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Impact of Career and Technical Education Among High School Students in Texas

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IMPACT OF CAREER AND TECHNICAL EDUCATION AMONG HIGH SCHOOL STUDENTS IN TEXAS

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Tammy Ridgway

DEDICATION

To my late mother and grandfather. Mom, you always believed in me and encouraged me to follow my dreams. I know you are up in the heavens looking down and beaming ear to ear with your contagious smile. I miss you so much. Grandpa, you set the bar high. Your passion for knowledge and wisdom was truly heartfelt. I am so blessed to be your granddaughter and to have inherited your love of learning.

IMPACT OF CAREER AND TECHNICAL EDUCATION AMONG HIGH SCHOOL STUDENTS IN TEXAS

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Existing research documents the importance and relevance of career and technical education (CTE) throughout American history. Beginning with the passage of the Smith-Hughes Act of 1917 to the passage of the Strengthening Career and Technical Education for the 21st Century Act in July of 2018, federal and state legislation continue to shape vocational education within our public-school systems. The literature provides strong evidence between student success, in terms of high school graduation rate and post-secondary educational attainment, and the participation in career and technical education during the high school years. This dissertation analyzes whether dual credit career and technical education classes improve the overall academic high school performance of students who enroll in these classes, with a specific focus on Dallas Independent School District (ISD). This analysis fills the gap in existing research by identifying the specific benefits of dual credit career and technical education coursework on graduating Grade-Point averages of individual students. This quantitative study sought to validate the improved academic performance by analyzing the relationship between the graduating grade-point average (GPA) of students who earned dual credit by completing at least one CTE course as compared to their peers who did not take any dual credit CTE courses. For this research, a causal-comparative design was selected to examine the relationship between the student's graduating GPA and the CTE courses they have taken during high school. Four distinct groups of

recent high school graduates were included in this study, students who had been identified and received special education services (SPED), students who had been identified and received gifted and talented services (GT), students who had been identified and received English language learner services (ELL), and remaining students who did not fall under any of these categories. The population for this study consists of May 2021 and May 2022 high school graduates from Dallas ISD, Texas. De-identified secondary data from a total of 16,043 students was obtained from the ISD. Employing STATA, a multivariate linear regression estimate was generated to test whether the GPA of the students was impacted by their enrollment in CTE classes, controlling for their sex, ethnicity, and group (SPED, GT, ELL, Other). Non-parametric Chi-square tests of Independence were performed using the binary variables to test whether CTE enrollment impacted GPA for all groups. The student's graduating GPA was the single dependent variable being researched. While the overall results of the linear regression show that the impact of the CTE variable on GPA is statistically significant, the magnitude is small. The results do confirm that students who earned education credits by completing dual credit CTE classes *are* likely to have a higher graduating GPA as compared to their counterparts, in all groups regardless of gender and ethnicity. The literature provides robust evidence between student success and the participation in CTE. This dissertation confirms and echoes the previous findings with the use of Dallas ISD data and supports the ongoing attention towards the growth of CTE course offerings in high schools and beyond. This research aims to help administrators of school districts, specifically in Texas, which have a different ethnic composition than a lot of the other districts in the country. The results can help administrations by arming them with the information they might need to make more specific choices in providing a larger variety and encouraging higher participation for dual credit CTE courses offered at public high schools.

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Chapter 1. Introduction: CTE Courses in High Schools

Background

Career and technical education (CTE) courses have been an integral part of public education since the Smith-Hughes Act of 1917 which provided the first federal funding for vocational education (Perkins Collaborative Resource Network, n.d.). In the following years and decades, additional legislative acts were instituted to continue providing federal funding including the Vocational Act of 1973, the Carl D. Perkins Act of 1984, commonly referred to as Perkin*s*, the Carl D. Perkins Vocational and Applied Technology Act of 1990, commonly referred to as Perkins II, the Carl D. Perkins Career and Technical Education Act of 1998, commonly referred to as Perkins III, the Carl D. Perkins Career and Technical Education Act of 2006, commonly referred to as Perkins IV, and most recently the Strengthening Career and Technical Education for the 21st Century Act of 2018, commonly referred to as Perkins V*,* which reauthorized the Carl D. Perkins Career and Technical Education Act of 2006 (Perkins Collaborative Resource Network, n.d.). It is the expectation of the U.S. Department of Education that these federal funds will be used to expand opportunities for high school students across the country to explore and choose a CTE program that adds value to their education and prepares them for their future (Perkins Collaborative Resource Network, n.d.).

Dual Credit in Texas

Though CTE has been addressed on a national level, many states have taken career and technical education a bit further offering dual credit career and technical education courses in high schools in conjunction with their local community college or university. This implies that the students have the opportunity to earn high school and college credit whilst fulfilling high school graduation requirements and completing the needed courses to earn a Level 1 certification

from the institution of higher education. In Texas, dual credit enrollment grew 57% between Fall 2007 to Fall 2017 (Texas Higher Education Coordinating Board, 2018). Of the 151,669 students enrolled in dual credit classes in Texas in Fall 2017, approximately 15% or about 22,750 students were enrolled in CTE courses (Texas Association of Community Colleges, 2018).

The Texas legislature has continually supported and promoted the foundation and expansion of dual credit opportunities in Texas. In 2006, the 79th Texas Legislature made provisions to the Texas Education Code (2006) Sec. 28.009 requiring that each school district in Texas devise a program allowing high school students to earn the equivalent of at least 12 college credit hours before finishing high school. In an effort to expand access to dual credit courses, in May 2015 the 84th Texas Legislature passed Texas House Bill 505, which eliminated the cap on the maximum number of dual credit courses or hours that a high school student may obtain. Additionally, this legislation also expanded the grade-ranges from only seniors to include freshmen, sophomores, and juniors for enrolling in dual credit courses. In 2017, House Bill 1638 was enacted requiring dual credit programs to develop a memorandum of understanding between the public school district and the certificate-granting higher education institution such as community college or local university. Most recently, Texas Senate Bill 346 signed by Texas Governor Greg Abbott in May 2021, expands eligibility of awarding grants, such as *Jobs for Educations for Texans* grant program to include open-enrollment charter schools that offer dual credit courses. While the detailed list of legislative actions in Texas are discussed in Chapter 2, the key ones discussed here clearly demonstrates that the Texas Education Agency (TEA), Texas Higher Education Coordinating Board (THECB), and the elected officials in Texas continue to focus on dual credit education.

Economic and Academic Impact of Career and Technical Education

Career and technical education (CTE) in secondary and post-secondary institutions is an integral component in developing skilled labor personnel. According to the Texas Workforce Commission 2021 annual report, 63% of jobs in Texas are classified as middle skills whilst only 33% of those actually employed in these jobs have middle skills training, this leaves 30% of the noted jobs filled with lower skilled workers. Middle skill jobs are defined as jobs requiring additional training after high school, but not a 4 year college degree (Texas Workforce Commission, 2021). The Texas Workforce Commission has partnered with the TEA and the THECB in a strategic effort to eliminate the middle skills gap and strengthen the Texas economy (Texas Workforce Commission, 2021). This skills gap is lessened by participants in a CTE program whether it was offered for only high school credit or for dual credit before graduating with a high school diploma.

Texas Workforce Investment Council (2018) suggests that literature has shown a direct correlation between students who participate in a CTE program and increased academic outcomes. Increased academic outcomes include higher graduation rates, higher test scores, lower dropout rates, as well as increased post-secondary enrollment. A study conducted by the Office of Community College Research and Leadership at the University of Illinois at Urbana-Champaign (Bragg & Ruud, 2007), found that students who participated in a CTE program reported having a clear career goal and a corresponding plan to achieve it. Additionally, the study found that CTE program participants developed superior problem-solving skills and notably higher scores on the Reading for Information subtest of the ACT WorkKeys National Career Readiness Certificate (NCRC). The ACT WorkKeys NCRC is an assessment that measures and certifies the essential work skills needed for success in jobs across industries and

occupations (ACT, n.d.). Higher score on this assessment are desirable achievements for employers seeking skilled workers.

In summary, early exposure of high school students to CTE has far reaching consequences, academically and economically. CTE is supported by the United States Department of Education through legislation and is federally funded. In Texas, as with many other states, career and technical education goes beyond high school and encompasses partnerships between school districts and institutions of higher education to offer dual credit programs. These programs positively impact the Texas economy by shrinking the middle skills gap with employable students that are academically stronger that their peers.

Statement of the Problem

The goal of this dissertation is to analyze if the impact of dual credit CTE classes goes beyond the classes and plays a role in improving the overall academic performance of students who enroll in these classes. This quantitative study seeks to validate the improved academic performance by analyzing the relationship between the graduating grade-point average (GPA) of students who earned dual credit by completing at least one dual credit CTE course as compared to their peers who did not take any dual credit CTE courses. Four categories of students who tend to have innate academic performance differences have been included in this study – GT group, SPED group, ELL group, and all others to control for within-group impacts of external influences.

This study was conducted by exploring secondary data obtained from a large Texas metropolitan area public school districts for students who graduated in May 2021 and May 2022. The public-school district Dallas ISD served a student population of approximately 153,861 students (Dallas ISD, n.d.-a)

Research Questions and Hypothesis

The primary hypothesis is that students who earned education credits by completing dual credit CTE classes are likely to have a higher graduating GPA as compared to their counterparts. The corresponding null hypothesis would be that taking dual credit CTE classes has no impact on a student's overall graduating GPA. The following research questions will be analyzed and discussed in this dissertation separately to address the overarching primary hypothesis:

H1. Students who earned education credits by completing dual credit CTE classes are likely to have a higher graduating GPA as compared to their counterparts.

Research questions for this dissertation include:

R1. For the student population who have been identified and receive SPED services, is there a significant relationship between the graduating GPA among students who completed at least one dual credit CTE course during high school and the graduating GPA of students who did not.

R2. For the student population who have been identified and receive GT services, is there a significant relationship between the graduation GPA among students who completed at least one dual credit CTE course during high school and the graduating GPA of students who did not.

R3. For the student population who have been identified and ELL services, is there a significant relationship between the graduation GPA among students who completed at least one dual credit CTE course during high school and the graduating GPA of students who did not.

R4. For the student population that is not included in the three previous student populations (identified in R1, R2, and R3), is there a significant relationship between the

graduation GPA among students who completed at least one dual credit CTE course during high school and the graduating GPA of students who did not.

Theoretical Framework

A causal-comparative design, also known as *ex post facto* research design, is described as a research approach that aims to find a relationship between dependent and independent variables, after the event has already taken place (Salkind, 2010). Additionally, a basic characteristic of causal-comparative research study involves two or more groups and one independent variable: specifically, two or more groups on a single endogenous variable (Maheshwari, 2018). The causal-comparative research design is considered appropriate for this dissertation because the primary independent variable of interest is the successful completion of at least one dual credit CTE course during high school and there are four separate groups of students included in the analysis. Since the data consists of students that have already graduated in the year 2022, the requirement that the event should have already occurred is also valid and therefore any analysis using that data will by default be, *ex post facto*.

For this research, the relationship between the student's graduating GPA and the courses they have taken were examined; specifically noting the presence or absence of dual credit CTE courses within their course transcript. In accordance with the characteristics of causal-comparative research, the population of students were naturally divided into four peer groups prior to examining the course and GPA relationship. These peer groups include students who have been identified and receive SPED, students who have been identified and receive GT services, students who have been identified and receive ELL services, and lastly the rest of the student population that was not included in the three previous student populations. By examining these peer groups separately, the study was able to support the relationship between the student's

graduating GPA and the courses they have taken, minimizing potential impact from learning abilities or disabilities.

Significance of the Study

Since the passage of the Smith-Hughes Act of 1917, which began the federal funding of vocational education, now known as career and technical education, CTE has been an integral part of secondary education in public schools. Substantial money is spent on dual credit CTE each school year on students pursuing a career pathway. The dual credit tuition owed to the higher education partnering institution is often paid for by the local school district through federal or local funds, thus offering an enhanced secondary education for the students at no direct cost to the student.

As stated above, literature has found a direct correlation between students who participate in a CTE program and increased academic outcomes (Texas Workforce Investment Council, 2018). A gap in current research exists as no studies could be found specifically examining the relationship between dual credit CTE courses and the graduating GPA for high school students. Administrators of school districts could really benefit from identifying whether persuading high school students could potentially improve their academic performances because of the higher rigor required in the dual credit CTE classes, which could result in spillover positive impacts on the overall institution as well. This dissertation aims to fill this gap of identifying the specific benefits of dual credit CTE coursework on graduating GPAs of individual students and to help administrators of school districts to make more specific choices in encouraging higher participation in dual credit CTE courses offered at public schools in Texas.

Definitions

To ensure understanding and clarity, the following terms are defined as they are integral to the research.

- Career and technical education. A broad term for education that combines academic and technical skills with the knowledge and training needed to succeed in today's labor market (Flynn, 2021)
- Dual credit. A system in which an eligible high school student enrolls in college course(s) and receives credit for the course(s) from both the college and high school (Texas Education Agency, 2020b)
- Gifted and talented student. A student who performs—or has the capability to perform—at higher levels compared to others of the same age, experience, and environment in one or more domains (National Association for Gifted Children, n.d.).
- Grade-Point average. A number representing the average value of the accumulated final grades earned in courses over time (Edglossary, 2013)
- Middle skills. Jobs requiring additional training after high school, but not a 4 year college degree (Texas Workforce Commission, 2021)
- Special education student. A student who differs socially, mentally, or physically from the average student to such an extent that they require modifications of usual school practices (Britannica, 2013)

Limitations and Delimitations of the Study

The research study was limited to a single metropolitan area public school district in Texas for students who graduated in May 2021 and May 2022. This research was also limited to a single dependent variable and was limited to four specific student peer groups.

The research was limited to a single metropolitan area public school district due to convenience and also satisfied the requirements of the research by providing a significant population of students representing the diversity of public schools.

Additionally, this study was limited to four specific student peer groups in an effort to minimize the influence of a student's learning ability or disability on the student's academic success. The four peer groups evaluated were (a) students who had been identified and received SPED services, (b) students who had been identified and received GT services, (c) students who had been identified and received ELL services, and lastly (d) the rest of the student population that was not included in the three previous student populations. Additional peer groups to consider for future research are students identified as *504 recipients* and students identified as *at risk*.

This research has a number of limitations including course dynamics such as classroom, facility, and instructor. An additional limitation includes student coding integrity in the data. Another limitation of this research includes course dynamics since the ability to establish a cohesive and uniform classroom setting with a single instructor for testing purposes would be near-impossible to achieve across the various schools, teachers, and school districts under consideration. The students were taught by multiple instructors that likely had varying teaching styles in numerous classrooms and multiple facilities.

Student coding in the data was a limitation as well. It is reasonable to believe student peer group identification has a margin of error. Student identification is a process with many variables and is not definitive. Thus, it is reasonable to believe that students could have been misidentified placing them in an incorrect peer group at the school or the school district levels.

Selection Bias should also be considered a limitation of this study. Selection bias can occur when the selections of individuals or groups to study are not randomized (Clancy, 2019). According to The World Bank (n.d.), the only sure way to avoid selection bias is to conduct a study such as this utilizing a randomized control trial in which the control group and the treatment group are equivalent in observed and unobserved characteristics. The randomized control trial method was not possible for this study.

Summary

Again, CTE has far reaching consequences, academically and economically. With continued federal and state support, including the most recent federal funding as a result of the Strengthening Career and Technical Education for the 21st Century Act of 2018 and state support through Texas Senate Bill 346 (2021) expanding eligibility of awarding grants to include open-enrollment charter schools offering dual credit courses to the school's students, it is evident that CTE and dual credit education has strong support for existence and growth. With a significant gap in research, school administrators are left without knowledge regarding the relationship of dual credit CTE courses and its impact on the student's academic performance. This research aims to fulfill this knowledge gap by exploring the relationship between students who complete dual credit CTE courses, and their graduating GPA as compared to their peers. This known relationship will better equip administrators to encourage student to pursue rigorous dual credit CTE course rather than on-level alternatives resulting in higher academic achievement.

Chapter 2. Literature Review

The intent of this study is to analyze whether the impact of dual credit CTE classes goes beyond the classes and plays a role in improving the overall academic performance of students who enroll in these classes. Limited research has been conducted on dual credit CTE courses, none of which could be identified as being conducted using peer groups nor could research be found regarding the examination of the relationship of dual credit CTE coursework on graduating GPAs of individual students. This chapter focuses on literature relevant to this dissertation by establishing the significance of CTE courses within the education system and examines existing research within the CTE areas of study. The relevant research and literature are organized into five major sections. These sections include Federal Education Policy and Key Elements, Federal and State Policies Impact on Texas, CTE in Texas Today, Existing CTE Research, and Conclusions from the research and literature review.

Federal Education Policy and Key Elements

Though not provided for in the U.S. Constitution, education and specifically career and technical education, has long been seen as a national area of interest and has been a topic of federal legislation beginning with the Morrill Act in 1862 which established land-grant colleges with the intent to prepare people for the *agricultural and mechanical arts* (Gordon & Shultz, 2020). In the 20th century, the Smith-Hughes Act of 1917 is considered the first vocational education act and provided for separation of vocational programs from the academic programs (Gordon & Shultz, 2020). Repealed in July 1997, the Smith-Hughes Act of 1917 was instituted in response to the superior vocational preparations displayed by the Germans during World War I. This act was an effort to educate students within the United States with a focus on vocational education as a separate and deliberate effort from academic education (Hillison, 1994).

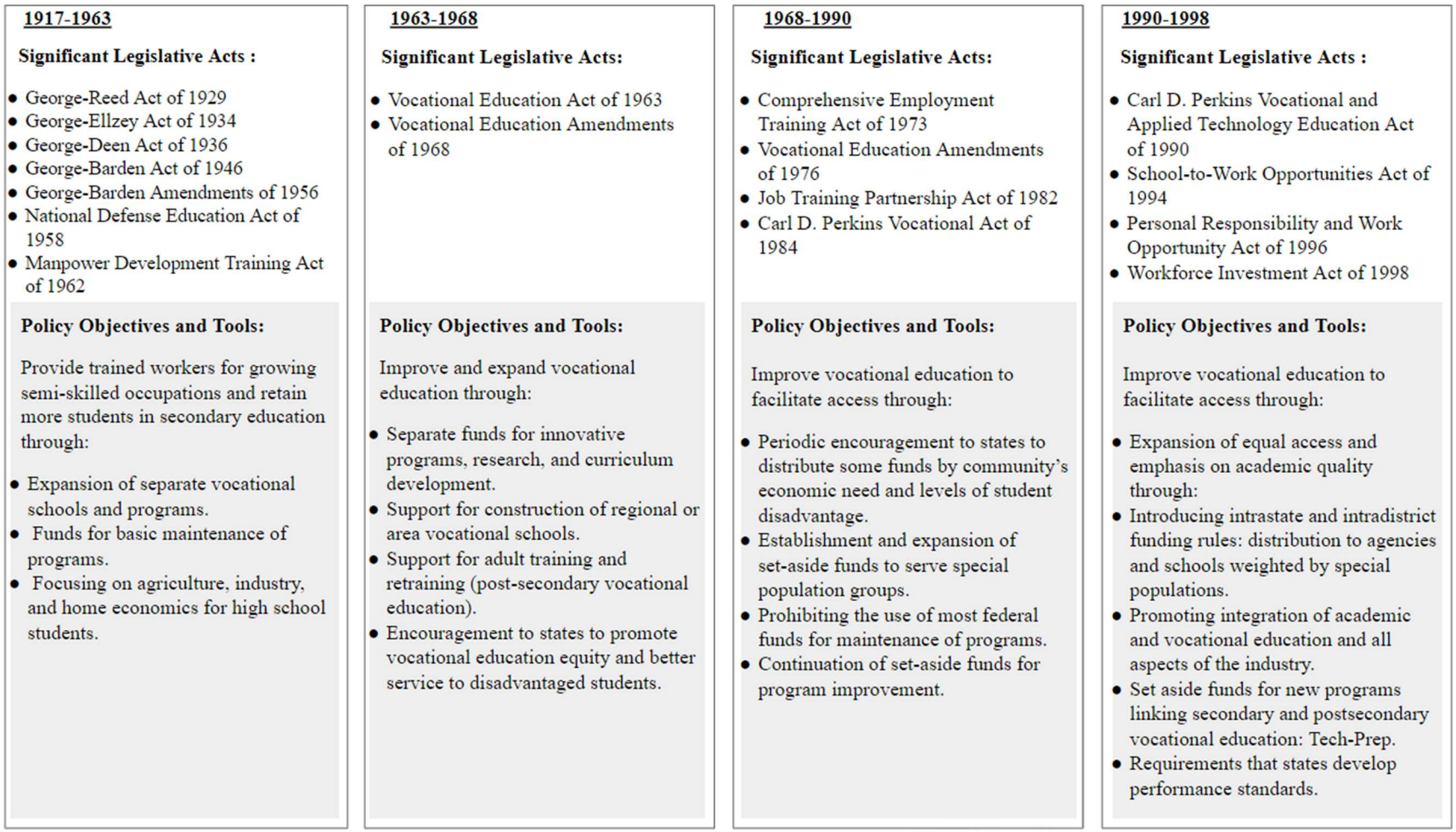
Prior to the National Defense Educational Act of 1958, the only federal funding for education was specifically for vocational education. As such, federal legislation has been the primary unifying force for career and technical education in the United States (Gordon & Shultz, 2020). Figure 1 provides a brief overview of federal vocational legislation from 1917 through 1998. The figure was adapted from the *National Assessment of Vocational Education Final Report to Congress* as required by the U.S. Department of Education to fulfill the program evaluation requirements demanded by the Perkins III legislative act.

Career and technical education federal legislature remained unchanged from 1998 with the passage of the Carl D. Perkins Vocational and Technical Education Act of 1998, Perkins III, until the passage of the Carl D. Perkins Career and Technical Improvement Act of 2006, Perkins IV. In addition to replacing the term *vocational education* with *career and technical education*, another key requirement of the Carl D. Perkins Career and Technical Improvement Act of 2006 that is prevalent and impactful to students today is the requirement to establish Programs of Study. A Program of Study is a nonduplicative sequences of secondary and postsecondary courses that lead to an industry recognized credential (Congressional Research Service, 2016).

On July 21, 2018, the most recent federal legislative act, Strengthening Career and Technical Education for the 21st Century, was signed into law by President Trump. This act is also known as Perkins V. The most notable change required by this legislature is the requirement for a comprehensive local needs assessment that includes examination of student performance, local labor market needs, educator development, and special population's access to programs (Gordon & Shultz, 2020). Re-assessment must take place every 2 years. Additionally, funds provided under this act can now be used for career exploration in younger student populations, namely in 5th-8th grade.

Figure 1

Timeline of Previous Federal Vocational Education Legislation



Note. Adapted from *National Assessment of Vocational Education Final Report to Congress*, by U.S. Department of Education, 2004. (https://www2.ed.gov/rschstat/eval/sectech/nave/navefinal.pdf). In the public domain.

Examination of the progression of vocational education in America from the Morrill Act in 1862, to the Smith-Hughes Act of 1917, and the sequence of Carl D. Perkins Acts from 1984 to 2018, Perkins through Perkins V, it is evident the impact of federal policies on career and technical education. Federal funding for career and technical education existed decades prior to federal funding for academic education. Career and technical education is a corner stone in America's education.

Federal and State Policies Impact on Texas

Since the early 20th century, Texas law makers have made career and technical education an important element woven into our culture and education system. The first vocational bill in Texas was passed in 1903 providing manual training and agriculture classes. Four years later, a legislative bill was passed in 1907 requiring that all rural schools with total enrollment of more than 300 students must require the teaching of agriculture as a part of the student's overall curriculum (Rich, 2021).

With the passage of the Smith-Hughes Act of 1917, the first federal dollars were provided for career and technical education in Texas. These funds were required to be match by state funding to pay the salaries of the vocational educators since a significant requirement of the Smith-Hughes Act was the separation of vocational education from academic education. In the years since, Texas became well versed in vocational education and by 1948 had one of the largest career and technical education programs in America (Rich, 2021).

Texas has continued to be a powerhouse for career and technical education. Throughout the years, the Texas legislature has made numerous efforts to bolster vocational education including the creation of the Governor's Conference on Technical Vocational Education in 1973

and the Advisory Council for Technical-Vocational Education in 1986 which called for integration of academic and computer literacy with attention to career awareness (Rich, 2021).

Between 1987 and 1991, Texas saw a decrease in voluntary vocational enrollment as did many other states (Boesel et al.,1994). In an effort to maintain staffing, school administrators often times placed students who were not interested but easily persuaded into vocational education courses as a way of filling the classrooms and preserving the vocational staff (Boesel et al.,1994). Although overall participation in vocational education declined during this brief time period, the population of students who were disabled, special needs, limited English proficient, and economically disadvantaged increased in the vocational programs. This practice became known as *dumping* and as enrollment of students of color and those identified as low-income continued into CTE programs the term *tracking* was used (Giani, 2019b). This practice gave vocational education an image of inferiority (Giani, 2019b).

With the passage of the Carl D. Perkins Vocational and Applied Technology Education Act of 1990, Perkins II, vocational education in Texas underwent a transformation. The formation of Tech Prep programs in 1990 gave way for a new image for career and technical education. The Tech Prep program was established as an important school-to-work transition strategy incorporating secondary and post-secondary education prior to the student entering the workforce (U.S. Department of Education, 2014). With attention towards post-secondary vocational education, the Perkins II Act expanded the population of students interested and the numbers of student served in vocational education began to increase once more (Giani, 2019b).

In response to the passage of the Carl D. Perkins Career and Technical Improvement Act of 2006, *Perkins IV*, signed into law by President George W. Bush on August 12, 2006, Texas Education Agency has been hard at work reforming its approach to career and technical

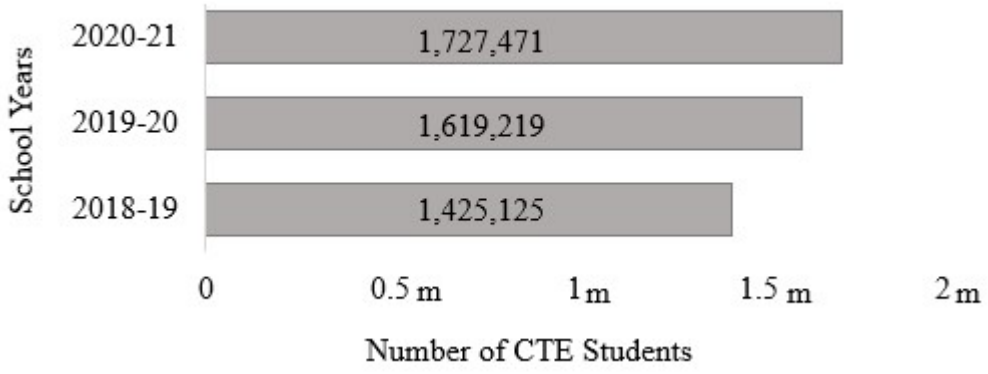
education (Giani, 2019a). Giani emphasizes that the most significant changes in Texas regarding CTE occurred between 2009 and 2010 when the Tech Prep programs required by the passage of Perkins II began to phase out in an effort to replace these programs with CTE Programs of Study as required by Perkins IV.

The passage of the Strengthening Career and Technical Education for the 21st Century in July of 2018, *Perkins V*, brought great demand for career in technical education in Texas increasing the population served over 21% from 2018 to 2021 as shown in Figure 2 (Perkins Collaborative Resource Network, 2022).

Texas law makers have been steadfast in the support and funding for Texans pursuing vocational education. In 2021 alone, Texas law makers passed eleven pieces of legislation directly related to career and technical education, Table 1. These laws reflect Texas' commitment to a robust and efficient CTE program that prepares the students for fruitful employment or continued academic success in post-secondary education upon high school graduation.

Figure 2

Participation in Career and Technical Education in Texas



Note. Adapted from *State Profiles*, by Perkins Collaborative Resource Network, 2022. (https://cte.ed.gov/profiles/texas). In the public domain.

In September 2022, the Texas Education Agency updated the statewide programs of study frameworks including newly developed CTE innovative courses, Technology Application courses, and a newly revised list of industry-based certifications that are aligned to each program of study (Texas Education Agency, 2022a). As required by the passage of the Strengthening Career and Technical Education for the 21st Century, the Texas education agency is in the midst of conducting the 2022-2023 Comprehensive Local Needs Assessment. The outcome of this assessment will steer career and technical education in Texas for the next several years. (Texas Education Agency, 2022b)

CTE in Texas Today

The origins of career and technical education, formerly known as vocational education, in Texas dates back to the early 1900's. Since then, career and technical education has evolved from agrarian in nature to providing students with hi-tech education in preparations for living-wage careers in industry or further academic endeavors in post-secondary education.

A 2019 study conducted by the American Enterprise Institute sought to understand why students who concentrate in career and technical education may actually be more likely to go to college than otherwise equivalent students who do not (Giani, 2019b). The research posed three questions, (a) Have CTE programs become more rigorous? (b) Has the population of students who concentrate in CTE evolved? and (c) Who is the modern CTE student? (Giani, 2019b).

To answer these questions, data from more than 300,000 2016 high school graduates was obtained from the Texas Educational Research Center at the University of Texas at Austin. Significant to the outcome of the research, attention was given to the demographic characteristics and academic achievement of each student by the subject of CTE concentration rather than student population and CTE courses as a whole. The study resulted in four key findings, (a) CTE

Table 1

Advance CTE 2021 State Policy Tracker—Texas

Bill #	Date Passed	Description
H.B. 773	May 28, 2021	H.B. 773 expands indicators for scoring districts' annual performance rating, in which districts are assigned a letter grade, to include high school students who successfully complete a program of study in a CTE program as an allowable indicator.
H.B. 572	June 14, 2021	H.B. 572 directs the Texas Education Agency to conduct a study on the implementation of competency-based educational programs, including funding models, performance assessment, and the inclusion of non-traditional learners. The agency must report findings to the Legislature by December 1, 2022.
H.B. 3938	June 15, 2021	H.B. 3938 establishes the industry-based certification advisory council to advise the Texas Workforce Commission on the alignment of K-12 CTE programs with current and future workforce needs. The council consists of nine members, appointed by the governor, lieutenant governor and speaker of the House. The members represent industry, public secondary CTE programs and public postsecondary education, and each member serves a 4 year term. The council is also directed to develop, maintain and disseminate an inventory of industry-recognized credentials.
H.B. 3767	June 18, 2021	H.B. 3767 establishes a Tri-Agency Workforce Initiative to coordinate information among the Texas Education Agency, the Texas Higher Education Coordinating Board and the Texas Workforce Commission. The purpose of this initiative is to ensure that state and federal education and workforce funds are coordinated among agencies to achieve state workforce development goals, align CTE programs to industry demand, and identify outcomes of CTE programs related to state workforce development goals. The law also requires a data sharing policy, coordination of staff and resources, and quarterly meetings among the agencies. In addition, the initiative will create publicly accessible tools for education and workforce data, approved credentials, and career exploration and development resources.
H.B. 1525	June 16, 2021	H.B. 1525 changes full-time equivalency allotments for students enrolled in CTE courses based on the level and number of courses the student is enrolled in. The law also changes definitions of approved career and technical education program and approved program of study and requires that the Texas Education Agency annually publish a list of CTE courses that qualify for allotment.

Bill #	Date Passed	Description
H.B. 1247	June 15, 2021	H.B. 1247 directs the Texas Workforce Commission, the Texas Education Agency and the Texas Higher Education Coordinating Board to jointly develop a coordinated strategic work-based learning framework across agencies. This framework, including common definitions and standards, alignment of programs across agencies, partnership and engagement strategies for workforce and postsecondary partners and other opportunities for regional collaboration, strategies for data identification and collection, potential training models, and recommendations for coordination of funds or grant opportunities, will be presented as a report no later than December 31, 2022.
S.B. 788	May 24, 2021	S.B. 788 directs the Texas Education Agency, the Texas Higher Education Coordinating Board and the Texas Workforce Commission to develop model data sharing agreements for public schools, institutions of higher education, and state and local workforce entities to reciprocally share information for system evaluation and improvement.
S.B. 1277	May 30, 2021	S.B. 1277 requires that school districts provide academic advising to learners who enroll in a dual enrollment course before the learner begins the course.
S.B. 1677	June 7, 2021	S.B. 1677 gives the Texas Higher Education Coordinating Board the authority to eliminate data collection or reporting requirements for institutions of higher education if the commissioner of higher education determines the board has access to an alternative method for collecting that data.
S.B. 1095	June 14, 2021	S.B. 1095 directs school districts to notify each parent of a student in ninth grade or above about the availability of CTE or other work-based education programs in the district, including internships, externships or apprenticeship programs.
S.B. 1102	June 14, 2021	S.B. 1102 establishes the Texas Reskilling and Upskilling through Education (TRUE) program using funding from the Governor's Emergency Education Relief fund. This program awards grants to an eligible agency, such as a junior college, technical institute or local chamber of commerce, to create, redesign or expand training programs that lead to industry-recognized credentials and create pathways to employment for learners in accordance with local workforce needs. This law also directs the Texas Higher Education Coordinating Board to work with the Texas Workforce Commission and employers to identify postsecondary industry certifications or workforce credentials in high-demand occupations.

Note. Adapted from *State Policies Impacting CTE: 2021 Year in Review*, by Advance CTE and Association for Career & Technical Education, 2021. (https://www.acteonline.org/wp-content/uploads/2022/02/2021YIR_AdvanceCTE_ACTE.pdf). In the public domain.

course taking is widespread, (b) CTE is highly regional, (c) There is limited tracking into CTE, and (d) While there is limited tracking into CTE, there is evidence of tracking within CTE.

The study found that nearly all high schools students completed at least one CTE course with approximately 75% earning at least three CTE credits. Of these 75%, approximately 30% earned their credits in a single program of study while the remaining 45% earned their CTE credits in two or more programs of study. The research also found that concentration within a single program of study varied greatly by geographic classification. Students in rural communities earned more CTE credits focused on a single program of study whilst students in metropolitan areas preferred to concentrate in areas such as science, technology, engineering or mathematics.

With regards to *tracking* students into CTE programs, the data did not support this practice that was once prevalent in the late 1980's to early 1990's. All racial and ethnic groups were shown to participate in CTE programs of study at equivalent rates with White students having the highest percentage to concentrate in a single program of study. There was a marginal difference when considering low-income and non-low-income students; low-income students were slightly more likely to concentrate in a single program of study compared to non-low-income students. Within the CTE programs of study, males were more apt to concentrate in male dominated fields such as manufacturing and construction while females had a greater presence in programs of study such as healthcare and education, a resemblance of the gendered workplace. When considering ethnicity, the study found that Hispanic students enrolled in more of the hands-on careers such as manufacturing and construction compared to the Asian population that had highest enrollments in STEM, finance, and healthcare.

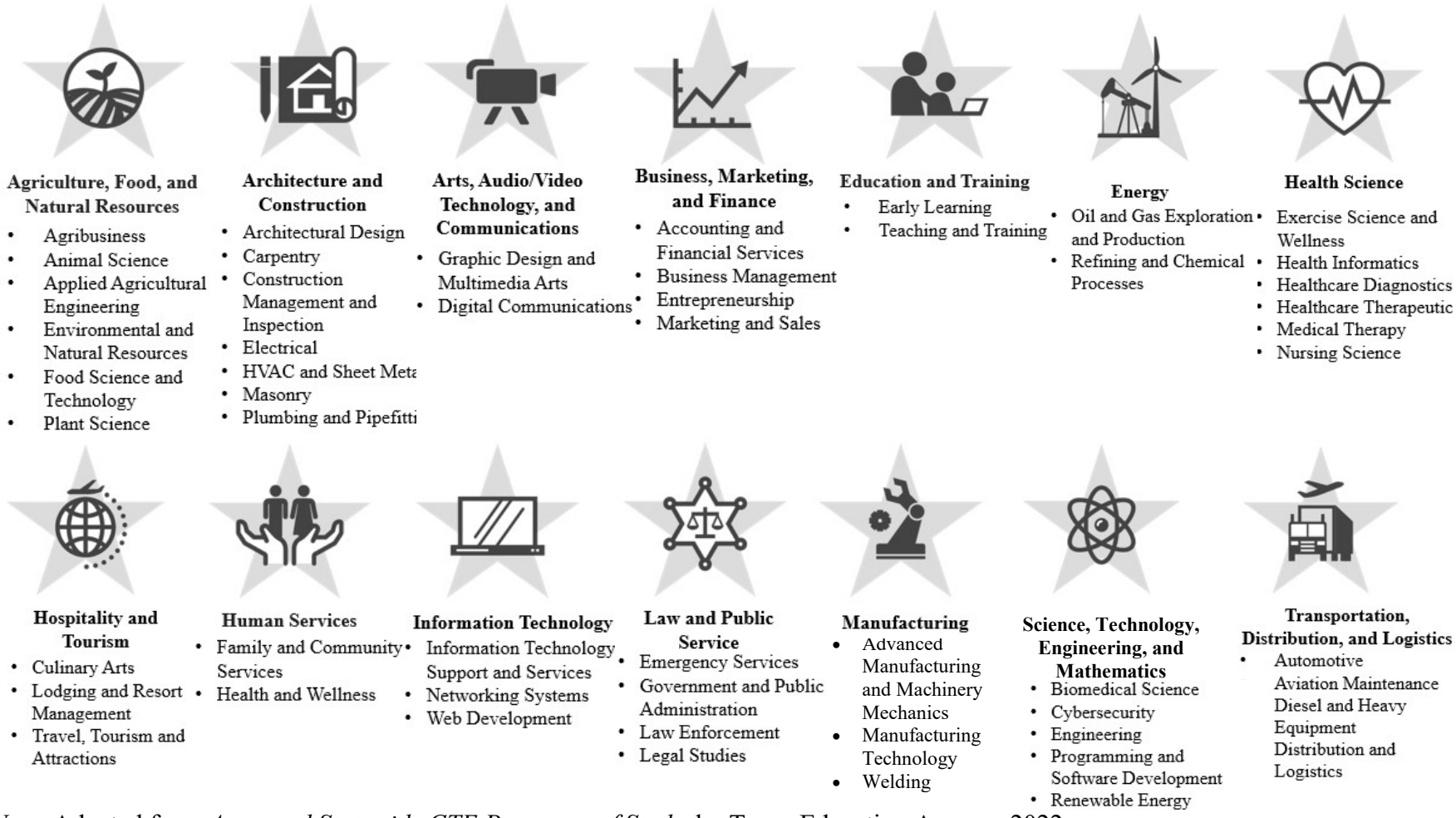
In conclusion, the study determined that two possible reasons have contributed to the fact that students who concentrate in career and technical education are more likely to go to college than otherwise equivalent students who do not. Reasons noted, (a) CTE programs have become more rigorous and prepare students for post-secondary education and (b) the improved CTE programs and focused programs of study have attracted a diversified population, both of which are desired outcome from the passage of Perkins Act II, III, and IV.

Today, the Texas Education Agency offers CTE programs of study that are rigorous and relevant, attracting diverse student populations and enhancing student success. The Texas Education Agency (2022a) has defined 14 career clusters that support 53 programs of study as shown in Figure 3. Each region and subsequent school district in Texas determine the best career clusters and programs of study to offer for their area. Some programs of study may be high school credit only, while others are dual credit.

Dallas ISD offers 26 unique pathways disseminated across 18 of the district campuses that are designated at Pathways in Technology Early College High School campuses or P-TECH campuses as shown in Table 2 (Dallas ISD, n.d.-b). The TEA describes P-TECH campuses as "innovative open-enrollment high schools that allow students least likely to attend college an opportunity to receive both a high school diploma and a credential and/or an associate degree. The hallmark of the P-TECH model is its career focus and the provision of work-based education". The P-TECH model allows students to earn both core dual credits and CTE dual credits. Dual credit opportunities are made possible to Dallas ISD students by a partnership between Dallas ISD and two post-secondary education institutions, Dallas College and University of North Texas-Dallas.

Figure 3

Approved Statewide Programs of Study in Texas



Note. Adapted from *Approved Statewide CTE Programs of Study*, by Texas Education Agency, 2022a. (https://tea.texas.gov/academics/college-career-and-military-prep/career-and-technical-education/approved-statewide-cte-programs-of-study). In the public domain.

In Texas, the Perkins Collaborative Resource Network (2022) reports in the 2019-2020 school year there were 1,807,780 secondary CTE participants with approximately 45%, or 826,786 students, identified as CTE concentrators. A CTE concentrator is a student who has completed at least two courses in the same CTE pathway (Perkins Collaborative Resource Network, 2022). Additionally, the Perkins Collaborative Resource Network (2022) reports of the 14 possible career clusters, four career clusters account for approximately 74% of the CTE concentrator enrollment shown in Figure 4. These career clusters include (a) Health Science, (b) Arts, Audio/Video Technology, and Communications, (c) Business, Marketing, and Finance, and (d) Agriculture, Food, and Natural Resources.

Career and technical education has expanded in depth and rigor to include many dual credit programs of study. The Texas Workforce Commission has partnered with community colleges, state universities, and technical colleges along with the school districts across Texas to expand dual credit technical education programs in an effort to respond to industry demands for skilled workers (Texas Workforce Commission, 2022). The Texas Workforce Commission 2021 Annual Report discloses that 30% of the middle skills jobs in Texas are filled by workers who are inadequately skilled. With the education partnerships, the Texas Workforce Commission is able to lessen these skill gaps with the CTE program participants and strengthening the Texas economy.

To ensure students enrolled in dual credit instruction in Texas receive the same academic level of post-secondary instruction a standard college student would receive, the Texas Administrative Code outlines *dual credit Requirements* in rule 4.85. The Texas Administrative Code (2019) establishes three key requirements to ensure academic rigor and integrity of dual credit education; (a) dual credit instructors must meet the same requirements, including minimal

Table 2

Dallas ISD Pathways by P-TECH Campus

Dallas ISD High School	Higher Education Partner	Pathway
Bryan Adams High School	Dallas College Eastfield Campus	• Criminal Justice • Early Childhood Education
David W. Carter High School	Dallas College Cedar Valley Campus	• Business • Criminal Justice • Network Administration and Support
W.H. Adamson High School	Dallas College El Centro Campus	• Internet Development Technology • Personal Computer Support
Dr. Emmett J. Conrad High School	Dallas College Richland Campus	• Allied Health • Game Design • Network Administration and Support • Software Programming
Hillcrest High School	Dallas College Richland Campus	• Pre-Electrical Engineering • Electrical Engineering Technology
Thomas Jefferson High School	Dallas College Brookhaven Campus	• Business Administration • Software Programming • Visual Communications
Justin F. Kimball High School	Dallas College Mountain View Campus	• Electronics Technology with Advanced Manufacturing Mechatronics

Dallas ISD High School	Higher Education Partner	Pathway
Lincoln and Humanities/Communications Magnet High School	Dallas College El Centro Campus and UNT-Dallas	• Early Childhood Education • Hospitality Management
James Madison High School	Dallas College El Centro Campus	• Management • Personal Computer Support • Sports Management
Moises E. Molina High School	Dallas College Mountain View Campus	• Business Administration • Business
North Dallas High School	Dallas College Brookhaven Campus	• EMT Program • Software Programming
L.G. Pinkston High School	Dallas College El Centro Campus	• Allied Health • Management • Network Administration and Support
Franklin D. Roosevelt High School	Dallas College El Centro Campus	• Allied Health • Business Management • Internet Development Technology
Seagoville High School	Dallas College Eastfield Campus	• Business Administration • Personal Computer Support
South Oak Cliff High School	Dallas College Mountain View Campus	• Electronic Technology • Network Administration and Support
Sunset High School	Dallas College Mountain View Campus and UNT-Dallas	• Criminal Justice • Early Childhood Education • Public Health

Dallas ISD High School	Higher Education Partner	Pathway
W.T. White High School	Dallas College Brookhaven Campus	• Business/Accounting • Dance Education • Early Childhood Education
Wilmer-Hutchins High School	Dallas College North Lake Campus	• Construction Technology • Dance Education • Energy Management • Music Education

Note. Adapted from *P-TECH and Early College High Schools/Collegiate Academies*, by Dallas ISD, n.d.-c (https://www.dallasisd.org/Page/41445). In the public domain.

Figure 4

CTE Concentrator Career Cluster Enrollment

Note. Top four career clusters as identified by CTE concentrator enrollment in Texas in 2019-2020

requirements of the Southern Association of Colleges and Schools Commission on Colleges, used by the college to select faculty responsible for teaching the same courses at the main campus of the college, (b) dual credit instructors must be evaluated and supervised in the same manner as faculty at the main campus of the college, and (c) dual credit courses must have

equivalent curriculum, materials, instruction, and academic rigor for student evaluation as the matching course offered at the main campus of the college.

Existing CTE Research

With the significance of CTE and dual credit education, there is an ever-growing sea of knowledge. From high school achievement to college readiness, to post-secondary enrollment and completion. Many of these topics have been examined through various lenses including gender, ethnicity, socio-economic status, and geographic location.

High School Achievement

Research shows that career and technical education has a positive impact on high school graduation rates (Bennett, 2016; Dougherty, 2016; The University of Wisconsin Population Health Institute, 2022; U.S. Department of Education, 2019). Dougherty (2016) followed three cohorts of students in Arkansas at a critical time in the state's history as the legislature had recently revamped their CTE programs of study to align with the local labor market. The cohorts combined consisted of more than 100,000 students and the study followed the cohorts from 8th grade, through high school, and into post-secondary education and/or the workforce. The study sought to answer the following three questions, (a) Which students are taking CTE courses? Which courses-and how many of them-are they taking? (b) Does greater exposure to CTE improve education and employment outcomes (high school graduation, college enrollment, employment status, and wages)? and (c) Does CTE "concentration" (taking a sequence of three or more courses in an occupationally aligned "program of study") have benefits for students? Do certain students benefit more than others?

Specific to high school graduation, the Dougherty (2016) revealed two key findings: (a) the student's education and labor market outcomes increased with the increase in completed CTE

courses and (b) students who concentrated in a specific CTE program of study saw an increase in high school graduation rate as well as other benefits. The study found that students taking one additional CTE course above the average increases the student's likelihood to earn a high school diploma by over 3%. Even more impactful, CTE concentrators were 21% more likely to earn a high school diploma than their non-CTE counterparts. Additionally, the study found that students who earn high school credit through dual credit CTE enrollment were twice as likely as their high school credit only peers to enroll in a 2 year post-secondary institution. The study noted that each of these differences were statistically significant (Dougherty, 2016).

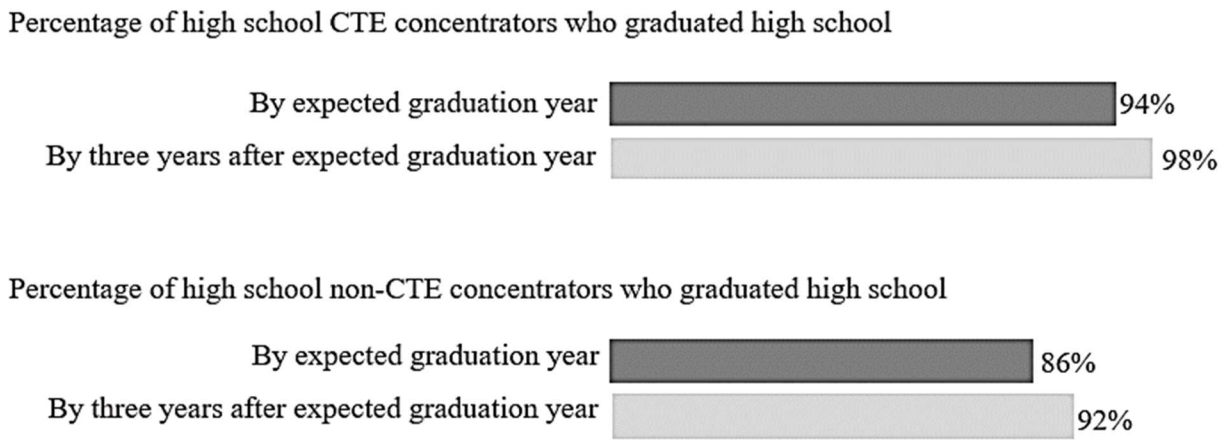
Bennett (2016) confirms the Dougherty (2016) results. The Bennett (2016) study extracted data from the Kentucky Department of Education's Technical Education Data system to analyze graduation rates from the 2012-2013 school year pertaining to CTE students who participated in CTE programs in one of the 53 Area Technology Centers compared to those in the general Kentucky public school system. The research found the CTE students had a graduation mean of 97.61% compared to the general school system of 86.1% leading to the conclusion that CTE students that participate in CTE in Area Technology Centers in Kentucky have a higher graduation rate than students who did not by over 11% (Bennett 2016).

A September 2019 report from the U.S. Department of Education, highlighted the significance in high school graduation rates between students who were identified as CTE concentrators compared to their non-concentrator peers. In the United States, when considering graduation from high school in the students expected graduation year, a CTE concentrator student was 8% more likely to earn their high school diploma on time, Figure 5 (U.S. Department of Education, 2019).

The University of Wisconsin Population Health Institute (2022) expresses there is significant research that shows at-risk students who participate in CTE programs have increased high school graduation rates by as much as 16%. Additionally, these same at-risk students who participate in CTE programs have increased post-secondary enrollment, employment, and earnings (University of Wisconsin Population Health Institute, 2022). Regardless of geographic location, student indicators, or CTE program of study, the four research studies reviewed each have a consensus indicating CTE positively impacts high school graduation rates.

Figure 5

U.S. CTE Concentrator Graduation Rates



Note. Adapted from *Bridging the Skills Gap: Career and Technical Education in High School*, by U.S. Department of Education, 2019. (https://www2.ed.gov/datastory/cte/index.html) In the public domain.

College Readiness

For students who wish to pursue post-secondary education, college readiness matters (ACT Research and Policy, 2013). College ready students gain early momentum towards long-term college success and are more likely to complete a post-secondary degree (ACT Research and Policy, 2013). College readiness can be defined as students having a prescribed level of

preparedness to enroll and succeed in college without requiring academic remediation (Venezia & Jaeger, 2013). College readiness is often determined by scores on standardized exams such as ACT or SAT, class rank, courses taken, and graduating grade-point average (Wignall, 2020).

In 2007, the Office of Community College Research and Leadership at the University of Illinois at Urbana-Champaign conducted a study that examined students who participated in two specific and seemingly unrelated dual credit CTE programs of study in high school while earning, Information Technology/Computer Information Sciences or Emergency Medical Technology Basic/Paramedic (Bragg & Rudd, 2007). The Information Technology/Computer Information Sciences CTE programs were offered at 52 high schools and connected to a single comprehensive community college. The Emergency Medical Technology Basic/Paramedic CTE programs were offered by a large comprehensive community college serving multiple high schools within the designated five county region. The study found that in both CTE programs, participants developed superior problem-solving skills and notably higher scores on the Reading for Information subtest of the ACT WorkKeys National Career Readiness Certificate (NCRC). In contrast, no differences were found between the CTE students and the non-CTE students on the ACT Applied Mathematics sub-test. Additionally, the students in the computer related programs of study performed better than their non-CTE peers on the placement tests as administered by the community college.

Bae et al. (2007) examined two cohorts of students during their junior year in high school. The cohorts of students were both enrolled in CTE programs and were placed in the specific cohort group based on similarities in their 8th grade math proficiency scores. During the students' junior year in high school, students were administered a state-mandated proficiency test. The study found no statistically significant difference in the reading proficiency on the math

exam scores, but noted that in one of the cohorts, the CTE students performed lower than their non-CTE peers on the arithmetic section. Upon examination, it was determined that the CTE students did not take as many college-prep math classes as their non-CTE peers, thus could have impacted the students' performance on the standardized exam, not related to the CTE program of study specifically.

Evidence of a positive relationship between students who partake in CTE programs and increased test scores can be found in a 2012 qualitative study conducted by Blowe & Price (2012). This study examined 11th grade students from 131 school divisions in the Commonwealth of Virginia during the 2008-2009 and 2009-2010 school years. Upon completion of the school year, 11th grade student take end of year exams in reading and math. The study found that students who completed CTE programs earned significantly higher scores on the end of year math exam during both years examined. The CTE population had a mean passing rate nine percentage points higher than their non-CTE peers. Similar results were identified for students on the end of year English exam with CTE students scoring 7%–8% higher than their non-CTE peers. Additionally, graduation the rate for students who completed CTE programs was 96% for the years studied compared to 87% for student in the non-CTE group.

A study by Cothron (2019) sought to answer four research question related to college readiness, (a) If there was a statistically significant difference in graduation rates between students who completed a CTE program of study and those that did not, (b) If there was a statistically significant difference in ACT composite scores between students who completed a CTE program of study and those that did not, (c) If there was a statistically significant difference in the number of early postsecondary opportunity (EPSO) credits earned between students who completed a CTE program of study and those that did not; for clarity, EPSO include college

credit opportunities such as advance placement courses (AP) and dual credit classes, and (d) How did each group of participants, CTE and non-CTE, perceive their college and career readiness. The study participants included 1,553 twelfth-grade students that were selected from an urban Tennessee public school district. 597 of the participants were students in a CTE program of study while 956 students were not. The results of the study indicated that (a) indeed, CTE students did have statistically superior graduation rates than their non CTE peers, (b) no statistically significant difference was found when examining the ACT composite scores between the two groups of students, (c) no statistically significant difference was found when examining the number of EPSO credits earned between the CTE and non-CTE student groups, and (d) both groups specified the necessity and want for relevant course work, 85% of the CTE students felt the CTE course work was preparing them for college or career.

A recent study by Michaels and Barone (2020) found that CTE students scored roughly 4% higher than their non-CTE peers on the ACT composite score. The study examined the scores from 1,000 high school graduates, 500 students who participated in a CTE program of study and 500 who did not. These 1,000 students were randomly selected from a total population of 4,000 high school graduates from a large western school district with well-established CTE programs of studies. The 500 CTE students represented six programs of study including (a) agriculture and natural resources, (b) business and marketing education, (c) education, hospitality, and human resources, (d) health science and public safety, (e) information and media technologies, and (f) skilled and technical sciences. Michaels and Barone (2020) found that the 500 CTE students had a mean score of 19.98 out of 36 on the ACT composite score compared to their non-CTE peers who had a mean score of 18.53. In each of the five areas of assessment including English, math, reading, science, and writing, the CTE students outperformed their non-

CTE peers. Gender, ethnicity, and socio-economic information was not collected for use in this study.

Combined, the studies reviewed above provided mixed results regarding superior performance on standardized exams, as one indicator signaling college readiness. More importantly, in no instance thus far, did a study reveal that CTE proved a detriment to college readiness.

Post-Secondary Enrollment and Completion

Karp and Hugh (2008) sought to understand the impact of dual credit CTE on college enrollment and success using four questions to guide the research: (a) What are the short-term effects of participation in a dual enrollment program for CTE students as measured by high school graduation and college enrollment rates?; (b) What are the effects of participation in a dual enrollment program on CTE student's initial entry into post-secondary education?; (c) What are the long-term effects of participation in dual enrollment for CTE students as measured by their persistence into the second year of post-secondary education, grade-point average, and credit accumulation?; (d) Does the program effect vary by high school achievement, gender or socioeconomic status? Existing data from the state of Florida and New York City was used in the study. Karp and Hughes (2008) analyzed the student data and saw significantly statistical difference between dual credit CTE students and their non- dual credit CTE peers. When examining the student data, the study found that dual credit CTE students were more likely to graduate high school and to enroll in post-secondary education upon high school graduation. Additionally, it was found that these dual credit CTE students were also more likely to enroll full time in post-secondary education and 9% more likely to enroll in a 4 year higher education institution than their non- dual credit CTE peers. Longevity of the dual credit CTE student in

post-secondary education was also noted to be more likely than that of their non- dual credit CTE peers. In reference to academic performance, Karp and Hugh (2008) concluded that participants in dual credit CTE earned higher grades while attending post-secondary classes than the non-dual credit CTE peers and their grade-point averages were higher after one year of college and remained higher. Dual credit CTE students were also found to have earned more college credits than their non-dual credit peers when examined along their post-secondary educational journey. Thus, dual credit CTE students are more likely to graduate high school, enroll in college, stay in college, earn higher grades/GPA, and earn more college credits in a shorter period of time in pursuit of a post-secondary degree than their non-dual credit CTE peers (Karp & Hugh, 2008).

In a study focused on dual credit students transition to college, specific to the University of Texas (UT) college system, Troutman et al. (2018) found that dual credit students, as compared to non-dual credit students, were more likely to stay in and graduate from the UT college system. Additionally, these former dual credit students have higher GPAs and graduate with fewer semester hours compared to their non-dual credit peers (Troutman et al., 2018).

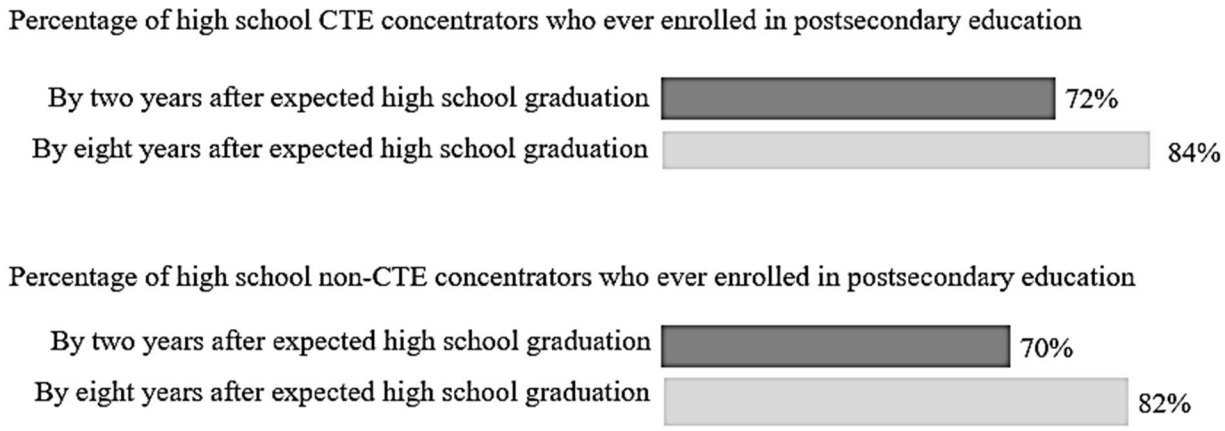
The U.S. Department of Education (2019) reports that nearly all public-school districts offered CTE programs to high school students with nearly 75% offering dual credit CTE. When examining CTE students, it is reported that CTE students enroll in post-secondary at higher rates that their non-CTE peers, nearly 2% higher within two years of high school graduation, Figure 6. (U.S. Department of Education, 2019).

Conclusions from the Literature Review

The literature documents the importance and relevance of career and technical education throughout American history (Gordon & Shultz, 2020; U.S. Department of Education, 2004). Beginning with the passage of the Smith-Hughes Act of 1917 to the passage of the Strengthening

Figure 6

U.S. CTE Concentrator Postsecondary Enrollment



Note. Adapted from *Bridging the Skills Gap: Career and Technical Education in High School*, by U.S. Department of Education, 2019. (https://www2.ed.gov/datastory/cte/index.html) In the public domain.

Career and Technical Education for the 21st Century in July of 2018, federal and state legislation continue to shape vocational education within our public-school systems. As of September 2022, the Texas Education Agency maintains 14 career clusters and 53 subsequent programs of study that support the growing Texas economy (Texas Education Agency, 2022a; Texas Workforce Commission, 2022).

The literature provides strong evidence between student success and the participation in career and technical education. An unwavering positive relationship was found between students who participated in CTE programs of study and increased high school graduation rate and subsequent post-secondary education enrollment (Bennett, 2016; Dougherty, 2016; The University of Wisconsin Population Health Institute, 2022; U.S. Department of Education, 2019). As a college readiness and post-secondary success model, CTE research has shown mixed results, none of which indicates CTE as a detriment (Bragg & Rudd, 2007; Bae et al. 2007;

Blowe & Price, 2012; Cothron, 2019; Karp & Hugh, 2008; Michaels & Barone, 2020; Troutman et al., 2018; U.S. Department of Education, 2019).

Chapter 3 details the current research study's approach and methodology used to understand the relationship between students who have earned dual credit CTE credits and the student's graduation GPA. Additionally, the independent and dependent variables are detailed, and statistical model explained.

Chapter 3. Data and Research Methodology

This chapter will cover the research design and methodology for this quantitative causal-comparative research study. The purpose of this study was to understand if students in Dallas ISD who earned education credits by successfully completing dual credit career and technical education classes while in high school graduated high school with a higher grade-point average compared to their peers. Four student peer groups were evaluated (a) students who had been identified and received SPED services, (b) students who had been identified and received GT services, (c) students who had been identified and received ELL services, and lastly (d) the rest of the student population that was not included in the three previous student populations.

This chapter is divided up into four primary sections including (a) Research Methodology, (b) Research Questions and Hypothesis, (c) Population, Sampling, and Data Collection, and (d) Statistical Method. This chapter closes with a comprehensive conclusion.

Research Methodology

A causal-comparative design was selected for this research project. Causal-comparative research design is described as research that looks to find a relationship between variables, independent and dependent, after the event has already taken place (Salkind, 2010). For this dissertation the relationship between student's GPA and the courses they had taken has been analyzed based upon the presence (or absence) of dual credit CTE courses in the student's transcript. The event under examination was May 2022 high school graduation, which had already occurred.

Martella et al. (2013) describes appropriate use of causal-comparative research when the researcher is looking to compare two or more groups from the same population that are different on a crucial variable, but otherwise comparable. Additionally, causal-comparative research

would be used to compare two or more groups on a crucial variable to detect changes over time (Martella et al., 2013). Fitting within the specified parameters, a casual-comparative research method is appropriate for this research. By understanding if the presence of dual credit CTE credits is related to an increased GPA average, school administrators will have critical information needed to aide them in establishing course offerings and guidance for their schools and students.

Research Questions and Hypothesis

This research aims to understand whether students who earned education credits by successfully completing dual credit career and technical education classes in high school in Dallas ISD graduated with a higher grade-point average compared to their peers. The primary hypothesis was that students who earned education credits by completing dual credit CTE classes are more likely to have a higher graduating GPA as compared to their counterparts. The corresponding null hypothesis would be that taking dual credit CTE classes had no impact on a student's overall graduating GPA. The following research questions will be analyzed:

R1. For the student population who have been Identified and receive SPED services, is there a significant relationship between the graduating GPA among students who completed at least one dual credit CTE course during high school and the graduating GPA of students who did not?

R2. For the student population who have been identified and receive GT services, is there a significant relationship between the graduation GPA among students who completed at least one dual credit CTE course during high school and the graduating GPA of students who did not.

R3. For the student population who have been identified and receive ELL services, is there a significant relationship between the graduation GPA among students who completed at least one dual credit CTE course during high school and the graduating GPA of students who did not.

R4. For the student population that is not included in the three previous student populations (identified in R1, R2, and R3), is there a significant relationship between the graduation GPA among students who completed at least one dual credit CTE course during high school and the graduating GPA of students who did not.

From the investigations of the research questions, the study will test the following hypothesis:

H1. Students who earned education credits by completing dual credit CTE classes are likely to have a higher graduating GPA as compared to their counterparts.

Population, Sampling, and Data Collection

The population for this study consisted of May 2021 and May 2022 high school graduates from Dallas Independent School District in Dallas, Texas. Dallas ISD was used in this study due to the diversity and depth of the available data and the ease of data access. Dallas ISD provided the research data in response to an open records request. Dallas ISD serves a student population of approximately 153,861 students (Dallas ISD, n.d-a). The study included data from high school graduates who have earned education credits by successfully completing dual credit CTE classes and those who did not and who took traditional high school classes. Data from a total of 16,043 high school students was obtained.

This research study examined the relationship between GPAs of students in Dallas ISD who earned education credits by successfully completing dual credit CTE classes while in high school and students who took traditional classes. The dependent variable (DV) was the student's

GPA upon high school graduation. This was a numeric value ranging from 2.35-3.98. The primary independent variable (IV) was the student's CTE dual credit education credits. The primary IV was a numerical value ranging between 0-13 in .5 increments. Other independent variables include student classification (identifying GT/SPED or non-GT/non-SPED students), ELL identified students, gender, ethnicity, and disruption (COVID disruption explained by graduation year) are represented by categorical values. As described, Table 3 displays the research variables and explanations. Additionally, Table 4 displays the summary statistics for each variable.

Table 3

Research Variable Explanation

Variable	Description
Independent Variables	
cte	number of dual credit CTE credits earned
classi	=0 if student was SPED, =1 if student was not SPED or GT, =2 if student was GT
ell	=1 if student was identified as an ELL, 0 otherwise
male	=1 if the student was identified as male, 0 otherwise
hispanic	=1 if the student was identified as Hispanic, 0 otherwise
disruption	=1 if the student graduated in a year disrupted by COVID, 0 otherwise
Dependent Variable	
gpa	student's earned grade-point average upon high school graduation

For statistical computation, this study utilized the multivariate linear regression model. In a multivariate linear regression model, the coefficients and p-values for the coefficient enabled the researcher to determine if the earned dual credit education credits were statistically

Table 4

Variable Summary Statistics

Variables	Obs	Mean	Std. Dev	Min	Max
gpa (DV)	16,043	3.37	0.24	2.35	3.98
cte (IV)	16,043	1.01	2.13	0	13
classi (IV)	16,043	1.11	0.50	0	2
ell (IV)	16,043	0.31	0.46	0	1
male (IV)	16,043	0.47	0.50	0	1
hispanic (IV)	16,043	0.71	0.45	0	1
disruption (IV)	16,043	0.49	0.50	0	1

Statistical Method

significant in relation to the student's graduating GPA. The multivariate linear regression equation for this analysis was:

$$GPA_i = \beta_0 + \beta_1 cte_{i1} + \beta_2 classi_{i2} + \beta_3 ell_{i3} + \beta_4 male_{i4} + \beta_5 hispanic_{i5} + \beta_6 disruption_{i6} + \in_i$$

Where GPA is the dependent variable and *i* represents the number of observations. β_0 is the vertical intercept and β_1 through β_6 represents the regression coefficients of the corresponding independent variables. $\in$ is the model error.

Utilizing STATA, a multivariate linear regression function was performed on the dataset yielding the regression coefficients and associated p-values for each of the independent variables. If the calculated p-value was less than the significance level, the researcher would reject the null hypothesis (H_o) and would accept the alternative hypotheses (H_1) stating that students who earned education credits by completing dual credit CTE classes did have a higher GPA compared to those students that did not.

Other statistical computations such as one-tailed test (t-test) or one-way analysis of variance (ANOVA) were considered. The disadvantage of utilizing the t-test for statistically testing the hypotheses is the likelihood of a Type-1 error. The ANOVA computation controls for

these errors providing a greater level of confidence but is best used with a large dataset and must include two distinct groups. As the dataset available for this research was limited and the specified classification of GT and non-GT, SPED and non-SPED, and ELL and non-ELL students are not independent groups, the ANOVA computation, though a better choice than the t-test, was also ruled out in favor of the multivariate linear regression computation.

Upon completion of the multivariate linear regression model, post-estimation analysis of regression is important. Post-estimation analysis can be used to test underlying assumptions, analyze residuals, make predictions, and can be used to identify issues that may skew the model (Whiting, 2019). Additionally, post-estimation analysis can be utilized to test the model's robustness (Whiting, 2019). For this research, post-estimation analysis included testing for heteroskedasticity, skewness, kurtosis, and multicollinearity. Given the number of categorical variables, a Chi-square test was conducted to test the hypotheses. Chi-square tests allow the researcher to determined statistical significance when comparing observed and expected frequencies (Beals et al., 1999). The post-estimation analysis for this research is covered in detail in Chapter 4.

Conclusion

From as early as 1917 with the passage of the Smith-Hughes Act, special attention has been given to CTE in secondary schools. Existing literature has found a direct correlation between students who participate in a CTE program and increased academic outcomes (Texas Workforce Investment Council, 2018). This study applied a causal-comparative design utilizing the multivariate linear regression model to analyze student data and expand the body of knowledge around CTE and academic outcomes. Specifically, this analysis fills a knowledge gap in existing research by identifying the specific benefits of dual credit CTE coursework on

graduating GPAs of individual students. In doing so, administrators of school districts will have more information to make more specific choices in encouraging higher participation in dual credit CTE courses offered at Public Schools in Texas.

The following chapter 4, Results, includes the statistical analysis of the student data and findings of the research. The discoveries expand the current body of knowledge providing important data for school administrators based on the analysis of Dallas ISD students.

Chapter 4. Results

CTE in secondary and post-secondary education has far reaching consequences, academically and economically. The goal of this dissertation is to analyze if the impact of dual credit CTE classes goes beyond the classes and plays a role in improving the overall academic performance of students who enroll in these classes. Additionally, this quantitative study seeks to validate the improved academic performance by analyzing the relationship between the graduating GPA of students who earned dual credit by completing at least one dual credit CTE course as compared to their peers who did not take any dual credit CTE courses. To fulfill a knowledge gap, this research explores the relationship between students who complete dual credit CTE courses, and their graduating GPA as compared to their peers. This known relationship will better equip administrators to encourage students to pursue rigorous dual credit CTE courses which have been shown to increase academic achievement rather than on-level alternatives.

This chapter will begin with a discussion of the descriptive statistics for the data provided by Dallas ISD. Table 5 is a reproduction of Table 4 from Chapter 3 and shows the descriptive statistics for the dataset used for this dissertation. Thereafter, the results of the Multivariate Linear Regression analysis are discussed prior to highlighting the specific research questions. The chapter ends with a brief discussion about the impact of omitted variables and overarching conclusions from the data.

Descriptive Statistics

GPA

The student's graduating GPA is the sole dependent variable under examination for this research. For the two years of graduation data examined, 16,043 Dallas ISD students graduated

with a GPA ranging from 2.35 to 3.98. As evidenced in Figure 7, the students' GPAs are mostly normally distributed with the mean, median, and mode all equal to 3.37.

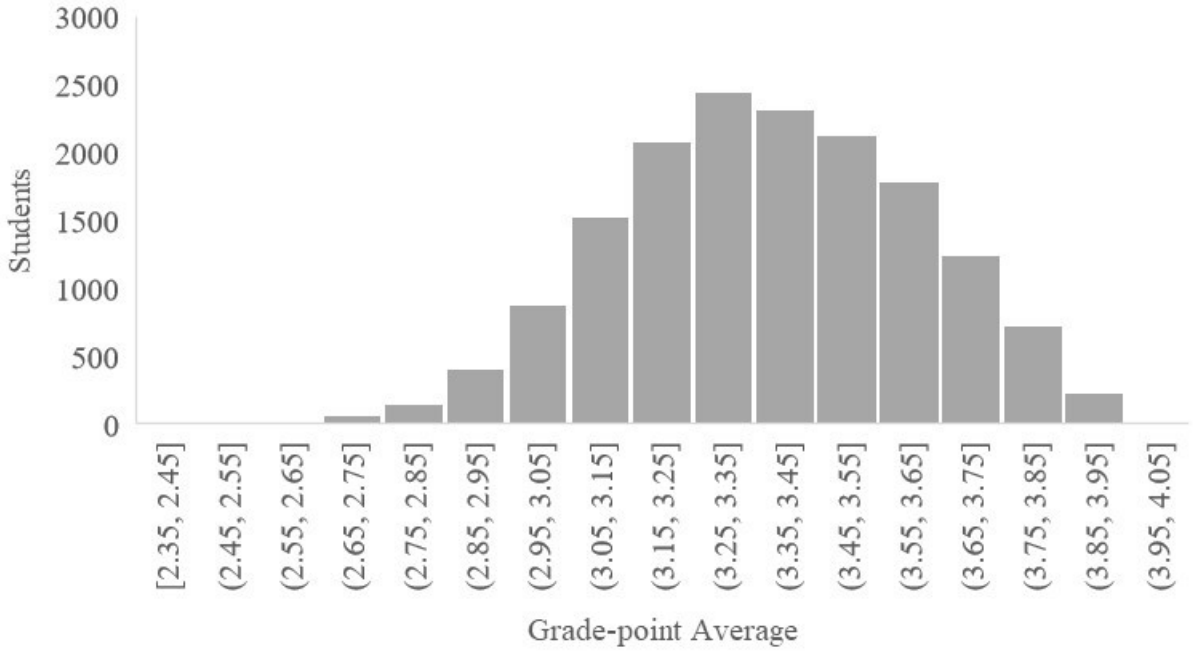
Table 5

Variable Summary Statistics

Variables	Obs	Mean	Std. Dev	Min	Max
gpa (DV)	16,043	3.37	0.24	2.35	3.98
cte (IV)	16,043	1.01	2.13	0	13
classi (IV)	16,043	1.11	0.50	0	2
ell (IV)	16,043	0.31	0.46	0	1
male (IV)	16,043	0.47	0.50	0	1
hispanic (IV)	16,043	0.71	0.45	0	1
disruption (IV)	16,043	0.49	0.50	0	1

Figure 7

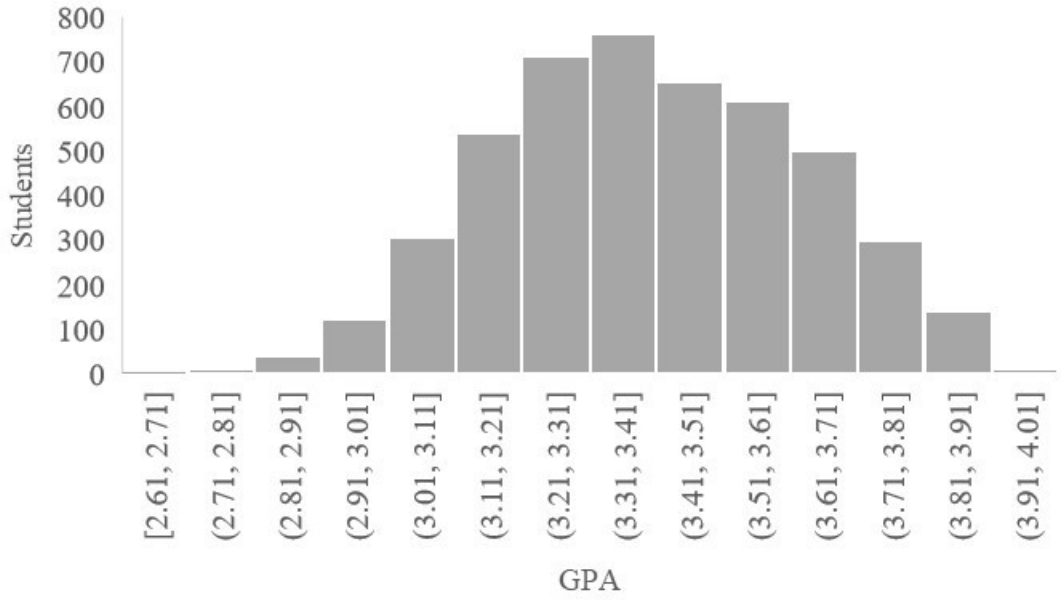
Distribution of Graduating Grade-Point Average – All Students



When considering only the students who have earned dual credit CTE credits, $n = 4{,}687$, the GPAs range from 2.61 to 3.94 as demonstrated in Figure 8. The mean and median are both equal to 3.4 with the mode slightly lower at 3.12.

Figure 8

Distribution of Graduating Grade-Point Average – CTE Students



Career and Technical Education

The data from Dallas ISD indicated that 4,687, or 29%, of the 16,043 students earned at least some amount of dual credit CTE credits. Of the 4,687 students who have earned dual credit CTE credits, approximately 60% of these students earned 3 or less credits. In contrast, less than 10% of the students who have earned dual credit CTE credits have earned more than 8 credits. The distribution of CTE credits is shown in Figure 9.

Special Education and Gifted & Talented

Of the 16,043 students, 1,265 students were identified as receiving SPED services and 2,990 were identified as receiving GT services. These two special populations account for approximately 27% of the total 16,043 student population as shown in Figure 10.

Figure 9

Distribution of CTE Credits

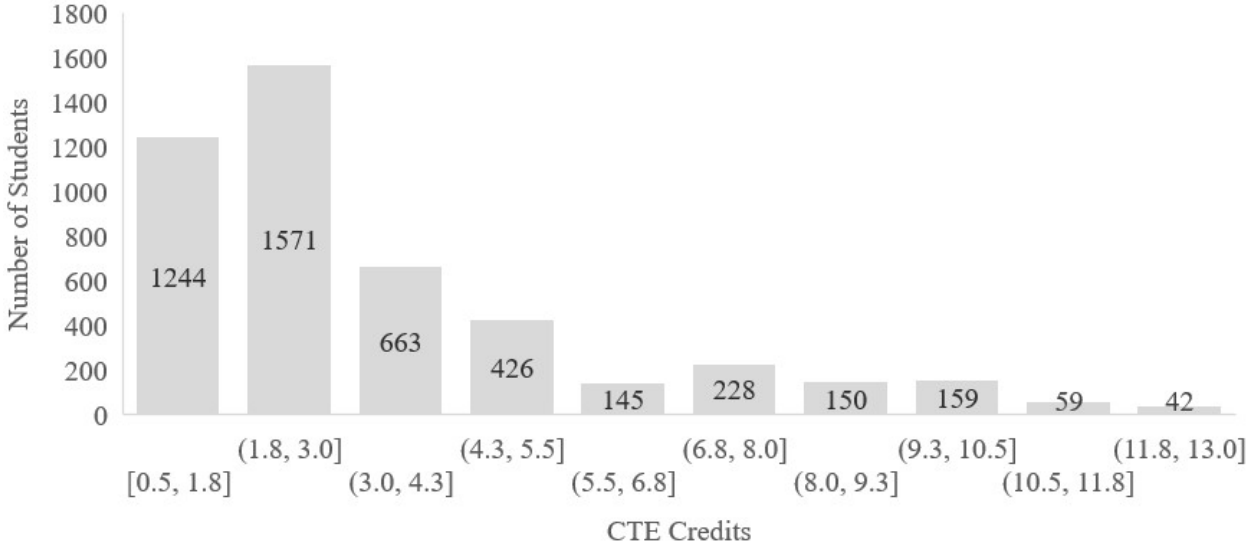
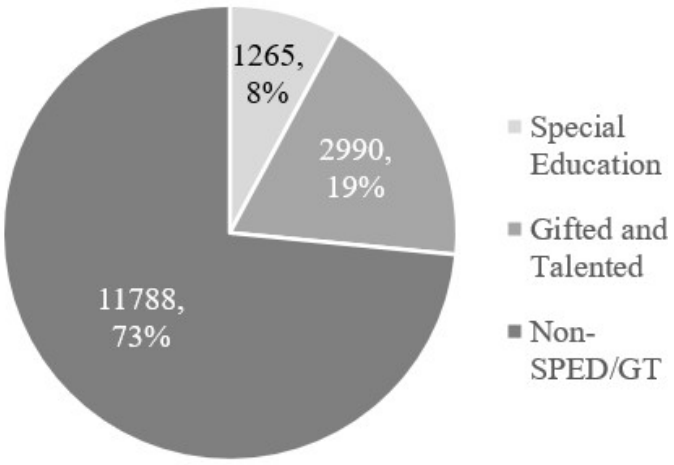


Figure 10

Classification: Total Student Population



Markedly, when examining the 4,687 students who have earned some amount dual credit CTE credits, 1,264 or 27% were identified at either GT or SPED. This is the same percentage of the total special population, 4,255, identified in the total 16,043 population examined. A disproportional difference was noted in the special population breakdown with only 3% of dual

credit CTE students identified as SPED compared to approximately 8% in the total population while 24% of the dual credit CTE students have been identified at GT compared to 19% in the total population as shown in Table 6. It can be concluded that though the special population of students represented in both the total population and the dual credit CTE population is equal at 27%, the break-down of the special population is markedly different with GT students represented in higher concentration and the SPED population substantially underrepresented.

Table 6

Crosstabulations—Classification

	CTE Students		Non-CTE Students		Total Population	
GT	1,145	24%	1,845	16%	2,990	19%
SPED	119	3%	1,146	10%	1,265	8%
Non-GT/SPED	3,423	73%	8,365	74%	11,788	73%
	4,687		11,356		16,043	

SPED and GT are two key independent variables that are examined in research questions R1 and R2 respectively. Students can be identified as SPED or GT. These two groups of students are mutually exclusive of each other. The variable CLASSI was created for use in the multivariate linear regression model discussed in the following section. CLASSI represents SPED, GT, and Non-SPED/GT. SPED students are given the value 0, GT students given the value 2, and Non-SPED/GT represented by the value 1.

English Language Learner

When examining students identified as ELL, a 5% population distribution difference was noted between students who earned dual credit CTE credits and those that did not. ELL accounts for 27% of the students who earned dual credit CTE credits compared to 32% ELL in the population of students that did not earn dual credit CTE credit. When considering the total

population, 31% was identified as ELL as shown in Table 7. As a percent representation, ELL are underrepresented in the dual credit CTE population.

Table 7

Crosstabulations—ELL

	CTE Students		Non-CTE Students		Total Population	
ELL	1,260	27%	3,656	32%	4,916	31%
Non-ELL	3,427	73%	7,700	68%	11,127	69%
	4,687		11,356		16,043	

ELL is a key independent variable in research question 3, R3. As the majority of the students in Dallas ISD are identified as Hispanic, discussed below, the impact of being an ELL student are relevant for research.

Gender

Of the 4,687 dual credit CTE students, 43% are male and 57% female. When compared to the total population, females who have earned dual credit CTE credits have higher representation by 4% and males who have earned dual credit CTE credits have a lower representation by 4% as shown in Table 8.

Table 8

Crosstabulations—Gender

	CTE Students		Non-CTE Students		Total Population	
Male	2,036	43%	5,524	49%	7,560	47%
Female	2,651	57%	5,832	51%	8,483	53%
	4,687		11,356		16,043	

Though not within the scope of this study, the CTE programs of study offered by the school district will directly impact the gender make-up of the student population taking CTE classes. The programs of study, as discussed in Chapter 2, cover the various professions ranging from Accounting, Teaching, and Business Management to Welding, Automotive Technology,

and Manufacturing just to name a few and there might be a gender-bias in selection of some of these courses. This disparity might be reflected in the gender-differential within the CTE students in a school.

Ethnicity

When considering ethnicity, 75% of the students who have earned dual credit CTE credit was identified as Hispanic/Latino compared to 71% of the total student population. 20% of the students who have earned dual credit CTE credit was identified as Black or African American which is also the percent identified in the total population. Students identified as White represent 5% of the total population and represent 2% of the students who have earned dual credit CTE credits as shown in Table 9.

Table 9

Crosstabulations—Ethnicity

	CTE Students		Non-CTE Students		Total Population	
American Indian or Alaskan Native	4	0%	15	0%	19	0%
Asian	39	1%	173	2%	212	1%
Black or African American	956	20%	2,217	20%	3,173	20%
Hispanic/Latino	3,505	75%	7,965	70%	11,470	71%
Native Hawaiian or other Pacific Islander	27	1%	19	0%	46	0%
Not Avaiable	1	0%	4	0%	5	0%
Two or More Races	75	2%	219	2%	294	2%
White	80	2%	744	7%	824	5%
	4,687		11,356		16,043	

Ethnicity is not directly studied within this research to answer specific research questions but was included in the multivariate linear regression model as an independent variable. With Hispanic/Latino students representing the majority of the student population, a binary variable *Hispanic* was created for use in the statistical model. It is important to note that Dallas ISD has a

very different student composition by race/ethnicity and therefore extreme caution is advised in extrapolating or generalizing the results discussed in this dissertation to other school districts.

COVID Disruption

COVID Disruption indicates if the student's senior year was disrupted by the COVID-19 pandemic. With direct impact to this study, Texas public school students started the 2020-2021 school year in a virtual learning environment for approximately eight weeks due to the impact of COVID-19 (Texas Education Agency, 2020a). The 2021-2022 school year returned to face-to-face learning in an unrestricted environment and is considered as not being impacted by COVID-19 . The data provided by Dallas ISD includes students that graduated in May 2021, for which their senior year was identified as a COVID Disruption year, and students that graduated in May 2022, whose senior year was not identified as a COVID Disruption year. It is important to acknowledge that even though the post-COVID group's senior year was not impacted by the vagaries of distance-learning, there might be underlying educational issues that occurred in their junior year due to the changed modality of education. For the purpose of this dissertation, these issues are not being considered extensively or as having long term impacts.

In May 2022, there were 463 more students who graduated than in May 2021. In contrast, there were 61 fewer students who graduated that earned dual credit CTE credit in May 2022 than in May 2021, shown in Figure 11.

Multivariate Linear Regression Analysis

The goal of this dissertation is to analyze if the impact of dual credit CTE classes goes beyond the classes and plays a role in improving the overall academic performance of students who enroll in these classes. This quantitative study seeks to validate the improved academic performance by analyzing the relationship between the graduating grade-point average (GPA) of

students who earned dual credit by completing at least one dual credit CTE course as compared to their peers who did not take any dual credit CTE courses. Four categories of students who tend to have innate academic performance differences have been included in this study – GT group, SPED group, ELL group, and all others to control for within-group impacts of external influences. Specifically, four research questions were tested:

R1. For the student population who have been identified and receive SPED services, is there a significant relationship between the graduating GPA among students who completed at least one dual credit CTE course during high school and the graduating GPA of students who did not.

R2. For the student population who have been identified and receive GT services, is there a significant relationship between the graduation GPA among students who completed at least one dual credit CTE course during high school and the graduating GPA of students who did not.

R3. For the student population who have been identified and receive ELL services, is there a significant relationship between the graduation GPA among students who completed at least one dual credit CTE course during high school and the graduating GPA of students who did not.

R4. For the student population that is not included in the three previous student populations (identified in R1, R2, and R3), is there a significant relationship between the graduation GPA among students who completed at least one dual credit CTE course during high school and the graduating GPA of students who did not.

Overarching primary hypothesis:

H1. Students who earned education credits by completing dual credit CTE classes are likely to have a higher graduating GPA as compared to their counterparts.

A multivariate linear regression model was used the examine the effect of six independent variables, *cte*, *classi*, *ell*, *male*, *hispanic*, and *disruption* had on the single criterion variable, *GPA*. The multivariate linear regression equation for this analysis was:

$$GPA_i = \beta_0 + \beta_1 cte_{i1} + \beta_2 classi_{i2} + \beta_3 ell_{i3} + \beta_4 male_{i4} + \beta_5 hispanic_{i5} + \beta_6 disruption_{i6} + \in_i$$

Where GPA is the dependent variable and *i* represents the number of observations. β_0 is the vertical intercept and β_1 through β_6 represents the regression coefficients of the corresponding independent variables. $\in$ is the model error.

The multivariate linear regression analysis shown in Table 10 indicates an $R^2 = 0.1088$, or roughly 11% of the variance in graduating GPA was explained by the six predictors or independent variables. To determine statistical significance, alpha level of .05 was used. As expected, each predictor variable is considered significant given the large data set, *n* = 16,043, and the few numbers of predictor variables.

Figure 11

Population of Students by Graduation Year

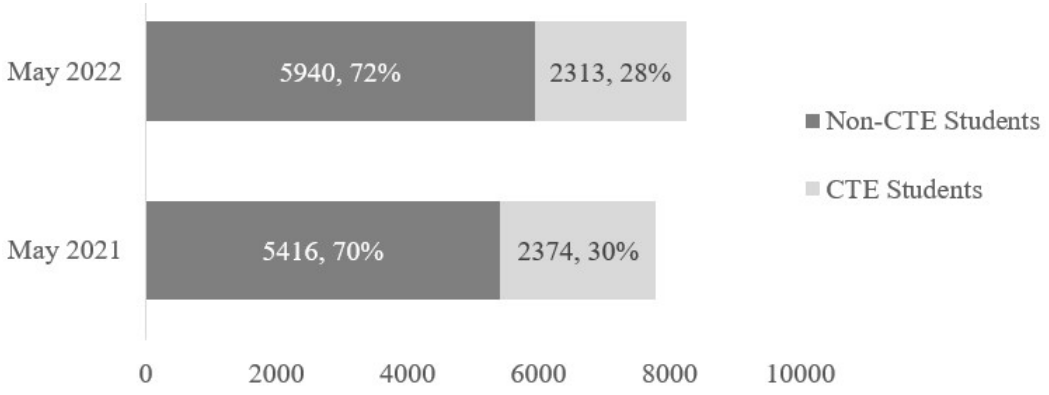


Table 10

Results of the Multivariate Linear Regression for Graduating Grade-Point Average

	ß	*SE*	*p* -value
cte	0.0101	0.0009	0.000
classi	0.0867	0.0037	0.000
ell	-0.0745	0.0043	0.000
male	-0.0786	0.0036	0.000
hispanic	-0.0112	0.0043	0.009
disruption	0.0165	0.0036	0.000

Examining the results in Table 10, the presence or absence of dual credit CTE credits within our multivariate linear regression model is minimally but positively impactful. Students who have earned some level of dual credit CTE credits have a higher graduating GPA than their peers. For every additional dual credit of CTE, it is expected the students GPA will increase by .01. When considering the presence of dual credit CTE credits, it is important to note the direction of the impact rather than the magnitude.

As stated above, this Multivariate Linear Regression model explains 11% of the variation in GPA. Even though 11% is small, the implications are significant as this model continues to echo previous research results. As previous research has shown, and this research agrees, CTE has a positive impact on student outcomes, in this case graduating GPA. Based on the results discussed above, one can reject the null hypothesis and confirm that students who earned education credits by completing dual credit CTE classes are likely to have a higher graduating GPA as compared to their counterparts.

Research Questions

Four specific research questions were developed for this study. As the results of the multivariate liner regression were significant, a Chi-square Test for Independence was performed in conjunction with each specific independent variable, SPED, GT, and ELL. This nonparametric

test was utilized to determine if there is an association between the dependent and independent variable enabling the research questions to be answered.

To aid in examining the research questions, the continuous GPA dependent variable has been converted to a categorical variable, GPACLASS, as shown in Table 11 The categorical variable for GPA will permit the Chi-square Test for Independence to be performed in conjunction with a specific independent variable, such as SPED, GT, or ELL.

Table 11

Distribution of CTE Credits

GPACLASS	GPA
0	< 3.0
1	3.0 - 3.49
2	≥ 3.5

Additionally, the continuous CTE independent variable has also been converted to a categorical variable, CTEbinary. Within the CTEbinary categorical variable, students who have earned dual credit CTE credits are represented by the number 1, while those that have not earned dual credit CTE credits is represented by the number 0. The research questions guiding this study do not examine the quantity of the dual credit CTE credits earned, just the presence or absence of the credits. The results for the research questions are discussed as follows.

Research Question #1

For the student population who have been identified and receive SPED services, is there a significant relationship between the graduating GPA among students who completed at least one dual credit CTE course during high school and the graduating GPA of students who did not.

When considering a significance level of 10%, one can conclude that for the student population identified as and receiving SPED services, there *is* a significant relationship between

the graduating GPA among students who completed at least one dual credit CTE course during high school and the graduating GPA of students who did not. The significance level of the Chi-square Test for Independence was $p = .067$ as shown in Table 12.

The significance level for SPED was expanded to 10% from the more conservative 5% significance level to account for the wide abilities of students who are identified as SPED. The intellectual ability of SPED students can vary widely from a disability that has minimal if any impact on the student's intellectual ability, such as hearing impaired, to students in a life-skills program that require assistance to complete everyday routines such as personal hygiene tasks (National Research Council, 1997).

Table 12

Chi-Square Test for Independence—SPED

GPACLASS	CTE Students	Non-CTE Students	Total Population
0	6	107	113
1	97	816	913
2	18	236	254
	121	1159	1280

Note. Pearson's chi-square result = 5.3914

$p < .10$

Research Question #2

For the student population who have been identified and receive GT services, is there a significant relationship between the graduation GPA among students who completed at least one dual credit CTE course during high school and the graduating GPA of students who did not.

When considering a significance level of 5%, one can conclude that for the student population identified and receiving GT services, there *is* a significant relationship between the graduation GPA among students who completed at least one dual credit CTE course during high

school and the graduating GPA of students who did not. The significance level of the Chi-square Test for Independence was $p = .000$ as shown in Table 13.

Table 13

Chi-Square Test for Independence—GT

GPACLASS	CTE Students	Non-CTE Students	Total Population
0	22	80	102
1	555	800	1355
2	568	965	1533
	1145	1845	2990

Note. Pearson's chi-square result = 17.1505

$p < .001$

Research Question #3

For the student population who have been identified and receive ELL services, is there a significant relationship between the graduation GPA among students who completed at least one dual credit CTE course during high school and the graduating GPA of students who did not.

When considering a significance level of 5%, one can conclude that for the student population identified and receiving ELL services, there *is* a significant relationship between the graduation GPA among students who completed at least one dual credit CTE course during high school and the graduating GPA of students who did not. The significance level of the Chi-square Test for Independence was $p = .000$ as shown in Table 14.

Research Question #4

For the student population that is not included in the three previous student populations (identified in R1, R2, and R3), is there a significant relationship between the graduation GPA among students who completed at least one dual credit CTE course during high school and the graduating GPA of students who did not.

Table 14

Chi-Square Test for Independence—ELL

GPACLASS	CTE Students	Non-CTE Students	Total Population
0	59	404	463
1	856	2581	3437
2	345	671	1016
	1260	3656	4916

Note. Pearson's chi-square result = 78.2424

$p < .001$

When considering a significance level of 5%, one can conclude that for the student population that is not included in the three previous student populations (identified in R1, R2, and R3), there *is* a significant relationship between the graduation GPA among students who completed at least one dual credit CTE course during high school and the graduating GPA of students who did not. The significance level of the Chi-square Test for Independence was $p = .000$ as shown in Table 15.

Table 15

Chi-Square Test for Independence—Non-SPED/GT/ELL

GPACLASS	CTE Students	Non-CTE Students	Total Population
0	69	355	424
1	1556	3322	4878
2	751	1649	2400
	2376	5326	7702

Note. Pearson's chi-square result = 44.9630

$p < .001$

Significance of Omitted Variables

Many extraneous individual-level variables can have a significant positive or negative impact on a student's GPA. Such variables can include family intervention and support, emotional intelligence, sports and physical activity, sleep, library use, household income, area of

residence, and lifestyle just to name a few (Garg et al., 2016; LeMaistre et al., 2018; Rajendran & Chamundeswari, 2019; Sodeinde, 2020; Stormshak et al., 2009; Zeng, 2021). Variables that could influence the dependent variable but are not present in the analytic model are referred to as omitted variables (Busenbark et al., 2022). If omitted variables exist, omitted variable bias may be present as well. Omitted variable bias occurs when an omitted variable is highly correlated with a predictor variable that is in the analytical model causing the coefficient of the present predictor variable in the model to be biased (Zach, 2020).

Such omitted variables can impact the coefficients and their significance in the Multivariate Regression Model that was presented in Table 10. However, due to the lack of individual level personal data of the DISD students at this time, it is impossible to predict which direction the extraneous variables could impact the results presented here. To offset some of these delimitations of the Multiple Regression Model estimated in the known presence of omitted variables, the series of non-parametric Chi-squared tests was performed for each type of student population in this dissertation to confirm or reject the research questions underlying the overarching research statement and design.

As this study was causal-comparative research, each research question was evaluated using two groups of students from the same population divided only on the presence or absence of dual credit CTE credits. This method minimized the impact that any omitted variables might have had on the study results yielding valuable and meaningful results.

Conclusion

This chapter discussed the results of the data analysis used to answer the four research questions and ultimately reject the null hypothesis that *students who earned education credits by completing dual credit CTE classes are likely to have a higher graduating GPA as compared to*

their counterparts. Additionally, one can conclude that for the four groups of students under evaluation, SPED, GT, ELL, and Non-SPED/GT/ELL there *is* a significant relationship between the graduation GPA among students who completed at least one dual credit CTE course during high school and the graduating GPA of students who did not. Each if these four groups of students represent the four research questions respectively.

In the final chapter, Chapter 5, recommendations, conclusions, and future scope of this study will be discussed in more detail.

Chapter 5. Recommendations and Conclusion

The goal of this dissertation was to examine and analyze if the impact of dual credit CTE classes goes beyond the classes and plays a role in improving the overall academic performance of students who enroll in these classes. This chapter reviews the research and provides a summary of the quantitative statistical analysis that was used to answer the four research questions and ultimately respond to the hypothesis. The study's findings and the literature review emphasize the significance and relevance of the of the study. Suggestions for future research will be discussed as there is limited current research and a wealth of opportunities to continue adding valuable knowledge to the critical education topic of career and technical education. Lastly this chapter and study will close with a comprehensive conclusion.

Summary of Findings

Utilizing data provided by Dallas ISD, a multivariate linear regression analysis was utilized to reject or fail to reject the primary null hypothesis. Subsequently, with the multivariate linear regression indicating each variable was significant, Chi-square Test for Independence was performed in conjunction with each specific independent variable. This nonparametric test was utilized to determine if there is an association between the dependent and independent variable enabling the research questions to be answered.

The student's graduating *GPA* was the single dependent variable being researched. Six independent variables, *cte, classi, ell, male, hispanic*, and *disruption* were included in the analysis to understand what impact they had on the single criterion variable, GPA. The data under examination consisted of 16,043 observations for students who graduated from Dallas ISD in May 2021 and May 2022.

To test the hypothesis, a multivariate linear regression analysis was utilized. The results, discussed in detail in chapter 4, indicate one should reject the null hypothesis and confirm that students who earned education credits by completing dual credit CTE classes are likely to have a higher graduating GPA as compared to their counterparts. The significance level of the multivariate linear regression model was $p = .000$ with each of the six independent variables also having a significance level of $p = .000$. With a beta coefficient = 0.0101 students who have earned some level of dual credit CTE credits have a higher graduating GPA than their peers. For every additional dual credit of CTE, it is expected the students GPA will increase by .01. The finding is significant as the results of this study align with previous studies as discussed in Chapter 2, Literature Review.

To answer the four research questions the Chi-square Test for Independence was performed. The four research questions were used to guide this research. The research questions only varied by the independent variable under examination, SPED, GT, ELL, and non-SPED/GT/ELL. Each research question followed the following format:

> For the student population who have been identified and receive [SPED, GT, ELL or non-SPED/GT/ELL], is there a significant relationship between the graduating GPA among students who completed at least one dual credit CTE course during high school and the graduating GPA of students who did not.

When examining research question one, R1, a Chi-square Test for Independence was performed to examine the relationship between students that were identified as SPED and earned dual credit CTE credit and their graduating GPA, the dependent variable. With a significance level of 10% and the resulting level of the Chi-square Test for Independence being $p = .067$, one can conclude there is a significant relationship between the student population identified as

SPED who completed at least one dual credit CTE course during high school and their graduating GPA compared to the graduating GPA of students who did not earn dual credit CTE credits within the same SPED peer group. As discussed in Chapter 4. Results, the significance level of 10% was expanded from 5% due to the wide variation in student abilities within the SPED population

When examining research question two, R2, a Chi-square Test for Independence was performed to examine the relationship between students that were identified as GT and earned dual credit CTE credit and their graduating GPA, the dependent variable. With a significance level of 5% and the resulting level of the Chi-square Test for Independence being $p = .000$, one can conclude there is a significant relationship between the student population identified as GT who completed at least one dual credit CTE course during high school and their graduating GPA compared to the graduating GPA of students who did not earn dual credit CTE credits within the same GT peer group.

Mimicking the results from research question two, R2, the results for research question 3, R3, which examines the ELL student population, and research question 4, R4, which examines the population of students not covered by R1, R2, or R3, non-SPED/GT/ELL, one can conclude there is a significant relationship between the student population identified as [ELL or non-SPED/GT/ELL] who completed at least one dual credit CTE course during high school and their graduating GPA compared to the graduating GPA of students who did not earn dual credit CTE credits within the same [ELL or non-SPED/GT/ELL] peer group.

To summarize the findings, (a) one should reject the null hypothesis and confirm that students who earned education credits by completing dual credit CTE classes are likely to have a higher graduating GPA as compared to their counterparts and (b) one can conclude that for the

four groups of students under evaluation, SPED, GT, ELL, and Non-SPED/GT/ELL there *is* a significant relationship between the graduation GPA among students who completed at least one dual credit CTE course during high school and the graduating GPA of students who did not. Each if these four groups of students represent the four research questions respectively.

Expanding the body of knowledge related to dual credit CTE credits is beneficial for school administration and the students they serve. With the findings of this study, students may be less apprehensive to embark on dual credit CTE credits if they are concerned about the impact these types of courses could have on their GPA. Students can embrace the rigor of dual credit CTE courses with confidence. Additionally, stigma bestowed on vocational programs is unfounded as students in these career and technical programs are shown to have a more superior graduating GPAs compared to their non-CTE peers. As continued federal, state, and local focus is given to CTE, research findings such as these continue to justify the importance of CTE as a valuable opportunity in a student's education journey.

Suggestions for Future Research

With the limited body of knowledge around dual credit CTE currently, there are so many opportunities to conduct research that would add value to this significant topic. When considering this research alone, we could begin by adding additional independent variables to build a more robust linear regression model that has a more significant R-squared value indicating the variance in graduating GPA explained by the model. Such additional variables could include age at graduation, socio-economic status, high school location, and standardized test score such as SAT and ACT.

The Texas Education Agency (2022a) has defined 14 career clusters that support 53 programs of study as shown in Figure 3 in Chapter 2, Literature Review. Studies regarding

student outcomes specific to the career clusters or even more specialized at the programs of study level would be advantageous. Student outcomes could be continued enrollment in post-secondary education after high school graduation or job availability and salary if the student is entering the workforce upon high school graduation. This information would be useful for entities such as the Texas Workforce Commission as they partner with the Texas Education Agency and Texas Higher Education Coordinating Board to develop skilled workers for today's jobs.

Qualitative research opportunities exist surrounding career and technical education as well. Are CTE students happier than there non-CTE peers while in high school? Does this happiness extend beyond high school into post-secondary education? Other areas of study could consider teacher qualifications, classroom atmosphere, or school-life balance. When considering future research on career and technical education, emphasis should be given on the steadily growing dual credit CTE as so many opportunities exist.

Conclusion

In conclusion, this casual-comparative quantitative study was designed to answer the statement of the problem if the impact of dual credit CTE classes goes beyond the classes and plays a role in improving the overall academic performance of students who enroll in these classes. From the literature review it was clear from as early as 1917 with the passage of the Smith-Hughes Act, special attention has been given to CTE in secondary schools. Existing literature has found a direct correlation between students who participate in a CTE program and increased academic outcomes (Texas Workforce Investment Council, 2018).

This study utilized the multivariate linear regression model and multiple Chi-square Test for Independence to analyze student data provided by Dallas ISD and expand the body of

knowledge around CTE and academic outcomes. With a limited body of knowledge on dual credit CTE, this analysis filled a knowledge gap in existing research by identifying the specific benefits of dual credit CTE coursework on graduating GPAs of individual students.

The literature provides strong evidence between student success and the participation in career and technical education (Bennett, 2016; Dougherty, 2016; The University of Wisconsin Population Health Institute, 2022; U.S. Department of Education, 2019). This study echoes the previous findings and supports the ongoing attention and growth given to CTE in secondary and post-secondary education. With the findings of this research, administrators of school districts now have more information to make more specific choices in encouraging higher participation in dual credit CTE courses offered at Public Schools in Texas.

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Appendix A: Institutional Review Board Protocol

January 30, 2023

PI: Mrs. Tammy Ridgway
Protocol title: IMPACT OF CAREER AND TECHNICAL EDUCATION AMONG HIGH SCHOOL STUDENTS IN TEXAS
Project link: https://uiw.forms.ethicalreviewmanager.com/Project/Index/5749

Hello,

Your project described above has been reviewed and found not to meet the federal regulatory requirements for human subjects research based on the following criteria:

- There will be no interaction or intervention with human subjects;
- The researchers' data will be collected from a public-use data set(s);
- Data to be analyzed is secondary, de-identified data;
- The researchers will not involve merging any of the public use data set(s) in such a way that individuals might be identified; and
- The researchers will not enhance the public data set so that individuals might be identified.

Keep this document with your project records as your **"Not Regulated Research Determination"** letter. Please use IRB number 2023-1338-NRR when inquiring about or referencing this determination. Should you determine at any point you wish to add additional elements to the project, please contact us before initiating those components as they may impact this determination.

Please contact us with any questions or for information regarding the IRB or the review process.

Sincerely,

Office of Research and Graduate Studies
Research Compliance
University of the Incarnate Word
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IRB #: 00005059 / FWA #: 00009201