resources teachers can utilize to determine this:

1. Experience – from the teacher's own experience with students of similar backgrounds or from the collective experience of the teacher and his or her colleagues;
2. Research – from documented evidence of students' commonly held ideas; and
3. Probes – from carefully designed questions or tasks that reveal students' prior knowledge and beliefs (CORD, 1999, p. 5).

Relying on students' prior knowledge can also be an impediment because students may reveal an incorrect, naïve, or incomplete understanding of concepts. Experiencing is learning by doing through exploration, invention, and discovery. This can be accomplished by utilization of manipulatives, problem-solving exercises, and laboratory simulations. The applying refers to expanding learning by placing the concepts to use. Teachers can increase student motivation by aligning the concept to realistic and relevant exercises. Cooperating focuses on the learning process by allowing students to share, respond, and communicate with other students. Small

group activities encourage cooperation between students because students feel less self-conscious and embarrassment (CORD, 1999).

Contextual teaching and learning signifies the notion of learning by doing, which has long been a pillar for agricultural education, a precursor to career and technical education (Curry, Wilson, Flowers & Farin, 2012). CTE courses, by nature, utilize contextual learning strategies as part of the instructional practice, which allows students multiple aspects of any learning environment by expose students to various forms of experiences.. The purpose of this study is to examine the differences between CTE completers vs. non-CTE completers as demonstrated on Grade 11 Reading SOL pass rates, SOL mathematics pass rates, and the graduation rates.

Chapter Summary

The Elementary and Secondary Education Act of 1965 (ESEA) sought to improve the educational system through standards-based educational reform by focusing on standards-based educational reform by holding state and local educational organizations accountable for student's academic success. NCLB, the latest iteration, expanded the role of the federal government's aim of improving the educational outcomes of disadvantaged students. NCLB, however, did not include career and technical education, except that state educational agencies will include CTE as part of its state plan.

This study compared the academic performance of CTE completers and non-CTE completers in the Commonwealth of Virginia on the Standards of Learning (SOL) Reading and mathematics assessments, and graduation pass rates and provided longitudinal research in examining subsequent years' data from a previous study published in 2012 by Blowe, after which this study was modeled.

Organization of the Study

This study is presented in five chapters. Chapter 1 contains the introduction, a history of vocational education, a statement of problem, the purpose of study, the research questions, the significance of study, the definition of terms, the theoretical and conceptual framework, and a summary of the chapter. Chapter 2 presents a review of the related literature, including a synopsis of career and technical education in the United States, accountability and high stakes testing, a discussion of college and career options for students, an overview of CTE student

academic performance and graduation rates, and a summary of the chapter. Chapter 3 presents the purpose of the study, the research design, the research questions, the population to be studied, data collection and procedures, data analysis, and the summary. Chapter 4 presents the results of the study by research questions, as well as the summary. Chapter 5 presents a discussion of findings, implications for practice, limitations of the study, recommendations for future research, and the researcher's reflections.

CHAPTER 2 LITERATURE REVIEW

Career and Technical Education in the United States

The Commonwealth of Virginia, through the Virginia Department of Education (VDOE), in support of career and technical education recognizes the importance of a career and technical education for students and through Commonwealth's Academic and Career Plan, awards diploma seals from the Board of Education, recognizing industry credentialing in its diploma requirements (VDOE, 2012). The concern, however, is that the VDOE does not go far enough to address the contributions that a career and technical education provides for all students as part of a comprehensive academic curriculum and, by not doing so, it appears to reinforce the paradigm of separate tracks for students participating in core academic courses and those enrolled in CTE courses. This failure to recognize the inherent flaw in "support" of CTE is at the heart of the argument regarding NCLB.

The goal of NCLB is to raise academic standards in the core curricula in preparation of students for post-secondary education. Under NCLB, states are required to assess student learning annually in grades 3 through 8, and once in high school, in the areas of reading and mathematics. However, many states, like Virginia, have included science and social sciences in their assessments (Fletcher, 2006). These high-stakes tests, or minimum competency exams (MCE), are "to define standards for learning (what *all* students are expected to know), test students against these standards, and require that students pass examinations assessing the achievement of these standards before graduating" (Bishop & Mane, 2005). The information gathered from MCEs is used to monitor student progress and identify schools that are underperforming (Fletcher, 2006) and not meeting Annual Measurable Objectives (AMO) – the minimum required percentages of students determined to be proficient in each content area (VDOE, 2012). Even then, a passing score does not necessarily indicate a student's achievement level in a given subject, but rather it indicates whether or not a student exceeded a specific cut score on the assessment, signaling the student's eligibility to graduate (Bishop & Mane, 2005). Furthermore, while the MCEs provide a common measure within states, they do not address parity issues across states.

By focusing on the core academic curriculum as a means of measuring the success of a student and/or a school, Bishop and Mane (2005) posit that:

MCEs produce two effects: first, there is a *signaling effect* that labels students as either a *passer or a failer*. Categorizing high school completers in this way makes it easier for employers to choose the right worker and should raise the wage offered students who pass the MCE and receive the standard diploma. Second, there should be a *learning effect* as a consequence of the greater effort put up by teachers and administrators (accountability of their performance is now much easier) and of students studying harder (p. 172).

The intention of NCLB, therefore, is to force the development of a stronger background in academic courses for all high school students. Because of the requirement “that students be proficient in core academic classes, teachers spend the greatest amount of time on curricula on which students will be assessed and may even neglect or de-emphasize curricula not tested” (Fletcher, 2006, p. 161).

The common belief among “policymakers and the public is that CTE students in general do not perform as well as the general non-CTE students in academic courses such as math and reading” (Bae, Gray & Yeager, 2007, p. 10). Based upon this belief, policymakers see no need to address CTE in NCLB. However, because of “federal legislative initiatives in the 1990s that attempted to reform the nature of vocational education by emphasizing an integrated approach to CTE and academic courses” (Plank, DeLuca, & Estacion, 2008, p. 349), CTE has the potential to enhance the level of students’ engagement with school through the incorporation of core academic skills within the CTE curriculum. Student engagement has been shown to have a positive link to student academic achievement. According to Plank, CTE may help students more readily see the value of school in preparing them for careers of interest and can encourage student to define their career goals. By connecting school with the transition to adulthood and a career, CTE can clarify the application and value of academic subjects as they pertain to jobs or perhaps the postsecondary education that is needed for a career of interest, thereby keeping youths engaged with school (Plank et al., 2008, p. 360).

Career and Technical Education in the Commonwealth of Virginia

Within the Commonwealth of Virginia, students are afforded opportunities to participate in CTE courses that help students explore the 16 careers clusters. The VDOEs Career Cluster webpage. “Virginia Career and Technical Education: Law, Public Safety, Corrections and Security” (2014), prefaces the Commonwealth’s plan, which states:

Virginia’s 16 Career clusters and career assessments help students investigate careers and design their plan of study to advance their career goals. Within each career cluster, there are multiple career pathways that represent a common set of skills and knowledge, including academic, technical, and career readiness skills that lead to credentials necessary to pursue a full range of career opportunities from entry level to management, including technical and professional career specialties. CTE actively partners with business and industry to design and provide high quality, dynamic programs to meet current, emerging, and projected labor market needs. Relevant work-based learning opportunities and leadership development offered through career and technical student organizations are incorporated into the academic and career plan.

A CTE completer is a student who has met the requirements for a CTE concentration and all requirements for high school graduation, or an approved alternative education program. A concentration is a coherent sequence of state-approved courses. Student must take additional CTE courses that will enhance their career pathway goals. Completion of certain skill sets and coursework enables student to participate in Board-approved external examinations that test essential employability and technical skills (VDOE, 2014).

Virginia’s vision for CTE is “to be an innovative education system that prepares individuals to succeed in education and their careers so that the United States flourishes in this global, dynamic economy” (VDOE, 2012). The need for these programs is two-fold: 1) to prepare young people for productive futures; and 2) to meet the commonwealth's need for well-trained and industry-certified technical workers (VDOE, 2012).

Accountability and High-Stakes Testing

Virginia Standards of Learning (SOL). The VDOE established assessments that identify minimum expectations for what students should know and be able to demonstrate at the end of each grade or course in English, mathematics, science, history/social science, technology, the fine arts, foreign language, health/physical education and driver education (VDOE, 2012). Annual end-of-course (EOC) SOL assessments are given to students in grades 3-8 and is inclusive of alternate and alternative assessments for students with disabilities. The following courses and grades are assessed: Writing – grades 5 and 8 and end-of-course; Reading – grades 3-8 and end-of-course in grade 11; Mathematics – Grades 3-8 and Algebra I, Geometry and Algebra II; and Science – Grades 3, 5, 8 and Biology, Earth Science and Chemistry.

The *No Child Left Behind (NCLB) Act of 2001* requires that all students, including those with disabilities and those with limited proficiency in English, be assessed on statewide accountability measures. The *Individuals with Disabilities Education Improvement Act of 2004 (IDEIA)* requires students with disabilities to participate in the same state assessments as those required of their non-disabled peers in the same grade level (VDOE, 2014). In Virginia, students with disabilities may participate in the Virginia Standards of Learning (SOL) assessments with or without accommodations. Students in grades 3 through 8 with disabilities that prevent them from accessing the SOL test(s) in a content area, even with accommodations, may participate in the VGLA in the content areas of *Writing, Science, and History/Social Science* (VDOE, 2014). Additionally, the VSEP is available to students with disabilities who are enrolled in courses or who have passed courses with end-of-course SOL assessments and students in grades 9-12 who need the grade 8 literacy and numeracy certification required to earn a Modified Standard Diploma (VDOE, 2014).

Based upon student performance on the Virginia SOLs, as well as other indicators, schools are rated in four core academic areas of English, history/social science, mathematics, and science. High schools have an additional requirement of meeting a minimum benchmark for graduation and completion (VDOE, 2012). If a school meets or exceeds all achievement objectives, it is considered “fully accredited” by the Virginia Board of Education.

Career and Technical Education Accountability. Preparing students for secondary education and workforce readiness requires states to develop standards to ensure students who are participating in secondary career and technical education programs obtain certain skills. In

order to track these skills, states across the United States are developing content standards for career and technical education, referred to as skill standards. Castellano, Harrison, and Schneider (2008) explored the progress of states and the District of Columbia in developing statewide standards for CTE. The following questions were asked:

- Has the state developed a system of CTE standards;
 - What state funding is available for secondary CTE programs;
 - Have the state academic standards been crosswalked or integrated into CTE course; and,
 - How does the state ensure that the established standards are reflected in practice?
- (Castellano, Harrison, & Schneider, 2008, p. 28)

Preliminary information for each state and the District of Columbia was collected from the states' department of education websites. Directors of CTE were contacted and interviewed to clarify and validate the accuracy of the online information (Castellano et al., 2005). Alabama and New Jersey were unable to participate in the interview process.

Findings revealed that 30 states had near-completed or completed a statewide standards systems, eleven states (i.e., Georgia, Hawaii, Idaho, Illinois, Maine, Nevada, New Mexico, North Dakota, Rhode Island, South Dakota, and Vermont) were in the process of completing a statewide standards system, and eight did not have a statewide standards system, but had developed local CTE standards; but these states (i.e., Alaska, Colorado, District of Columbia, Maryland, Michigan, Minnesota, Montana, and Pennsylvania) did not disavow the need for CTE standards (Castellano et al., 2008). Regarding funding sources for CTE programs, all states receive federal Perkins Grant funding to support CTE programs; however, these funds account for only approximately 5% of most states' CTE expenditures. States reported the allocation of CTE funds through either categorical funding or K-12 education funding from the local education agencies (LEAs). Out of the 30 states that near-completed or completed a statewide standards system, 22 reported that they provided ongoing categorical state funding for CTE programs. States who were in the process of completing a statewide standards system also provided categorical state funding. This alignment suggests that categorical funding can be beneficial in the development of statewide standards, but is not sufficient in its entirety. In addition to CTE statewide standards, 12 out of the 30 states that had near-completed or

completed statewide standards systems had a statewide postsecondary technical standards system. Ten out of these 12 states had aligned the two systems (Castellano et al., 2008).

This study also examined the alignment of secondary academic standards with CTE courses. This process of identifying academic skills in CTE programs areas and making these skills explicitly apart of the academic curriculum is called crosswalking. Eighteen out of the 30 states that were near-completed or completed a statewide standards system and four of the 11 that who were in the process of completing a statewide standards system had crosswalked their academic standards to the CTE courses. Some of these states had not even completed their CTE standards and had already crosswalked academic standards and CTE courses (Castellano et al., 2008). In order to ensure that statewide standards were reflected on the local level practice, states utilized a variety of assessments including end-of-program assessments, end-of-course assessments, online assessments, hands-on demonstrations, state-developed exams, and/or state-specific vendor-developed exams (Castellano et al., 2008). At the time of this study, Louisiana, Mississippi, North Carolina, and Ohio were at the forefront in the development of CTE standards systems. Additional states were definitely progressing to create these standards and progressing towards alignment with the vision in Perkins IV (Castellano et al., 2008).

The Great Divide: College vs. Career

In 2007, the Virginia Board of Education authorized the Virginia Department of Education (VDOE) to study what factors contributed to the success of postsecondary education of Virginia students. The VDOE requested assistance from Achieve, the American Diploma Project (ADP), the College Board, and ACT to conduct a comparative analysis of postsecondary readiness as readiness relates to the Virginia Standards of Learning in English/Reading and Mathematics (VDOE, 2012). Virginia's College and Career Readiness Initiative outlined the following standards: "(a) ensure that college and career ready learning standards in reading, writing, and mathematics are taught in every Virginia high school classroom and (2) strengthen students' preparation for college and the work force before leaving high school" (VDOE, 2012, p. 1). In addition, VDOE identified student indicators of college readiness and persistence in a four-year postsecondary institution,

- participating in a college preparatory curriculum that includes Algebra II and chemistry;

- earning advanced proficient scores on mathematics, reading, and writing SOL assessments;
- earning an advanced studies diploma;
- participation in Advanced Placement, International Baccalaureate, and dual-enrollment courses;
- participating in the Virginia Early College Scholars programs; and,
- earning college ready scores on placement tests such as the SAT and ACT (VDOE, 2012, p. 2).

Beginning in 2006, VDOE linked data from students' postsecondary experiences to their enrollment in institutions of higher education using data acquired from the National Student Clearinghouse (VDOE, 2012). The following is an excerpt of research conducted by the Center for Assessment, Evaluation, and Education Programming at Virginia Tech on the behalf of the VDOE:

- Students who earn advanced proficient scores on Virginia's end-of-course mathematics and English SOL assessments have a high probability of enrolling in four-year colleges and persisting into their second year, with students who earn advanced proficient in reading, writing, and Algebra II having the highest probability of success.
- Students who score proficient on reading, writing, and mathematics end-of-course assessments have a relatively low probability of enrolling and succeeding in four-year institutions. These students' probability for success in two-year institutions requires further study.
- Students who earn advanced studies diplomas in Virginia, including International Baccalaureate (IB) diplomas, have a high probability of enrolling in four-year colleges and persisting into their second year. Students who earn other diplomas have a low probability of enrolling in four-year institutions. These students' degree of preparation for success in two-year institutions requires further study.
- Students who participated in Virginia's Early College Scholar Program had high rates of enrollment (greater than 85 percent) in four-year institutions within three years of graduating from high school.

- Consistent with national trends, significant work must be done in Virginia to support particular groups of students to enroll and be successful in postsecondary education. Of particular note are students who are economically disadvantaged, male, Hispanic, or African American. VDOE's analysis showed that students in these groups generally have lower rates of enrollment and persistence. This was true even when their state assessment results suggest they were well prepared.
- Enrollment in two- and four-year colleges varies by Virginia's Superintendents' Regions, with northern Virginia enrolling the largest percent of students in two- and four-year colleges (VDOE, 2012, p.8).

Bartlett, Schlieff and Bowen (2011) highlighted the increase of interest in the "evaluation and assessment of students learning as well as the degree to which this provides students the needed knowledge, skills, and abilities to gain entry into and subsequently in the labor market" (p. 105). The Advanced Technological Education (ATE) program is recognized as education and training program that provides leadership for an abundance of CTE-related occupations (Bartlett, Schlieff & Bowen, 2011). The creation of the ATE program originated from the Scientific and Advanced Technology Act of 1992, which prompted a response from the National Science Education (NSF). The act established

a national advanced technician training program, utilizing the resources of the Nation's two-year associate-degree-granting colleges to expand the pool of skilled technicians in strategic advanced-technology fields, to increase the productivity of the Nation's industries, and to improve the competitiveness of the United States in international trade, and for other purposes (Cong. P.L.102-476).

The ATE program supports the following fields in technology: "agricultural technology, biotechnology, chemical technology, civil and construction technology, computer and information technology, cyber security and forensics, electronics, energy environmental technology, geospatial technology, manufacturing and engineering technology, marine technology, multimedia technology, nanotechnology, telecommunications, and transportation technology" (Bartlett et al., 2011, p. 109).

Bartlett et al. (2011) examined a component of the ATE program to determine the extent, the type, and the outcomes of workforce activities within participating CTE programs. A

workforce needs assessment, “frames the problems or opportunities of interest and builds relationships among the people and groups who have a stake in the issue” (Bartlett et al., 2011, p. 108). Only half of the CTE programs participating in the ATE programs utilized workforce need assessments, even though the National Science Foundation strongly encourages this practice. Workforce needs assessments can be conducted at a level of an individual organization or multiple organizations, industries, or geographic regions.

In preparing students for the workforce, the state of California projects that it will experience a shortage of baccalaureate-trained workers in the decades to come, particularly engineers, accountants, nurses, teachers, and law enforcement professionals. Individuals who usually pursue these careers begin their journey toward these occupations in CTE programs and community colleges (Karandjeff & Schiorring, 2011). The Research & Planning Group for the California Community Colleges conducted a multi-year study to investigate how the state could build the pathways to these professions.

The findings revealed that California’s community colleges have an expanding infrastructure of CTE programs, which is inclusive of coursework that is transferable and related to the occupations projected to experience a shortfall (Karandjeff & Schiorring, 2011). Unfortunately, the infrastructure is underutilized in aiding CTE students in completing major requirements at the community college level prior to transferring. Interestingly, California State University (CSU) receives the majority of transfers of CTE students. Within the cohort of students for this study, “two-thirds transferred to a CSU institution, 13% each of the University of California (UC) system and to private in-state institutions, and 8% to out-of-state institutions” (Karandjeff & Schiorring, 2011, p. 47). The majority of the students, who transferred to the University of California (UC) system, participated in computer software development and computer science at 48% and 52%, respectively (Karandjeff & Schiorring, 2011).

Flexer, Daviso, Baer, Queen, and Meindi (2011) applied a correlational methodology to examine evidence-based practices, and career pathways models of transition to determine their level of impact on post school outcomes for students with disabilities. The following research questions were developed: “(1) What is the effect of inclusion on post-secondary education (PSE)? (2) What is the effect of career and technical education on employment? (3) What is the impact of work-study experience on subsequent employment?” (Flexer et al., 2011, p. 85).

Enrollment in a 2-or 4- year college for eight or more credits within a year of leaving high school was defined as full-time post-secondary education and working 35 hours or more per week was competitive pay within a year of leaving high school was defined as full-time employment (Flexer et al., 2011, p.86).

The student sample was comprised of African American students who were identified as students (a) with an intellectual and/or developmental disability, (b) with learning and behavioral disabilities, learning disabilities, emotional disability, or other health impairment (Flexer et al., 2011).

The findings presented the following:

- students with intellectual and developmental disabilities were at a disadvantage to move to PSE;
 - students with disabilities were significantly more likely to gain full-time employment after one year of exiting high school if they had completed three or more semesters of career and technical education courses; and,
 - there was a positive relationship between work study and full-time employment.
- African American students in this study were more likely to be in health care, child care, and cosmetology fields and less likely to work in building maintenance, agriculture, construction, and computer and industrial fields (Flexer et al., 2011, p. 86).

CTE Student Academic Performance

As academic performance expectations increase throughout the United States, programs that do not directly address these expectations are questioned, including the CTE clusters. The clusters of agriculture; business; marketing; and computer family and consumer sciences; health occupations; or technology-trade and industry education are continuously at risk from being marginalized. Proponents of CTE need to display that these programs: “(a) contribute to academic success of students as measured by state academic tests and (b) serve as a motivation for students to stay in school and help students perform better in academic courses” (Chadd & Drage, 2006, p. 81).

In a recent study by Blowe (2011) the researcher examined data regarding CTE completers and non-CTE completers and academic performance as well as cohort graduation rates. Blowe performed a causal-comparative, ex post facto study of students enrolled in the 131 school divisions in the Commonwealth of Virginia for the 2008, 2009, and 2010 graduation cohort years who were labeled as either CTE completers or non-CTE completers. The “phenomenon” or “variable” for Blowe’s (2011) criterion group study was CTE student and one of the dependent variables was that of student achievement.

In considering student achievement, the results of study showed that “CTE completer pass rates outperformed those of the rest of the students on the Reading SOL by at least 3 percentage points. In the area of mathematics during the years of 2009 and 2010, CTE completers had pass rates of seven to ten percentage points higher than the rest of the Commonwealth of Virginia” (Blowe & Price, 2012, p. 4). In the first year of the study, school year 2008-2009, the performance of all other students on the Algebra I, Algebra II, and Geometry SOL outranked CTE completers by seven percentage points. These findings suggest that CTE completers do outperform non-CTE completers on the English 11 Reading SOL test, the highest mathematics attained SOL test; therefore, participation in a CTE curriculum does, based on Blowe’s findings, affect student achievement.

Chadd and Drage (2006) conducted a study to describe the perceptions of CTE teachers and secondary school principals on how the NCLB Act has impacted CTE programs. Participants were selected from 1,530 principals and 4,474 teachers from Illinois high schools. Out of the total population of principals and teachers, 499 principals and 499 CTE teachers were randomly selected for participation in a self-report survey. The study attempted to answer the following questions:

- What are the perceptions of high school principals related to the benefits of CTE in helping high schools achieve the goals of NCLB?
 - What are the perceptions of high school CTE teachers related to the benefits of CTE in helping high schools achieve the goals of NCLB? and
 - Was there a difference in the perceptions of high school principals and CTE teachers related to the benefits of CTE in helping high schools achieve the goals of NCLB?
- (Chadd & Drage, 2006, p. 81).

Findings revealed that high school principals and CTE teachers both believe that CTE programs have the ability to assist schools meeting the academic levels in mathematics, reading, and language arts. Both groups also agreed that CTE programs have ability to help students graduate from high school. Secondary principals and CTE teachers did disagree on the impact of NCLB on CTE enrollment within their schools. Principals believed that NCLB had a positive impact on the CTE enrollment with their schools, while CTE teachers disagreed (Chadd & Drage, 2006).

Anderson (2008) focused on the advantages of rural education programs. Rural educators are preparing students for careers as biologists, political officials, and business and industry leaders. In 1887, the Hatch Act was passed due to farmers demanding additional scientific research. The Hatch Act led the way for agricultural experimentation, cooperative extension service, and scientific research (Anderson, 2008). Due to the demand of No Child Behind Left Behind (NCLB) legislation for all students to achieve, current CTE programs must adapt to the standards. Anderson (2008) examined literature regarding academic achievement surrounding contextual learning in mathematics based on the six principles for mathematics developed by the National Council of Teachers of Mathematics; equity, curriculum, teaching, learning, and assessment; this study focused on the principle of equity. “The principle of equity states that all students are capable of learning mathematics when they have access to high quality mathematics instruction” (Anderson, 2008, p.2). Contextual learning methods allow students to receive a perspective of how math works in the real world (Anderson, 2008).

Research at the National Research Center for Career and Technical Education proposed a mathematics infusion model in CTE. The model allowed the students to see where the math is located in real world then follows with examples of mathematics terminology and methods. In addition, this model allowed CTE teachers to use mathematics already present in the curriculum in an explicit manner (Anderson, 2008). The initial step for this model was the willingness of the CTE teacher to want and be able to teach the mathematics. Based on research conducted in Virginia, “agricultural educators indicted that mathematics was component of the agriculture curriculum and they believe that math instruction in agricultural education would lead to higher academic achievement” (Anderson, 2008, p. 3). Educators also pointed out that there is a lack of training in mathematics education and due to that deficiency, mathematics rarely makes it to the forefront of their instruction.

Gentry, Hu, Peters and Rizza (2008) conducted a qualitative study of a CTE center focusing on the experiences of secondary students identified as gifted and talented within this setting. Out of 20 programs offered at this center, eight were selected to participate in this study. They included: certified network administrator, criminal justice, information technologies, auto-diesel technologies, business service technologies, early education, medical technologies, natural resources and agritechnologies (NRAT), and welding (Gentry, Hu, Peters & Rizza, 2008). Teachers selected students out of the participating programs as talented based on the following indicators:

- shows outstanding talent in this domain and career pathway when compared to age peers;
- performs or shows potential for performing at remarkably high level of accomplishment when compared to others similar in age, experience, or environment;
- has desire to work with advanced concepts and materials in this area;
- is willing to explore new concepts;
- seeks alternative ideas;
- actively considers others' values; and,
- often thinks out of the box (Gentry et al., 2008, p. 186).

Out of a total of 375 students in the nine programs, 16 students were selected to participate. Interestingly, 14 out of the 16 students identified as talented for the purpose of this study, had not been identified in their home school; however, 11 of the students did report they had taken advanced classes. Several of the students in the early education, welding, and auto-diesel programs would have been considered average to below average students in a general education setting, but excelled within these CTE programs (Gentry et al., 2008).

Four themes emerged from interviews with these students: individualization, student-centered meaningful choices, instructors as developers of talent, and participation in career and technical student organizations. Overall, students expressed having their educational and personal needs met in the CTE programs they attended. Students described the following advantages of their participation in the CTE programs:

- flexibility of instruction demonstrated by teachers, including independent study, mentorships, apprenticeships, and self-pacing;
- the ability to participate in dual enrollment courses and earn college credit, obtain certifications, choose their field placements, and be involved in areas of focused and advanced study;
- CTE instructors were competent and caring and demonstrated professional experience, as well as teaching skills. Instructors set high expectations, offered challenges, and provided encouragement to students in developing and achieving their individual goals; and,
- participation in Career and Technology Student Organizations (CTSO), including Future Farmers of American (FFA), Health Occupations Students of America, Business Professional of America; and SkillsUSA (Gentry et al, 2008, p. 187).

Stone, Alfeld and Pearson (2008) tested a model for enhancing the mathematical instruction for students in five high schools with CTE programs. CTE teachers were exposed to intense professional development and pedagogy with assistance from math teachers. Teachers were divided into two groups, an experimental groups and a control group. Fifty-nine CTE teachers were placed in the experimental group and assigned to work with math teachers to incorporate mathematical instruction within the CTE curriculum. Seventy-eight teachers were placed in a controlled grouped, which excluded the incorporation of mathematical instruction within the CTE curriculum. The following questions were asked:

- Does a math-enhanced CTE curriculum improve student math performance as measured by a traditional (TerraNova) test of math knowledge and skills;
- Does an enhanced CTE curriculum decrease students' likelihood of requiring postsecondary math remediation, as demonstrated by improved scores on college placement (ACCUPLACER) test;
- Does a math-enhanced CTE curriculum improve math performance as measured by an applied (WorkKeys) test of math knowledge and skills; and,
- Does enhancing a CTE curriculum with mathematics reduce students' acquisition of occupational skills they need for the workplace? (Stone, Alfeld & Pearson, 2008, p. 769).

The instructional model was developed from the ideal that the math content would be created from the occupational content. CTE teachers initially identified math concepts that were inherent in the CTE curriculum and created lessons that provided CTE students more abstract examples of the math concepts (Stone et al, 2008). A contextualized approach was utilized to allow students to view math as a “tool-like a saw, wrench, or thermometer needed to successfully solve workplace problems” (Stone et al., 2008, p. 279).

After a full school year of implementation, results indicated that students did benefit from inserting mathematical concepts in the CTE curriculum without negatively impacting the occupational skills needed. The interventions had a positive effect on students’ performance on a traditional math test, a college placement test, and an applied math test (Stone et al., 2008). Five core principles were identified from the inventions utilized for this study that would be required to replicate:

1. develop and sustain a community of practice among the teachers;
 2. begin with the CTE curriculum and not the math curriculum;
 3. understand the math is an essential workplace skill;
 4. maximize the math in the CTE curriculum; and,
 5. recognize that CTE teachers are teachers of Math-in-CTE and not math teachers
- (Stone et al., 2008, p.788).

These findings suggest that curriculum integration, in some instances, is beneficial to student achievement.

Bozick & Dalton (2013) examined a sample of high school students to determine the relationship between CTE coursework and high school achievement in mathematical instruction. The study focused on students attending high school from 2000-2001 through 2003-2004 and the acquisition of their math proficiency, paying close attention to the implications of a curriculum that included both academic and occupational courses. In order to determine course-takings of students, The Secondary School Taxonomy was utilized, which classifies school courses into four distinct curricula: academic, career and technical education, enrichment/other, and special education (Bozick & Dalton, 2013).

Proficiency probability scores were used to determine the level of mastery students did or did not have. Utilizing the Item Response Theory (IRT) cognitive assessment, five ordinal levels of math proficiency were used:

Level 1: simple arithmetic with whole numbers, such as multiplication or division of integers; Level 2: simple operations with decimals, fractions, powers, and roots; Level 3: intermediate problem solving, such as simplifying an algebraic expression; Level 4: advanced problem solving and/or multistep solutions to word problems, such as drawing an inference based on an algebraic expression or inequality; and Level 5: complex multistep word problems such as the evaluation of functions (Bozick & Dalton, 2013, p. 129).

For the purposes of this study, Level 1 was considered basic skills, Levels 2 and 3 were considered intermediate, and Levels 4 and 5 were considered advanced skills (Bozick & Dalton, 2013). The findings revealed that CTE courses did not limit the overall gains in mathematics learning or the acquisition of basic and intermediate mathematics skills. Interestingly, engineering and technology courses, which incorporate quantitative reasoning, problem-solving, and logic, were unrelated to math achievement.

Isreal, Myers, Lamm, and Gonzalez-Galindo (2012) conducted quantitative research on CTE students and performance on standardized science tests. The methodology was a non-experimental cross-sectional design focusing on 80,000 students enrolled in 10th grade CTE programs in 2003-2004 that were selected from administrative records contained in Florida Department of Education data warehouse. CTE clusters included agriculture, health science, STEM, and education/training. The following research questions were considered:

- How do different types of CTE students (i.e., concentrators, explorers, course takers) within occupational clusters influence students' performance on standardized science tests;
- Do differences in standardized science test scores exist between types of CTE students within CTE occupational cluster when student and school attributes are taken into account? (Isreal, Myers, Lamm, & Gonzalez-Galindo, 2012, p. 5)

Findings suggested that performance on the standardized science test showed a tendency to improve as a students' coursework in a CTE program increased. Additionally, students who took college preparatory coursework with CTE courses performed above all others on standardized science test with regard to agriculture, health, and STEM, but there was no clear pattern of increasing test scores in education/training (Isreal et al., 2012).

CTE Student Graduation Rates

In revisiting the study by Blowe (2011), where the author examined the affects of CTE participation on student achievement and graduation rates in the Commonwealth of Virginia using an ex post facto study, the second dependent variable analyzed was the graduation rate for the graduation cohort years for 2008, 2009, and 2010. In each of the graduation cohort years, CTE completers graduated at least six percentage points above that of non-CTE completers, with the graduation rate for CTE completers exceeding 90% in each of the three years examined. "Students in CTE courses graduated with their cohort classmates at an average graduation rate of 96%, whereas the average non-CTE cohort graduation rate was 87% for the three academic years of study" (Blowe & Price, 2012, p. 7). As with the findings with regard to the effects of participation in a CTE curriculum on student achievement, there would also appear to be a benefit with regard to improving student graduation rates.

Packard, Leach, Ruiz, Nelson and DiCocco (2012) analyzed the career development of CTE high school graduates during their school-to-work transition, concentrating on their adaptability with barriers. The sampled participants included 40 graduates from working-class backgrounds in baseline surveys and phenomenological interviews following one year post-graduation. Primary themes emerged: "job loss altered career plans, whereas relevant jobs propelled career development; limited access to college constrained options, whereas college experience expanded options; graduates experienced the loss of education-related support, and CTE served as a backup" (Packard, Leach, Ruiz, Nelson, & DiCocco, 2012, p. 134). As it relates to job loss altering career plans, 50% of the participants refined their careers plans based on their inability to find work, while 25% of the participants found validation in their career goals, due to the continuation of the co-op jobs organized by their participation in the high school CTE program (Packard et al., 2012).

The findings suggested that limited access to college constrained options, whereas college experience expanded options. Thirty-five percent of the participants expressed difficulties with their financial resources for college; specifically, they felt that college was not a good use of their scarce financial resources (Packard et al., 2012). In addition, 28% of the participants felt they would have benefited more if they had taken more advanced math and science classes in high school. Interestingly, 40% of the participants expanded in their career goals by attending college (Packard et al., 2012). Only 10% of the participants expressed that CTE served as a backup plan for them following graduation (Packard et al., 2012). The CTE participants expressed the importance of their skill to adapt to changing career goals toward a career field that they could secure work. This skill was important because participants highlighted the loss of educational support from the school-to-work transition. CTE graduates lost the support of social networks they had established with teachers, school counselors, and family members. Graduates were unable to maintain access to key resources that could assist with providing navigation with the college pathway (Packard et al., 2012).

Hirschy, Bremer and Castellano (2011) offered a conceptual model of CTE students in community colleges. The model included four sets on constructs: student characteristics, college environment, local community environment, and student success outcomes (Hirschy, Bremer, & Castellano, 2011). The model was based on the premise that “student characteristics influence and are influenced by the ways individuals interact with the college and local communities and a student’s performance and perception of achieving educational goals can affect his or her dispositions and future educational and employment goals” (Hirschy et al., 2011, p. 309).

Student characteristics were categorized as stable or malleable. Stable characteristics include, “traits which the college environment is unable or unlikely to influence, such as sociodemographic attributes, precollege academic preparation and performance, and student commitments to and responsibilities to their work, family, and community” (Hirschy et al., 2011, p. 310). Malleable characteristics include student disposition and skills, educational and employment goals and intentions, and the level of exposure the students has experienced to career awareness. The college and local community environments are important factors in supporting and challenging students and often overlap. The overlap of the college and local community environments is due to the aspect of career integration. Career integration allows students to explore career options, which requires resources from the college, as well as the local

community. Lastly, the student success outcomes were defined as the level to which individual students meet their educational goals (Hirschy et al., 2011).

Plank, DeLuca and Estacion (2008) collected data from the National Longitudinal Survey of Youth 1997, including 8,984 youths in the U.S. between the ages of 12-16 as of December 31, 1996. The final models presented were non-proportional hazards, which were useful for describing the timing of life-course events and for building statistical models of the risk of an event's occurrence over time, with time-varying covariates. Sampling weights were not used for the hazard models. Initially 1,628 cases from the NLSY97 sample members were examined, however, sampling weights were used to generate descriptive statistics to generalize to a national population. For the hazard models, only 846 individuals whose transcript data were available were used (Plank, Deluca & Estacion, 2008).

From analyzing the collection of data from the National Longitudinal Survey of Youth 1997, Plank et al. (2008) formulate four hypotheses:

- A positive linear relationship suggesting that a higher proportion of CTE courses leads to dropout;
- A negative linear relationship suggesting that when students have the opportunity to concentrate in CTE they are more likely to stay in school because more relevant and satisfying course choices are available to them;
- No effect suggesting that the substance of course taking has no independent effect of dropping out; and,
- A curvilinear relationship suggesting that the likelihood of dropping out initially decreases as the CTE-to academic ratio increases, then the likelihood of dropping out increases as the CTE-to-academic ratio increases.

For students who are of the model age or young for grade at the time of high school entry, some CTE, combined with core academic course taking, may decrease the risk of dropout – but only up to a point. Taking roughly one CTE course for every two academic courses is associated with the lowest risk of dropout after other variables are controlled. Being below or above this point implies an increased risk of dropping out. However, no definitive causal relationship was established (Plank et al., 2008).

Agodini and Deke (2004) examined whether or not vocational education could help reduce dropping out in high school, using a two-step process. The analysis was based on data collected for the National Education Longitudinal Study (NELS). The NELS contains longitudinal information for a nationally representative sample of eighth graders, and it provides accurate information about course-taking and dropping out. In the first step, regression methods were used to calculate the relationship between vocational and other course-taking, and dropping out. Regression methods were used to adjust for student characteristics, which research has found are related to both course-taking and dropping out. In the second step, results were utilized from the regression analysis to calculate the average student's probability of dropping out when following two well-defined course-taking patterns: (1) the vocational concentrator program and (2) the basic academic program (Agodini & Deke, 2004).

The following results were presented:

- the average high school student's chance of dropping out is the same when following the vocational concentrator or the basic academic program;
- the result for the average high school student holds as well for several important subgroups of students; and,
- for students who want to pursue vocational education, dropping out is less likely when they concentrate in vocational education than when they explore, but only for those who do not expect to go to college (Agodini & Deke, 2004).

Chapter Summary

In spite of a common belief among the general population that CTE students, in general, do not perform as well as the general non-CTE students in academic course (Bae, Gray & Yeager, 2007, p. 10), the Commonwealth of Virginia, through the Virginia Department of Education (VDOE), understands the importance of a career and technical education and has enacted several legislative policies that encourage student participation in a rigorous CTE program. Studies show that CTE has the potential to enhance the level of students' engagement, which has been shown to have a positive link to student academic achievement by connecting school with the transition to adulthood and a career (Plank et al., 2008). And, in studying the factors that contribute to the success of postsecondary education of Virginia students, the VDOE

has established the Virginia College and Career Readiness Initiative, which outlines standards of college readiness and persistence in a four-year.

A recent study conducted by Blowe (2011) examined data regarding CTE completers and non-CTE completers and academic performance as well as cohort graduation rates. The findings in the Blowe study suggest that CTE completers outperform non-CTE completers on the Grade 11 Reading SOL test and the EOC Algebra I, Geometry and Algebra II SOL tests. Additionally, there would also appear to be a benefit for CTE completers over non-CTE completers with regard to student graduation rates. This study was modeled after a study by Blowe (2012) and examined current data regarding the academic performance of CTE completers. The methodology is discussed in detail in Chapter 3.

CHAPTER 3 METHODOLOGY

Purpose of the Study

The purpose of the study was to compare the academic performance of CTE completers and non-CTE completers in the Commonwealth of Virginia on the Standards of Learning (SOL) Reading and mathematics assessments, and graduation pass rates. This study is modeled after a previous study (Blowe, 2011) and examined the subsequent three years data for students who graduated in the 2011, 2012 and 2013 school years. Creswell (2009) suggests that “[r]esearchers do not want to conduct a study that replicates exactly what someone else has studied; however, as indicated in Explorable.com (2009), the use of the replication of studies is validated when:

- The original research question is important and can contribute to the body of information supporting the discipline
- The existing literature and policies relating to the topic are supporting the topic for its relevance
- The replication study, if carried out carries the potential to empirically support the results of the original study, either by clarifying issues raised by the original study or extending its generalizability
- The team of researchers has all expertise in the subject area and also has the access to adequate information related to original study to be able to design and execute a replication
- Any extension or modifications of the original study can be based on current knowledge in the same field
- Lastly, the replication of the same rigor as was in original study is possible (pp. 2-3)

The methodology, to include the research questions, research design, population, data collection procedures, and data analysis used in this study to assess CTE completer status and student achievement were similar to the methodology used by Blowe (2011). The “phenomenon” or independent variable was CTE completer status (CTE completer vs. non-CTE completer) and the dependent variables are student achievement and graduation rates.

Research Questions

1. What, if any, difference is there between CTE enrollment status (CTE completer vs. non-CTE completer) and student achievement as measured by Grade 11 Reading SOL pass rates?
2. What, if any, difference is there between CTE enrollment status (CTE completer vs. non-CTE completer) and student achievement as measured by SOL mathematics pass rates for Algebra II?
3. What, if any, difference is there between CTE enrollment status (CTE completer vs. non-CTE completer) and the graduation pass rates of students?

Hypotheses

H₀: There is no difference between CTE enrollment status (CTE completer vs. non-CTE completer) and student achievement and graduation rates.

H₁: There is a difference between CTE enrollment status (CTE completer vs. non-CTE completer) and student achievement and graduation rates.

Research Design

To determine the difference between academic outcomes of CTE completers and non-CTE completers within the Commonwealth of Virginia, a quantitative evaluation methodology was used. Based upon the nature of the research questions proposed, a quantitative study was the most appropriate method available and represents a quasi-experimental, correlational evaluation of ex post facto data to determine the effects of being a CTE completer on student academic success in high school. By utilizing an ex post facto study, or after-the-fact research, there is no prior “manipulation or measurement before the fact occurs, as is the case in true experimental designs” (Silva, 2010, p. 465). The strength in using an ex post facto research design is that it is possible to study cause-effect relationship without “exposing human participants to certain experiments or treatments” (Silva, 2010, p. 465). The limitations of using an ex post facto research design are lack of control of the independent variable and that the participant selection is non-random. These limitations create both internal and external validity issues, making the findings less persuasive (Silva, 2010). However, given the context of the study, the ex post

facto research method is the most appropriate research design “for an exploratory investigation of cause-effect relationships or for the identification of hypotheses that can later be tested through true experimental research designs” (Silva, 2010, p. 466).

Population

The population for this study consisted of 131 school divisions listed by the Virginia Department of Education (VDOE). The units of study consisted of SOL data representing students who were characterized as either CTE completers or non-CTE completers. For reporting purposes, the Commonwealth of Virginia defined CTE completers as “a student who has met the requirements for a CTE concentration (sequence) and all requirements for high school graduation or an approved alternative education program” (VDOE, 2012, p. 3). As with the previous study by Blowe (2011), the data were taken from information submitted to the VDOE by each of the school divisions as required yearly in compliance with state accountability reporting. The data submitted to the VDOE is compiled annually for the creation of VDOE CTE Performance Reports, VDOE School Division Report Cards, and VDOE Cohort Reports and Virginia Assessment Results.

Data Collection

Approval for this research project was requested and obtained, as required, through the Virginia Polytechnic Institutes’ Institutional Review Board. See Appendix A and B for the researcher’s IRB Certificate and the IRB Approval. Data collected for the 2011, 2012, and 2013 school years with regard to SOL student performance as well as graduation data for the same years were used for evaluation purposes. As with the previous study by Blowe (2011), Grade 11 Reading SOL and Algebra II pass rates were used to evaluate student SOL performance. The data for Grade 11 Reading SOL performance, Algebra II SOL performance, and student graduation rates were collected from the VDOE Office of Educational Information Management websites. The reports utilized for this study included aggregate data from:

- The CTE Annual Performance Reports for each school division;
- The VDOE School Division Report Card and Virginia Assessment Results; and,
- The VDOE High School Graduates and Completion Report.

Data Gathering Procedures

To obtain data necessary for analysis, a number of pre-existing VDOE data sources were utilized. For reporting purposes, the VDOE collects data on all school divisions within the Commonwealth of Virginia on student achievement based upon the SOL assessment and publishes the results in School, School Division, and State Report Cards. The report cards are updated annually to provide detailed information on student achievement by subject and grade level based on the performance of students on Standards of Learning tests and other statewide assessments which are used to determine student graduation and school accreditation status. In order to meet the minimum standard graduation requirement, high school students are expected to earn at least six verified credits by passing end-of-course SOL tests or other assessments approved by the Board of Education (VDOE, 2012). These minimum requirements include two English, one math, one laboratory science, one history and social science, and one student-selected end-of-course assessment. Below, the data acquisition plan is provided to address each of the research questions.

***Question 1.** What, if any, difference is there between CTE enrollment status (CTE completer vs. non-CTE completer) and student achievement as measured by Grade 11 Reading SOL pass rates?*

The CTE completer percentages and Grade 11 Reading pass rates collected from the VDOE Career and Technical Education Performance Reports and the VDOE State Division report cards was used to analyze student achievement for CTE completers and non-CTE completers on the Grade 11 Reading SOL. A Microsoft Excel spreadsheet was developed to organize the gathered data for further analysis using the Statistical Package for the Social Sciences (SSPS) to perform statistical calculations.

***Question 2.** What, if any, difference is there between CTE enrollment status (CTE completer vs. non-CTE completer) and student achievement as measured by SOL mathematics pass rates for Algebra II?*

The CTE completer percentages and Algebra II pass rates collected from the VDOE Career and Technical Education Performance Reports and the VDOE State Division report cards was used to analyze student achievement for CTE completers and non-CTE completers on the

Algebra II SOL. A Microsoft Excel spreadsheet was developed to organize the gathered data for further analysis using the Statistical Package for the Social Sciences (SPSS) to perform statistical calculations.

Question 3. What, if any, difference is there between CTE enrollment status (CTE completer vs. non-CTE completer) and the graduation rates of students?

The CTE completer percentages and cohort graduation rates collected from the VDOE Career and Technical Education Performance Reports and the VDOE Graduation and Completion Report was used to analyze graduation rates for CTE completers and non-CTE completers. A Microsoft Excel spreadsheet was developed to organize the gathered data for further analysis using the Statistical Package for the Social Sciences (SPSS) to perform statistical calculations.

Data Treatment

The VDOE, as part of Virginia’s accountability system, “supports teaching and learning by setting rigorous academic standards – known as the Standards of Learning (SOL) – and through annual assessments of student achievement” (VDOE, 2014). Since all data were published by a state agency in aggregate, neither confidentiality nor anonymity were concerns in data treatment. VDOE utilizes a suppression rule policy consistent with DOE standards, which will be discussed in Chapter 4 with regard to the EOC Algebra II SOL assessment data for non-CTE completers. Additionally, because the research being conducted was an ex post facto study, by definition, no manipulation occurred prior to the collection of the data.

Data Analysis Techniques

Microsoft Excel, a data organization software, and SPSS, a statistical analyses software were used to organize and analyze the collected data. Both software systems were used in the management of the large data set and to enable accurate statistical analyses in an efficient manner. Analyses included various forms of descriptive statistics, to include frequencies, means, and standard deviations. Additionally, a *t*-test analysis was used to assess any statistical difference that occurred between the mean for SOL pass rates and cohort graduation rates of

CTE completers and non-CTE completers. An alpha level of 0.05 was used to measure the significance that occurred between the two sample groups.

Chapter Summary

This study compared the academic performance of CTE completers and non-CTE completers in the Commonwealth of Virginia on the Standards of Learning (SOL) Reading and Algebra II assessments, as well as graduation rates for students who completed their graduation requirements in the 2011, 2012 and 2013 school years. By utilizing an ex post facto study, or after-the-fact research, to determine the difference between academic outcomes of CTE completers and non-CTE completers within the Commonwealth of Virginia, a quantitative evaluation methodology was used and represents a quasi-experimental, correlational evaluation of ex post facto data.

The units of study consist of SOL pass rates and cohort graduation rates for students who were characterized as either CTE completers or non-CTE completers from 131 school divisions currently listed by the Virginia Department of Education (VDOE) from the 2011, 2012, and 2013 school years. Several software applications were used to organize and analyze the collected data, to include Microsoft Excel, a data organization software, and SPSS, a statistical analyses software.

CHAPTER 4

RESULTS

The purpose of the study was to compare the academic performance of CTE completers and non-CTE completers in the Commonwealth of Virginia on the Standards of Learning (SOL) EOC Reading and Algebra II assessment pass rates, and cohort graduation rates. This chapter presents the results of the analyses conducted for the school years 2010-11, 2011-12, and 2012-13. During the period of the study, the Commonwealth of Virginia had more than 120,000 students who participated in career and technical education to the level of being considered CTE completers, having taken two sequential CTE electives in a prescribed program area with 80% proficiency in the competencies required for the courses. Table 1 shows the number of students enrolled in one or more Career and Technical Education courses and the number of CTE completers for the Commonwealth of Virginia during the years of this study.

Table 1

Number of Career and Technical Education Completers in the Commonwealth of Virginia 2011-2013

Academic Year	Students enrolled in CTE courses (duplicated count)	CTE Completers (N) (unduplicated count)
2010-11	578,126	41,329
2011-12	584,172	41,671
2012-13	576,454	40,753

Virginia Department of Education, Career and Technical Education (2014) www.vdoe.gov/CTE

In a previous study published in 2012, by Blowe, entitled *The Impact of Career and Technical Education on Student Academic Achievement and Graduation Rates of Students in the Commonwealth of Virginia*, Blowe concluded that, from examination of data from school year 2008-09 through 2009-10:

- CTE Completers experienced higher pass rates than non-CTE completers with regard to the Grade 11 Reading SOL;
- CTE completers experienced higher pass rates than non-CTE completers with regard to Algebra II SOLs; and,

- CTE completers experienced higher cohort graduation rates than non-CTE completers (Blowe, 2011).

The current study considered the subsequent three years data for cohort graduates of the 2011, 2012 and 2013 school years within the Commonwealth of Virginia.

Within the data sets collected, the suppression rule was applied by VDOE in order to mitigate the identification of a single student or small groups of students, typically student groups of 9 or fewer, which is consistent with VDOE practices. Because it was not possible to approximate the number of students in different years taking the EOC Algebra II SOL assessments in some divisions, they were excluded from analysis. For example, in EOC Algebra II reporting year 2010-11, the researcher excluded 53 divisions due the inability to quantify accurate Algebra II participation counts. In 2011-12, 48 divisions were excluded, and in 2012-13, 47 divisions were excluded. In addition, the researcher excluded 19 divisions in 2010-11, 35 divisions in 2011-12, and 34 divisions in 2012-13 due to reporting errors.

This investigation included 131 school divisions within the Commonwealth of Virginia and considered students categorized as CTE completers based upon data collected by VDOE in the CTE Annual Performance Reports by division. The results of data analysis that follows will be organized and reported by the following research questions, which guided the study:

- 1) What, if any, difference is there between CTE enrollment status (CTE completer vs. non-CTE completer) and student achievement as measured by Grade 11 Reading SOL pass rates?
- 2) What, if any, difference is there between CTE enrollment status (CTE completer vs. non-CTE completer) and student achievement as measured by SOL mathematics pass rates for Algebra II)?
- 3) What, if any, difference is there between CTE enrollment status (CTE completer vs. non-CTE completer) and the graduation rates of students?

Research Question One

What, if any, difference is there between CTE enrollment status (CTE completer vs. non-CTE completer) and student achievement as measured by Grade 11 English SOL pass rates?

With regard to the Grade 11 Reading SOL pass rates, the data from each school division were downloaded from the Virginia Department of Education website, placed in an Excel spreadsheet, and organized by cohort for the 2010-11, 2011-12 and 2012-13 school years. The data collected included information obtained from the Final Completer Demographics Report (CDR) which was “used to analyze program completer demographics, calculate performance measures, and compile federal, state, and local accountability reports” (VDOE, 2014). The CTE completer pass rate percentages were then matched with academic performance data from the VDOE Division School Report Card for the 131 divisions in the study from the assessment year, the year prior to the reporting year. The data reported on the Division school Report Card for the EOC Reading SOL included Pass Proficient Count, Pass Advanced Count, Participation Count, Pass Rate and Participation Rate for each division. In each of the reporting years, at least one division was excluded due to possible reporting errors, with reporting year 2011-12 having two divisions excluded.

In considering the descriptive statistics with regard to the EOC Reading Pass Rates for CTE completers and non-completers, Table 2 includes division counts and measures of central tendency. In 2010-11, 130 divisions were analyzed, in 2011-12, 129 divisions were analyzed,

Table 2

Mean Standard Deviation for EOC Reading SOL Pass Rates for Included School Divisions (N)

	<i>M</i>	<i>SD</i>	<i>N</i>
CTE Completer EOC Reading Pass Rate 10/11 (1S1)	98.16	1.85	130
Non-completer Reading Pass rate 10/11 (using 09/10)	86.02	11.24	130
CTE Completer Gr 11 Reading Pass Rate 11/12	98.54	1.677	129
Non-completer Reading Pass rate 11/12 (using 10/11)	84.23	10.58	129
CTE Completer Gr 11 Reading Pass Rate 12/13	98.84	1.33	130
Non-completer Reading Pass rate 12/13 (using 11/12)	84.49	10.64	130

and in 2012-13, 130 divisions were analyzed. The results show that the mean pass rate for CTE completers in the 2010-11 reporting year was 98.16 and 86.02 for non-completers. For the 2011-12 reporting year, CTE completers achieved a mean pass rate of 98.54, whereas the mean pass rate for non-completers was 84.23. And, in the 2012-13 school year, the mean pass rate for CTE completers was 98.85 and for non-completers the mean pass rate was 84.50. For all three years of the study, the mean pass rate averages 13.6 percentage points higher for CTE completers on the EOC Reading SOL assessment, with the mean difference being 12.14 in 2010-11, 14.31 in 2011-12, and 14.35 in 2012-13. These results indicate that CTE completers perform better on the EOC Reading SOL assessment than non-CTE completers.

In Table 3, the results of the paired samples t-test for the EOC Reading SOL pass rates are illustrated. The *t*-test was used to measure the significance of the mean difference of students obtaining a CTE completer status in high school compared to that of non-completers, as indicated by their results on the EOC Reading SOL. For school year 2010-11, CTE completers

Table 3

Paired Sample t-test for EOC Reading SOL Pass Rates

		<i>M</i>	<i>SD</i>	<i>T</i>	<i>df</i>	<i>Sig.</i>
Pair 1	CTE Completer EOC Reading Pass Rate 10/11 (1S1) - Non-completer Reading Pass rate 10/11 (using 09/10)	12.14	11.17	12.39	129	.000*
Pair 2	CTE Completer Gr 11 Reading Pass Rate 11/12 - Non-completer Reading Pass rate 11/12 (using 10/11)	14.31	10.57	15.38	128	.000*
Pair 3	CTE Completer Gr 11 Reading Pass Rate 12/13 - Non-completer Reading Pass rate 12/13 (using 11/12)	14.35	10.72	15.27	129	.000*

had a mean pass rate of 98.16 as opposed to non- CTE completers whose mean pass rate was 86.02, and $t(129) = 12.39, p = 0.00^*$, for school year 2010-11. For school year 2011-12, $t(128) = 15.38, p = 0.00^*$, CTE completers had a mean pass rate of 98.54 and non-completers had a mean pass rate of 84.23. For school year 2012-13, $t(129) = 15.27, p = 0.00^*$, CTE completers had a mean pass rate of 98.85 and non-completers had a mean pass rate of 84.50. A p -value equal to 0.00^* for each of the three years studied indicated a significant difference between CTE completers and non-CTE completers at the 0.05 level with regard to EOC Reading SOL pass rates. Therefore, the researcher should reject the null hypothesis.

Research Question Two

What, if any, difference is there between CTE enrollment status (CTE completer vs. non-CTE completer) and student achievement as measured by SOL mathematics pass rates for Algebra II.

With regard to the SOL mathematics pass rates for Algebra II, the data from each school division were downloaded from the Virginia Department of Education website, placed in an Excel spreadsheet, and organized by cohort for the 2010-11, 2011-12 and 2012-13 school years. The data collected included information obtained from the Final Completer Demographics Report (CDR) which is “used to analyze program completer demographics, calculate performance measures, and compile federal, state, and local accountability reports” (VDOE, 2014). The CTE completer pass rate percentages were then matched with academic performance data from the VDOE Division School Report Card for the 131 divisions in the study from the assessment year, the year prior to the reporting year. The data reported on the Division School Report Card for the EOC Algebra II SOL included Pass Proficient Count, Pass Advanced Count, Participation Count, Pass Rate and Participation Rate for each division. In each of the reporting years, more than half of the data points for the 131 total school divisions were omitted from this study due to the suppression rule and/or possible reporting errors. For example, in 2010-11, 72 divisions were excluded from the study; in 2011-12, a total of 83 divisions were excluded; and, in 2012-13, 81 divisions were excluded from the study.

Examining the descriptive statistics with regard to the EOC Algebra II Pass Rates, Table 4 includes division counts and measures of central tendency. In the 2010-11 school year, data from 58 division were analyzed, 48 divisions in 2011-12, and 50 divisions in 2012-13. The mean pass rates for CTE completers in the 2010-11 reporting year were 98.62 and 69.72,

respectively. For the 2011-12 reporting year, CTE completers achieved a mean pass rate of 98.86, whereas the mean pass rate for non-completers was 39.19. And, finally, in the 2012-13 school year, the mean pass rate for CTE completers and non-completers was 99.27 and 52.44, respectively. For all three years of the study, the mean pass rate averages 45.13 percentage points higher for CTE completers on the EOC Algebra II SOL assessment, with the mean difference being 28.9 in 2010-11, 59.67 in 2011-12, and 46.83 in 2012-13. These results indicated that CTE completers perform better on the EOC Algebra II SOL assessment than non-CTE completers.

Table 4

Means Standard Deviation for EOC Algebra II Pass Rates for Included School Divisions (N)

	<i>M</i>	<i>SD</i>	<i>N</i>
CTE Completer Algebra II Pass Rate 10/11 (1S2)	98.62	1.42	58
Non-completer Alg II Pass rate 10/11 (using 09/10)	69.72	22.67	58
CTE Completer Algebra II Pass Rate 11/12 (1S1)	98.86	1.35	48
Non-completer Alg II Pass rate 11/12 (using 10/11)	38.19	23.64	48
CTE Completer Algebra II Pass Rate 12/13 (1S1)	99.27	.95	50
Non-completer Alg II Pass rate 12/13 (using 11/12)	52.43	21.63	50

In Table 5, the results of the paired samples t-test for the EOC Algebra II SOL pass rates are illustrated. The *t*-test was used to measure the significance of the mean difference of students obtaining a CTE completer status in high school compared to that of non-completers, as indicated by their results on the EOC Algebra II SOL. For school year 2010-11, $t(57) = 9.56$, $p = 0.00^*$, CTE completers had a mean pass rate of 98.62 as opposed to non-completers who had a mean pass rate of 69.72. For school year 2011-12, $t(47) = 17.99$, $p = 0.00^*$, CTE completers had

a mean pass rate of 98.86 and non-completers had a mean pass rate of 38.19. And, for school year 2012-13, $t(49) = 15.28$, $p = 0.00^*$, CTE completers had a mean pass rate of 99.27 and non-completers had a mean pass rate of 52.44. A p -value equal to 0.00^* for each of the three years studied indicates a significant difference between CTE completers and non-CTE completers at the 0.05 level with regard to EOC Algebra II SOL pass rates. Therefore, the researcher should reject the null hypothesis.

Table 5

Paired Sample t-test for EOC Algebra II SOL Pass Rates

		<i>M</i>	<i>SD</i>	<i>T</i>	<i>df</i>	<i>Sig</i>
Pair 1	CTE Completer Algebra II Pass Rate 10/11 (1S2) - Non- completer Alg II Pass rate 10/11 (using 09/10)	28.90	23.01	9.56	57	.000*
Pair 2	CTE Completer Highest Math Pass Rate 11/12 (1S1) - Non-completer Alg II Pass rate 11/12 (using 10/11)	60.67	23.37	17.99	47	.000*
Pair 3	CTE Completer Algebra II Pass Rate 12/13 (1S1) - Non- completer Alg II Pass rate 12/13 (using 11/12)	46.84	21.68	15.28	49	.000*

Research Question Three

What, if any, difference is there between CTE enrollment status (CTE completer vs. non-CTE completer) and the graduation rates of students?

With regard to the graduation pass rates for students in each academic year, the data from each school division were obtained from the Virginia Department of Education website, placed in an Excel spreadsheet, and organized by cohort for the 2010-11, 2011-12 and 2012-13 school years. Examining the descriptive statistics with regard to the graduation rates, Table 6 includes division counts and measures of central tendency. In school year 2010-11, 128 divisions were included in the analysis, 131 divisions in school year 2011-12, and 130 divisions for school year 2012-13. For CTE completers in the 2010-11 school year the cohort graduation rate was 99.24 and 76.60 for non-completers. For the 2011-12 school year, CTE completers achieved a mean graduation rate of 99.34, whereas the mean graduation rate for non-completers was 77.84. And, in the 2012-13 school year, the mean graduation rate for CTE completers was 99.38 and for non-completers, 80.71. For all three years of the study, the mean pass rate averages 20.94 percentage points higher for CTE completers in graduation cohort rates, with the mean difference being 22.64 in 2010-11, 21.50 in 2011-12, and 18.67 in 2012-13. These results indicated that CTE completers graduate with their cohort class at a higher rate than non-CTE completers.

Table 6

Mean Standard Deviation for Cohort Graduation Rates for Included School Divisions (N)

	<i>M</i>	<i>SD</i>	<i>N</i>
CTE Completer grad rate 10/11 (3S1)	99.24	1.38	128
Non-completer Grad rate 10/11 (using 09/10)	76.60	16.24	128
CTE Completer grad rate 11/12	99.34	1.15	131
Non-completer Grad rate 11/12(using 10/11)	77.84	15.02	131
CTE Completer grad rate 12/13	99.38	1.13	130
Non-completer Grad rate 12/13(using 11/12)	80.71	13.23	130

Table 7 illustrates the results of the paired samples t-test for the cohort graduation rates are shown. The *t*-test was used to measure the significance of the mean difference of students obtaining a CTE completer status in high school as compared to that of non-completers, as indicated by the results of each school division's cohort graduation rate. For school year 2010-11, $t(127) = 15.66, p = 0.00^*$, CTE completers had a mean graduation rate of 99.24 as opposed to non-completers who had a mean graduation rate of 76.60 for school year 2010-11. For school year 2011-12, $t(130) = 16.271, p = 0.00^*$, CTE completers had a mean graduation rate of 99.34 and non-completers had a mean graduation rate of 77.84. For school year 2012-13, $t(129) = 16.02, p = 0.00^*$, CTE completers had a mean graduation rate of 99.39 and non-completers had a mean graduation rate of 80.71. A *p*-value equal to 0.00^* for each of the three years studied indicates a significant difference between CTE completers and non-CTE completers at the 0.05 level with regard to graduation rates. Therefore, the researcher rejected the null hypothesis.

Table 7

Paired Sample t-test for Cohort Graduation Pass Rates

	<i>M</i>	<i>SD</i>	<i>t</i>	<i>df</i>	<i>Sig</i>
Pair 1 CTE Completer grad rate 10/11 (3S1) - Non-completer Grad rate 10/11 (using 09/10)	22.64102	16.35254	15.66	127	.000*
Pair 2 CTE Completer grad rate 11/12 - Non-completer Grad rate 11/12(using 10/11)	21.50374	15.12601	16.27	130	.000*
Pair 3 CTE Completer grad rate 12/13 - Non-completer Grad rate 12/13(using 11/12)	18.67231	13.29349	16.01	129	.000*

Limitations, Data Discrepancies, and Exclusions

Limitations of the study include data set counts not reported due to the suppression rule which was applied by VDOE in order to mitigate the identification of a single student, typically student groups of 9 or fewer. Data suppression rules are used to balance the potentially

conflicting goals of information dissemination with protection of the privacy of individuals. For this reason, smaller schools and/or divisions do not provide counts for certain SOL assessment where doing so would possibly allow identification of a specific person. This limitation was most apparent when reporting students taking the EOC Algebra II SOL assessment where small divisions had limited numbers of non-CTE completers participating in Algebra II courses, making them ineligible for this study. For EOC Algebra II reporting year 2010-11, 53 divisions did not report non-CTE completer Algebra II participation; in 2011-12, 48 divisions did not report non-CTE completer Algebra II participation counts; and, in 2012-13, 47 divisions did not report. It should be noted that, unlike the English Grade 11 course and EOC Reading SOL, Algebra II is not a required course for graduation and the EOC Algebra II SOL is not a required verified credit based on the VDOE Graduation Requirements for the Advanced Studies Diploma (2012):

NOTE 1

- **For students entering the ninth grade for the first time in 2003-2004 through 2010-2011:** Courses completed to satisfy this requirement shall be at or above the level of algebra and shall include at least three different course selections from among: Algebra I, Geometry, Algebra II, or other mathematics courses above the level of Algebra II. The Board may approve additional courses to satisfy this requirement.
- **For students entering the ninth grade for the first time in 2011-2012 and beyond:** Courses completed to satisfy this requirement shall include at least three different course selections from among: Algebra I, Geometry, Algebra II, or other mathematics courses above the level of Algebra II. The Board shall approve courses to satisfy this requirement.

An additional limitation to the study stemmed from apparent reporting errors, particularly with regard to the EOC Algebra II SOL assessment. The researcher found 19 possible reporting errors for the EOC Algebra II SOL assessment for reporting year 2010-11; 35 possible reporting errors for reporting year 2011-12; and, 34 possible reporting errors in reporting year 2012-13. However, because it is difficult to speculate the reason for the number of reporting errors for each division, the correlating data sets were removed from the statistical analysis.

Chapter Summary

This study considered the subsequent three years of statistical data for cohort graduates of the 2011, 2012 and 2013 school years within the Commonwealth of Virginia. However, due to the utilization of the suppression rule and apparent reporting errors, some school divisions were excluded from this research.

In reviewing the comparative data (i.e., mean, standard deviation and population) for 131 divisions, the results indicated that the mean pass rate for CTE completers was higher than the mean pass rate for non-CTE completers for the EOC Reading SOL, Algebra II SOL, and graduation rates. The *t*-test was used to measure significance of the mean difference between students obtaining a CTE completer status in high school and CTE non-completers. The findings, implications for practitioners, and recommendations for future research will be discussed in the subsequent chapter.

CHAPTER 5

DISCUSSION

The final chapter of this research provides a summary of the study, discussion of findings, limitations of the study, implications of the findings, recommendations for future research and practice, recommendations for future research, and the researcher's reflection.

Summary of the Study

The goal of this quantitative study was to provide a comparison of the academic performance of CTE completers and non-CTE completers in the Commonwealth of Virginia on the Standards of Learning (SOL) Reading and Algebra II assessments, and graduation rates. This study constituted longitudinal research in the examination of the subsequent years' of data partially modeled after a previous study published by Blowe (2012) entitled *The Impact of Career and Technical Education on Student Academic Achievement and Graduation Rates of Students in the Commonwealth of Virginia*. As in the previous study by Blowe, the independent variable was the identified student status of the student as either a CTE- completer or a non-CTE completer. Moreover, student status was analyzed in relationship to three dependent variables, which consisted of division pass rates for both the Grade 11 EOC Reading SOL and the Algebra II EOC SOL, and cohort graduation rates for school years 2010-11, 2011-12, and 2012-13 at the division level.

This study addressed the following research questions:

- 1) What, if any, difference is there between CTE enrollment status (CTE completer vs. non-CTE completer) and student achievement as measured by Grade 11 Reading SOL pass rates?
- 2) What, if any, difference is there between CTE enrollment status (CTE completer vs. non-CTE completer) and student achievement as measured by SOL mathematics pass rates for Algebra II?
- 3) What, if any, difference is there between CTE enrollment status (CTE completer vs. non-CTE completer) and the graduation rates of students?

As schools and school divisions seek to improve student performance under the current NCLB legislation, it is increasingly important to examine the impact of student participation in CTE

upon their academic achievement and success in completing high school due to the increasing scrutiny placed upon education organizations to produce college and career ready graduates. This quantitative study adds to the current research examining the hypothesized correlation between student participation in a developed CTE curriculum and academic and graduation success, the overall findings, of which, indicate that there is a difference between CTE enrollment status (CTE completer vs. non-CTE completer) and student achievement and graduation rates.

Discussion of Findings

Finding 1. The mean pass rate for CTE completers was higher than the mean pass rate for non-CTE completers for the EOC Reading SOLs during the period examined.

The results of the statistical analysis of CTE completers as compared to non-CTE completers yielded a significant difference with regard to the EOC Reading SOLs for each of the three years of the study. The mean difference in pass rates between CTE completers and non-Completers in the 2010-11 school year was 12.14. For the 2011-12 school year, the mean difference was 14.31. And, for the 2012-13 school year, the mean difference was 14.35. The average mean difference of all three school years combined was 13.6 for CTE completers over non-CTE completers.

This finding regarding the average mean difference for all three years indicates that CTE completers are performing at higher levels than their non-CTE completer peers within each of the three years' cohorts as assessed by the EOC Reading SOL. This finding is consistent with the previous study by Blowe, which found that "the mean reading SOL pass rates for CTE completers during the years of [the] study were seven to eight percentage points higher than that of non-CTE completers" (Blowe & Price, 2012, p.7). The study's findings, that CTE completers scored higher on the EOC Reading SOL for each of the three years of the study, are aligned with the beliefs of high school principals and CTE teachers "that CTE programs have the ability to assist schools meeting the academic levels in mathematics, reading and language arts" (Chadd & Drage, 2006, p. 81). These results would appear to support the Contextual Learning Theory that learning occurs when students process new information in such a way that it makes sense to them in their own frames of reference real-world (CORD, 1999), which is the basis of the CTE curriculum. By emphasizing learning by doing (Curry, Wilson, Flowers & Farin, 2012),

students who participate in a developed CTE curriculum score significantly higher on the EOC Reading SOL than non-CTE completers.

Finding 2. The mean pass rate for CTE completers was higher than the mean pass rate for non-CTE completers for the EOC Algebra II SOLs during the period examined.

The results of the statistical analysis of CTE completers as compared to non-CTE completers with regard to EOC Algebra II SOLs indicate a significant difference for all three years of the study. The mean difference in the pass rates for CTE completers and non-completers in the 2010-11 school year was 28.90. For school year 2011-12, the mean difference between CTE completers and non-CTE completers was 60.67. And, for school year 2012-13, the mean difference was 46.84. The average mean difference between CTE completers and non-CTE completers for the three years of the study was 45.47 in favor of CTE completers, which would indicate that students who complete a CTE curriculum consistently perform better on the EOC Algebra II SOLs than students who do not participate in CTE to the same degree.

In the previous study published by Blowe (2012), CTE completers earned higher mean pass rates in two of the three research years, averaging nine percentage points higher than non-CTE completers. Another study that supports these findings was conducted by Bozick and Dalton (2013), and revealed that CTE courses did not limit the overall gains in mathematics learning or the acquisition of basic and intermediate mathematics skills. When considering the role of contextualization in a well-developed CTE curriculum, these “instructional strategies [are] designed to more seamlessly link the learning of foundational skills and academic or occupational content by focusing teaching and learning squarely on concrete applications in a specific context that is of interest to the student” (Mazzao, Rab, & Alssid, 2003, p. 269). The Contextualized Learning Theory includes two types of contextualization, contextualized basic skills instruction and integrated basic skills instruction. “Contextualized basic skills instruction involves the teaching of reading, writing, or mathematics skills against a backdrop of specific subject matter such as philosophy, statistical process control, allied health, business, history, and science” (Perin, 2011, p. 271); and, “integrated basic skills instruction occurs in content area classrooms” (Perin, 2011, p. 271); the goal of which is “to teach the disciplinary content, not basic skills; however, teaching basic skills is a necessary step toward critical thinking about the content area” (p. 272). A well-developed CTE curriculum utilizes contextualized skills

instruction where students are systematically taught the academic skills necessary to successfully acquire the content outside of the content course; therefore, mathematic skills can be attained through CTE courses that utilize real-world applications of mathematical concepts. This may explain why CTE completers score significantly higher on the EOC Algebra II SOL assessment in comparison to their non-CTE completer counterpart.

Finding 3. The mean graduation rate for CTE completers was higher than the mean graduation rate for non-CTE completers for graduation cohorts during the period examined.

The results of the statistical analysis of CTE completers as compared to non-CTE completers shows a significant difference with regard to the cohort graduation rates for each of the three years of the study. The mean difference in the graduation rates between CTE completers and non-Completers in the 2010-11 school year was 22.64. For the 2011-12 school year, the mean difference was 21.50. And, for the 2012-13 school year, the mean difference was 18.67. The average mean difference of all three school years combined was 20.9 for CTE completers over non-CTE completers, demonstrating a higher proclivity to graduate for students completing a CTE curriculum within their high school academic program, than do students not completing a CTE curriculum.

As with the previous study by Blowe (2012), the findings of this study indicate that CTE completers graduated with their cohort of classmates at higher average graduation rates than those of non-CTE completers. These findings would also corroborate the beliefs of both high school principals and CTE teachers, as shown by Chadd and Drage (2006), that CTE programs have the ability to help students graduate from high school. Studies show that CTE has the potential to enhance the level of students' engagement, which has been shown to have a positive link to student academic achievement by connecting school with the transition to adulthood and a career (Plank et al., 2008, p. 360). Additionally, studies by both Plank et al (2008) and Agodini and Deke (2004) show that participation in a CTE curriculum has the ability to reduce student drop-out rates in high school students, but only up to a certain point.

Finding 4. The mean pass rate and the mean graduation rate for CTE completers was higher for non-CTE completers for the EOC Reading SOLs and graduation cohorts, respectively, for the past six years.

In considering the results for mean pass rates for EOC Reading SOLs and cohort graduation rates for both the current study and that of Blowe (2012), the past six years (2008-2013) data shows a significant difference with regard to CTE completers and non-CTE completers.

The previous study by Blowe (2012) showed that:

the mean reading SOL pass rates for CTE completers during the years of this study [2008-2010] were 7-8 percentage points higher than that of the non-CTE completers. It should also be noted that for the years of this study, CTE completers had 99-100% of the school divisions to have reading SOL pass rates at or above 90%. This is higher than the non-CTE completers where an average of 55% of the school divisions had pass rates of 90% or higher on the reading SOL. The Wilcoxon's *t*-test conducted on the reading SOL pass rates did elicit that there was a difference in the pass rates of CTE completers to non-CTE completers ($z = -9.358, -9.119, -7.779, p < .001$) (p.76).

Within the current study, the average mean difference of all three school years combined was 13.6 for CTE completers over non-CTE completers. The average mean difference for all three years indicates that CTE completers are performing at higher levels than their non-CTE completer peers within each of the three years' cohorts as assessed by the EOC Reading SOL. With regard to the cohort graduation rates, the study by Blowe (2012) indicated that:

similar to the results of the previous dependent variables- mathematics and reading SOL pass rates- CTE completes also attained mean high school cohort graduation rates of 6-13% higher than non-CTE completers for the years of the study. Data indicate that CTE completers had a statistically significant difference in their cohort graduation rate to that of the students who had not completed a CTE approved sequence of courses. Students in CTE courses graduated with their cohort of classmates at an average graduation rate of 96% where the average non-CTE cohort graduation rate was 87% for the three academic years of the study (p. 77).

Again, the results of the current study a significant difference with regard to the cohort graduation rates for each of the three years of the study. The average mean difference of all three school years combined was 20.9 for CTE completers over non-CTE completers.

The combined data for the past six-year (2008-2013) indicates that students completing a CTE curriculum within their high school academic program, perform at a higher rate with regard to the Reading SOL pass rates and cohort graduation rates than do students not completing a CTE curriculum.

Finding 5. Reporting discrepancies were discovered in mining division-reported data published by the VDOE.

In collecting and organizing the data from the VDOE, apparent reporting errors, particularly with regard to the EOC Algebra II SOL assessment were evident. In the reporting year 2010-11, 19 possible reporting errors were discovered for the EOC Algebra II SOL assessment; in reporting years 2011-12, 35 possible reporting errors were discovered; and, in 2012-13, 34 possible reporting errors were discovered. The researcher does not speculate as to the reasons behind the reporting errors; however, it should be noted that several divisions showed evidence of reporting errors in more than one of the three study years.

Implications for Practice

The results of the study indicate that students who participate and complete course sequences in a CTE curriculum show a significant benefit with regard to student achievement and graduation rates. The findings and the literature review should prompt educational leaders to consider the following:

Implication 1. Schools and/or school divisions should consider a rigorous CTE curriculum as a strategy for improving SOL scores for all students.

As schools and/or school divisions seek strategies to improve student MCE/SOL assessment scores in compliance with NCLB regulations for an improving schools model, a rigorous CTE curriculum should be incorporated as a means to reaching that objective. Based upon the findings in the current study regarding higher mean pass rates for CTE completers versus non-CTE completers in both the Grade 11 Reading and Algebra II SOLs, schools and/or

school divisions should consider incorporating a well-developed and rigorous CTE program as a strategy to improve SOL scores for all students. A study conducted by Stone, Alfeld and Pearson (2008) in which a math-enhanced CTE curriculum was developed for students in an experimental group resulted in significant benefits to the students given the treatment. By utilizing a contextual approach in the instruction, teachers allowed student to view math as a tool used in solving workplace problems (Stone et al, 2008). These types of innovative learning strategies may assist in student understanding of mathematical concepts.

In a quantitative study conducted by Isreal, Myers, Lamm and Gonzalez-Galindo (2012), 80,000 10th grade students in Florida were selected from the Florida Department of Education data warehouse in an effort to determine the impact involvement in CTE on standardized science test scores. The researchers found that test scores and the number of CTE courses taken to be positively related – the higher the number of CTE courses taken, the higher the student test scores. These gains may be attributable to the use of contextualization within the CTE curriculum which emphasizes learning by doing (Curry, Wilson, Flowers & Farin, 2012), where learning occurs when students process new information in such a way that it makes sense to them in their own frames of reference “real-world” (Center for Occupational Research and Development, 1999).

Implication 2. Schools and/or school divisions should consider a CTE curriculum as a strategy to improve cohort graduation rates.

In an effort to improve cohort graduation rates, schools and/or school divisions should incorporate an engaging CTE curriculum for all students. Based upon the findings in the current study regarding higher mean graduation rates for CTE completers versus non-CTE completers, schools and/or school divisions should consider incorporating a well-developed and rigorous CTE program as a strategy to improve graduation for all students. In addition to the data from the current study and the study by Blowe, several studies have been published with regard to the effects of a CTE curriculum on student graduation rates. For example, Agodini and Deke (2004) examined the effects of vocational education on high school drop-out rates, using a two-step process. This research was based on data collected for the National Education Longitudinal Study (NELS). The results of the study included:

- the average high school student's chance of dropping out is the same when following the vocational concentrator or the basic academic program;
- the result for the average high school student holds as well for several important subgroups of students; and,
- for students who want to pursue vocational education, dropping out is less likely when they concentrate in vocational education than when they explore, but only for those who do not expect to go to college (Agodini & Deke, 2004).

Additionally, Plank, DeLuca and Estacion (2008) examined data collected from the National Longitudinal Survey of Youth 1997 and formulated:

- a positive linear relationship suggesting that a higher proportion of CTE courses leads to dropout;
- a negative linear relationship suggesting that when students have the opportunity to concentrate in CTE they are more likely to stay in school because more relevant and satisfying course choices are available to them;
- no effect suggesting that the substance of course taking has no independent effect of dropping out; and,
- a curvilinear relationship suggesting that the likelihood of dropping out initially decreases as the CTE-to academic ratio increases, then the likelihood of dropping out increases as the CTE-to-academic ratio increases.

Other research concerning the effects of taking CTE courses on graduation rates is not definitive, however, the aforementioned research by Plank et al (2008) posits that CTE has the potential to enhance student engagement, which is key to retaining students through graduation. Although the reasons supporting the results from this study and that of Blowe (2012) were not included in the scope of these two studies, the findings of both suggest that enrolling students in an engaging CTE curriculum positively influences higher cohort graduation rates.

Implication 3. School divisions should ensure that students have access to and are encouraged to participate in a rigorous CTE curriculum in preparation for opportunities in post-secondary education.

In accordance with the NCLB goal of preparing students for post-secondary education, educational leaders should seek to prepare students to be college and career ready, as expressed in the goals set forth by the VDOE. CTE completers can and do achieve in a manner in accordance to the goal of NCLB, which is to raise academic standards in core curricula in preparation of students for post-secondary education. Even though the common belief regarding CTE students is that they “do not perform as well as non-CTE students in academic courses such as math and reading” (Bae, Gray & Yeager, 2007, p. 10), these findings contradict that general premise. Policymakers should, therefore, seek to further study the connection between CTE participation and student academic achievement and graduation. As posited by Plank et al (2008), educational leaders should consider the value of a CTE curriculum in engaging students by connecting school with the transition to adulthood and a career.

Based upon the findings of this study with regard to CTE completers and student academic success and graduation rates, research conducted by the Center for Assessment, Evaluation, and Education Program at Virginia Tech on behalf of the VDOE found that students who earn advanced proficient scores on Virginia’s EOC Reading and mathematics SOL assessments have a high probability of enrolling in four-year colleges and persisting into their second year, with students who earn advanced proficient in reading, writing, and Algebra II having the highest probability of success (VDOE, 2012, p. 8). And, as the Commonwealth of Virginia seeks to produce more college and career ready graduates, the results of this study would suggest that enrolling students in a well-developed CTE curriculum may present a viable option to do so.

Implication 4. Schools, school division, and/or the state education agency should seek to improve data collection and reporting processes regarding the impact of a CTE curriculum on student academic achievement.

Based upon the limitations identified in this study, it is incumbent upon the reporting schools, school divisions, and the VDOE to find ways to improve reporting practices within the state to align data with regard to an identified CTE curriculum. Castellano, Harrison and Schneider (2008) examined the alignment of secondary academic standards with CTE courses in order to identify academic skills in CTE programs areas and making these skills explicitly apart

of the academic curriculum. In order to ensure that statewide standards were reflected on the local level practice, states utilized a variety of assessments:

- end-of-program assessments;
- end-of-course assessments;
- online assessments;
- hands-on demonstrations;
- state-developed exams; and/or,
- state-specific vendor-developed exams (Castellano et al., 2008, p. 37).

Even though the Commonwealth of Virginia is comparably ahead of many states in reporting CTE data outcomes based upon the study by Castellano, et al. (2008), an improved process could provide better analysis for student achievement.

While suppression rules consistent with the Department of Education are currently in place at the VDOE, measures should be considered to help facilitate greater transparency and understanding between state and localities. These improvements will help provide clear-cut, error free data for use in further research conducted throughout the Commonwealth of Virginia.

Recommendations for Future Research

The following recommendations have been made for future researchers as a result of this study:

- Analyze student “pass proficient” and “pass advanced” scores on the EOC Reading and mathematics SOL assessments as a point of comparison for CTE completers and non-CTE completers.
- Analyze the data for gender and identified Gap group differences within the CTE completer/non-CTE completer study.
- Analyze the data comparison for urban, suburban, and rural school division; as well as based upon student enrollment sizes for large, medium, and small school divisions.
- Study matriculation rates for CTE completers vs. non-completers to two- and four-year colleges/universities.

- Expand the study to include other states with developed CTE curriculums and established guidelines for division expectations with regard to CTE.

Reflections

This study provided the researcher with valuable insight into the potential role CTE plays in the greater academic curriculum and student academic and graduation outcomes. The growing body of literature that exists on CTE enabled the researcher to gain a deeper understanding of components of CTE in an improving schools model. This information is particularly beneficial to educational leaders as a basis for developing and incorporating a rigorous and engaging CTE curriculum in support of student achievement.

In order to develop successful student improvement models, educational policymakers must utilize accurate and timely data in the decision making process where CTE is concerned. This data is vital to educational leaders for solving some of the challenges with student engagement, achievement and graduation. It is interesting to note, that although the argument can be made through the evidence of prior research, CTE has not, as yet, received the sincere notice that this research warrants.

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APPENDIX A

TRAINING IN HUMAN SUBJECTS PROTECTION CERTIFICATE OF COMPLETION

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Certificate of Completion

This certifies that

David Owen White

Has completed

Training in Human Subjects Protection

On the following topics:

Historical Basis for Regulating Human Subjects Research
The Belmont Report
Federal and Virginia Tech Regulatory Entities, Policies and Procedures

on

September 8, 2012



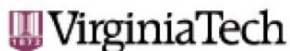
David Moore, IRB Chair

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APPENDIX B

INSTITUTIONAL REVIEW BOARD APPROVAL



Office of Research Compliance
 Institutional Review Board
 North End Center, Suite 4120, Virginia Tech
 300 Turner Street NW
 Blacksburg, Virginia 24061
 540/231-4606 Fax 540/231-0959
 email irb@vt.edu
 website <http://www.irb.vt.edu>

MEMORANDUM

DATE: September 17, 2014
TO: Ted S Price, David Owen White
FROM: Virginia Tech Institutional Review Board (FWA00000572, expires April 25, 2018)
PROTOCOL TITLE: The Impact of Career and Technical Education (CTE) on Student Academic Achievement and Graduation Rates of Students in the Commonwealth of Virginia
IRB NUMBER: 14-898

Effective September 16, 2014, the Virginia Tech Institutional Review Board (IRB) Chair, David M Moore, approved the New Application request for the above-mentioned research protocol.

This approval provides permission to begin the human subject activities outlined in the IRB-approved protocol and supporting documents.

Plans to deviate from the approved protocol and/or supporting documents must be submitted to the IRB as an amendment request and approved by the IRB prior to the implementation of any changes, regardless of how minor, except where necessary to eliminate apparent immediate hazards to the subjects. Report within 5 business days to the IRB any injuries or other unanticipated or adverse events involving risks or harms to human research subjects or others.

All investigators (listed above) are required to comply with the researcher requirements outlined at:

<http://www.irb.vt.edu/pages/responsibilities.htm>

(Please review responsibilities before the commencement of your research.)

PROTOCOL INFORMATION:

Approved As: **Exempt, under 45 CFR 46.110 category(ies) 4**
 Protocol Approval Date: **September 16, 2014**
 Protocol Expiration Date: **N/A**
 Continuing Review Due Date*: **N/A**

*Date a Continuing Review application is due to the IRB office if human subject activities covered under this protocol, including data analysis, are to continue beyond the Protocol Expiration Date.

FEDERALLY FUNDED RESEARCH REQUIREMENTS:

Per federal regulations, 45 CFR 46.103(f), the IRB is required to compare all federally funded grant proposals/work statements to the IRB protocol(s) which cover the human research activities included in the proposal / work statement before funds are released. Note that this requirement does not apply to Exempt and Interim IRB protocols, or grants for which VT is not the primary awardee.

The table on the following page indicates whether grant proposals are related to this IRB protocol, and which of the listed proposals, if any, have been compared to this IRB protocol, if required.

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