

The Impact of Career & Technical Education Concentration on the Success of High School Students

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This research is dedicated in memory of my daughter Eleanor Harper Shoemaker. Her strong will and fighting spirit inspire me every day.

Abstract

The purpose of this study was to investigate the effects of Career and Technical Education (CTE) concentration on academic and behavioral success among high school students. The research design involved a quantitative approach, analyzing data from 931 students in a single high school collected through convenience sampling. The students were categorized into two groups: CTE concentrators and non-concentrators, with concentrators being those who finished two or more courses in a single pathway. The findings revealed that students who have a concentration in a CTE pathway tend to have higher American College Testing (ACT) scores, Kansas Assessment Program Science Exam (KAP Sci) scores, and final grade point average (GPA). Moreover, CTE concentration showed a significant positive effect on classroom attendance. However, no significant impact was observed on overall behavioral outcomes as measured by the number of office referrals. Notably, students with a CTE concentration graduated at a higher rate than those who did not. The results indicate that enrolling in two or more CTE courses throughout high school may enhance student success. This study contributes to the existing literature by highlighting the influence of CTE concentration on student outcomes and the importance of the effect of CTE programs on academic achievement and graduation rates. These findings have implications for educators and school administrators seeking to enhance student success through involvement in CTE pathways. Future research should explore additional impacting factors such as socioeconomic status, program concentration subject, and student motivation.

Keywords: career and technical education, CTE concentrators, education policy, graduation outcomes, secondary education, student outcomes, vocational training

Introduction

Career and Technical Education (CTE) is an essential component of secondary education that enriches students' academic and professional prospects, yet it often remains underappreciated (Jacob, 2017). According to the National Center for Education Statistics (NCES, 2020), CTE is defined as “courses that focus on the skills and knowledge required for specific jobs or fields of work” (p. 1). According to NCES, these courses encompass a wide range of industries and occupational clusters: Agriculture; Business Support, Management, and Finance; Communications; Computer and Information Sciences; Construction; Consumer Services;

THE IMPACT OF CAREER & TECHNICAL EDUCATION CONCENTRATION ON THE SUCCESS OF HIGH SCHOOL STUDENTS

Education; Engineering and Architecture; Health Sciences; Manufacturing; Marketing; Public, Social, and Protective Services; Repair; and Transportation.

While CTE's influence on graduation rates has been previously acknowledged (Dougherty, 2018), its broader impact on academic achievement and behavioral outcomes necessitates further exploration. Previous research by Kamin (2023) has shown a struggle with the inherent program differences in schools across the United States, highlighting access and quality as key issues.

A notable study of these programs was conducted in CTE-focused career academies, which proposed utilizing a single-school setting to effectively control extraneous variables when examining the impact of CTE (Ross et al., 2021). This approach addressed a critical methodological gap and offered new insights, particularly as it accounted for student agency in CTE participation—students in the study had the discretion to choose CTE pathways within a broader curriculum that was not exclusively CTE-oriented. Building on these findings, this study investigated the outcomes of CTE programs in a single school district to determine if they mirror the successes reported in prior literature. By narrowing the research scope to a single location within one district, this study endeavored to refine our understanding of how CTE affects student academics and behavior.

Specifically, this study addressed the following research questions:

1. What is the impact of concentration in a CTE pathway on high school student success as measured in various ways such as GPA at graduation, ACT score, state test scores, average daily attendance, and number of behavioral occurrences?
2. What is the impact of concentration in a CTE pathway on high school students' graduation?

These questions were explored through a comprehensive review of existing literature and analysis of data collected from a targeted study within one district, aiming to refine our understanding of CTE's multifaceted impact on student academics and behavior.

The Role of CTE in Secondary Education

In 1936, President Franklin D. Roosevelt established the Advisory Committee on Vocational Education, assigning it the task of evaluating federal efforts to strengthen career-based learning in K-12 education (Jacobs & Grubb, 2002). The committee's recommendations to Congress led to the passage of the 1946 George-Barden Act (Jacobs & Grubb, 2002), making vocational instruction a reimbursable activity to schools by the federal government (Barrett, 1948). Over time, the limited scope and inflexibility of the 1946 George-Barden Act prompted the passage of the Vocational Education Act of 1963 and its amendments in 1968 (The Vocational Education Act, 1963), which were renamed after Carl Perkins in 1984 and reauthorized in 1990, 1998, 2006, and 2018 (Lange, 2020).

In 2006, vocational education was re-branded to career and technical education to help kickstart a more widespread acceptance and overall understanding of what these programs entail (Dougherty & Lombardi, 2016). In 2018, the Perkins V Act was passed, reauthorizing the legislation for a fifth time and providing \$1.4 billion annually for CTE programs across the United States. This act allowed students to "explore, choose, and follow career and technical

THE IMPACT OF CAREER & TECHNICAL EDUCATION CONCENTRATION ON THE SUCCESS OF HIGH SCHOOL STUDENTS

education programs of study and career pathways to earn credentials of value" (Perkins Collaborative Resource Network, 2018, para. 1).

Substantial development in CTE legislation occurred with the 2006 reauthorization of Perkins IV, which provided funding for Basic State Grants programs (Dortch, 2012). These grants allowed states to develop, implement, and improve CTE programs, services, and activities if they offered CTE programs of study and maintained compliance with accountability requirements set forth by the act (Dortch, 2012). This development incentivized states to develop and push enrollment toward these CTE programs of study in their schools. It proved to be a vital turning point in the overall perception of how these programs should be used in secondary education nationwide.

Academic Success

In this study, academic success can be defined by graduation rate, KAP Sci score, ACT Science score, and terminal GPA. This section focused on graduation rates and academic progress by analyzing each measure. For brevity in this review, the measures of both KAP and ACT were analyzed as standardized testing.

Grubb and Oakes (2007) argued that structuring the high school curriculum around career-themed pathways not only nurtures multiple concepts of rigor but also distributes responsibility for standards throughout the educational community, providing students with the benefits of curricular choice and several routes to graduation.

The participating district in this study outlined in its graduation requirements that all students must successfully complete a half-credit course in Business Communications and a half-credit course in Business Management to provide students with employability skills (Anonymous High School, 2023). By designating this fundamental course as a requirement for all students, the district ensures that all students complete a minimum of one full credit of career-themed study. Due to this factor, students were required to have a minimum of two full credits in a single CTE pathway to be considered a part of the concentrator group. Per Perkins V, a "CTE concentrator" is defined as a secondary student who completes two courses in a single CTE program of study (Office of Career, Technical, and Adult Education, 2020).

Graduation Rate

Graduation rate was operationally defined as a measure of students' educational performance. A study by Castellano et al. (2016) reported a positive relationship between the number of CTE credits earned by students and their probability of graduation. Specifically, each additional CTE credit increased the likelihood of graduation by 4%. Additionally, in an earlier study of 12th-grade students in northeast Tennessee during the 2007-2008 academic year, Shadden (2011) found that CTE concentrators had higher graduation rates than non-CTE concentrators. Furthermore, research by Gottfried (2017) showed that students who completed a greater number of CTE units were less likely to drop out of high school and were more likely to graduate on time. Gottfried suggested that a possible explanation for this phenomenon was the increased school engagement these programs provide to students.

THE IMPACT OF CAREER & TECHNICAL EDUCATION CONCENTRATION ON THE SUCCESS OF HIGH SCHOOL STUDENTS

Standardized Testing

Michaels and Barone (2020) stated that “the more CTE courses a student undertook and completed within one CTE program translated to higher science assessment scores” (p. 14). These researchers recommended that future studies pilot additional variables that may impact student achievement, including GPA. Other standardized test scores, such as the ACT, were discussed in work by Michaels et al. (2022), where they indicated that students who concentrated in CTE, on average, scored higher than those who were non-concentrators.

Israel et al. (2012) found a positive correlation between concentration in CTE programs and performance on standardized testing. The author recommended that parents, teachers, and guidance counselors discuss the potential benefits of taking a sequence of courses that comprise an occupational concentration with their students. A separate study by Levesque et al. (2010) partially supported the idea that occupational concentrators score higher than non-concentrators at lower credit levels when taking 2.00 core science credits or fewer. On the National Assessment of Educational Progress (NAEP) science test, engineering concentrators scored higher than non-concentrators, health science concentrators generally scored lower than non-concentrators, and agriculture concentrators scored higher than non-concentrators who earned a similar number of core science credits. These outcomes were attributed to factors such as students' self-selection into CTE coursework based on their academic abilities, individual interests, and the potential science-related content of the CTE courses.

Grade Point Average

In one school district involved in a study conducted by Castellano et al. (2012), the authors found a non-significant trend in 9th-grade GPA toward the treatment group (concentrators), but a significant improvement in 10th grade GPA for the treatment group compared to the control group (non-concentrators). Castellano et al. (2012) suggested that the disparity may arise from the more structured curriculum of general education classes during the first year of high school. However, the same study showed a non-significant trend in 9th and 10th grade academic GPA and one end-of-term assessment toward the treatment group (concentrators) in another school district. In a later study, Castellano (2016) contrasted this point with results that had shown “the direct effect of CTE credits on GPA was not significant ($p = .960$), while its direct effect on graduation was $b = .12$ ($p < .001$)” (p. 15).

Behavioral Success

This section examined literature relevant to the second research measure: the factors surrounding students' success as related to behavior. Specifically, student engagement was measured by attendance and disciplinary occurrences. The researcher was interested in how each group engaged and behaved in their environment. This section reviewed factors implicated in the literature on attendance, engagement, behavior, and discipline (Dougherty et al., 2020; Heckman et al., 2018; Lochner, 2004; Plasman & Passarella, 2022).

THE IMPACT OF CAREER & TECHNICAL EDUCATION CONCENTRATION ON THE SUCCESS OF HIGH SCHOOL STUDENTS

Absence & Engagement

Student interest and engagement were threads that currently link CTE and school attendance rates. A thorough review of existing literature yielded a shortage of research on the relationship between CTE and school attendance rates. However, McConnell and Kubina (2014) explained that student attendance rates were considered one of the most pressing issues facing American schools today. Students who skip school or drop out were at risk of negative outcomes, such as delinquency, unemployment, and incarceration.

Dougherty et al. (2020) emphasized the importance of attendance as a measure in CTE research and the improvement of how it is measured. The authors stated that attendance is often included in school accountability systems and is now a more reliably captured measure than in the past. Eimers (2017) conducted a survey comparing the level of engagement of CTE and non-CTE students in their classes. When asked to respond to the following statement, “This class does not keep my attention—I get bored” (p. 72), the authors found that the majority (73%) of CTE students disagreed with the statement, and 0% of non-CTE students disagreed. Eimers and Fritz (2017) held focus groups with both groups and observed that CTE students found their classes engaging because they were interested in the topic, the teacher made the lessons enjoyable, and they could see the relevance to their learning. Non-CTE students, however, felt they had no say in how the class impacted their learning because they did not choose the class. Brunner et al. (2019) supported this idea, stating “CTE has a positive impact on attendance and high school completion rates, with students being approximately ten percentage points more likely to graduate from high school” (p. 26). Hodge et al.’s (2020) research support these findings and revealed that high school students who participated in CTE felt more connected to their school and were more likely to complete their education.

Behavior and Discipline

In reviewing the literature on behavior and discipline, a gap was found in understanding how CTE concentration plays a role in the behavior of students and their propensity to be disciplined. Plasman and Passarella (2022) addressed this gap in the literature by comparing individuals who participated in career-related education during high school with those who did not to determine if CTE participation was linked to a reduction in the probability and number of arrests post-high school. While Plasman and Passarella (2022) did not explicitly address behavior during their enrollment, they did provide a link to overall behavioral patterns. Plasman and Passarella (2022) found a positive correlation between CTE concentration in high school and fewer post-high school arrests. These findings aligned with Heckman et al.’s (2018) and Lochner (2004) research, which demonstrated a relationship between criminal behavior and academic measures such as high school graduation, number of academic credits, and GPA. However, limited research exists regarding the correlation between in-school behavior and referral frequency among students in CTE concentrations versus general academics. Dougherty et al. (2020) stated that “measures of student discipline or suspensions are often hypothesized to be an indirect measure of engagement” (p. 15).

THE IMPACT OF CAREER & TECHNICAL EDUCATION CONCENTRATION ON THE SUCCESS OF HIGH SCHOOL STUDENTS

The purpose of this study was to investigate the impact of CTE concentration on the academic achievement and behavior of high school students, specifically examining its influence on GPA, ACT scores, state test scores, attendance, behavioral occurrences, and graduation rates.

Theoretical Framework

This study employed Rubin's (1974) Causal Model (RCM), also known as the Potential Outcome Framework, as its theoretical framework. RCM provides a comprehensive understanding of the causal relationships between CTE concentration and academic/behavioral success, as well as the likelihood of high school graduation. It allows for the estimation of causal effects by comparing potential outcomes under different treatment conditions (Rubin, 1974).

The history of RCM can be traced back to 1974, when Rubin (1974) introduced his framework for estimating causal effects in both randomized experiments and observational studies. Rubin (1974) emphasized the importance of counterfactual reasoning and introduced the concept of potential outcomes, which represent the different outcomes that would be observed for everyone under different treatment conditions. In the context of the current study, RCM was applied to investigate the relationship between treated and non-treated groups with the tested variables. Its implementation aims to identify the causal effect of a specific treatment (CTE concentration) by comparing the outcomes of individuals who received the treatment (CTE concentrators) with those who did not (non-concentrators). The study conducted was quasi-experimental, assessing the differences between students within two independent groups rather than outcomes before and after implementation. Identification of causal effects required careful consideration of potential confounding factors, which were considered but not controlled for in this study. These factors include but were not limited to socioeconomic status, school characteristics, and demographics. Other potential confounding factors not included in the study include prior academic success, parental involvement, personal motivation, and external factors.

By utilizing this model, this study aimed to investigate the relationship between CTE concentration and student success, identify causal pathways, and quantify the impact of CTE concentration on various outcome measures, including academics, behavior, and graduation statistics. Using RCM contributes to existing knowledge by enhancing our understanding of how CTE programs influence high school students' academic and behavioral success and likelihood of graduating. It provides a rigorous framework for examining the causal effects of CTE concentration, thereby advancing the understanding of the implications of CTE programs in the educational context.

By applying this framework, I aim to uncover the underlying causal mechanisms through which CTE concentration influences various measures of student success, including GPA, ACT scores, state test scores, attendance, undesired behavioral occurrences, and graduation rate. In this study, the variables were binary categories that represent whether a student was or was not a CTE concentrator (1 = CTE Concentrator; 2 = Non CTE Concentrator). Its use provides a structured approach to both analyze the causal pathways and gain a deeper understanding of the effects of CTE concentration on high school students' outcomes through the calculation of Average Treatment Effect (ATE). This study examined how enrollment in a minimum of two CTE courses within a single pathway can influence academic and behavioral outcomes. The current

THE IMPACT OF CAREER & TECHNICAL EDUCATION CONCENTRATION ON THE SUCCESS OF HIGH SCHOOL STUDENTS

study aims to understand how CTE concentrators compare to non-concentrators in terms of academic and behavioral measures and graduation rates.

Methods

The effect of the independent variable of CTE pathway concentrator status on the dependent variables of academics and behavior was examined using the RCM Potential Outcome Framework. A quantitative evaluation of 931 students was conducted in a single school district spread across four academic years.

The researcher used this study on CTE to understand how concentrators compared to non-concentrators in terms of academic measures (ACT score, GPA, and KAP Sci scores), behavioral measures (average daily attendance and frequency of behavioral referrals), and graduation rate.

Research Design

The sample included students who completed school between the academic years of 2019 and 2022. The independent variables were concentrators and non-concentrators. The dependent variables were graduation status, GPA, state test score, ACT score, average daily attendance, and behavioral occurrences. In this study, non-concentrators served as the control, and concentrating students served as the treated group.

Academic measures of achievement included student KAP scores, an exam taken by all Kansas students in their 11th year of school, GPA at the time of exit from secondary education, and their science ACT score. Kansas separates scoring into four performance categories based on their overall score between 220 and 380. Level 1 is 220-277, Level 2 278-299, Level 3 300-327, and Level 4 328-380. They did not, however, report a statewide average score for this exam. In the years observed, the percentage of scores in Level 1 was 56% in 2019, no test administered in 2020, 48% in 2021, and 71% in 2022. For the measure of grade point average, Kansas does not report an average GPA for the state, and therefore, this study used an average of 3.0 as a standard of achievement based on the College Board (College Board, 2022). Finally, the state average for the ACT for those same academic years ranged between 19.8 and 21.1. On average, the school reported results on the ACT that were roughly two points lower than the state average for each year observed, ranging between 16.9 and 18.3 across the four academic years. Finally, the overall graduation status of the student was analyzed, with students being separated into categories of “Graduated” or “Other than Graduated.” The “Other than Graduated” group included any student with a status that did not equal “Graduated” at the time of exit from the participating high school. The behaviors studied were the average daily attendance of students during total enrollment and the cumulative number of behavioral referrals the student incurred during enrollment.

During annual enrollment, students could indicate an interest in specific courses that would place them into a pathway. Students in the school had access to all pathways offered by the school through open choice. The control group was based on the sample of students who did not concentrate in a CTE pathway. However, this group also included students who may have

THE IMPACT OF CAREER & TECHNICAL EDUCATION CONCENTRATION ON THE SUCCESS OF HIGH SCHOOL STUDENTS

participated by taking a single class in a pathway without subsequently enrolling in any additional classes.

Participants

This study involved the analysis of student information system (SIS) data from all graduating 12th graders who attended a single general education high school in the Midwest from 2019 to 2022. The National Center for Educational Statistics (2023) showed that the school is in a midsized locale inside an urbanized area with a population of less than 250,000. Demographic data, according to U.S News and World Report (2022), indicated that the school population was 48% Hispanic, 34% White, 11% Black, 4% two or more races, and 3% Asian. Most participants were within the traditional high school age range of 14 to 18.

According to a report by the National Center for Educational Statistics (2023), the observed school district had 63% of students who were eligible for the National School Lunch Program (NSLP) through direct certification (e.g., children that were in households that receive Supplemental Nutrition Assistance [SNAP] or other assistance). On average, the academic achievement of students across all four cohorts studied was below average. According to the Kansas Department of Education (2021), the average graduation rate for the state of Kansas in 2022 was 89.3%, while the school observed a graduation rate of 81.6%. Since this study observed four graduating cohorts, the overall graduation rate versus the state average as reported by the Kansas Department of Education (2021) for each year was as follows: 81.6% versus 89.3% in 2022, 71.5% versus 88.1% in 2021, 73% versus 88.3% in 2020, and 74.3% versus 87.5% in 2019.

Ethical Considerations

This study was approved by an Institutional Review Board (2023-10). This study also obtained the full written consent of the school district featured in this study to collect and analyze data. The study used archival data of students who had exited secondary education. All data was deidentified by the district administration prior to the researcher obtaining access. Each student was assigned a study identification number in sequence with their graduation cohort. All individual data was associated to the study identification number. Deidentified student data was kept secure and confidential through storage on password-protected encrypted university OneDrive.

Measures

Grade Point Average

GPA was used as a measure of academic achievement. GPA was calculated on a 4.0 scale, with 4.0 being the highest possible GPA and 0.0 being the lowest. GPA was reported on a semester basis, with the final GPA at graduation being the average of all semester GPAs. The school district did not use weighted grades in their calculations; therefore, all GPAs were between 0.0 and 4.0.

THE IMPACT OF CAREER & TECHNICAL EDUCATION CONCENTRATION ON THE SUCCESS OF HIGH SCHOOL STUDENTS

ACT Science Score

ACT Science scores assess “the interpretation, analysis, evaluation, reasoning, and problem-solving skills required in the natural sciences” (ACT, 2024, para. 4). Scores range from 1 to 36, with a higher score indicating greater mastery of the content and skills assessed. The school district provided the ACT Science scores for each participant who had taken the test as part of their high school academic career. However, 62.1% of students included in the study took the ACT examination, including 256 CTE concentrators and 322 non-concentrators. Kansas Assessment Program Science Score.

The KAP Sci Score is a standardized test developed by the Kansas State Department of Education to assess students' knowledge and skills in science. The test is administered annually to all students in grades 5, 8, and 11. According to the Kansas Department of Education (2021), “the test consists of multiple-choice and open-ended questions and covers a range of science topics, including life science, physical science, and earth and space science” (p. 1). The scores were collected from the students during their 11th-grade year, ranged from a minimum score of 220 to a maximum score of 380, and were divided into four performance levels. Level 1 showed a limited ability to understand and use the skill, level 2 showed a basic ability to use and understand the skill, level 3 showed an effective ability to use and understand the skill, and level 4 showed an excellent ability to use and understand the skill. Scores were not reported for the graduating class of 2021 due to the COVID-19 pandemic preventing the state from conducting the test.

Average Daily Attendance

The average daily attendance was used as a measure of student academic engagement. It was assessed as the proportion of missed days to the total number of days possible for an individual's total high school enrollment.

Behavioral Referrals

Behavioral referrals were included in this study as a measure of student behavior. Referrals were tracked by the school's administration and recorded in the student's Infinite Campus SIS profile. A referral was defined as any instance in which a student received disciplinary action for a negative behavioral occurrence during the years they were enrolled in high school.

Graduation Status

Graduation status was interpreted as a binary outcome, calculated for both CTE concentrators and non-concentrators. It was measured as a dichotomous variable indicating whether a student graduated or did not graduate at the end of their senior year. Students who completed all graduation requirements and received a diploma were coded as "graduated" (1). In contrast, those who did not meet the requirements withdrew from the school before graduation, transferred out, or had any status other than graduated were coded as "not graduated" (2).

THE IMPACT OF CAREER & TECHNICAL EDUCATION CONCENTRATION ON THE SUCCESS OF HIGH SCHOOL STUDENTS

Data Collection

This study collected data from a single source: the SIS Infinite Campus, which was provided by the district office in a de-identified form. The specific CTE courses included in this study were those that belong to an official pathway, as outlined previously. Concentrators were identified based on the official report submitted to the state by the school, which declares the students who met the criteria for this status. Students' GPA and state and national test scores were provided, along with their attendance percentage and aggregate count of behavioral incidents. This study examined these variables across four separate cohorts: the classes of 2019, 2020, 2021, and 2022, each divided into two groups consisting of concentrators and non-concentrators.

Data Analysis

Once the data was obtained, data analysis was conducted using SPSS. Independent t-tests were used to compare the control group (non-CTE concentrator) to the treatment group (CTE concentrator). For this study, the level of significance was set at $\alpha = .05$. The independent variable in this study is student's status as a CTE concentrator or non-concentrator. The dependent variables for academic achievement included GPA, ACT, and KAP Sci scores. The dependent variables for behavior included average daily attendance and behavioral occurrences. Each of these dependent variables offers a different lens through which to measure the broad aspects of student success. They collectively encompass the spectrum of student performance. The final dependent variable and decisive measure of student success, graduation status, captured all other dependent variables and served as a comprehensive indicator of overall student success. This served as a key metric in assessing the overall effectiveness of CTE programs.

Results

Cases of missing data were identified for ACT scores in the 2021 cohort. Missing data were deemed inconsequential as inferences were not made for each cohort; instead, data was assessed based on the overall averaged means of all cohorts. Most of the dependent variables did not meet the assumption of normality as assessed via skewness: ACT, KAP Sci, Behavior, and Absences, and kurtosis statistics: GPA, ACT, KAP Sci, Behavior, and Absences (Field, 2013). Some significant differences were found in the variances of each of the dependent variables; therefore, the assumption of homogeneity was not met. Adjusted t values were used for analysis.

Research Question 1: Impact on Student Success

Independent samples t-tests showed CTE concentrators tend to exhibit significantly higher GPAs ($M_{CTE} = 2.82 \pm .69$, $M_{NON} = 2.24 \pm .91$, $t(929) = 9.67$, $p < .001$, $d = .674$), significantly lower absences ($M_{CTE} = 12.65 \pm 10.09$, $M_{NON} = 18.52 \pm 17.81$, $t(929) = 5.36$, $p < .001$, $d = -.374$), significantly fewer behavior referrals ($M_{CTE} = 2.70 \pm 2.48$, $M_{NON} = 3.61 \pm 3.31$, $t(929) = 4.24$, $p < .001$, $d = -.269$), and significantly higher KAP Sci scores ($M_{CTE} = 279.52 \pm 25.63$, $M_{NON} = 268.10 \pm 44.03$, $t(540) = 3.49$, $p < .001$, $d = .304$) for students in the district studied. Additionally, ACT scores among CTE concentrators in this district were higher than non-CTE concentrators, but the difference was not significant ($M_{CTE} = 17.52 \pm 3.61$, $M_{NON} = 17.09 \pm 3.86$, $t(576) = 1.37$, $p = .170$, $d = .115$).

THE IMPACT OF CAREER & TECHNICAL EDUCATION CONCENTRATION ON THE SUCCESS OF HIGH SCHOOL STUDENTS

Table 1

Data for Measures of Academic and Behavioral Success in All Academic Years

	CTE (<i>n</i> = 307)		Non-CTE (<i>n</i> = 624)		Two-Sided <i>p</i>	Cohen's <i>D</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>p</i>	<i>d</i>
ACT*	17.52	3.61	17.09	3.36	.170	.115
GPA	2.82	0.69	2.24	0.91	< .001	.674
KAP Sci	279.52	25.63	268.10	44.03	< .001	.304
Absence	12.65	10.09	18.52	17.81	< .001	-.374
Behavior	2.70	2.48	3.61	3.31	< .001	-.296

Note. KAP Sci = KAP Science; Absence = proportion of days absent to the total number of school days. *62.1% (*n* = 578) completed the ACT.

Research Question 2: Impact on High School Graduation

Cross-tabulation analysis revealed a significant difference in high school graduation rates between the two groups in the district studied: approximately 99.02% of CTE concentrators (*n* = 307) graduated, compared to 73.24% of non-CTE students (*n* = 624). This disparity is statistically significant, as evidenced by the Pearson Chi-Square value of 91.666 (*p* < .001).

Table 2

Graduation Status for CTE and Non-CTE Students

		Graduated	Other	Total
CTE Status	CTE	304	3	307
	Non-CTE	457	167	624
Total		761	170	931

Note. Other is defined as any student who did not complete high school with a status of graduated.

With RCM, the Average Treatment Effect (ATE) is calculated as the difference in outcomes between the treated (CTE students) and untreated (non-CTE students) groups. To interpret graduation status, the average graduation rates across these two groups were compared. As the outcome is binary (a student either graduates or does not graduate), this study considered the average graduation rates in the calculations. For a given individual, this effect is typically measured as $Y_i(1) - Y_i(0)$ (Rubin, 2005). In this instance, Y_1 was the potential outcome for a student if they receive the treatment (CTE student), and Y_0 is the potential outcome for a student if they did not receive treatment (non-CTE). In this model, the ATE was produced by $ATE = E[Y_1 - Y_0]$, where E represents the expectation or average. Table 3 below provides the graduation rates for each group in each year.

THE IMPACT OF CAREER & TECHNICAL EDUCATION CONCENTRATION ON THE SUCCESS OF HIGH SCHOOL STUDENTS

Table 3

2019 – 2022 Graduation Rates for CTE (Y1) and Non-CTE (Y0) Students

Year	Group	Graduated	Total Students	Graduation Rate
2019	Y1	77	77	1.0
2019	Y0	113	162	0.70
2020	Y1	75	75	1.0
2020	Y0	123	172	0.72
2021	Y1	69	71	0.97
2021	Y0	112	150	0.75
2022	Y1	83	84	0.99
2022	Y0	109	140	0.78

Using the formula above, the results for calculating the ATE were as follows. $ATE_{2019} = 1.0 - 0.70 = 0.30$, $ATE_{2020} = 1.0 - 0.72 = 0.28$, $ATE_{2021} = 0.97 - 0.75 = 0.22$, $ATE_{2022} = 0.99 - 0.78 = 0.21$. The ATE for each year represents the additional probability of graduating from the studied district if a student is in a CTE program, over if they were not. This calculation showed that CTE students in this district had a 21% to 30% higher probability of graduating high school compared to non-CTE students.

Discussion

The purpose of this study was to shed light on the influence of CTE programs on student success within a low-income school district using a convenient sample from an urban Midwest high school. Data indicated that students in this school, who concentrated in a CTE pathway by taking at least two courses in the same field during their high school years, achieved greater success academically. These students not only had higher grades and better performance on standardized tests but also had fewer absences and behavioral issues. Furthermore, a distinct trend was observed, showing that students involved in CTE were more likely to graduate compared to their peers who did not participate in CTE programs.

An examination of graduation rates revealed that CTE programs seem to increase the likelihood of students completing high school. The consistently higher graduation rates for CTE students from 2019 to 2022 underscore the effectiveness of these programs. However, a gradual decline in the positive impact on graduation rates over the studied years suggested potential external influences, such as the COVID-19 pandemic, which may warrant further investigation.

These results aligned with Michaels and Liu's (2020) findings that revealed the contribution of CTE programs to improved academic performance. Similarly, Jaime (2017) reported that CTE concentrators were significantly more likely to graduate on time than students with one or fewer sections of CTE coursework. The study also echoes the work of Childs (2016), who found a noteworthy effect of CTE on improving student attendance year-over-year. Complementary findings by Miller and Riccardo (2021) suggest a slight yet significant difference in on-time high

THE IMPACT OF CAREER & TECHNICAL EDUCATION CONCENTRATION ON THE SUCCESS OF HIGH SCHOOL STUDENTS

school graduation rates depending on CTE participation, reinforcing the patterns identified by other researchers. Similar research by the Westchester Institute for Human Services Research (1997), as cited in Allensworth and Easton (2007), into work-based academic programs, such as the 1994 School-to-Work (STW) program, found that STW elicited positive effects on attendance, a factor related to increased odds of high school graduation.

The academic benefits to students noted regarding CTE programs can be attributed to the tailored nature of CTE pathways, which allow students to engage deeply with subjects that aligned with their interests. Supporting this, Mukuni and Price (2016) found that students could connect classroom activities to real-world experiences, notably through collaborative lesson plans that integrated mathematics with practical marketing scenarios. According to Ormrod (2008), immersive educational contexts, which he refers to as contextual theories, significantly shape learning through the influence of social and physical environments.

However, it is important to note that while CTE students historically have shown a more positive response on engagement surveys (Eimers, 2017) and generally had higher GPAs and fewer absences, the differences in the ACT scores of this study were not statistically significant, while the KAP Sci scores were. These results suggested that while CTE programs might have enhanced certain academic outcomes, they did not necessarily translate to an impact on all standardized tests.

Similar outcomes to the current study would be anticipated in comparable districts. This study showed that CTE programs not only foster academic success but also prepare students for the workforce. As the educational landscape evolves, institutions must recognize and integrate the value that CTE programs offer. The outcomes of this study serve as a testament to the pivotal role of vocational training in secondary education.

Limitations

The use of archival data in this study has limitations and potential biases that should be considered. One limitation is the incomplete data, particularly for students who had an end status of "unknown" when the data was collected. These students were automatically categorized as "Other Than Graduated" in the analysis unless the data specified a future graduation date beyond their original class. "Other Than Graduated" also included students who transferred out, switched to home school, or left the school for any other reason. Another missing data point was the state science exam for the class of 2021, which was not administered due to the COVID-19 pandemic. Additionally, data on student performance related to modality shift was not collected for this study. It was assumed that students in all groups had equivalent time in both in-person and virtual environments.

Finally, some participants in the study did not take the ACT examination during high school and did not have an associated score. It is also possible that the data contains minor selection bias, as the master roster used for grouping students was pulled from each respective graduating year. This means that students who were part of a specific graduating class but withdrew prior to their final year were not included in this study, which may have affected the results. Another source of bias that may exist was the frequency and severity of behavioral referrals from teachers. Due to

THE IMPACT OF CAREER & TECHNICAL EDUCATION CONCENTRATION ON THE SUCCESS OF HIGH SCHOOL STUDENTS

the subjective nature of infractions of lesser severity, there may be inconsistencies in the number of referral issues to students based on personal bias. Finally, changes in data collection practices over time could also have impacted the accuracy and completeness of the data.

Implications and Recommendations for Future Practice

This study illustrates the vital role of CTE in strengthening secondary education outcomes. CTE concentrators display superior GPAs, standardized test scores, behavioral markers, and markedly higher graduation rates, signifying CTE's efficacy in enhancing academic success and completion rates. While CTE's influence on ACT scores was inconclusive, its positive impact on other academic domains advocates for its integration into educational policy. The evidence of CTE as a pathway to reduce dropout rates and improve engagement was compelling, indicating that CTE programs are critical in addressing educational disparities and tailoring learning to diverse student needs. Consequently, this research substantiates the argument for expanding CTE programs to cultivate a more adaptive and skilled future workforce. Results indicate that CTE programs are a powerful tool in improving student outcomes in secondary education both academically and behaviorally, highlighting the role of CTE in educational reform and workforce readiness and marking it as a significant component in shaping future educational strategies.

Building on the findings of this study, several avenues for future research emerge. First, longitudinal studies that extend beyond the pandemic's impact would offer insight into the sustained efficacy of CTE programs. This could involve examining cohorts both before and after the COVID-19 pandemic to parse out the effects of the pandemic from the effects of CTE programs on students.

Second, there is a need to explore the differential impact of various CTE concentrations. Investigating which specific fields yield the highest academic and behavioral benefits could guide curriculum development and resource allocation. This also includes examining the CTE pathways with a focus on science, technology, engineering, and mathematics (STEM) education, and how these pathways can be optimized for student engagement and success.

Third, incorporating qualitative data through interviews or focus groups with students and teachers would provide a richer context for the quantitative outcomes. Qualitative insights could reveal student motivations, educator challenges, and the classroom dynamics that underlie the statistical trends observed and provide context for why students choose certain courses. Finally, a comparative analysis across different school districts representative of different socioeconomic classes would demonstrate the role of CTE in addressing educational disparities. This could also include investigating the policy implications for scaling CTE programs in under-resourced schools to ensure equitable educational opportunities.

In addition to further research, based on the findings, the author recommends that CTE teachers integrate industry-specific skills into their curriculum, utilizing project-based learning that reflects real-world scenarios, such as simulations, to enhance student engagement and academic success. School counselors should actively promote CTE pathways by emphasizing the study's evidence that concentrators demonstrate higher GPAs, improved attendance, and increased

THE IMPACT OF CAREER & TECHNICAL EDUCATION CONCENTRATION ON THE SUCCESS OF HIGH SCHOOL STUDENTS

graduation rates while offering tailored guidance to aligned CTE choices with students' career and academic aspirations. State CTE directors and program specialists should focus on expanding access to CTE programs in underrepresented schools, ensuring program quality remains consistent across districts, and developing metrics to monitor student outcomes, including graduation rates and standardized test performance. CTE teacher preparation programs must prioritize training that incorporates data-driven instructional strategies, cross-disciplinary learning, and methods to foster student engagement, equipping educators to drive both academic achievement and long-term career readiness. Finally, all teachers can enhance student outcomes by incorporating project-based learning and real-world applications into their instruction. Adopting CTE's strengths such as hands-on, experiential learning can improve engagement, boost academic performance, and foster critical thinking. This approach benefits all students by making education more relevant to future careers, promoting both academic success and workforce readiness.

Conclusion

This study demonstrates the significant impact of CTE programs on secondary education outcomes. It shows that CTE concentrators achieve a higher GPA and test scores and that a higher number of earned CTE credits among students produces a higher probability of graduation compared to non-CTE students. However, the lack of significant ACT score differences suggests traditional college enrollment assessments may not fully capture the hands-on skills and competencies developed in CTE programs. This gap points to a need for evaluation models aligned with experiential learning, which could be incorporated into post-secondary admissions to accurately reflect student success. Additionally, the findings show an overall decrease in behavioral referrals and an increase in attendance demonstrating that CTE students are more engaged with their academic career than non-CTE students.

Given these benefits, school districts should actively guide student enrollment toward completing at least three CTE credits to cultivate a more adaptive and skilled future workforce and improve holistic student outcomes. While this study is limited to one district, it highlights the need for further research across different contexts, particularly in rural and underserved areas. Exploring whether CTE's benefits extend to these regions could lay the groundwork for scaling programs equitably, transforming secondary education to meet diverse student needs and industry demands. This study contributes to the literature advocating for personalized, skills-based education, offering a pathway for meaningful educational reform that aligns learning with real-world applications.

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AUTHORS' NOTES

THE IMPACT OF CAREER & TECHNICAL EDUCATION CONCENTRATION ON THE SUCCESS OF HIGH SCHOOL STUDENTS

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