

University of Nevada, Reno

**A Quantitative Study of Career and Technical Education Curricula and Student
Achievement**

A dissertation submitted in partial fulfillment of the requirements for the degree of
Doctor of Philosophy in Education

by

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May 2019

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THE GRADUATE SCHOOL

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**A Quantitative Study Of Career And Technical Education Curricula
And Student Achievement**

be accepted in partial fulfillment of the
requirements for the degree of

DOCTOR OF PHILOSOPHY

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Abstract

Career and Technical Education (CTE) is hot topic and trend in education; in part because of the increased demand from Americans to include CTE programs and opportunities in schools along with increased federal funding to build new CTE programs and improve existing ones. Today's schools are faced with pressure to improve the student achievement. High-stakes testing performance is a central method schools utilize to demonstrate adequate student achievement and school quality. This quantitative study analyzed high school students undergoing Career and Technical Education (CTE) curricula and student achievement. It probed into examining for differences between curricula and academic performance. The study presented the academic achievement of CTE completer high school graduates and non-CTE high school graduates as measured by their performance on the nationwide ACT examination covering the subjects of English, reading, writing, math, and science. By utilizing the testing results from the entire graduating class of 2017 in a large school district with over 64,000 students, several key results were determined. Findings indicate that statistically ($p < .01$), CTE completers had significantly higher ACT scores on the ACT composite, reading, writing, math, science, and English assessments than those of non-CTE general academic students who undertook one or no CTE courses during high school. Therefore, a CTE curricula influences student achievement as measured by high-stakes national testing.

Acknowledgements

There are many people who earned my appreciativeness for their contributions to my education and research during my doctoral journey. More specifically, I would like to thank three groups of people for which my dissertation would not have been possible.

Those groups are my committee members, my industrial partners, and my family.

Firstly, I am forever indebted to my advisor Dr. Diane Barone. From the very first day, Dr. Barone believed in me and offered her endless support. She was the first to open my eyes to professional academic research and everything that it entails. Under her instruction, I learned how to define a research problem, find a solution, and convey the results to an audience through writing and presenting. On a personal level, Dr. Barone is one of the most welcoming, encouraging, and hard-working people I have ever had the privilege of meeting. I am more than proud to say that Dr. Barone is my mentor, advisor, and friend. To summarize, I give Dr. Barone endless credit for becoming the kind of teacher, scientist, and researcher I am today. Dr. Liu, thank you for being the incredible mentor and professor that you are. I learned an amazing amount about how to conduct studies based on numbers and statistics, one of which is this very dissertation. Dr. Sanchez, thank you for your wonderful nature and being there from the very beginning. I was lucky enough to have enrolled in a class you were teaching during my first semester of courses, which set a positive trajectory for the rest of my doctoral journey. I knew that if I stuck by you and learned from you, that I too could succeed. You always will be a role model to me in every aspect of work and life. To Dr. J. Kyle Dalpe, thank you for all of your knowledge and teaching in the field of higher education, employment, and career and technical education. It was because of you that I found something to be passionate

about to research and dedicate myself. You never hesitated to invite me to learn more about career and technical education and you always kept me in mind whenever an opportunity arose. I am so proud to call you my friend and colleague. Dr. Ethan Ris, thank you for your positive attitude, care, concern, and expertise. The timing of our acquaintance and comradery could not have come at a better time. It was thanks to you that I knew exactly where to direct my research efforts and how to shape the study relative to current and historical variables. Thanks to you, I gained a great amount of knowledge and expertise in the field.

I am also very grateful to my industry school partners whom this study would not have been possible without. The study utilized testing data from a large western school district and everyone I worked with was always so generous and kind. They were so helpful and I hope to continue working with them.

I would also like to thank my family for their endless love and support. Especially to my mother and father who I forever cherish, adore, and love. They have and always will be the people I strive to be.

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CHAPTER ONE

Introduction

My daughter is now in her third year of college working on a bachelor's degree in culinary arts. However, the degree she will earn will probably not be the deciding factor in her first job out of college. In this case, insisting she earn a four-year degree had more to do with the stigma I attached to CTE and community college certificate programs than it did with the actual education she needed in order to pursue her career path. Career-technical education is not a lesser form of learning; it's a different form of learning. CTE courses are brimming with opportunities for teachers to integrate literacy and math skills as real-life applications. And ultimately, isn't that what learning is all about — real-life skills that benefit the individual and the community? If we want successful doctors, where better to start than in a health sciences course that blends medical knowledge with training in a community health clinic each week? If we want creative mechanical engineers who design environmentally friendly vehicles, why not cultivate those interests and skills in a high school auto mechanics class? (Gammill, 2015, pp. 18).

In the above quote, Deidra, a National Board Certified Teacher and also a mother shared her lived experience of being a teacher and concerned mother. For many similarly concerned students and parents, the dilemma of where students should direct themselves during and after high school and for what reason(s) is common (Matteucci & Helker, 2018). The narration above demonstrated the rationales, optimism, and thought processes

of a mother concerned about her child's education, future, and well-being (Gammill, 2015).

Career and Technical Education (formerly called vocational education) is a term applied to schools, institutions, and educational programs that specialize in skilled trades, applied sciences, modern technologies, and career preparation (Garza Mitchell, 2017). Career and technical education programs offer both academic and career-oriented courses, and many provide students with the opportunity to gain work experience through internships, job shadowing, on-the-job training, and industry-certification opportunities (Smith, 2017). Career and technical programs provide a range of learning experiences spanning many different career tracks, fields, and industries, from skilled trades such as automotive technology, construction, plumbing, or electrical contracting to fields as diverse as agriculture, architecture, culinary arts, fashion design, filmmaking, forestry, engineering, healthcare, personal training, robotics, or veterinary medicine (Castellano, Richardson, Sundell, & Stone, 2017).

The practicality, efficiency, public demand, and benefits students received from a CTE education resulted in forms of higher quality job prospects, higher financial gains, and a reduction in poverty (Gammill, 2015). These results made CTE missions of secondary and post-secondary institutions in the United States important to the country economically and socially (Lowry & Thomas-Anderson, 2017). Eighty two percent of CTE students said their education gave them the ability to learn real world skills while 51 percent of non-CTE students reported similar sentiments (Advance CTE, 2017). In addition to students learning real-world skills, ninety percent of students and parents agreed that finding a career they were passionate about was essential and CTE students

and their parents were more than twice as likely to report that they were satisfied with their child's education compared to students and parents not involved in CTE (Advance CTE, 2017). Harris and Wakelyn (2007) reported that CTE students tended to be more motivated to learn and participate because they were learning skills they felt had relevance to their future careers.

The Phi Delta Kappa (PDK) Poll is one of the most trusted sources regarding the public's opinion about public education since 1969 (49th Annual PDK Poll, 2017). The poll covers all 50 states and its credibility and reliability is due to its rigor, depth, and its commitment to gathering all perspectives and opinions. Annually, the PDK Educational Foundation finances the PDK poll in an effort to gather an independent and unbiased report of American public opinion. The culminating objectives of the PDK Educational Foundation are to engage educators and serve schools with current information to best serve students. Education policy makers use the annual findings to inform their decision making, and local educators utilize the results to guide planning and objectives within their communities (49th Annual PDK Poll, 2017). The results of the 2017 PDK poll overwhelmingly showed strong public support for schools to work towards positioning and preparing students for their working lives after school along with educating students in academic subjects. Highlights from the 2017 PDK poll include: 1) 82% of Americans encourage career and job skills even if it translates to students spending less time in academic classes; 2) 89% believe that schools in their community should offer licensing and certificate granting programs which students can utilize for employment in a field; and 3) 80% view technology and engineering courses as vital components of school quality (49th Annual PDK Poll, 2017).

Although the benefits experienced by CTE students who complete their program are desirable, unfortunately there are many students who may lose their motivation prior to program completion when analyzing the low national completion rates (Bishop & Mane, 2004). There are possible synergies that can occur between a college and students to increase the probability of student completion and success such as instructor continuity, self – paced programs, and sound student advising (Hoops & Complete College, 2010).

Statement of the Problem

The data of how secondary students are performing in the United States is troubling when analyzing the results of nationwide testing. In 2011, the National Assessment of Educational Progress (NAEP) ran its first computer based assessment in writing. In this test, 24,100 eighth-graders and 28,100 twelfth-graders were engaged in writing tasks and composing responses. At the conclusion of the NAEP's written testing for eighth and twelfth graders, it was found that only 24 percent of students in both grades performed at the proficient level of writing required in 2011 (National Center for Education Statistics, 2012). Coupled with this data, Rumberger (2012) found that in the United States: 1) 607,789 students dropped out of school in 2008-09 and an even higher number failed to graduate; 2) schools across America are losing on average of more than 7,000 students daily with an overall census estimating that in October of 2010, there were almost 28 million dropouts over the age of 18 in the United States; and 3) in 2010, 1.3 million students from the high school class of 2010 who failed to graduate represented 30 percent of the 4.3 million students enrolled in the ninth grade in 2006.

The high number of high school students who are dropping out is associated with detrimental outcomes for adolescents including uninviting economic futures and increased risks of health problems (Tyler & Lofstrom, 2009). They are the least educated workers in the labor market, and because of this circumstance they have the poorest prospects for employment compared to more educated workers (Bjerk, 2012). Dropouts are also less likely to invest in additional education and training which has the effect of further limiting their prospects of securing well-paying jobs over their entire working lives. As a result, dropouts are more likely to live in poverty and require public assistance throughout their lifetimes (Rumberger, 2012).

Gottfried and Plasman (2018) reported that a large body of research exists on the positive consequences of students engaging in vocational courses including reducing the potential for dropout and increasing the rate of high school completion. Also examined was the ability of CTE courses to engage students more closely in school and create a more realistic and tangible connection between schoolwork and postsecondary experiences be they in college or career. Bishop and Mane (2004) found that for students aged 15 or younger entering high school, a balance of approximately one CTE course to two academic courses benefitted them the most. The results from the Bishop and Mane (2004) study suggested that there is an ideal balance between CTE and academic courses to create and sustain motivation while in school and these results were confirmed in the Plank, DeLuca, and Estacion (2008) study. Plank et al. (2008) analyzed data from the National Longitudinal Survey of Youth beginning in 1997 to investigate the associations between curriculum and dropout. They utilized a sample of 8,984 youths who were aged 12 to 16 and found that a middle-range mix of exposure to CTE and academic courses

can strengthen a student's attachment to school. These patterns of success held when compared to international contexts: increased numbers of students involved in CTE (or vocational education) were connected to increased graduation rates in multiple countries (Plank et al., 2008). In a study conducted in Florida, researchers analyzed the testing patterns of CTE students as they progressed from CTE course taker, to explorer, to occupational concentrator. The analysis utilized a cohort of approximately 80,000 students enrolled in 10th grade CTE programs in 2003-2004 across the state of Florida. The analysis revealed that performance on the standardized science test improved as a student's coursework in a CTE program increased in the hierarchy of course taker, explorer, and occupational concentrator (Israel, Myers, Lamm, & Galindo-Gonzalez, 2012). In a similar study, Castellano, Sundell, Overman, & Aliaga (2012) examined the impacts of CTE programs of study on high school achievement through quantitative and qualitative research methods. The researchers found few differences between 9th grade CTE students and 9th grade non-CTE students. By the end of 10th grade, student test scores, grade point averages, and progress towards graduation tended to be better for students enrolled in CTE programs. Qualitatively the researchers found that CTE schools had created a unique school culture around CTE programs, which appeared to explain the boosted engagement and achievement of CTE students. Graduation from high school affected the probability of students acquiring employment and financial security (Gammill, 2015)

Another outlook worth noting on the topic of CTE and dropout suggests a negative relationship between students and CTE curricula. The work conducted by Oakes (1985) and Rosenbaum (1978) focused on the low quality of content and teaching in

vocational tracks and how the vocational realm acts as a de facto remedial educational track removing poor-performing students from classes with their college directed peers. However, many of the studies that reported a negative connection between students and CTE were conducted during the 1970s and 1980s prior to 1990s federal legislations aimed at reforming vocational education to be more academic. Regardless of the 1990s federal legislations to reform CTE education to be more encompassing and applicable to all citizens, the trend of high schools shutting down CTE programs nationwide at the time was in full-swing (Brown, 2012). Although the pattern of closing down CTE programs was common during the 1990s regardless of legislation aimed to promote CTE programs, the United States remained resilient to reinvent and deliver CTE options to students (Stipanovic, Lewis, & Stringfield, 2012). On July 31st, 2018, President Trump signed the Strengthening Career and Technical Education for the 21st Century Act, a \$1.2 billion program last overhauled by Congress in 2006. The new law granted exclusive power to states to establish objectives without the education secretary's approval while requiring evidence of progress in meeting set objectives (Ujifusa, 2018).

Purpose of the Study

The purpose of this quantitative study was to examine for differences in student achievement amongst CTE endorsed high school graduates and non-CTE high school graduates in a school district in the Western United States. Non-CTE high school graduates were classified as students who undertook one or no CTE courses during their high school careers. Student achievement and the dependent variables for this study utilized six state mandated examination scores students obtained in order to graduate high

school. These examinations were developed and vetted by the ACT organization and covered the academic subjects of: English, math, reading, science, and writing.

Significance of the Study

Since the early 1990s, governments and private organizations invested heavily with the intention of reforming vocational education. In certain cases, it was an attempt at reforming the content taught in vocational courses, while in other cases it was a reform of the pathways that may link school to the workplace (Rose, 2016). In accordance with once anticipated employment trends, traditional shop classes in construction trades, automotive repair, and machining were cut back and replaced by programs in health care, computer, and green technologies without much success (Karandjeff & Schiorring, 2011). The CTE programs that were considered new and innovative for their time, struggled to attract students because employment opportunities in these fields were scarce (Dougherty & Lombardi, 2016). CTE was inundated by various set-backs which had the effect of disrupting CTE inclusion and continuity in public schools during the 1990s and 2000s. Educational budget cuts and a general drop of local support for CTE in schools caused this educational stream a substantial setback (Scott & Kienzl, 2006).

Brown (2012) reported that in the Los Angeles Unified School District (LAUSD), serving over 660,000 students in K-12, 90 percent of all shop classes were cut with the intent of eliminating all shop classes by the end of 2013. More recently, a range of commentators from a variety of backgrounds including economists and social critics, have been calling for an expansion of vocational education; including the return of old shop classes, though updated and computer infused to match the current labor market

(Aliaga, Kotamraju, & Stone, 2014; Rose, 2016). The advocates for a resurrection of abandoned CTE programs easily gain support from local communities of students and parents who overwhelmingly demand CTE program availability in their schools (49th Annual PDK Poll, 2017).

This study contributes to the growing research platform on the connection of a recently and continually reformed CTE mission and programs to student achievement and post-secondary outcomes. In addition to analyzing connections between curriculum and student outcomes, this research may also lend itself to the large body of research examining the effect of CTE engagement and achievement in high school and college engagement and completions by means of the phenomena known as *academic momentum* (Attewell, Heil, & Reisel, 2012). A promising option for students that appears to promote college success are dual-enrollment CTE programs which allow high school students to enroll in college courses and earn college credits. The process that may underlie the relationship of dual-enrollment and student success is *academic momentum*-course load amount and progress during the initial stages of college (Attewell, Heil & Reisel, 2012). The combination of the initial academic experience and academic momentum has gained prominence amongst educators and policy-makers alike in that increasing academic momentum is possibly an inexpensive solution to improving student outcomes (Wang, Chan, Phelps, & Washbon, 2015). Educators argue that when high school CTE programs offer dual-enrollment and articulated credits that it serves as a pre-college momentum building mechanism that consequently helps build early college enrollment and success (Wang et al., 2015). This study contributes to academic momentum theory in relation to CTE programs and courses. Advanced placement (AP) academic courses which allow

students to obtain college credits while in high school has also been found to contribute to academic momentum (An, 2013).

The knowledge acquired from this research can be impactful for educators, parents, and policy experts in their continual mission of raising student achievement. Students require career guidance from adults who are knowledgeable, experienced, and have extensive information regarding careers and training. School counseling and guidance staffs are responsible for meeting the advising needs students require (Stipanovic & Stringfield, 2013). Research focused on the improvement of practice that leads to school improvement is popular given changes to educational policies and required improvements bestowed upon institutions (Lochmiller & Lester, 2017). Research based results yield findings that CTE engagement may have a positive correlation to student achievement in the form of increasing the graduation rate (Wang, Chan, Phelps & Washbon, 2015). The objective of this research study was to examine academic achievement differences affecting graduation and college admittance of high school students who do and do not undergo and execute a CTE curriculum and pathway in a large school district.

CHAPTER TWO

Literature Review

This review of literature is intended to examine the historical origins of a CTE education dating back to the 19th century. The middle of the review highlights sociological issues and discussions related to CTE, and 20th and 21st federal legislations promoting vocational education and CTE. The review is concluded with contemporary conceptualizations of CTE and STEM as drivers for industrialization, and employment opportunities.

The Emergence of a Career and Technical Education in the United States

Originally called vocational education, CTE was reserved for public K-12 and higher education institutions following the Smiths-Hughes Act of 1917 (Friedel, 2011). Prior to official 20th century federal legislation promoting vocational educational programs, educational programs meant to equip students with skills required by trades such as teaching and agriculture spontaneously developed in the United States during the late 19th century (Burrows, 1999).

The industrial revolution of the 19th century had a huge effect on American society and culture. Not only did the workplace and the economy change, but American values and education would also see transformation (Rauscher, 2015). A product of the rapid industrial expansion included owners and managers dividing and specializing labor in order to optimize business operations (Rauscher, 2015). Because of the division of labor that was occurring in large companies, the dignity that work provides to people would often come under threat (Sison, Ferrero, & Guitian, 2016). A component of

morality that many Protestant Americans carried relied on the human dignity provided by fruitful artisan work. The component of morality that Protestants believed in regarding work dignity hinged on the belief that success at work was a sign of divine favor or predestination (Sison, Ferrero, & Guitian, 2016). The drive to optimize business operations threatened the artisan work ethic. The new industrialism would eventually change social institutions along with causing a profound moral crisis (Wyatt, 2009).

Background on Manual Training Before 1917

A mathematics professor and president of the Massachusetts Institute of Technology (MIT), John D. Runkle, addressed this moral crisis in American society. The model Runkle used to remedy the situation was inspired by the Russian manual training educational system. At the 1876 Philadelphia Centennial Exposition, Runkle noticed the teaching innovations provided by a Russian tool exhibit. The exhibit that Runkle observed would have profound effects on American education and society (Kleibard, 1999).

Industry began developing in Russia following the reign of Peter the Great (Zitser & Collis, 2015). With industry expanding, the need for trained workers increased. Following the emancipation of serfs in 1861, factories began to compete with artisans and instruction in the use of tools became a priority. In Moscow, Victor Della Vos initiated the Russian system of assessing students by their correct and appropriate use of tools at the Imperial Technical School (Schenck, 1984). His idea was that through systematic instruction, the skills necessary for a trade would be taught independently from the actual creation of a product. Runkle would describe his experience of viewing the Russian tool

exhibit as an epiphany of sorts. Runkle's diary (1876, as cited in Kleibard, 1999, p. 4) included the following quotation:

At Philadelphia, in 1876, almost the first thing I saw was a small case containing three series of models: one of chipping and filing, one of forging, and one of machine-tool work. I saw at once that they were not part of machines, but simply graded models for teaching the manipulations in those arts. In an instant, the problem I had been seeking to solve was clear to my mind; a plain distinction between mechanical art and its application in some special trade became apparent.

Under the *Della Vos* curricula, the student prepared for work by learning discrete skills through carefully crafted school lessons (Coates, 1927). The system took less time than apprenticeships and the skills could be taught to many students at once. Runkle would eventually move ahead with his idea of replicating the "Russian Tool System" in the United States by organizing secondary instruction shops (Coates, 1927). Within one year of seeing the exhibit in Philadelphia, Runkle established his School of Mechanic Arts. The slogan of the school was "Arts, not trades; instruction, not construction" (Kliebard, 1999, p. 4). By elevating the social status of students enrolled in his school to artists and not humble apprentices, Runkle appeared to have been the first proponent of the social mobility theory. Influential 19th and 20th century educational reformer, philosopher, and psychologist John Dewey believed that the native capabilities of children should be to methodically extended during schooling so that they may be capable of taking part in communal activities without being restrained by the social status of their parents (Knoll, 2009). Simply defined, social mobility is the up and down

movement of people or groups in socioeconomic status relative to other people and groups within the same context (Romano & Eddy, 2017).

Runkle's ambitions of replicating and spreading this new form of education continued by advocating the incorporation of manual training into the curriculum of public schools (Coates, 1927). His public platform to mainstream manual training into nationwide curricula relied on the argument that the system of education at the time was neither successful in promoting high culture nor in preparing future generations for the world of industry. Runkle's model of education instilled respect of manual labor while educating students for the industrial age's demands of efficiency and discipline (Coates, 1927). Runkle's new paradigm would act as a bridge between the dignity inherently attached to artisans' work and the dehumanized forces unleashed by a rapidly changing industrial society. In this light, the manual training movement forged unification between two contradictory justifications. Simultaneously, manual training preserved values associated with the Protestant artisan work ethic whose origins were in preindustrial America and addressed the needs of companies requiring skilled workers (Coates, 1927; Sison, Ferrero, & Guitian, 2016). Manual training combined the symbolic reassurance that well-established values were not being abandoned with the practical prospect of manual training which industry demanded (Kliebard, 1999).

Manual Training to Vocational Training

The new system of education addressed the desires of industry while not threatening the order of traditional morality (Coates, 1927). As manual training increased in popularity in the United States, national organizations which aimed to promote

vocational trade education in school curricula began to mobilize including the National Association of Manufacturers (NAM), the American Federation of Labor (AFL), and the National Society for the Promotion of Industrial Education (NSPIE) (Bradshaw & Bohan, 2013). A new economic standard was born in the wake of the Industrial Revolution that included the need of a steady flow of workers. In addition to the economy needing a steady supply of workers; apprenticeships were declining and trade training was limited (Gordon, 1999). Conceivably the most permanent effect of the drive to implement manual training in American schools was that it ruptured the academic citadel through which organized armies of vocational education could operate (Gordon, 1999). Although manual training was achieving success in terms of national recognition and implementation in schools, dedicated advocates of vocational education such as Charles Prosser challenged the efficacy of manual training arguing that it did not meet all of the requirements required by the new industrial order (Gordon, 1999). The increase in professional training programs in the United States began to replace the manual training system that Runkle had promoted. As the new 20th century progressed, manual training and its rationales founded in moral and pedagogical issues gave way to courses designed to teach students only the skills required by the industrial order (Kleibard, 1999).

The national groups who shared common interests formed a powerful alliance which reordered the school curriculum on the public platform that vocational education was tied to direct economic advantages (Bradshaw & Bohan, 2013). Vocational education secured the demands of the job market while simultaneously providing graduates the option of raising their general and professional skills at higher levels of education (Melnarowicz & Melnarowicz, 2017). The powerful alliance of vocational

advocates now looked at the German system of vocational education. They claimed that the German vocational system provided an abundant source of skilled laborers which American companies desired (Hansen, 2009). NAM leaders were ready to begin a national campaign to institute a full-scale system of industrial training in American schools (St. John, 2010). This way, the rationale of the social efficiency theory appeared to have been born. The social efficiency philosophy viewed education as a social process that upheld and promoted existing social functions such as the preparation of qualified farmers, doctors, and teachers for the future (Schiro, 2013).

Visions of Education

The fast evolution and objectives of education in the United States during the late 19th and early 20th centuries would at times be controversial in relation to labor unions, intentions of companies, and worker rights (Labaree, 1997). Three common ideologies of American education over the years included the democratic equality ideology, social efficiency ideology, and social mobility ideology (Schiro, 2013). The democratic equality and social efficiency objectives of education were regarded as public goods and social mobility as a private good and signal of personal liberty. These competing visions of education were the root of conflicts and impaired the effectiveness of the American educational system (Labaree, 1997). It was evident that the practical benefits of a CTE for companies and people made the social efficiency form and vision of instruction desirable and productive. CTE benefitted people because they could equip themselves with skills in a short amount of time that made them employable and companies had adequate sources to hire from (Lowry & Thomas-Anderson, 2017).

Social Efficiency

There are several theories including the social efficiency theory and social mobility theory as to how and why secondary and higher education institutions in the United States were established (Schiro, 2013). The theory of institutions being established to meet the needs of businesses gave rise to the social efficiency ideology (SEI) of education (Schiro, 2013). Social efficiency defended the position that schools should adapt to the existing socioeconomic structure by creating curricula that cater to and encourage the practice and refinement of skills required by the current economy of the time (Labaree, 1999). During the industrial revolution that occurred in the United States, the country experienced unprecedented population growth, average income growth, and the standard of living for the entire population rose rapidly (Lucas, 2002). The intent of social efficiency was to best prepare students for what available jobs required of them. The methods by which students were prepared for available jobs were structured into their curriculum by the incorporation of realistic and industry standards (Schiro, 2013).

The identity by which people are recognized under the social efficiency model is defined by the specific skills and behaviors a person can perform. An example of how people are viewed under the social efficiency theory is someone being defined by the profession they practice such as identifying someone as a lawyer, farmer, or doctor (Schiro, 2013). The social efficiency ideology also implies there is no need to improve society, but instead there is a need to perpetuate the existing society into the future (Bergen, 1981). Society is the source from which objectives are determined and because society does not explicitly state important terminal objectives, it is the responsibility of

the educator to determine them. Educators, who act as agents of maintaining the current society, are tasked with determining the needs of society and the products that accomplishes those needs including the production of skilled students that are employable (Schiro, 2013).

The planning of a society for the future is based on standards within current society and strategies for change are not based on looking for new behaviors more appropriate than existing ones (Bergen, 1981). A component to the SEI is that cultural evolution occurs by training the youth to do what is most efficient and avoid that which is done ineffectively and inefficiently (Schiro, 2013). Often, efficiency is related to teaching the use and mastery of new technologies which expedites manufacturing processes (Bergen, 1981). In addition to not searching for new behaviors, SEI reinforces strengths and desirable traits within the current society while eliminating its weaknesses and deficiencies (Bergen, 1981). SEI being practiced in education consists of establishing programs which offer both academic and career-oriented courses, provides students with opportunities to gain work experience through internships, job shadowing, on-the-job training, and industry-certification opportunities (Smith, 2017).

SEI has done much to make education practical over the last century with regards to students finding employment following their education and companies possessing the ability to hire trained and qualified people. Critics of the ideology argue that the social efficiency of education is a mechanistic notion that does not allow for individuality and self-expression because often an SEI curriculum is predetermined based on industry needs and not catered to students' interests, learning styles, and abilities (Gromet, Kunreuther, & Larrick, 2013; Lefeber & Vietorisz, 2007; McCluskey, 1999). Despite the

criticisms of the social efficiency ideology of education, its practicality and appeal has made it permanent in many settings including teacher education programs and occupational development programs found in secondary and postsecondary institutions (Schiro, 2013).

Social Mobility

Another theory, which offers a rationale as to why higher education institutions were established and their rapid growth, can be attributed to the idea that all American citizens should be granted the opportunity to reach their highest desired potential (Romano & Eddy, 2017). While the social efficiency ideology advocates that students should adapt to current socioeconomic conditions, the social mobility goal argues that students should be provided with obtainable credentials they need to get ahead in the current socioeconomic structure (Romano & Eddy, 2017; Schiro, 2013). An assumed component to individuality that citizens in the United States are awarded is the opportunity to enter any profession regardless of the requirements of that profession and that citizens will possess different qualifications and skills at any given moment (Cohen, Brawer, & Kisker, 2013). Using data provided by United States Department of Labor, experts determined that on average, people in the United States change careers between three to seven times (McKay, 2018). The result is an educational system focused on students accomplishing individual status rather than the production of human capital desired by employers (Kleibard, 1999; Labaree, 1997). Horace Mann (1848, as cited in Kendall, 1968, p. 13) is quoted as having said “education beyond all other devices of human origin is the great equalizer of the conditions of man, the balance-wheel of social

machinery.” This quote echoes the belief of Western society that education will open the opportunity for individuals to accomplish and change their socioeconomic status as a result of the social mobility that possessing an education can afford people. In addition, the motivation to enter higher education is not rooted solely in the desire for people to change their socioeconomic status, but also the opportunities these socioeconomic changes may provide in helping one’s family or community (Mugabe, Brug, & Catling, 2016).

The objective of education under the social mobility model is for the student to accumulate educational credentials that allow the student to gain an advantage in the competition for social position (Romano & Eddy, 2017). The implications of the social mobility objective to schooling are great. One such implication is the promotion of stratification in the educational sphere that is also promoted by the social efficiency ideology by means of obtainable certifications offered by institutions that can be leveraged for lucrative employment opportunities (Kleibard, 1999; Labaree, 1997; Schiro, 2013). While social mobility and its availability may help motivate an individual to begin a new endeavor, the social efficiency ideology and educational programs based on the ideology are often the vehicles for a person to accomplish social mobility (Brown, Reay, & Vincent, 2013).

Both the social efficiency and social mobility ideologies impede the objectives set forth by the democratic equality ideology of education which searches to better a society collectively instead of the individual bettering his or her socioeconomic status by means of social efficiency and mobility (Labaree, 1997). The confusion in American education that occurs because of lack of perspective on curriculum ideologies, ignorance

about the nature of the ideologies, and the ongoing disagreements between educators and the general public over the purpose of the school curriculum disrupts the effectiveness of teachers as individuals and schools as organizations (Schiro, 2013). With so many people possessing competing visions of what an education should provide to people and society; cohesiveness, productivity, and comradery amongst educators is challenged (Anagnostopoulos, Lingard, & Sellar, 2016)

The Evolution and Expansion of the Occupational, Technical, and Workforce Development Mission

The expansion in industry and population that took place during the two industrial revolutions in the United States created more professions to sustain and further the expansion that was already occurring (Hirschman & Mogford, 2009). The United States had transformed from isolated rural, agrarian societies to industrial economies based in metropolitan cities. Within the new metropolitan hubs, where the supply and lowered costs of manufactured goods were available, a consumer revolution for rural and urban households was underway (Wyatt, 2009). By 1920, one half of northern farms had automobiles and telephones (Hirschman & Mogford, 2009). The incredible amount of growth in the number of professions that were a consequence of the expanding economy could not be sustained solely by the four-year higher education institutions available at the time; more institutions needed to be built to address the increased nationwide demands of students wishing to enroll (Cohen, Brawer, & Kisker, 2013). The development and expansion of career and technical education programs in secondary and post-secondary schools were organic and necessary phenomena that were agreed upon by

not only the economy demanding skilled laborers, but was also the result of many citizens desiring an education that was not extensive, lengthy, and expensive (Cohen, Brawer, & Kisker, 2013). Even long after the American industrial revolution, career and technical education programs continued to attract students for reasons related to convenience and affordability (Harbour & Wolgemuth, 2015).

The pursuit of many current CTE trades does not require a four-year degree and the cost of enrolling and completing a CTE program at a community college is much more affordable than a degree at a four-year college (Harbour & Wolgemuth, 2015). The public's view of high schools and community colleges serving as agents of upward mobility for individuals continues to be a popular notion for students wishing to enter the workforce (Cohen, Brawer, & Kisker, 2013).

Successes of the Occupational, Technical, and Workforce Development Mission

Although there were criticisms with regards to schools offering a vocational track to citizens such as the educational track being terminal and people would be indirectly foreclosing their freedom to eventually further their studies at a later time, the enrollment numbers of individuals enrolling in occupational education in the United States was not only growing steadily, but it was growing at a greater rate than liberal arts enrollment for 20 years beginning in the 1960s (Cohen, Brawer, & Kisker, 2013). To accommodate the high growth in popularity of occupational education programs, community colleges and high schools became places where people who did not have options previously for employment, could now equip themselves with skills that made them employable (Cohen, Brawer, & Kisker, 2013). The average American switches professions anywhere

between three to seven times and high schools and community colleges have often been the vehicle for change (McKay, 2018).

The quantitative data regarding enrollment in occupational education in the United States during the 20th century was substantial. The popularity of occupational programs across the nation was experienced by many higher education institutions. The rise in popularity was attributed to several factors including the increase in size of public two-year colleges, the increase in part-time women, disabled and disadvantaged individuals entering the workforce, and the changing shape of the labor market (Cohen, Brawer, & Kisker, 2013).

However, despite impressive enrollments and growth between the 1960s and 1980s, current completion of occupational programs in community colleges and high schools is rather unimpressive (Dietrich, Lichtenberger & Kamalludeen, 2016). Although an occupational education may hold the benefits of higher quality job prospects, higher financial gains, and a reduction in poverty, more than two thirds of students enrolled in occupational programs at sub-baccalaureate universities leave after completing one year or less of coursework towards their original occupational program and are less likely to complete their program of study than their baccalaureate student counterparts (Hirschy, Bremer, & Castellano, 2011). Theories as to why there is such a high drop-out rate of occupational students include: a) the students intend to upgrade their skills with one or two classes and drop-out once they secure a promotion; and b) students officially declare an occupation or credential plan in order to receive financial aid and not because they have a strong interest in completing the program they have declared (Hirschy, Bremer, & Castellano, 2011). Hirschy et al. (2011) recommend that policy adjustments be made to

address the financial aid loophole that students may be tempted to exploit and better align occupational education with career integration.

In a case study conducted by Hoops and Complete College (2010) utilizing the Tennessee Technology Centers which are a statewide system of 27 occupational education institutions, the researchers addressed the high national drop-out rate average of occupational students. The Tennessee Technology Centers boasted a student completion rate of over 70% which was an impressive rate when compared to the national completion rates of occupational education programs ranging from 30 to 50%. Hoops et al. (2010) attributed the success experienced by the Tennessee Technology Centers to four factors including: a) program structures that were organized and simple to understand for students; b) a self-paced competency-based learning model where students learned and progressed at their pace; c) foundational technology skills which were contextualized by integrating them into the program; and d) supportive services including advising and crisis intervention. Contrary to many other CTE institutions, students within the Tennessee Technology centers were not passed from one instructor to the next. Typically, a student retained the same one or two instructors for the duration of the entire program allowing for a student to expect consistency, loyalty, and trust. Although CTE enrollment has historically been popular with the public, many institutions which offer a CTE education may benefit from strategies employed by the Tennessee Technology Centers in an effort to increase the graduation rate.

In a study conducted by Wang, Chan, Phelps, and Washbon (2015), the researchers were aware of the high enrollments experienced in CTE education programs in the United States along with their high drop-out rates and attempted to locate

correlations between students who underwent dual-enrollment during their high school careers and their educational success in technical colleges in the state of Wisconsin. Dual-enrollment in Wang et al.'s (2015) research was defined as the process of high school students enrolling in college courses while earning college credits simultaneously. The researchers located a positive correlation between students who underwent dual-enrollment and a higher completion rate in a technical education program once out of high school. Wang et al. (2015) attributed this positive correlation to what they defined as *academic momentum* between high school and community college. Dual-enrollment students in Wang et al.'s (2015) research were also found to have higher completion rates if the student opted to continue their education and earn a baccalaureate degree when compared to students who did not undergo dual-enrollment. In a similar study, Phelps and Chan (2016) studied the relationship between college and career success and the completion of dual credit courses in high school. Utilizing longitudinal student record data from college and K-12 data systems combined with unemployment insurance wage records, the researchers located by means of hierarchical linear modeling that dual credit high school CTE learners had significantly better outcomes than non-dual credit learners in regards to college course completions, second-year college retention, three-year graduation rate, and earnings in 2012-13. What also lends credibility to the perspective of academic momentum is that the successes and benefits that academic momentum provides is independent of students' high school academic preparation, sociodemographic, and family socioeconomic status. Academic momentum has an influence of its own that is above and beyond other factors that may hinder student achievement (Attewell, Heil, & Reisel, 2012).

The Federal Government and 20th-21st Century Vocational Education Legislation

The popularity and practicality of occupational employment has been validated by many federal and state acts aimed at funding and growing vocational education programs in the United States. As early as 1939, the Commission on Junior College Terminal Education reported that at least 62 junior colleges spanning 14 states were receiving federal funds (Cohen, Brawer, & Kisker, 2013). Since 1939 and the 62 colleges receiving federal funds aimed at promoting and growing occupational programs, the United States has repeatedly reinforced and promoted more and more schools to develop career and technical education programs through legislation (Aliaga, Kotamraju, & Stone, 2014).

The Smiths-Hughes National Vocational Act of 1917 was the first of many federal investments made in career and technical education (Aliaga, Kotamraju, & Stone, 2014). What the Smith-Hughes Act also accomplished was to segregate vocational education from the standard academic curriculum by placing the two educational tracks separate from each other (Aliaga, Kotamraju, & Stone, 2014). Federal CTE policies since the Smith-Hughes Act have evolved in response to changing economic and social conditions in the United States (Cohen, Brawer, & Kisker, 2013).

The George-Deen Act of 1936 broadened CTE education to include nationwide funding and program development for teacher education and training for marketing occupations. In 1946, the George Barden Act doubled funding earmarked for student-led agricultural organizations. The George Barden Act was the first federal law which recognized vocational student organizations (VSOs) by asserting that federal funds could be used for vocational agricultural teacher undertakings related to the VSO (Friedel, 2011). Although new fields were continually being added to the CTE realm in the United

States, federal funding for CTE was mostly directed towards the secondary education level until 1968 (Cohen, Brawer, & Kisker, 2013).

The Vocational Education Amendments of 1968 were the first legislations which set aside CTE funds to be exclusively reserved for post-secondary students from specific populations (United States Congress, 1973). The 1968 amendments extended the work of the 1963 vocational amendments, but the focus and emphasis changed from occupations to people (Forsythe & Weintraub, 1969). Modern vocational education began to take shape in 1990 with the Carl D. Perkins Vocational and Applied Technology Education Act Amendments of 1990. What this new act of 1990 accomplished was to align secondary and post-secondary CTE programs, business partnerships to be forged between schools and enterprises, academic integration, and accountability (Wirt, 1991). In 1998, the Carl D. Perkins Vocational and Technical Act continued to emphasize alignment between institutions and in the same year, the American Vocational Association was renamed to the Association for Career and Technical Education in an effort to reflect the transition from job-specific vocational training to a skill-based and rigorous education (Imperatore & Hyslop, 2017). In 2006, the term “vocational education” was retired by legislation renaming the previous Carl D. Perkins Vocational and Technical Act to the Carl D. Perkins Career and Technical Education Act of 2006 (Stipanovic, Lewis, & Stringfield, 2012). The House of Representatives in 2016 passed the Strengthening Career and Technical Education for the 21st Century Act, a renewal of the Perkins Act, by a landslide vote of 405 to 5. The new bipartisan legislation included initiatives including increased flexibility for states to use federal funds for building and modifying CTE programs, ensuring students have the proper training and skills to enter high-wage

occupations, streamlining performance measures to ensure CTE programs are delivering results to students and taxpayers, and encouraging engagement between schools and employers (United States Congress, 2018). Following the policy changes, career and technical programs flourished. Currently 58.1% of high school students in the U.S. participate in some type of CTE event and enroll in at least one CTE course regardless of race or socioeconomic status (Imperatore & Hyslop, 2017).

Contemporary Conceptualizations of CTE and STEM As Drivers for Industrialization

The state of California leads the fifty states with regards to gross domestic product (GDP), population, and economic size (Bureau of Economic Analysis, 2018). In California, professions such as logistics, accounting, biotechnology, engineering, nursing, teacher education, and green technologies are forecasted to experience debilitating shortages in the availability of qualified people to hire (Karandjeff & Schiorring, 2011). The dearth of qualified people for industries to hire from is not a problem experienced only by California. Many states across the United States are experiencing a similar dilemma including Nevada which is currently experiencing shortages of people to hire in fields including aerospace and defense, construction, health care, information technology, manufacturing and logistics, mining, natural resources, tourism, gaming, and entertainment (Nevada Governor's Office of Economic Development, 2017).

If America wishes to maintain its position leading the world, it must upkeep its national security, reputation, and quality of life by means of meeting the demands of future generations of American workers (Berube, 2014). Remedies to the dearth of

qualified employees available for hire in the United States include the capability for current CTE students to transfer into four-year institutions, predominantly into high demand occupational science, technology, engineering, and mathematics (STEM) disciplines with ease and efficiency (Bragg & Soler, 2016). Karandjeff and Schiorring (2011) proposed that if CTE students have the option of utilizing already completed credits for purposes outside of completing a CTE pathway like meeting the prerequisite requirements necessary for completion of baccalaureate academic degrees, that more students will be interested and engaged in undergoing a CTE education earlier on in their academic careers. The combination of increasing the number of students who execute a CTE pathway, and their ability to transfer their education to a four-year institution by means of articulated credits which can be utilized for baccalaureate degrees in STEM disciplines, may begin to address the dilemma of sustaining the current industries available in America and driving new ones (Bragg & Soler, 2016).

All across America, there are thousands of such students. Students that would benefit from science education, if only they had the resources, support systems and psychological ownership. There are brilliant young minds that could be called on to solve a myriad of world problems, earning money and respect in the process. But these students don't see science as a viable option for life. Or they do, but there are no textbooks in the classroom, or the teacher in the fifth one this semester...and he is on the verge of leaving too. If STEM (science, technology, engineering, and mathematics) careers are the future driving force of American economy, and if only an anointed few American students choose STEM as a career path, where will that leave us a nation as we strive to compete on the global

stage? Will America maintain its position as leader of the free world? Can a country that shuns the word “elite” ever maintain its elite status? Everything we value depends on this; our national security, reputation and quality of life all depend on our ability to meet the needs of future generations of American workers as they compete for jobs. Jobs that will require problem solving skills, innovation, creativity, scientific literacy, and mathematical knowledge. Jobs will require Americans who are tops in their fields with expertise and ambition and vision. The future is here. Will we rise to the occasion? (Berube, 2014, pp. vii-viii).

While CTE and STEM are clearly related, the difference between the two is their emphasis. STEM promotes the teaching of sciences as fundamental skills necessary in the modern world, CTE places its emphasis on science related to the acquisition of professional and career skills (Yoon & Strobel, 2017). In many states, top policy experts who include, governors, K-12 chief state school officers, and economic commissioners, have placed STEM at the center of their reform platforms (Kitchen, Sonnert, Gerhard, & Sadler, 2018). A significant number of states have STEM designated coalitions mobilized to coordinate and plan all STEM activities across agencies and industries (Malik, 2017). Leaders in business consistently call for more STEM graduates broadly and within specific industries available at the national, state, and local levels (Graham, Frederick, Byars-Winston, Hunter, & Handelsman, 2013). STEM has direct ties to economic development and betterment, global competition, and innovations (Kim, 2017). Students who practice and comprehend the role of STEM and are capable of excelling in STEM anchored courses are the nation’s future inventors, investors, and industrialists (Berube,

2014). There is no coincidence that more than 20 percent of Fortune 500 CEOs hold backgrounds in engineering, the most common undergraduate major for these leaders (CTE Is Your STEM Strategy, 2013).

While states and school districts attempt to operationalize the concept of STEM, many are offering high-quality Career Technical Education (CTE) programs that communicate critical academic, technical, and employability abilities (Yoon & Strobel, 2017). To be more specific, every state already has developed programs of study that are preparing students for careers in STEM fields. Simply put, STEM must not be regarded as a separate enterprise from CTE (CTE Is Your STEM Strategy, 2013). CTE programs include explicit inclusion of engineering into the curriculum, whereas many science academic subjects such as mathematics and computer science do not require engineering components for their completion (Yoon & Strobel, 2017). In addition to CTE requiring engineering components, CTE programs are designed to address students who may be more interested in entering the workforce instead of college; thus, offering students a lower entry point into STEM careers than a college-bound track (Yoon & Strobel, 2017).

Summary of the Literature

CTE engagement and completion at the secondary level is critical to student achievement (Attewell, Heil & Reisel, 2012; Israel, Myers, Lamm, & Galindo-Gonzalez, 2012; Wang, Chan, Phelps, & Washbon, 2015). This chapter highlighted studies that demonstrated connections between vocational and CTE programs to student achievement, the historical evolution of a CTE in the United States beginning in the 19th century, and implications for policy experts and educators regarding the continuing frontier of a newly

developing CTE mission. Additionally, this chapter included research on the public opinion of current CTE programs and economic outlooks (49th Annual PDK Poll, 2017; Karandjeff & Schiorring, 2011).

This research study expands and deepens the work by Blowe and Price (2012). The Blowe et al. (2012) work focused on the academic achievement of CTE completers and non-CTE students as measured by their performance on two state-mandated high-stakes standards of learning tests; whereas, this study explored student performance on five state-mandated high stakes college admission examinations. Secondly, the American College Testing (ACT) assessment scores for the English, math, reading, science, and writing scores were used for this study. The ACT is the leading US college admissions test that measures what students learn in high school to determine their readiness for college and employment. In 2011, the ACT surpassed the SAT in total test takers and all four year colleges and universities in the U.S. accept the ACT (ACT, 2018). Lastly, this study analyzes linkages between a reinvented and academically influenced form of CTE (formally called vocational education) to high-stakes testing.

CHAPTER THREE

Methodology

The purpose of this quantitative study was to examine for differences in student achievement between CTE endorsed high school graduates and non-CTE endorsed high school graduates in a large western school district. Non-CTE endorsed high school graduates for this study were defined as general academic students who took one or no CTE classes during their high school careers. Student achievement and the dependent variables for this study utilized the ACT examination scores in the subjects of English, math, reading, science, and writing students obtain in order to graduate high school and apply for college(s). This chapter presents the research questions, design of the study, description of the population, instrumentation, and data collection processes.

The research was designed to examine the following questions:

1. Are there significant mean differences in student achievement (as measured by the combination of all ACT assessment scores) for CTE completer high school graduates and non-CTE general academic high school graduates?
2. Are there significant mean differences on the Composite ACT scores for CTE completer high school graduates and non-CTE general academic high school graduates?
3. Are there significant mean differences on the English ACT scores for CTE completer high school graduates and non-CTE general academic high school graduates?

4. Are there significant mean differences on the Math ACT scores for CTE completer high school graduates and non-CTE general academic high school graduates?
5. Are there significant mean differences on the Reading ACT scores for CTE completer high school graduates and non-CTE general academic high school graduates?
6. Are there significant mean differences on the Science ACT scores for CTE completer high school graduates and non-CTE general academic high school graduates?
7. Are there significant mean differences on the Writing ACT scores for CTE completer high school graduates and non-CTE general academic high school graduates?

Research Design

This causal-comparative quantitative study involved a nonexperimental design and employed the use of independent and dependent variables. In comparative research, the focus is the relationship between one or more categorical independent variables and one or more quantitative variables (Mertler & Vannatta, 2013). The study analyzed the differences in student achievement as measured by ACT scores for high school graduates with a CTE endorsement and non-CTE general academic high school graduates. A one-way MANOVA statistical test, six univariate tests, and the non-parametric Mann Whitney U statistical test were used for this study.

School District Characteristics

A large western school district with a developed career and technical educational endorsement system for high school students was utilized for this research. The district is currently serving over 18,000 high school students. Of the total student population, approximately 7,200 students in the district are enrolled in a CTE program across 11 high schools which offer CTE pathway programs. CTE programs currently available in the school district include modern computer science and environmental protection programs, construction technology, diesel and automotive technology, furniture and cabinet making, machine tool technology, and more.

Sample

The population of interest involved approximately 4,000 graduated high school student ACT scores from the school district. In order to meet the statistical assumptions recommended for a multivariate analysis of variance study, of the 4,000 student ACT scores, 500 CTE-completer student graduate ACT scores and 500 non-CTE high school graduate ACT scores were selected at random from the target population consisting of 4,000. The CTE students successfully obtained high school CTE credentials in the following program areas: 1) agriculture and natural resources; 2) business and marketing education; 3) education, hospitality, and human resources; 4) health science and public safety; 5) information and media technologies; and 6) skilled and technical sciences. Convenience sampling was the sampling strategy used for this study. The convenience sampling method is a nonprobability strategy utilized by researchers based on locating

“convenient” sources of data. The sampling procedure involved a school authority releasing the archived data of approximately 4,000 graduated high school students.

Randomization of data

The Statistical Package for the Social Sciences (SPSS) was the software package employed for this study. SPSS is equipped with a *random sample of cases* feature that can select a precise number of cases from a known number of cases, with all cases possessing an equal probability of being selected. The *random sample of cases* SPSS feature was utilized for this study when extracting the cases required for the study.

American College Testing (ACT)

The ACT is the leading US college admissions test that measures what students learn in high school to determine their readiness for college and employment. The ACT is a non-profit organization devoted to helping people achieve educational and workplace success. The success of the ACT organization is founded in nearly 60 years of research. In 2011, the ACT surpassed the SAT in total test takers and all four-year colleges and universities in the U.S. accept the ACT (ACT, 2018). There are 25 states that require high school students to undertake the ACT or SAT to qualify for graduation. The state of Nevada requires high school students to undergo the ACT examination in order to meet graduation requirements. The ACT examination is considered to be a high-stakes assessment because it is tied to important outcomes such as receiving a high school diploma and future educational placements (Yell, Katsiyannis, Collins, & Losinski, 2012).

Understanding ACT Scores

The ACT examination students undertook during the 2016-17 school year was composed of five components covering the subject areas of math, science, English, reading, and writing. The subjects of math and science represent a students' STEM score while the subjects of English, reading, and writing represent a students' ELA score. The composite score, required by many colleges and universities for admittance, is an average score generated by the English, reading, science, and math components of the ACT (Xu & Liu, 2016). For the English, reading, science, and math subject-area ACT components, a test taker receives a point for every correct answer and no points are deducted for incorrect answers. The total number of correct answers is then converted to a scaled score ranging from 1-36 (ACT, 2017).

The writing test was graded by two trained evaluators. For each writing domain: 1) ideas and analysis; 2) development and support; 3) organization; and 4) language use and conventions, each evaluator offers a score ranging from 1-36. The sum of scores from both evaluators is what the test taker received as a final score for each writing domain (ACT, 2017).

Average ACT scores for the graduating class of 2017 across the state of Nevada included: a) ACT English = 16.3; b) ACT mathematics = 18.0; c) ACT reading = 18.1; d) ACT science = 18.2; and e) ACT composite = 17.8.

Data Collection

Several meetings were conducted with the school district Chief Accountability Officer and Director of Research. The required protocols for the Institutional Review

Board and the school district were followed to obtain permission to conduct the research. When the approvals were obtained from the IRB and the school district, the Chief Accountability Officer emailed the data-set and data analysis was conducted.

Assumptions and Limitations of the Study

The subsequent assumptions were made for this study:

1. A valid and reliable assessment of English, undertaken by students, was provided by the ACT organization and administered by the school district with fidelity.
2. A valid and reliable assessment of Math, undertaken by students, was provided by the ACT organization and administered by the school district with fidelity.
3. A valid and reliable assessment of Reading, undertaken by students, was provided by the ACT organization and administered by the school district with fidelity.
4. A valid and reliable assessment of Science, undertaken by students, was provided by the ACT organization and administered by the school district with fidelity.
5. A valid and reliable assessment of Writing, undertaken by students, was provided by the ACT organization and administered by the school district with fidelity.

The MANOVA analysis was conducted with fidelity by conducting several measures. The four fidelity assumptions that were met for this MANOVA study were: 1) the observations within each sample were randomly sampled and were independent of each other; 2) the observations on all dependent variables followed a multivariate normal distribution for both groups; 3) the population covariance matrices for the dependent variables for each group were equal, also known as *homoscedasticity*; and 4) the relationships among all pairs of DV's for each cell in the data matrix were linear.

This study followed the recommendations set forth by Mertler and Vannatta (2013) in utilizing a random sample. A selection of 1000 participant scores were obtained at random from the original pool of data containing over 4000 participant scores. Students in the school district from where the data was obtained undertook the ACT examination independently and under strict supervision.

Multivariate normality is obtained by univariate assessments of normality for all variables along with examinations of bivariate scatter plots (Mertler & Vannatta, 2013). All skewness and kurtosis values fell between the acceptable range of +1 and -1. Although the Kolmogorov-Smirnov test remained significant regardless of transformations aimed at increasing normalization and removal of all outliers, histograms and normal Q-Q plots displayed normal distributions. Consequently, the data was assessed as having a normal distribution (Mertler & Vannatta, 2013, p. 48).

The test for the homoscedasticity assumption was obtained utilizing the results yielded by the *Box's test*. *Box's test* yielded a significant result and homogeneity of variance-covariance could not be assumed. Because of this violation, the multivariate test statistic *Pillai's Trace* was utilized for interpretation of results as recommended by Mertler and Vannatta (2013). In addition to inspecting *Box's Test* for homoscedasticity, results from the *Levene's test for equality of Variances* displayed non-significant values for all dependent variables except for the ACT Math and ACT Writing scores. Despite not obtaining homogeneity of variance for the ACT Math and ACT Writing dependent variables, equal sample sizes between both groups being studied allowed for a continuation of the MANOVA process without violating the assumption of homoscedasticity as recommended by Denis (2018). As a measure of diligence, a Mann-

Whitney (U) Test was employed for the two dependent variables of ACT Math and ACT writing to examine if the results of the Mann-Whitney (U) test confirm the results of the MANOVA tests regarding the two dependent variables which did not have homoscedasticity under the Levene's test. Accordingly, the Mann-Whitney (U) test is an acceptable non-parametric alternative in situations where homogeneity of variance is not obtained and there are unequal samples between both groups (Mertler and Vannatta, 2013). As mentioned, this study employed equal sample sizes between both groups and the Mann-Whitney (U) test was included for confirmation purposes. The bivariate scatterplots all displayed elliptical oval-shaped figures implying that the dependent variables were related.

The subsequent limitations apply to this study:

1. Scores from examinations were collected from only one school district.
2. The study has a narrow focus of relating student achievement to only examination performance.

Data Analysis and Statistical Methods

An obvious advantage to the MANOVA is its ability to utilize several dependent variables. This not only creates for efficiency and a more robust research design, but two pivotal rationales are also offered (Warner, 2013). The first is that any meaningful intervention or treatment will likely affect the research subjects in more than one way. This assumption offers good credibility as to why there is a need for more than one dependent measure. The rationale that treatments will affect people in more than one way leads to the second justification that the use of more dependent variables will offer the

researcher the ability to obtain a more realistic and holistic picture of the phenomenon under investigation. For example, the ANOVA is capable of testing if the mean differences among a certain amount of groups on a single dependent variable hold statistical significance or if the differences between the groups occurred by chance or coincidence. In contrast, the MANOVA process is capable of measuring whether the mean differences between a certain number of groups on a combination of related and justified dependent variables are predictable or occur by random chance. As a result of the MANOVA process, a new dependent variable is created (Warner, 2013). The new dependent variable is combination of the original variables under analysis, or more simply conceptualized, a hybrid dependent variable born from the original variables. The mathematical algebraic equation which represents all variables under a multivariate analysis and the new variable created by means of MANOVA is represented as:

$$Y_{new} = a_1 Y_1 + a_2 Y_2 + a_3 Y_3 + \dots + a_n Y_n$$

whereas Y_{new} is an original dependent variable (DV), a_n is its associated weight, and n is the total number of original DVs (Mertler & Vannatta, 2013).

An explanation of how to conceptualize the original dependent variables utilized in this MANOVA research study and the new dependent variable that was created is as follows: This research examined for differences in student achievement as measured by ACT scores in five academic subjects between CTE completer high school graduates and non-CTE general academic high school graduates. After inputting all of the original data into SPSS, the analysis involved the creation of a new dependent variable, which consisted of a linear assembly (DV_{new}) of all the research participants' ACT scores and

maximized the separation amongst the two groupings of students. The newly created dependent variable would then be utilized for several univariate ANOVA tests by comparing the variances found in both groups.

As previously mentioned, there were advantages to conducting a MANOVA analysis instead of univariate analysis such as offering a more holistic picture of the phenomenon under investigation. Another statistical reason which offers rationale as to why MANOVA analysis was selected for this study includes the idea that by having several dependent variables at play in one analysis allowed for viewing what actually changes because of different curriculum paths being undertaken and executed. Another advantage to the MANOVA analysis over separate ANOVA's is the MANOVA has a higher likelihood of revealing differences that the separate ANOVA's are incapable of revealing. This probability that the MANOVA may reveal findings the ANOVA cannot suggests that the MANOVA is a more powerful research tool. Another advantage to the MANOVA is that many univariate tests increase the probability of a Type 1 error occurring. A Type 1 error is known as a false positive, or that something is occurring when it in reality it is not occurring. If a Type 1 error occurs, a researcher may incorrectly reject the null hypothesis and report that significance was located. The MANOVA research design greatly reduces the risk of an error occurring along with being more efficient and organized (Denis, 2018).

Variables

The independent variable of CTE status has two levels, whether the student obtained a CTE endorsement on their high school diploma or if they were a general

academic student graduate who undertook one or no CTE classes during high school. Student achievement and the dependent variables for this study utilized the ACT examination scores students obtained in order to graduate high school. The ACT examination subjects included: 1) English; 2) math; 3) reading; 4) science; and 5) writing. The subject areas of English, math, reading, writing, and science covered on the ACT examination were evaluated on scales ranging from 1-36.

After coding was organized numerically and completed, the researcher proceeded to input all of the coded data into SPSS for analysis. It is important for all involved in the research study and potential readers to understand that the model was constructed by using existing data. The importance of understanding this is that there were no interventions or treatments applied by the researcher. Instead, the investigator is attempting to notice the differences in results on examination marks due to students, parents, and guardians themselves choosing different options along their educational careers. Upon completion of inputting the organized and coded data into the statistical package, the actual process for a MANOVA was conducted. The utility of the MANOVA was that it constructed a holistic picture of the phenomenon(s) being studied, had the capability of unearthing factors other statistical tests were incapable of, and reduced the error rate.

Error Rate Avoidance Measures

One of the first steps when undertaking a MANOVA analysis is the overall multivariate hypothesis test. This translates to a test that seeks to locate whether all groups are equal on the combination of dependent variables. If the null hypothesis is

retained and significance was not located, then it is an accepted practice that the researcher(s) halt their analysis and conclude that the treatments or interventions applied to the groups have no effect on the dependent variables. In contrast, if the results are significant from the multivariate hypothesis test as was in this study, the researcher(s) is/are encouraged to continue the investigation into which independent variables are affecting the dependent variable(s). In order to facilitate the continuation of the investigation, the researcher conducted a series of univariate analyses of variance on each individual dependent variable. These tests with certainty will result in an inflated Type 1 error rate. In order to reduce the potential for Type 1 errors occurring, precautions were taken.

Bonferroni-type adjustment

Precautions against error(s) occurring during the multiple ANOVAs were taken including an adjustment to the alpha levels. This encouraged alpha level adjustment is known as the *Bonferroni-type* adjustment. What this adjustment accomplishes is a readjustment to a more stringent alpha level for the tests conducted on each dependent variable. This required that the alpha set does not exceed a critical value for the set of DV's. The standard critical alpha level for each DV being tested is ($\alpha=.05$) divided by the total number of DV's under investigation. For this study the Bonferroni adjustment for the MANOVA procedure included five dependent variables. In order to maintain an alpha level of 0.05, each univariate test was conducted at $\alpha=0.01$ ($.05 \div 5 = 0.01$). Take note that the final number need be rounded down after division in order to maintain the 0.05 alpha level. The final step for any of the univariate tests of a dependent variable that is located to hold significance is to conduct univariate post hoc tests in order to find where

exactly the specific differences lie amongst the independent variables. In other words, to which magnitudes is each independent variable influencing the dependent variables (Denis, 2018; Merler & Vannatta, 2013; Warner, 2013).

CHAPTER FOUR

Results

The purpose of this ex post facto research, also known as causal-comparative research, was to determine the impact of a CTE endorsement on student achievement at a school district in the Western United States. In ex post facto research, there is an objective to relate an after-the-fact treatment that cannot be administered or manipulated by the researcher to an outcome or dependent measure (Cohen, Manion, Morrison, & Morrison, 2007). The exact type of ex post facto research design this study followed was criterion group. The “phenomenon” in this study was CTE concentration and the dependent variables were student achievement as measured by high-stakes national assessment scores.

Current quantitative standards and protocols guided the study. Multivariate and univariate statistical methods were utilized including descriptive analyses, multivariate analysis of variance, and univariate analysis of variance. In an effort to confirm the results from the univariate tests, the nonparametric Mann-Whitney U test was conducted on two of the dependent variables: ACT Math and Writing scores. This chapter reviews the results of these analyses.

Descriptive Analysis

The examination of the descriptive analysis provided a general understanding of the data. The data for this study included 1,000 cases with six scores attached to each case. There were 500 CTE-completer high school graduate cases (50%) and 500 general high school graduate cases (50%). The mean scores of the CTE completers and non-CTE

students indicated that students who underwent and completed a CTE pathway had higher mean scores on the dependent variables in comparison to the general non-CTE students. Specifically, CTE completer high school graduates had a mean score of 19.98 out of 36 on the ACT composite score whereas general academic high school graduates had a mean score of 18.53. CTE completer high school graduates had a mean score of 18.26 out of 36 on the ACT English score whereas general academic high school graduates had a mean score of 16.84. CTE completer high school graduates had a mean score of 20.41 out of 36 on the ACT Math score whereas general academic high school graduates had a mean score of 19.00. CTE completer high school graduates had a mean score of 20.37 out of 36 on the ACT reading score whereas general academic high school graduates had a mean score of 18.84. CTE completer high school graduates had a mean score of 20.44 out of 36 on the ACT science score whereas general academic high school graduates had a mean score of 18.89. CTE completer high school graduates had a mean score of 17.35 out of 36 on the ACT writing score whereas general academic high school graduates had a mean score of 16.14. Table 1 supplied the means and standard deviations for CTE and general students based on the six dependent variables.

Table 1

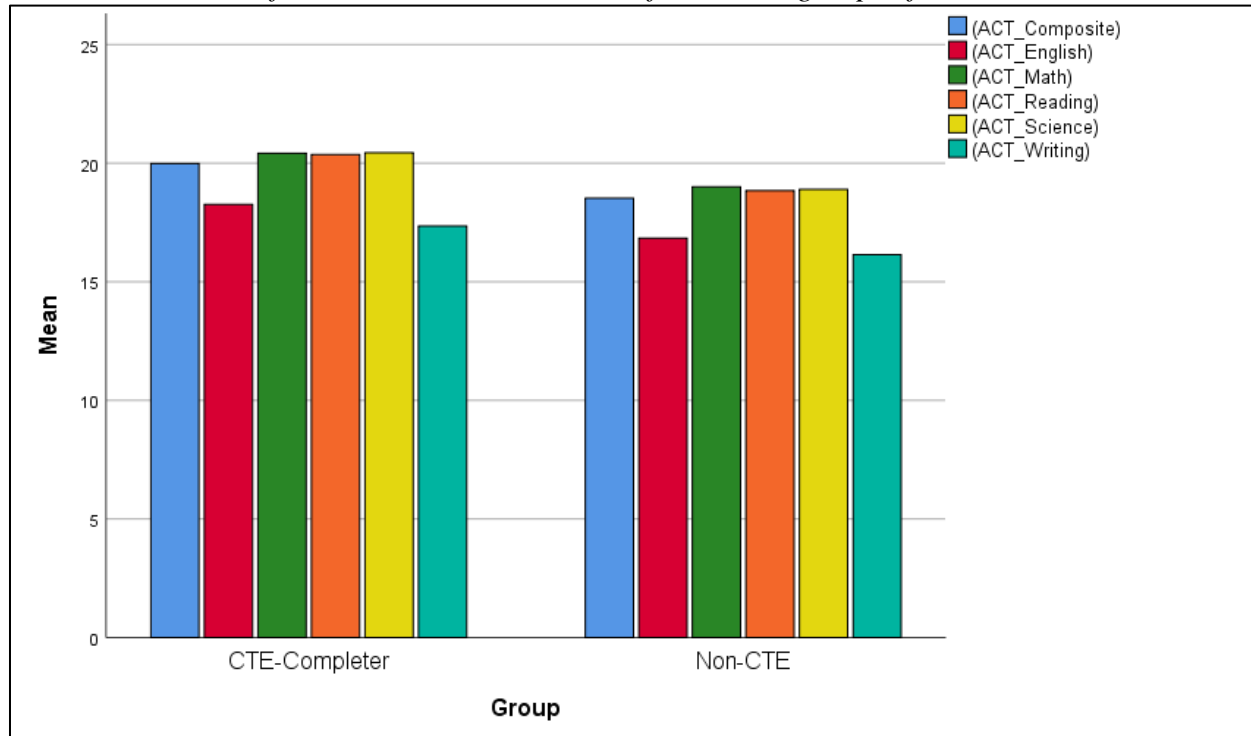
Means and standard deviations for ACT composite score, ACT Math score, ACT Science score, ACT English score, ACT Reading score, and ACT Writing score by student type

Assessment	Student Category	<i>M</i>	<i>SD</i>
ACT Composite	CTE Completer	19.98	4.88
	General Student	18.53	4.66
ACT English	CTE Completer	18.26	5.98
	General Student	16.84	5.86
ACT Math	CTE Completer	20.41	5.00
	General Student	19.00	4.56
ACT Reading	CTE Completer	20.37	5.86
	General Student	18.84	5.76
ACT Science	CTE Completer	20.44	4.81
	General Student	18.89	4.62
ACT Writing	CTE Completer	17.35	5.27
	General Student	16.14	6.12

The differences in the mean ACT scores of the CTE completer high school graduates and the general academic high school graduates ranged between 1.21 points to 1.55 points. The smallest difference in scores was on the ACT writing between both types of students and the largest differential found was on the ACT science score. The average mean differential between both types of graduates on all six ACT scores was 1.43. Figure 1 shows the distributions of the scores on all ACT assessments for the two groups of students.

Figure 1

Mean distributions of all ACT assessments scores for the two groups of students.



Quantitative Results: MANOVA

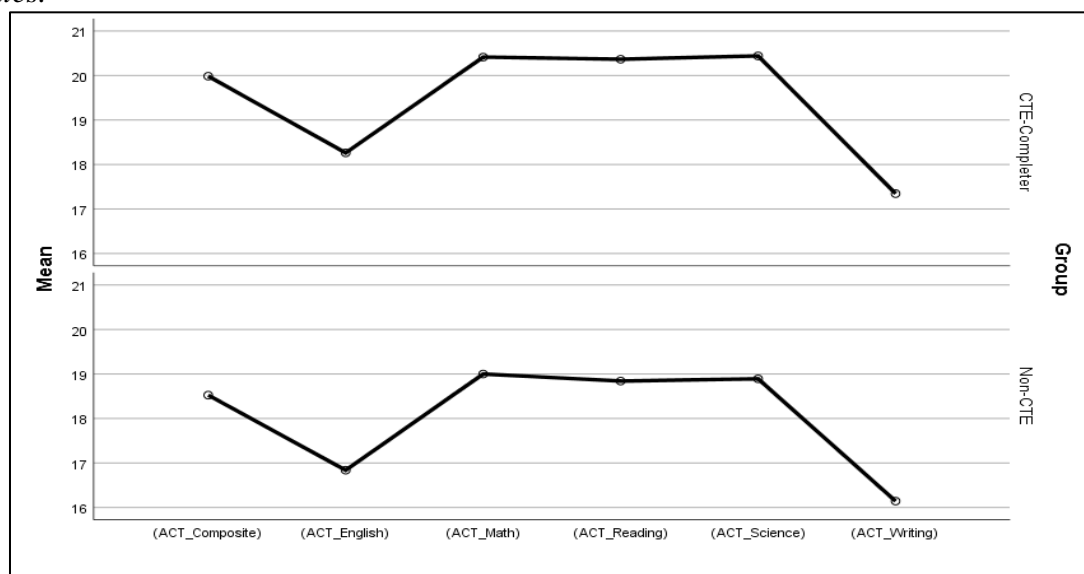
A one-way MANOVA was conducted to determine the effect of type of high school student graduate (CTE completer or general) on six dependent variables of respondents' ACT composite score, ACT Math score, ACT Science score, ACT English score, ACT Reading score, and ACT Writing score. The analysis was employed to assess whether the means between both sample groups (CTE completers vs. general academic students) were statistically different from each other on six ACT assessment scores. To test the level of significance, the stringent alpha level of .01 was used to determine whether there was a significant difference located in the means of the two groups (Leahey, 2005).

Results and Analysis for Question One

Are there significant mean differences in student achievement (as measured by a combination of ACT writing, English, math, science, and reading assessment scores) for CTE completer high school graduates and non-CTE general academic high school graduates? MANOVA results revealed statistically significant mean differences with a moderate effect among the type of high school student graduate (CTE completers vs. general academic students) on the combination of dependent variables [*Pillai's Trace* = .030, $F(5, 994) = 5.994$, $p < .001$, *multivariate n^2* = .029]. Figure 2 demonstrated the general trend of all ACT assessment mean scores between the two types of high school graduates.

Figure 2

General trend of all ACT assessment mean scores between the two types of high school graduates.



Because the overall test was significant, the assumption that there would be no significant statistical difference between both groups of students was ruled invalid. After it was

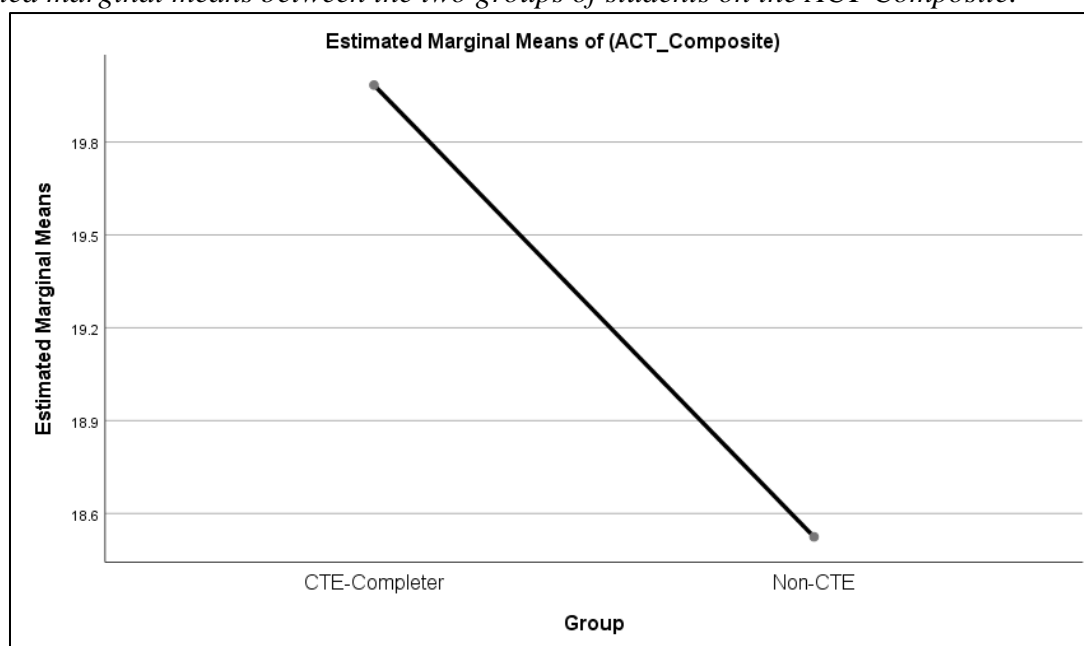
discovered that there is a significant difference on the combination of ACT scores, individual analysis of variance was conducted on each ACT component. Questions two through seven below are the results of the individual analysis of each ACT score.

Results and Analysis for Question Two

Are there significant mean differences on the Composite ACT scores for CTE completer high school graduates and non-CTE general academic high school graduates? The univariate test on the individual ACT composite dependent variable revealed statistically significant mean differences between the two groups of students [$F(1, 998) = 23.39, p < .001, \text{partial } n^2 = .023$]. Therefore, a CTE curricula increases student achievement in the academic subjects of English, reading, mathematics, and science as measured by high-stakes national testing. Figure 3 displayed the estimated marginal means between the two groups of students on the ACT composite dependent variable.

Figure 3

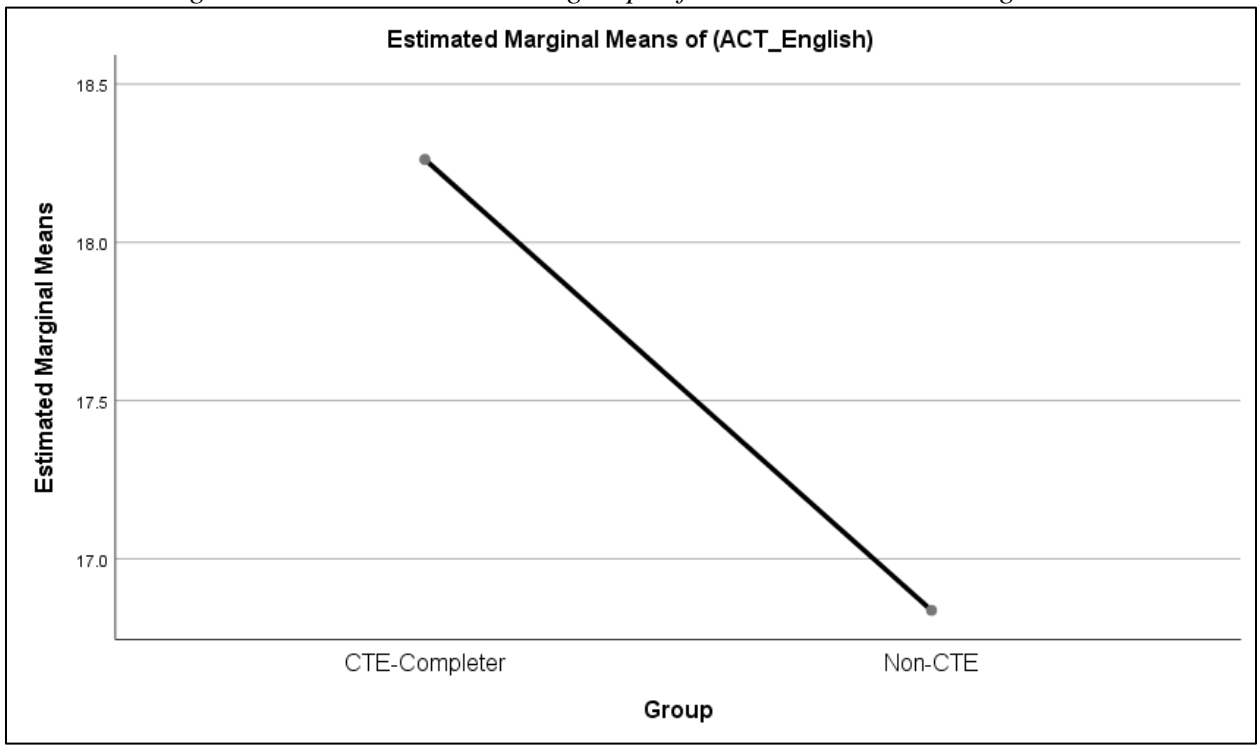
Estimated marginal means between the two groups of students on the ACT Composite.



Results and Analysis for Question Three

Are there significant mean differences on the English ACT scores for CTE completer high school graduates and non-CTE general academic high school graduates? The univariate test on the individual ACT English dependent variable revealed statistically significant mean differences between the two groups of students [$F(1, 998) = 14.48, p < .001, partial n^2 = .014$]. Therefore, a CTE curricula increases student achievement in the academic subject of English as measured by high-stakes national testing. Figure 4 displayed the estimated marginal means between the two groups of students on the ACT English dependent variable.

Figure 4
Estimated marginal means between the two groups of students on the ACT English.

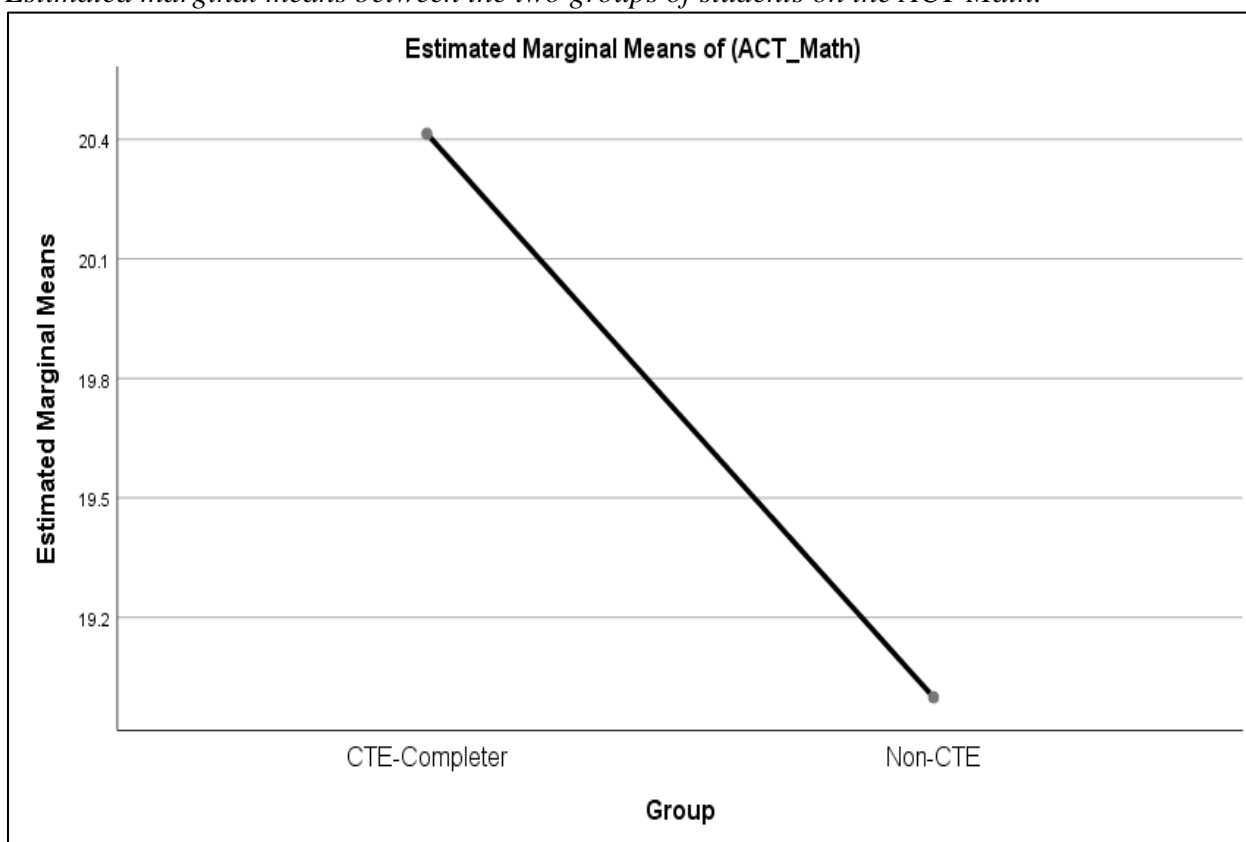


Results and Analysis for Question Four

Are there significant mean differences on the Math ACT scores for CTE completer high school graduates and non-CTE general academic high school graduates? The univariate test on the individual ACT Math dependent variable revealed statistically significant mean differences between the two groups of students [$F(1,998) = 21.908, p < .001, partial \eta^2 = .021$]. Therefore, a CTE curricula increases student achievement in the academic subject of math as measured by high-stakes national testing. Figure 5 displayed the estimated marginal means between the two groups of students on the ACT Math dependent variable.

Figure 5

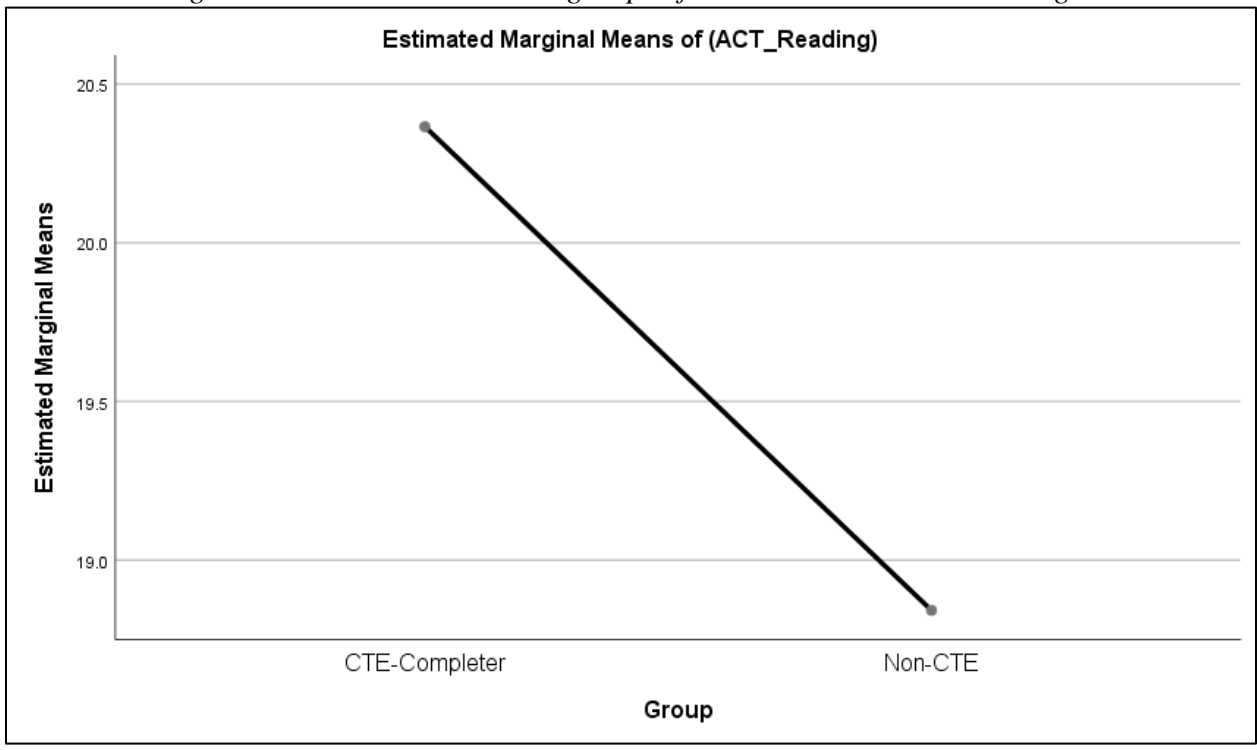
Estimated marginal means between the two groups of students on the ACT Math.



Results and Analysis for Question Five

Are there significant mean differences on the Reading ACT scores for CTE completer high school graduates and non-CTE general academic high school graduates? The univariate test on the individual ACT Reading dependent variable revealed statistically significant mean differences between the two groups of students [$F(1, 998) = 17.24, p < .001, partial n^2 = .017$]. Therefore, a CTE curricula increases student achievement in the academic subject of reading as measured by high-stakes national testing. Figure 6 displayed the estimated marginal means between the two groups of students on the ACT Reading dependent variable.

Figure 6
Estimated marginal means between the two groups of students on the ACT Reading.

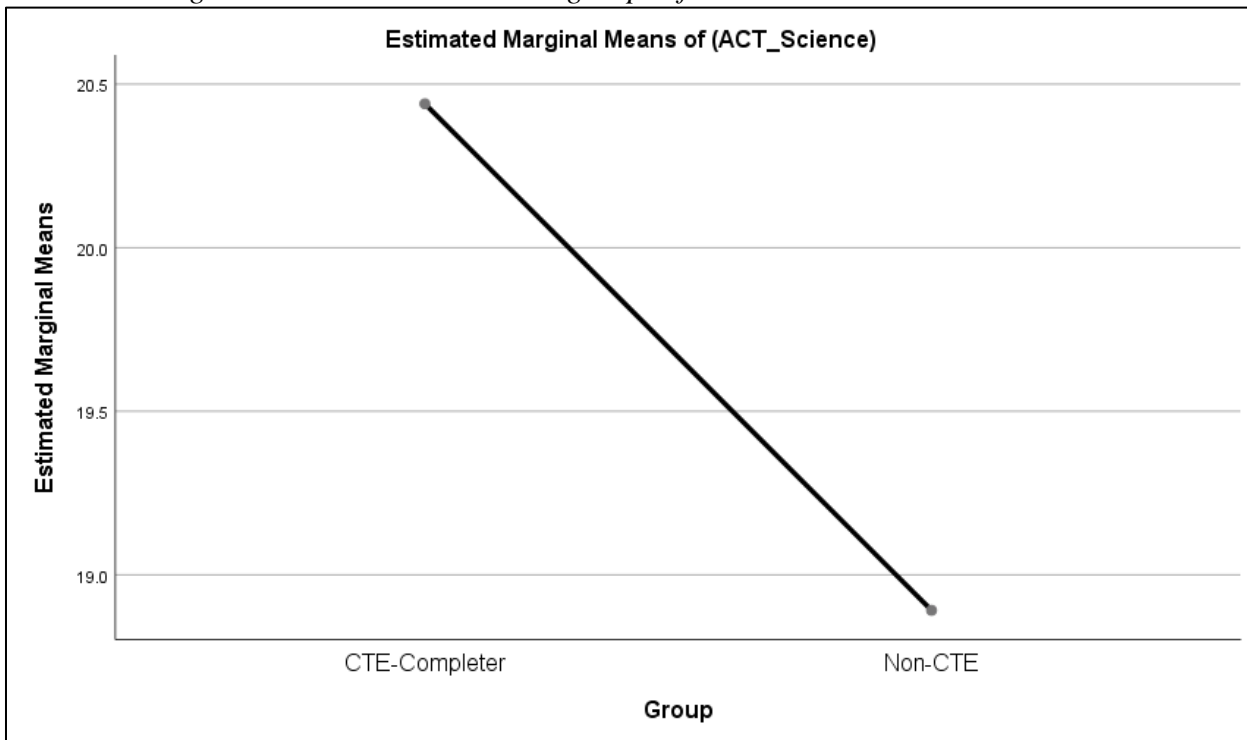


Results and Analysis for Question Six

Are there significant mean differences on the Science ACT scores for CTE completer high school graduates and non-CTE general academic high school graduates? The univariate test on the individual ACT Science dependent variable revealed statistically significant mean differences between the two groups of students [$F(1, 998) = 17.24, p < .001, \text{partial } n^2 = .017$]. Therefore, a CTE curricula increases student achievement in the academic subject of science as measured by high-stakes national testing. Figure 7 displayed the estimated marginal means between the two groups of students on the ACT Science dependent variable.

Figure 7

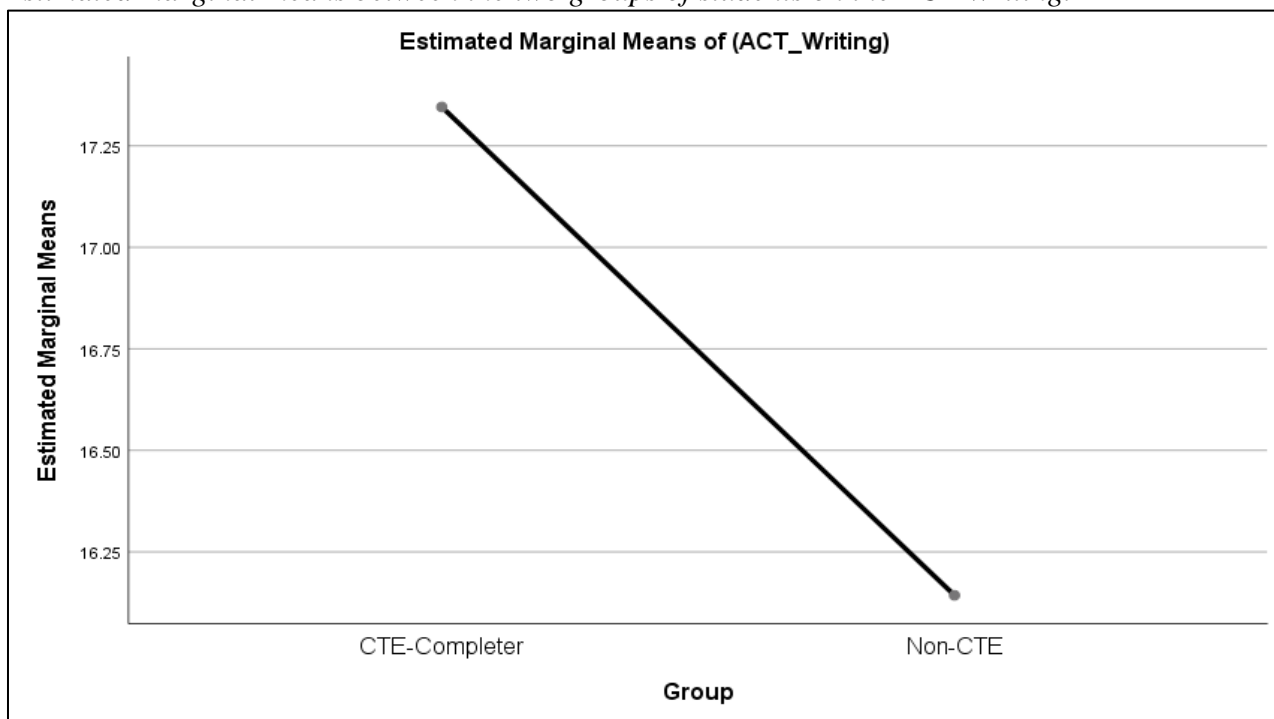
Estimated marginal means between the two groups of students on the ACT Science.



Results and Analysis for Question Seven

Are there significant mean differences on the Writing ACT scores for CTE completer high school graduates and non-CTE general academic high school graduates? The univariate test on the individual ACT Writing dependent variable revealed statistically significant mean differences between the two groups of students [$F(1, 998) = 11.08, p = .001, \text{partial } n^2 = .011$]. Therefore, a CTE curricula increases student achievement in the academic subject of writing as measured by high-stakes national testing. Figure 8 displayed the estimated marginal means between the two groups of students on the ACT Writing dependent variable.

Figure 8
Estimated marginal means between the two groups of students on the ACT Writing.



Quantitative Results: Mann Whitney Test

Mann-Whitney (U) Test was employed for the two dependent variables of ACT Math and ACT writing to examine if the results of the Mann-Whitney (U) test confirm the results of the MANOVA tests regarding the two dependent variables which did not have homoscedasticity under the Levene's test from the data screening stages. Table 2 provided the details from the results of the Levene's test of homogeneity.

Table 2

Levene's Test of Homogeneity for the Quantitative Measures.

Dependent Variable	Estimates derived from	Levene's Statistic	df1	df2	Sig.
ACT Composite	Based on Mean	1.67	1	998	.197
	Based on Median	1.50	1	998	.221
	Based on median adjusted df	1.50	1	995.00	.221
	Based on trimmed mean	1.84	1	998	.175
ACT English	Based on Mean	1.09	1	998	.297
	Based on Median	1.90	1	998	.168
	Based on median adjusted df	1.90	1	990.48	.168
	Based on trimmed mean	1.20	1	998	.274
ACT Math*	Based on Mean	10.42	1	998	.001
	Based on Median	9.54	1	998	.002
	Based on median adjusted df	9.54	1	996.97	.002
	Based on trimmed mean	10.53	1	998	.001
ACT Reading	Based on Mean	0.37	1	998	.545
	Based on Median	0.44	1	998	.505
	Based on median adjusted df	0.44	1	996.96	.505
	Based on trimmed mean	0.38	1	998	.539
ACT Science	Based on Mean	0.00	1	998	.987
	Based on Median	0.01	1	998	.919
	Based on median adjusted df	0.01	1	984.21	.919
	Based on trimmed mean	0.01	1	998	.942
ACT Writing*	Based on Mean	7.74	1	998	.005
	Based on Median	7.80	1	998	.005
	Based on median adjusted df	7.80	1	970.24	.005
	Based on trimmed mean	7.98	1	998	.005

Note: *signified a statistically significant result ($p < .01$)

The Mann Whitney U Test results indicated that there was a significant mean rank difference by student type on the ACT Math assessment [$U(500, 500) = 103,764.50, Z =$

$-4.67, p < .001, n^2 = .02$]. CTE completers had an average rank of 542.97 , whereas general students had an average rank of 458.03 on the ACT Math. The results also indicated that there was a significant mean rank difference by student type on the ACT Writing assessment [$U(500, 500) = 110946.00, Z = -3.09, p < .05, n^2 = .01$]. CTE completers had an average rank of 528.61 , whereas general students had an average rank of 472.39 on the ACT Writing. The significances located in the Mann Whitney U Test regarding the ACT Math and ACT Writing confirms the significances from the multivariate and univariate tests.

Summary

Using a one-way MANOVA the research questions were answered. The effects of student type (CTE or general) on the dependent variables were reviewed from Pillai's Trace. The results indicated that there were significant effects of student type on all dependent variables. Based on the MANOVA findings, six one-way univariate ANOVA tests were conducted. All six ANOVA tests yielded significant results indicating that student type had an effect on all ACT scores.

Due to violations of the MANOVA assumptions regarding homoscedasticity of the ACT Math and Writing scores, the non-parametric Mann Whitney (U) test was conducted as a confirmation of the MANOVA findings and an act of diligence. The findings from the Mann Whitney Test paralleled the MANOVA results that there were statistically significant differences in student achievement on the ACT math and writing assessments.

CHAPTER FIVE

Discussion

The purpose of this quantitative study was to investigate the student achievement of CTE completer high school graduates and general academic high school graduates as measured by the ACT composite, math, science, English, reading, and writing assessment scores. This study included all graduating student scores on the ACT assessments covering 16 high schools based on ACT data that each school submitted to the school district. There was one independent variable with two levels, whether the student obtained a CTE endorsement on their high school diploma or if they were a general academic student graduate who undertook one or no CTE classes during high school. The six dependent variables were the ACT composite, math, science, English, reading, and writing assessment scores.

One of the objectives of this study was to evaluate whether the new and evolving mission of career and technical education programs is a worthwhile curriculum option and investment that may contribute to academic mastery required for high-stakes testing such as American College Testing (ACT). Secondly, this study was intended to be a source to provide quantifiable data for a school district and other schools when making decisions related to curriculum and evaluation during this era of rigorous school accountability. Thirdly, this study begins to answer the demand from the educational community to conduct rigorous research on CTE programs. Jacob (2017) claims that CTE can motivate students to attend school regularly and be engaged, which can in turn improve core academic skills. He also makes the argument that because states play a large role in developing and overseeing CTE programs, they need to support a research

agenda that will help guarantee that these new programs are successful. The results of this study support Jacob's notion that a CTE curriculum can support student motivation and achievement as measured by high-stakes national testing that assessed core academic skills in the subjects of math, reading, writing, English, and science.

The results of this study signal that CTE engagement and completion affects student achievement. In the 2012 Florida study conducted by Israel et al., the researchers found that student performance on a statewide science assessment improved as a student's coursework within a CTE program increased. In simpler terms, the more CTE courses a student undertook and completed within one CTE program translated to higher science assessment scores. In this study, the largest difference found between non-CTE student graduates and CTE completer graduates was on the ACT science assessment. The result that CTE completers had a mean ACT science score of 4.30% points higher than general academic high school graduates align with the results from the Israel et al. (2012) study. The implication that student achievement increases with more exposure and engagement in CTE programs also coincides with the Castellano et al. (2012) research which found that differences in achievement amongst ninth grade CTE students and ninth grade non-CTE students was not significant, but by the end of 10th grade, differences in achievement between both types of students became significant with regards to assessment scores, grade point averages, and progress towards graduation.

Blowe et al. (2012) found that CTE completers had higher reading and math passing rates than non-CTE completers across the state of Virginia. The results from this analysis complement the Blowe et al. (2012) findings. This study found that CTE completers had a mean ACT reading score of 4.25% points higher than general academic

high school graduates along with mean ACT Math scores 4% points higher than general academic high school graduates. This study expanded on previous research by examining nationwide testing instead of localized testing along with including multiple assessments.

This study also found that CTE completers had mean ACT composite scores that were four percentage points higher than general academic high school graduates, or 1.45 test points higher on range of 1-36. These results imply that CTE completers outperform their general academic counterparts on the ACT composite score. Often, the ACT composite score is a main component of evaluation higher education institutions utilize during admission decisions (Xu & Liu, 2016). In addition to higher ACT composite scores obtained by CTE completers, completers also had mean ACT English scores that were four percentage points higher than general academic high school graduates, or 1.42 test points higher on a range of 1-36. Lastly, CTE completers had a mean ACT writing scores that were 3.4% points higher than general academic high school graduates, or 1.21 test points higher on a range of 1-36.

Implications for Practice

As states and school districts make decisions regarding continuation, expansion, or elimination of CTE programs, the findings in this research should be reviewed as it concludes that students who execute a CTE program demonstrate higher ACT scores. The literature indicates that there were and are different views regarding CTE programs and student achievement (Jacobs, 2017; Roska, 2006). These studies served as a catalyst for this study and fulfilled a desire and curiosity of the researcher to investigate the high-stakes testing performance of CTE completers. Founded on the implications below,

educators and policy-makers should take into account the role of CTE and student achievement.

Implication 1

School administrators should encourage general academic students to engage in CTE courses and execute a CTE pathway. Increasing the number of CTE students would benefit school divisions and students. Students would have an increased likelihood of experiencing higher high-stakes testing scores and academic momentum if they engage in CTE courses. CTE programs which offer dual-enrollment and articulated credits serve as a pre-college momentum building mechanism that consequently helps build early college enrollment and success (Wang et al., 2015).

Implication 2

School administrators concerned with increasing testing rates should encourage more CTE programs be built and/or refined within their schools. Based on the results of this research study, CTE completers tested higher on all ACT assessments when compared to their general academic counterparts. Improved school-wide testing rates can help schools meet district and state accountability requirements.

Implication 3

School administrators should continue to collect data on the student achievement of CTE students to monitor the effectiveness of CTE programs. In order to advocate for CTE programs, data connected to specific program areas and achievement should be researched. During this time of changing teaching standards and accountability, CTE

programs need to be capable of demonstrating their effectiveness in meeting the responsibility of equipping students with the skills they need to prosper after high school.

Recommendations for Further Research

More research should focus on the student achievement of students amongst varying CTE programs. School districts offer a variety of different CTE programs to their students and often which program to choose presents a dilemma to students, parents, guardians, and educators. High-stakes ACT assessment scores were the variables linked to student achievement for this study; therefore, future research should be piloted to include other variables that may influence student achievement such as GPA, course grades, and demographic variables if possible. Such findings will better illuminate the effect of CTE on student achievement and outcomes. Enlightening would also be qualitative research attempts to better understand students' dispositions and attitudes towards CTE programs and their effectiveness.

Other quantitative research attempts should be conducted annually to analyze the progression of CTE programs regarding student achievement during this time of CTE growth, encouragement, and increased federal funding. CTE programs nationwide are continually being modified. How the programs are progressing and whether this progression year-to-year is affecting students positively or negatively is valuable information to parents and schools in their mission of bettering student outcomes and meeting accountability requirements.

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