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RESEARCH BRIEF:

# Investigating the Differential Academic Outcomes of Career and Technical Education (CTE) Students in Pennsylvania (PA) Secondary Schools

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# Abstract

The present study compared academic outcomes for career and technical education (CTE) students and non-CTE students in Pennsylvania (PA). Using statewide student population data from the Pennsylvania Information Management System (PIMS), three cohorts of Pennsylvania high school students ( $N = 418,341$ ) were tracked from Grade 9 entry to various points in their postsecondary education through 2017–18. Academic outcomes (standardized state assessment performance, on-time high school graduation, postsecondary enrollment, persistence, retention, and degree completion) were compared based on CTE participant status, defined by the Pennsylvania Department of Education (PDE) as the completion of at least 10% of a CTE program. Outcomes within the CTE student population were likewise differentiated based on the percentage of the program that students completed (i.e., program intensity, CTE concentration, and CTE completion status) and the program characteristics (i.e., internship, work-based experience, postsecondary credit earning, etc.) in which students elected to participate. Results of the chi-square and logistic regression analyses found that CTE participants in PA had significantly lower odds of achieving all academic outcomes, except graduating on-time from high school. These odds differed for CTE participants by the intensity of students' respective programs, such that CTE students who persisted along their program sequences to concentration or completion were often less involved in traditional 4-year degree seeking opportunities. Finally, CTE participants who took advantage of the various program characteristics available to them often had higher odds of pursuing further postsecondary education. Implications and recommendations for state stakeholders are discussed.



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## KEY FINDINGS:

### Description of the CTE Population

- CTE participants (students who completed at least 10% of their respective CTE programs) in PA were majority male (57.5%).
- The majority (73.3%) of the CTE population identified as white, followed by Black/African American (13.7%), Hispanic (10.0%), Multi-racial (1.5%), and Asian (1.3%). American Indian/Alaskan Native and Native Hawaiian or other Pacific Islander students constituted a combined 0.2% of the population.
- Over half (51.4%) of CTE participants were economically disadvantaged, 25.6% were Special Education students, and 1.9% were English Learners (EL).
- Although more CTE participants in PA attended suburban schools (32.4%) than any other geographic locale, students from suburban schools were underrepresented in CTE when compared to their presence in the overall student population (42.0%). Conversely, students from rural locales were overrepresented in the CTE population (22.6%) relative to the statewide rural populace (16.2%).

## KEY FINDINGS:

### Academic Outcomes

- The proportion of CTE participants in PA who scored Advanced/Proficient on the Keystone Algebra (45.5%), Biology (38.5%), and Literature (52.7%) standardized state assessments was significantly lower than that of non-CTE students (70.1%, 65.0% and 78.7% respectively).
- The rate of on-time high school graduation was slightly higher for CTE participants (86.5%) than for non-CTE students (85.0%). According to the logistic regression analysis, CTE participants had

1.312 times higher odds of graduating on-time from high school than non-CTE students.

- CTE participants enrolled in postsecondary education at a significantly lower rate (43.5%) than non-CTE students (76.6%). Of the students who enrolled in postsecondary, a significantly higher proportion of non-CTE students (88.6%) than CTE participants (75.5%) entered at full-time status.
- CTE participants enrolled in 2-year postsecondary institutions at a significantly higher rate (48.2%) than non-CTE students (23.7%), but the majority (51.8%) of the CTE population enrolled in 4-year institutions.
- Non-CTE students in PA had significantly higher rates of persistence (86.3%) and retention (77.1%) to year two of postsecondary education compared to CTE participants (70.2% and 62.7%, respectively). These differences were even more pronounced in year three, when non-CTE students had significantly higher rates of persistence (80.1%) and retention (65.2%) compared to CTE participants (55.6% and 43.5%, respectively). Still, the effect sizes for persistence and retention to both years two and three of postsecondary were small.
- Less than half of all students who entered postsecondary graduated with a degree within four years; however, non-CTE students did so at a significantly higher rate (47.8%) than CTE participants (34.9%).
- Finally, although non-CTE students who graduated within four years in Pennsylvania received at least a bachelor’s degree at a significantly higher rate (86.7%) than CTE participants (53.1%), with a moderate effect ( $\phi = -.24$ ), this indicates CTE participants still earned a bachelor’s degree or higher more often than any other degree type. Still, non-CTE students had 4.894 times higher odds of earning a bachelor’s degree than CTE participants.

## KEY FINDINGS:

### Program Intensity

- CTE participant outcomes differed by program ‘intensity’, or the percentage of the program completed. Indicators of intensity included CTE concentration, defined by PDE as the completion of at least 50% of a CTE program, and CTE completion.
- Although both CTE concentration and CTE completion were associated with slightly higher rates of Keystone Algebra exam passage, performance on the Keystone Biology and Literature exams did not differ by concentration status alone. Still, CTE completers scored Advanced/Proficient on the Biology and Literature exams at a significantly higher rate than students who did not complete their CTE program.
- Both CTE concentration and CTE completion had significant moderate effects ( $\phi = .26$  and  $\phi = .31$ ) on the rate of on-time high school graduation. Binary logistic regression analysis found that even in the context of other significant program-level variables, CTE completers had over five times higher odds than non-completers of graduating on-time from high school. Differences based on CTE concentration were significant, but less pronounced (1.526 times higher odds than non-concentrators).
- CTE concentrators and CTE completers had significantly lower rates of college entry, full-time enrollment, and initial entry at a 4-year institution when compared to students who did not persist to these program intensity thresholds.
- CTE concentration was the only variable significantly associated with the rate of full-time enrollment in the logistic regression analysis. In the final model, non-concentrators had 1.244 times higher odds of entering postsecondary at full-time status than CTE concentrators.
- Although CTE concentrators and CTE completers appeared to have lower rates of persistence and retention to year two of postsecondary, these differences lost significance when contextualized with other variables in the logistic regression models.
- Non-concentrators had 1.259 times higher odds of persistence and 1.226 times higher odds of

retention to year three of postsecondary than CTE concentrators. Likewise, non-completers had 1.203 and 1.122 times higher odds than CTE completers of persistence and retention to year three, respectively.

- The effects of CTE concentration ( $\phi = -.21$ ) and CTE completion ( $\phi = -.26$ ) on the highest degree earned by CTE participants in PA were moderate; in fact, students who completed at least 50% of their program earned an associate/certificate as their highest degree at a significantly higher rate (53.2%) than students who completed less of their program (29.9%). CTE non-completers had 2.758 times higher odds of earning a bachelor’s degree than CTE completers.

## KEY FINDINGS:

### Program Characteristics

- Just under one quarter (23.5%) of CTE participants in these cohorts participated in at least one CTE program characteristic (internship, cooperative work experience, job exploration, work-based experience, or postsecondary credit earning) during the course of their programs. Students who participated in at least one characteristic passed all Keystone subject exams at slightly higher rates than students who did not.
- CTE participants in PA who participated in at least one characteristic of interest had slightly higher rates of on-time high school graduation, postsecondary entry, full-time enrollment, 4-year institution entry, persistence and retention to years two and three of postsecondary, and college graduation compared to students who did not participate in these experiences. However, participating in at least one program characteristic of interest had no effect on the highest degree earned by college graduates.
- CTE participant outcomes differed depending on the individual program characteristics in which students participated.
  - o *Internship*: Students who participated in an internship during their CTE program passed the Keystone Algebra and Literature exams

at higher rates than students who did not. Internship students had higher odds of on-time high school graduation, postsecondary enrollment, and 4-year institution entry. They also had higher odds of retention to years two and three of postsecondary, and persistence to year three.

- o *Cooperative work experience*: Students who participated in a cooperative work experience passed the Keystone Algebra and Biology exams at higher rates than students who did not participate. Cooperative work experience was associated with higher odds of on-time high school graduation and postsecondary graduation within four years. However, students who did *not* participate in a cooperative work experience had higher odds of enrolling in postsecondary, and persistence and retention to year three.
- o *Job exploration*: Students who participated in job exploration in high school CTE passed the Keystone Algebra and Literature exams at higher rates than students who did not participate. Job exploration students also had higher odds of on-time high school graduation, postsecondary enrollment, 4-year institution entry, and persistence to year two.
- o *Work-based experience*: Students with work-based experience passed all Keystone exams at higher rates than students without this experience. Participation in a work-based experience was associated with higher odds of postsecondary enrollment, 4-year institution entry, and retention to year three of postsecondary.
- o *Postsecondary credit earning*: Earning postsecondary credit in high school was associated with higher odds of achieving all postsecondary outcomes. The exception was initial entry to college at full-time status, which was not associated with participation in any of the program characteristics of interest.

# Literature Review



Career and technical education (CTE) students appear to differ from non-CTE students in terms of academic outcomes. Several studies found that overall, CTE students are likely to have lower grades and GPAs than non-CTE students (Dietrich et al., 2016; Palmer & Gaunt, 2007; Stone & Aliaga, 2005). This disparity in academic performance may even differ within the CTE population, depending on the percentage of the program students complete (Castellano et al., 2014). Still, research comparing CTE student performance on standardized assessments is more ambiguous. Despite research from Dietrich et al. (2016) which found that community college applicants who had participated in CTE during high school had lower ACT scores compared to college preparatory or general curriculum students, it is unclear whether CTE students differ substantially from their non-CTE peers in terms of state standardized test performance.

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Several studies indicate that CTE coursetaking in general is associated with increased probability of high school graduation (Dougherty, 2016; Castellano et al., 2014). Moreover, beyond mere CTE enrollment, student outcomes like high school graduation appear to differ depending on the amount, or intensity, of CTE that students adopt in their course loads (Dougherty, 2016; Plank, 2001). Likewise, high school graduation appears to also depend in part on the characteristics of the CTE program. Work-based learning (WBL) opportunities are key characteristics offered in many CTE programs. Several studies highlighting the role of WBL revolve around the School-to-Work (STW) initiative of 1994, during which schools in the United States developed systems of partnership with business and community organizations to prepare students for transition to the workplace. Rivera-Batiz (2003) found that participation in any WBL opportunity (internships, apprenticeships, career academies) during STW significantly reduced the likelihood of high school dropout for students in the study. While this highlights the effects of STW on high school graduation, it provides insight to the outcomes associated with WBL opportunities in general.

In addition to high school graduation, the National Center for Education Statistics (2017) reports that it is less common for CTE students to enroll in postsecondary education after high school than their non-CTE peers. One explanation is that students who participate in CTE simply prioritize different postsecondary programs. After all, most students aspire to some form of postsecondary degree completion, regardless of their high school curriculum-type (Bromberg & Theokas, 2016). Furthermore, Dietrich et al. (2016) found that community college students who enrolled in CTE during high school were less likely to continue to a 4-year institution, but more likely to earn an associate degree or certificate than their non-CTE peers. Another study found that CTE students who enrolled in college completed ‘vocational’ programs at a higher rate than non-CTE students, while those who did not enroll in college were more likely to find full-time work in the three years following high school graduation (Cowan et al., 2020). These combined findings suggest that CTE participation in high school is associated with lower rates of enrollment at 4-year postsecondary institutions, but increased participation in alternative, shorter-term credential programs and full-time employment opportunities.

# Project Overview and Objectives

The goal of this longitudinal research was to analyze the association between participation in CTE and various academic outcomes among Pennsylvania students. This study had the following major objectives:

1. To examine the association of CTE program enrollment with academic performance (standardized test scores), high school graduation, and postsecondary outcomes (i.e., enrollment, persistence, retention, degree completion).
2. To investigate factors related to CTE program participation with academic performance, high school graduation, and postsecondary outcomes among CTE students overall and subgroups of students.
3. To develop direction for future research to guide policy decisions geared towards improving educational outcomes for CTE students.

These objectives reflect the following question related to CTE education from [the PDE Research Agenda](#):

How do the educational and labor market outcomes for students who completed career and technical education coursework and programs of study in high school compare with students who did not complete CTE coursework in high school?

Although the researchers did not have access to workforce data necessary to answer the above question in its entirety, the educational outcomes of CTE students in Pennsylvania are still of interest to state policymakers. The present study investigated the following research questions specifically, including one main research question and two additional sub-questions.

## **Main Research Question:**

1. How do CTE students differ from non-CTE students in Keystone exam performance, and rates of on-time high school graduation, postsecondary enrollment, persistence, retention, and degree completion?

## **Secondary Research Questions:**

1. What is the demographic description and breakdown of the CTE student population?
2. To what extent do CTE student outcomes differ depending on the characteristics (i.e. work-based experiences, internships, postsecondary credits earned) and ‘intensity’ (i.e. CTE concentrator and CTE completer status) of the CTE program curriculum?

# Method and Sample

Three cohorts of Pennsylvania students were followed from Grade 9 entry in school years 2010–2011, 2011–2012, and 2012–2013 to various points in postsecondary study by 2017–18. Table 1 shows how each cohort was differentially tracked through postsecondary enrollment and completion.

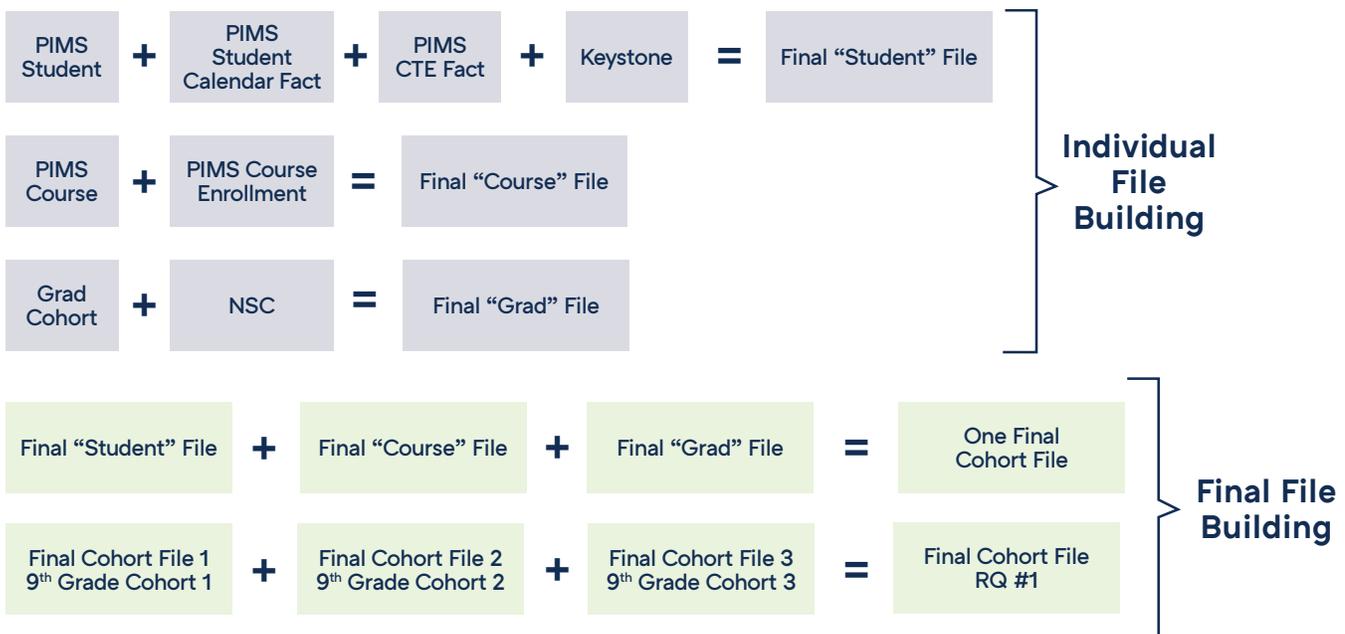
**TABLE 1: Educational Outcomes by 9th Grade Cohort**

Outcome	Cohort 1 2010–11 (N = 140299)	Cohort 2 2011–12 (N = 139071)	Cohort 3 2012–13 (N = 138971)
Keystone Exam Performance			✓
On-time High School Graduation	✓	✓	✓
College Enrollment	✓	✓	✓
Persistence & Retention to Year 2	✓	✓	✓
Persistence & Retention to Year 3	✓	✓	
College Graduation (with any degree, within 4 years)	✓		
Retention to College Graduation	✓		
Highest Degree Type	✓		

\*Note: Although the Keystone exams were a graduation requirement for students in all 3 cohorts, Keystone exam data were only available in PIMS for the 2014–15 school year and beyond, limiting analysis to the 2012–13 cohort.

All data used in the present study were pre-existing, housed in various locations. Most of the student-level data, including data on CTE participation, CTE characteristics, and high school graduation, originated from the Pennsylvania Information Management Systems (PIMS). Individual data templates from PIMS were combined to form full student cohort files. National Student Clearinghouse (NSC) data was used to track students’ postsecondary trajectories, including postsecondary enrollment patterns and graduation status. Figure 1 displays the linking process for each individual data file or template, culminating in final files to answer each research question. Lastly, varied statistical analyses were used, including descriptive statistics, Chi Square, and Binary Logistic Regression.

**FIGURE 1: Linking Process for all Data Files**



# Defining CTE

To answer the main research question, the CTE student population needed to be identified in contrast to the non-CTE population. Students were identified as CTE participants if they had completed at least 10% of their PDE-approved CTE program, according to the CTE Student Fact template of PIMS. CTE participants were not differentiated based on CTE delivery method (occupational, tech prep, POS), although Adult Affidavit Program students were excluded from analysis. To answer this primary research question, academic outcomes were compared between CTE participants and non-CTE students.

The secondary research questions required the comparison of outcomes depending on CTE participants' program characteristics and the percentage of the program they completed. Variables indicating percentage completed, or program *intensity*, included whether the student completed their CTE program (CTE Completion) or if they met PDE's definition for CTE concentration by completing at least 50% of their program (CTE Concentration). Variables of intensity indicate how far CTE participants elected to progress along their respective program sequences; they are not an indicator of the quality or difficulty of the program itself.

Students were identified as CTE participants if they had completed at least 10% of their PDE-approved CTE program.

Students were categorized as having participated in any CTE Program Characteristics or not, depending on whether they participated in any of the characteristics listed below. Program characteristics of interest included whether the CTE participant engaged in an internship, cooperative work experience, job exploration, work-based experience (WBE), or earned postsecondary credit during their high school CTE program. This study aims to inform career and technical education policy by clarifying the impact of these program experiences on students' educational trajectories.

## Results

### Academic Outcomes

*Although CTE students had slightly higher rates of high school graduation compared to non-CTE students, they had lower rates of Keystone exam passage. Regarding postsecondary outcomes, CTE students had lower rates of postsecondary enrollment, full-time and 4-year institution entry, persistence and retention, and bachelor's degree attainment.*

Chi-square results indicate that students in PA who elected to participate in CTE passed the Keystone exams at significantly lower rates than non-CTE students. Despite this finding, CTE participants in Pennsylvania graduated on-time from high school at a slightly higher rate (86.5%) than non-CTE students (85.0%).

CTE participants in Pennsylvania graduated on-time from high school at a slightly higher rate (86.5%) than non-CTE students (85.0%).

Postsecondary enrollment patterns differed between the two groups in more notable ways. Figure 2 shows the moderate association ( $\phi = -.28$ ) between CTE participation and postsecondary entry at any point following high school graduation. Less than half (43.5%) of all

CTE participants in the cohorts enrolled in postsecondary education, compared to 76.6% of non-CTE students. CTE students also demonstrated lower rates of enrollment in 4-year institutions (51.8%), persistence (55.6%) and retention (43.5%) to a third year of postsecondary, and bachelor’s degree completion within four years (53.1%) when compared to non-CTE students (76.3%, 80.1%, 65.2%, and 86.7%, respectively).

**FIGURE 2: Postsecondary Enrollment by CTE Participant Status**

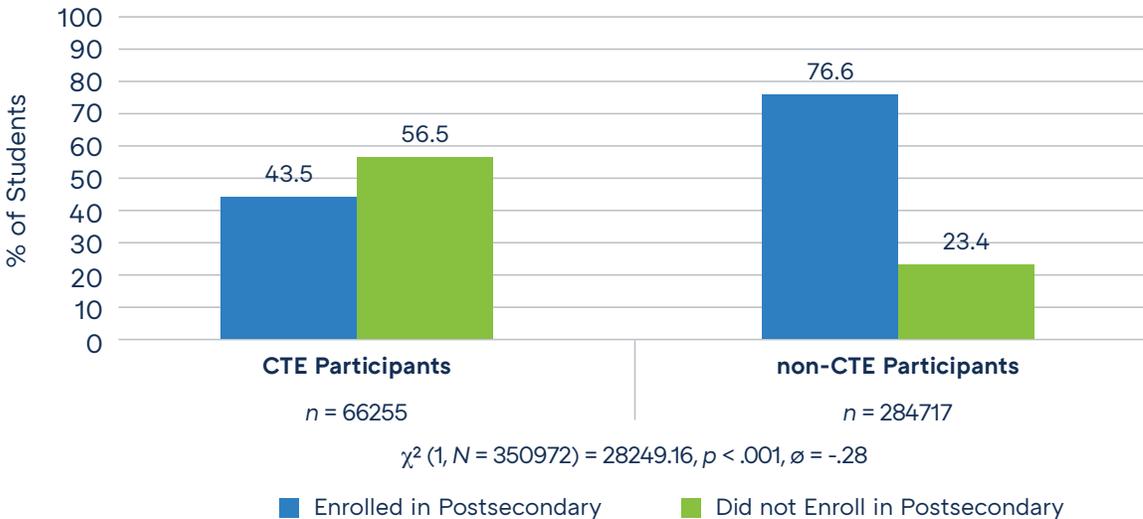
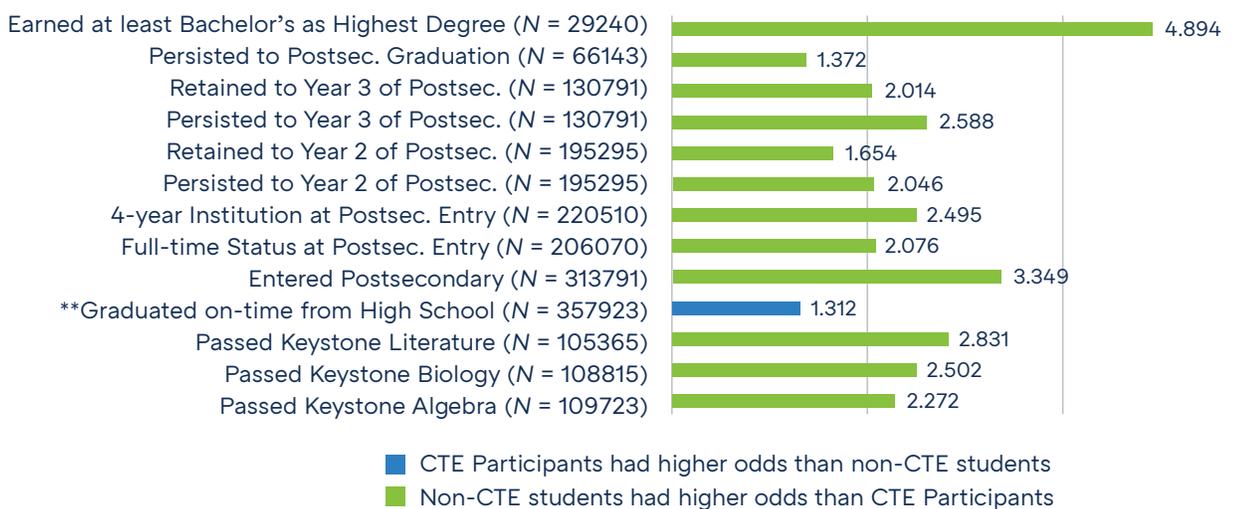


Figure 3 shows the odds of achieving each academic outcome by CTE participant status, according to the logistic regression analysis. Results confirm that although CTE participants had 1.312 times higher odds of graduating on-time from high school, non-CTE students had significantly higher odds than CTE participants of attaining all remaining outcomes. These results suggest that CTE students in PA are less likely to reach “traditional” milestones of postsecondary success, perhaps due to prioritizing early workforce entry.

**FIGURE 3: Odds Ratio (Exp(β)) for all Outcomes by CTE Participant Status**



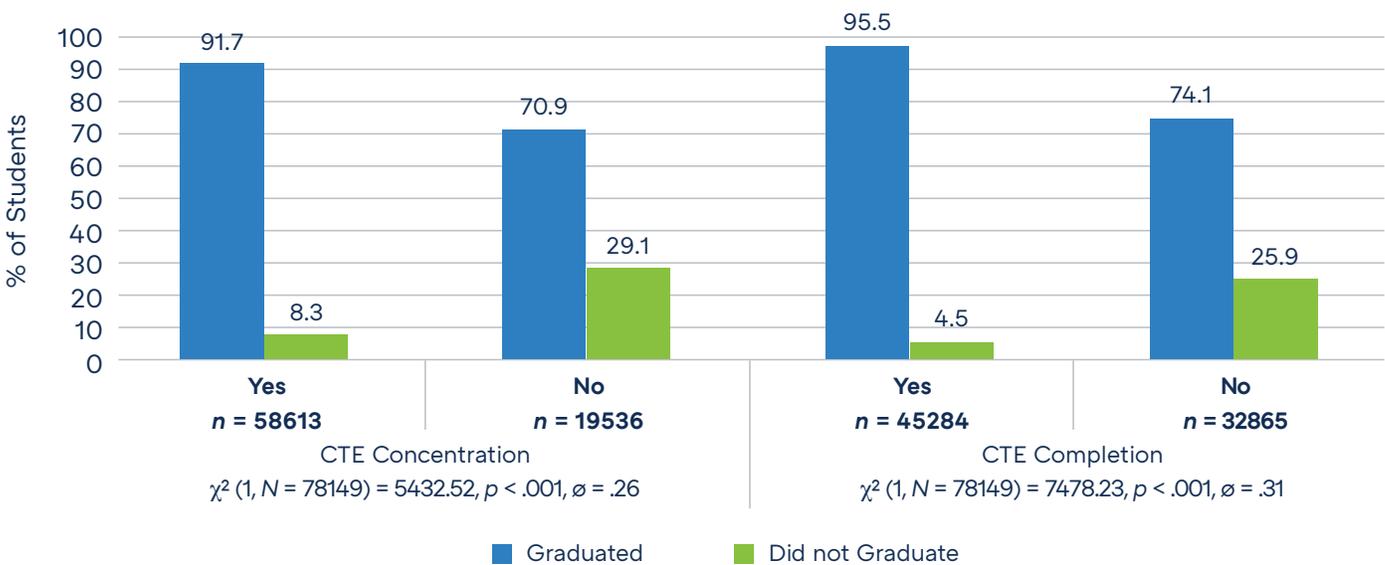
**Program Intensity:** CTE concentrators and CTE completers reached postsecondary milestones at lower rates than non-concentrators and non-completers.

Students who reached the threshold for CTE concentration or CTE completion had lower rates of postsecondary entry, full-time enrollment, 4-year institution entry, persistence and retention to years two and three of postsecondary, and college graduation compared to non-concentrators and non-completers. The effects of CTE concentration ( $\phi = -.21$ ) and CTE completion ( $\phi = -.26$ ) on the highest degree earned by CTE participants in PA were moderate; in fact, students who completed their program earned an associate/certificate as their highest degree at a significantly higher rate (58.1%) than those who did not (31.9%). This was confirmed by the logistic regression analysis, which found that CTE non-completers had 2.758 times higher odds of earning a bachelor's degree than CTE completers.

CTE non-completers had 2.758 times higher odds of earning a bachelor's degree than CTE completers.

However, CTE concentration and completion were associated with more positive outcomes on certain academic indicators in high school. CTE concentrators and CTE completers had slightly higher rates of Keystone Algebra exam passage. Although Keystone Biology and Literature exam performance did not differ significantly based on CTE concentration status, CTE completers passed these subject exams at slightly higher rates than non-completers. CTE concentration ( $\phi = .26$ ) and completion ( $\phi = .31$ ) even had moderate effects on the rate of on-time high school graduation. Figure 4 shows that CTE concentrators graduated on-time within four years at a significantly higher rate (91.7%) than non-concentrators (70.9%). In combination with results from the logistic regression, these findings suggest that students who progress along their CTE program sequences to these different intensity thresholds may have higher odds of high school graduation but lower odds of pursuing different postsecondary educational opportunities.

**FIGURE 12: On-time High School Graduation by CTE Concentration and Completion Status**



**Program characteristics:** *Although participation in at least one program characteristic during high school yielded higher rates of achievement in most academic outcomes, CTE participant outcomes differed depending on the individual program characteristics in which students participated.*

Students who participated in at least one CTE program characteristic during the course of their programs had slightly higher rates of the following outcomes compared to students who did not participate in these experiences: Keystone exam passage, on-time high school graduation, postsecondary entry, full-time enrollment, 4-year institution entry, persistence and retention to years two and three of postsecondary, and college graduation. The exception was highest degree earned, which was not associated with participation in at least one program characteristic.

Rather, participation in individual program characteristics (internship, cooperative work experience, job exploration, work-based experience, and postsecondary credit earning) was associated with varying academic outcomes. Earning postsecondary credit in high school was the only characteristic associated with higher bachelor's degree attainment. Participation in an internship, job exploration, work-based experience, and earning postsecondary credit in high school were all associated with more positive academic outcomes for CTE participants. The exception was cooperative work experience, in which participation was associated with lower rates of some outcomes (postsecondary enrollment, persistence and retention to year three). These results generally indicate that students who participate in CTE program characteristics are more likely to pursue postsecondary educational opportunities than those who do not, although outcomes vary by the type of characteristic.

Participation in an internship, job exploration, work-based experience, and earning postsecondary credit in high school were all associated with more positive academic outcomes for CTE participants.

## Conclusions

Career and technical education (CTE) in Pennsylvania offers extant educational opportunities for students interested in fast-tracking their careers. Understandably, it follows that CTE students pursue unique educational trajectories following secondary education. The findings presented herein indicate that students who participate in CTE programs pursue different educational opportunities than non-CTE students in Pennsylvania. Additionally, outcomes were found to vary depending on the intensity of CTE students' respective programs, such that students who persist along their program sequences are often less involved in traditional 4-year degree seeking opportunities. Finally, CTE students who take advantage of the various program characteristics (work-based experiences, internships, postsecondary credit earning, etc.) available to them often have higher odds of pursuing further postsecondary education. Pennsylvania students would likely benefit from schools offering as many CTE programs, and program characteristics, as feasible.

Students who participate in CTE programs pursue different educational opportunities than non-CTE students in Pennsylvania.

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