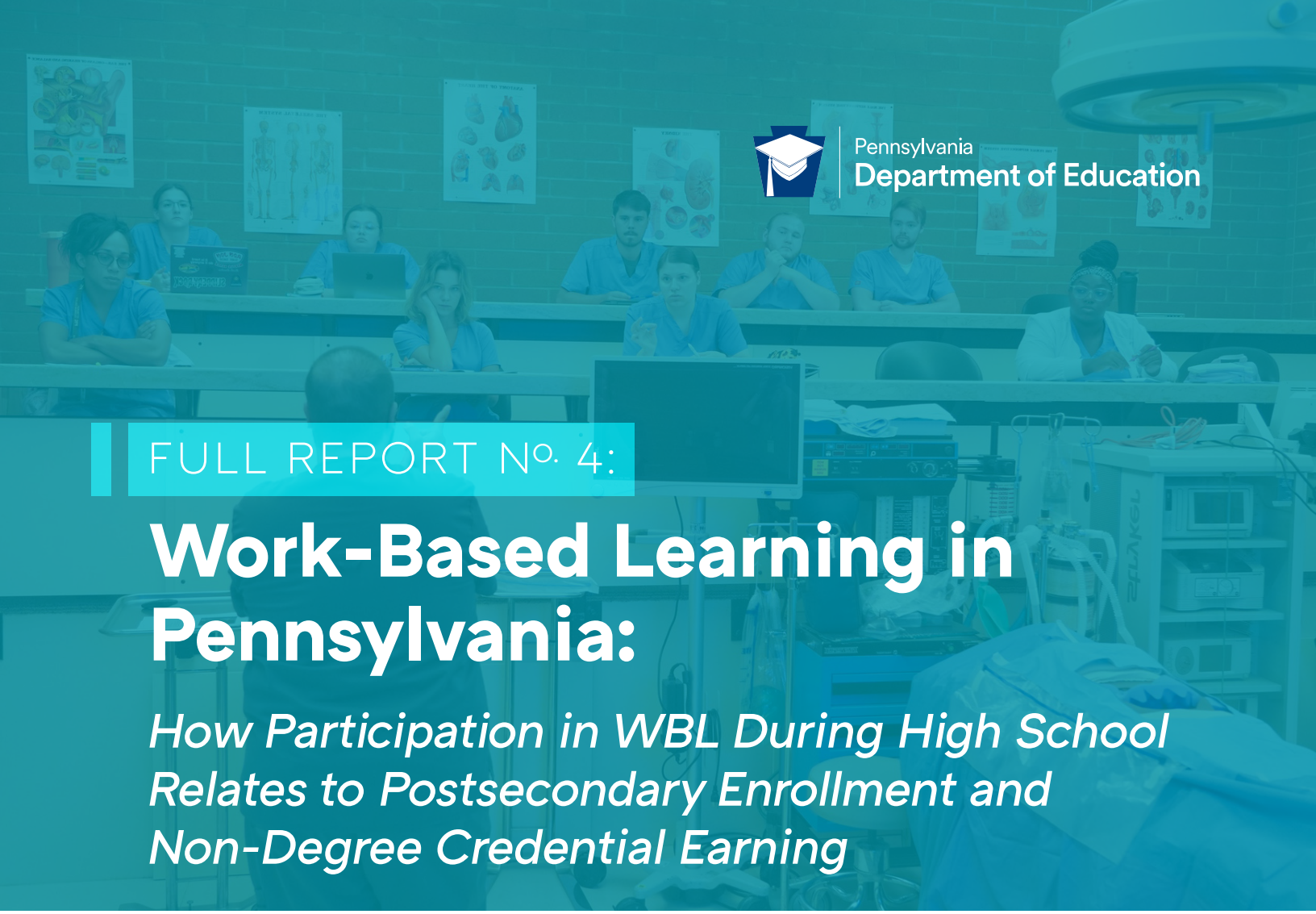

Pennsylvania
Department of Education

FULL REPORT NO. 4:

Work-Based Learning in Pennsylvania:

How Participation in WBL During High School Relates to Postsecondary Enrollment and Non-Degree Credential Earning

Candy M. Miller, Rosemary Riccardo, and Brian Hutchison

Pennsylvania Department of Education

Office of Administration

This report is the fourth in a series of research reports regarding work-based learning (WBL) in Pennsylvania (PA) secondary schools. This report focuses on inferential statistics for two cohorts of CTE and non-CTE high school graduates, investigating the role that participation in WBL plays in student outcomes.

Pennsylvania
Department of Education
Research and Evaluation

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ABSTRACT:

Secondary students in Pennsylvania (PA) can participate in work-based learning (WBL) opportunities both within career and technical education (CTE) programs and non-CTE academic tracks. The current study investigates whether participation in WBL by either avenue is associated with positive academic outcomes like postsecondary enrollment and non-degree credential earning. Two cohorts of PA high school graduates from the classes of 2019 (*N* = 121,895) and 2020 (*N* = 125,143) were followed from their last two years of high school to potential fall enrollment in a postsecondary institution. Binary logistic regression analyses modeled students' odds of achieving these outcomes depending on their participation in WBL, controlling for notable demographic characteristics. Results suggest that although participation in WBL is associated with positive outcomes in several cases, the relationship between WBL and student outcomes differs between the CTE and non-CTE student populations. These findings offer support for the potential of WBL to benefit student academic outcomes.

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KEY FINDINGS:

Full Cohort:

- Among the 247,038 students from the combined 2019 and 2020 high school graduating classes, 40,874 (16.5%) participated in some form of WBL opportunity during their junior and/or senior year.
- Students who participated in WBL during high school had almost 7% higher odds of enrolling in postsecondary education when compared to students who did not participate.
- Participation in WBL was not a significant predictor of students' likelihood of earning an industry-recognized credential (ICN) among the combined full graduate cohorts. However, note that significant associations were found between WBL participation and ICN earning when CTE and non-CTE student populations were examined separately (see below).
- CTE students had 24.26 times higher odds of earning an industry credential than non-CTE students.
- The full combined cohorts were then separated to CTE and non-CTE students to clarify the differential relationships between WBL and outcomes among these populations.

CTE students:

- Among the 44,913 CTE students followed for study, 16,036 (35.7%) participated in a WBL opportunity as part of their CTE program.
- Students who did *not* participate in WBL during their CTE program had 9% higher odds of enrolling in postsecondary than WBL participants.
- CTE students who participated in WBL had 43% higher odds of earning an industry-recognized credential (ICN) by graduation compared to non-participating CTE students.
- CTE students who participated in WBL had approximately 40% higher odds of earning an occupational competency certificate (OCC) via achievement on a NOCTI/NIMS credentialing test compared to other test-takers.
- Outcomes differed depending on the specific WBL opportunities in which students participated (see Table 2 in Appendix D). For example, among CTE WBL participants, internship participation was associated with significantly higher odds of postsecondary enrollment, ICN, and OCC earning, while students with agricultural experience had significantly lower odds of all outcomes.
- CTE students who participated in WBL during their senior year of high school had 18% higher odds of enrolling in postsecondary and over 2 times higher odds of earning an ICN compared to students who only participated during their junior year.

Non-CTE students:

- Among 202,125 non-CTE students, 23,511 (11.6%) participated in at least one WBL opportunity.
- Participation in WBL was associated with 15% higher odds of enrolling in postsecondary.
- Students who did *not* participate in WBL had almost two times higher odds of earning an industry credential.
- With each additional WBL opportunity in which non-CTE students participated, the odds of earning an industry credential increase by 21% among WBL participants.
- Participation in more WBL opportunities was not associated with odds of postsecondary enrollment beyond the initial benefit that participation in one WBL opportunity brings.

Summary:

Although participation in WBL is associated with positive outcomes in several cases, the relationship between WBL and student outcomes differs between the CTE and non-CTE student populations. The differences in outcomes between these groups suggest that CTE students may be less likely to prioritize postsecondary degrees in favor of more immediate term non-degree credentials and sooner workforce entry.

It is essential to better understand how WBL participation in high school is associated with Pennsylvania students' various educational outcomes, at both the high school and postsecondary level.

Literature

As defined by the Pennsylvania Department of Education (PDE), work-based learning (WBL) provides students with "an opportunity to reinforce their classroom learning, explore future career fields, and demonstrate their skills in a real-world setting" (Pennsylvania Department of Education, 2021-b). Work-based learning opportunities are beneficial not only for students who participate in career and technical education (CTE); through the blending of academic instruction and workforce preparation, well-integrated WBL opportunities provide unique benefits for students who participate in CTE and for those who do not (Zinth, 2018). For that reason, it is essential to better understand how WBL participation in high school is associated with Pennsylvania students' various educational outcomes, at both the high school and postsecondary level.

Driven by several high-priority questions from the PDE research agenda, the present study considered how participation in WBL during high school might be associated with outcomes like enrolling at a postsecondary institution or earning a non-degree credential (i.e., an industry-recognized credential (ICN) or occupational competency certificate (OCC)). Where possible, this project also investigated how these outcomes varied by the type of WBL opportunities (e.g., internships, job exploration, etc.) in which students engaged. This study serves as a direct companion piece to previous reports in this series on WBL in Pennsylvania (PA). Previous reports have documented descriptive statistics for both CTE and non-CTE students, investigated the relationship between career cluster and WBL participation, and depicted geographical differences in WBL participation across PA. The current study reports logistic regression findings modeling the likelihood of achieving the study's outcomes for CTE and non-CTE WBL participants while also investigating how engagement in multiple WBL opportunities might relate to student outcomes through an analysis of WBL "dosage". Finally, rather than only exploring academic outcomes at the postsecondary level, the present study included non-degree credential earning as an outcome of interest for Pennsylvanian students. Results were considered through the lens of Pennsylvania's various and diverse student groups to examine topics of equity by CTE student status and involvement in WBL.

Previous Findings from CTE Research in Pennsylvania

Key descriptive differences have been previously identified between CTE students and non-CTE students in Pennsylvania (Miller & Riccardo, 2021; Miller, Riccardo, & Hutchison, 2023-a). Demographically, a greater proportion of CTE participants in Pennsylvania were more likely to be male, experience economic disadvantage, have an individualized education plan (IEP), and attend rural high schools compared to non-CTE students. These demographic differences help to contextualize the observed differences in academic outcomes between these populations. Conversely, non-CTE students in PA were found to have higher odds of positive postsecondary outcomes when compared to CTE students, including postsecondary enrollment, persistence, retention, and degree completion. (Miller & Riccardo, 2021). Still, CTE participants had higher odds than non-CTE students of graduating on-time from high school (Miller & Riccardo, 2021), suggesting that although CTE students are less involved in postsecondary education, academic outcomes at the secondary level remain favorable. With these findings in mind, the present study expands analysis of academic outcomes to include both postsecondary enrollment and non-degree credential earning by the time of high school graduation, controlling for differences between student demographics.

The first report in this series on WBL in Pennsylvania (Miller, Riccardo, & Hutchison, 2023-a) provided descriptive statistics for two cohorts of high school graduates from 2019 and 2020, detailing rates of participation in WBL, postsecondary enrollment, and non-degree credential earning for the various student learner groups in Pennsylvania. Roughly 16% of students in both cohorts participated in some form of WBL opportunity by high school graduation. Non-CTE students were found to have higher rates of postsecondary enrollment (60.2%-63.8%) than CTE students (28.5%-31.2%); however, CTE students graduated with industry-recognized credentials at much higher rates (51.4%-55.8%) than non-CTE students (4.3%-6.2%). This descriptive report also detailed notable findings by career cluster and student demographics like gender, race/ethnicity, high school geographic locale, and EL, special education, and economic disadvantage statuses.

The second report (Miller, Riccardo, & Hutchison, 2023-b) investigated career cluster participation for CTE students in Pennsylvania, finding that certain CTE WBL opportunities were more or less frequently taken within specific career clusters. For instance, students in the Human Resources and Agriculture, Food, and Natural Resources career clusters were more likely to participate in WBL when compared to students in the STEM and Manufacturing, Sales, and Service career clusters. Additionally, approximately 10% of CTE students enrolled in a postsecondary Perkins Industry Credential (PIC) program, while over half of PIC earners enrolled in a postsecondary program that aligned to their high school CTE career cluster. More recently, the third report in this series (Miller, Riccardo, & Hutchison, 2023-c) highlighted geographic differences across Pennsylvania in WBL participation. Results showed that as a proportion of total CTE enrollments in the region, students in the Central/North Central region had the highest rate of participation in WBL (44.2%), while students in the Southeast region had the lowest (25.9%). The current study builds on these descriptive findings by utilizing data from the same cohorts of high school graduates to explore potential links between participation in WBL and student outcomes.

Study Objectives: WBL Types, Timing, Dosage, and Non-Degree Credential Earning

Pennsylvania's secondary CTE students engage in various forms of WBL experiences that are recognized by the PDE. These recognized WBL opportunities, defined in Appendix A, include internships, registered apprenticeships, simulated work environments, job exploration, school-sponsored enterprises, and cooperative work, agriculture, and work-based experiences. Recent research for the Commonwealth indicated that secondary CTE students who participate in these key WBL opportunities may have higher odds than their peers of achieving certain academic outcomes, such as graduating from high school and enrolling in postsecondary education (Miller & Riccardo, 2021).

Recent research for the Commonwealth indicated that secondary CTE students who participate in these key WBL opportunities may have higher odds than their peers of achieving certain academic outcomes, such as graduating from high school and enrolling in postsecondary education (Miller & Riccardo, 2021).

Considering the relative benefit for CTE students who engage in various kinds of WBL, the current research sought to expand analysis of WBL engagement to the non-CTE student population. The current project also expands upon Miller and Riccardo (2021) and previous reports in this series on WBL through an analysis of WBL timing and dosage. While no previous research related to WBL timing or dosage is available for Pennsylvania's students, a small number of studies have found academic benefits related to higher WBL dosage. For instance, Linnehan (2001) found that African American students who participated in WBL for a half-year or more had higher attendance rates and GPAs when compared to students who participated in WBL for less time. Therefore, it would be worth exploring at the state level whether the number of WBL opportunities and the grade in which students participate in WBL may also be associated with other educational outcomes, such as postsecondary enrollment and non-degree credential earning.

Another goal of the present research was to examine non-degree credential earning for both CTE and non-CTE students. Students in Pennsylvania secondary schools can prove skills competence by earning non-degree credentials by the time they graduate. CTE programs often lead to industry-recognized credentials (PIMS Manual Vol. 2, Appendix Q), which demonstrate to employers that student competencies align to workforce standards and the demands of the industry. Non-CTE students can also earn industry-recognized credentials, although data collection requirements are different for credentials earned outside of a CTE program. Likewise, expected high school graduates who qualify as CTE concentrators must take end-of-program assessments from the National Occupational Competency Testing Institute (NOCTI) or the National Institute for Metalworking Skills (NIMS) for federal accountability. Students who score at the advanced or competent level on the requisite components of these tests earn occupational competency certificates from PDE (Pennsylvania Department of Education, 2021-a). These non-degree credentials offer valuable alternatives for Pennsylvanian students who prioritize earlier workforce entry, making non-degree credential earning an outcome of interest for the current study.

Data Sources and Research Questions

The PDE recognizes that Pennsylvania's economic future is heavily tied to students' preparedness for a modern and competitive workforce. In recognition of the importance of work-based learning experiences for Pennsylvanian students, PDE has implemented a measurement tool for assessing students' industry and work-based learning experiences. Informed by Pennsylvania Information Management System (PIMS) data, the Industry-Based Learning Indicator is one of six College and Career Measures within Pennsylvania's public-facing school progress report, the Future Ready PA Index. The Industry-Based Learning Indicator displays the percentage of 12th graders (both CTE and non-CTE students) in a school who met at least one of the following criteria between grades 7 through 12: scored competent or advanced on an industry standards-based competency assessment such as the NOCTI or NIMS assessments, earned an industry-recognized credential, or completed a work-based learning experience (Pennsylvania Department of Education, 2021-b). Using the same sources of data, the current study explores a potential association between participation in WBL experiences and student outcomes like postsecondary enrollment and non-degree credential earning. Where appropriate, binary logistic regression analyses included elements related to WBL timing and dosage to examine their potential benefits for students' achievement of the study's outcomes.

The current study explores a potential association between participation in WBL experiences and student outcomes like postsecondary enrollment and non-degree credential earning.

With the methodologies and results of previous research in mind, the current study seeks to answer the following three research questions adapted from the PDE research agenda:

1. ***Is participation in WBL associated with postsecondary enrollment and/or earning an industry credential? What is the breakdown by CTE student status?***

2. ***Are CTE students who engage in CTE WBL opportunities more likely to enroll in postsecondary education or earn a non-degree credential than CTE students who do not engage in WBL?***

3. ***Are non-CTE students who engage in non-CTE WBL opportunities more likely to enroll in postsecondary education or earn a non-degree credential than non-CTE students who do not engage in WBL?***

Method

This project builds upon the sample, methodology, and findings from previous reports in this series. *Definitions for key variables and outcomes can be found in Appendix B.*

Two cohorts of Pennsylvanian high school graduates from the 2018-19 and 2019-20 school years (SYs) were included for analysis in the present study. All students were followed to potential postsecondary enrollment by October 1st in the fall semester after their high school graduation. A total of 121,895 students made up the graduating class of 2019, while 125,143 students were followed as part of the 2020 graduating class. All 247,038 students across both graduating classes attended a public Pennsylvania local education agency (LEA), Intermediate Unit (IU), public charter school, or public cyber charter school.

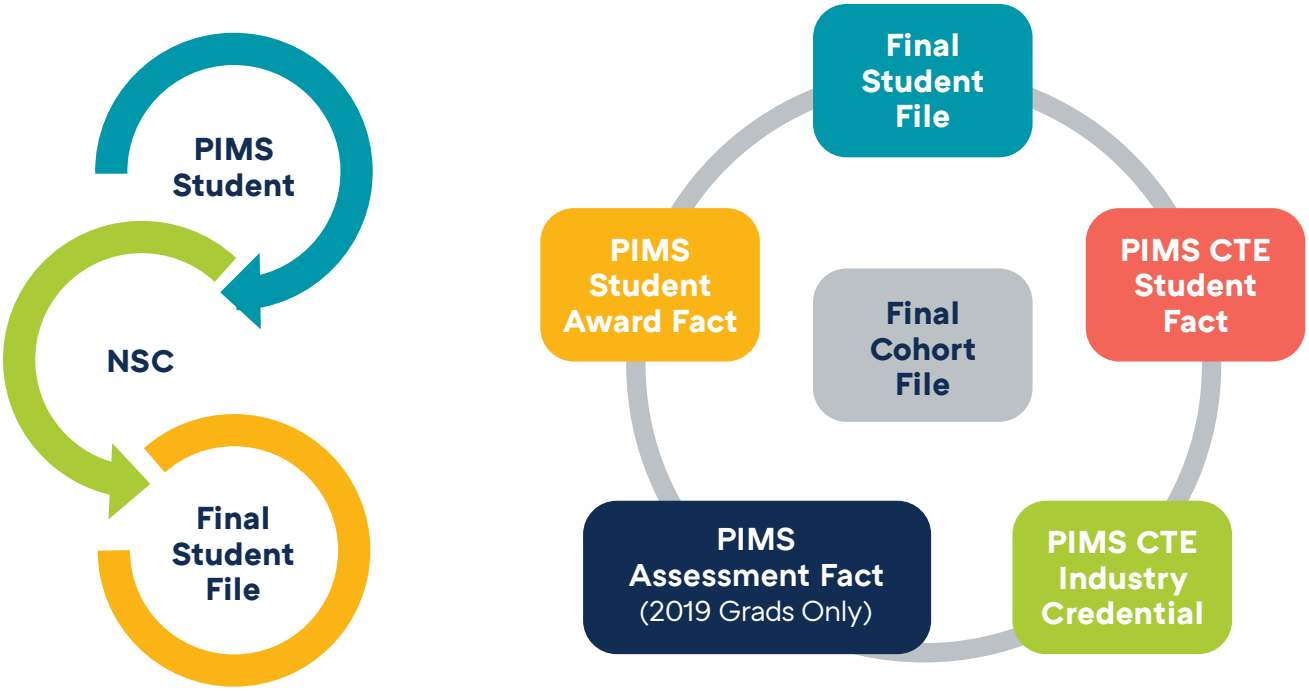
The present study was concerned with several outcomes for these cohorts of Pennsylvanian graduates: a) postsecondary enrollment by October 1st and b) earning a non-degree credential by high school graduation, defined as earning either an industry-recognized credential (ICN) or earning a PDE-awarded occupational competency certificate (OCC) for achievement on a National Occupational Competency Testing Institute (NOCTI) or National Institute for Metalworking (NIMS) credentialing test. These certificates include the Pennsylvania Skills Certificate and Pennsylvania Certificate of Competency. NOCTI/NIMS assessments were waived in 2020 due to COVID-19, limiting OCC analysis in the current study to the 2019 graduates. Note that for the current study, longitudinal analyses for both cohorts did not begin at the start of high school; instead, analyses began in students' assumed Grade 11, the year before their reported high school graduation. This decision was made to limit high school data to students' last two years of high school, when most students participate in WBL.

Research questions were answered through the analysis of several linked datasets from Pennsylvania's Information Management System (PIMS) and the National Student Clearinghouse (NSC) Student Tracker Services. PIMS data records were obtained for school years 2017-18 through 2019-20 and served as the source for all secondary-level student information. NSC records were obtained for the 2019-20 and the 2020-21 SYs to track students to potential postsecondary enrollment. The current study limited the timeframe for postsecondary enrollment to the fall after high school graduation, defined as October 1st of their graduating year according to the NSC enrollment date. Figure 1 displays the general linking procedure for both graduate cohorts.

Results from chi-square and logistic regression analyses are reported in three sections to account for differences in data between student populations. Section 1 evaluates outcomes for the full student populations of both graduate cohorts, including both CTE and non-CTE students. Regression analyses in this section model student outcomes by CTE student status and participation in any kind of WBL during high school (CTE WBL and/or non-CTE WBL). To allow for comparisons between CTE and non-CTE students, outcomes in Section 1 are

limited to postsecondary fall enrollment and ICN earning, as these outcomes could be tracked for both populations. Section 2 limits both graduate cohorts to only CTE students. Analyses in this section model the odds of a CTE student achieving the following outcomes, based on their involvement in CTE WBL: enrolling in postsecondary by fall, earning a CTE ICN, and earning an OCC via achievement on a NOCTI/NIMS test. Finally, Section 3 limits analysis to only non-CTE students from both cohorts, modelling the role of non-CTE WBL in student outcomes like postsecondary fall enrollment and non-CTE ICN earning. All models control for significant program-, school-, and student-level characteristics.

FIGURE 1. Data File Linking Procedure



Note: The merging process was performed twice: once for the high school graduates of 2019 and a second time for the graduates of 2020.

Results

SECTION 1:
All Graduates of 2019 and 2020

Is participation in WBL associated with postsecondary enrollment and/or earning an industry credential? What is the breakdown by CTE student status?

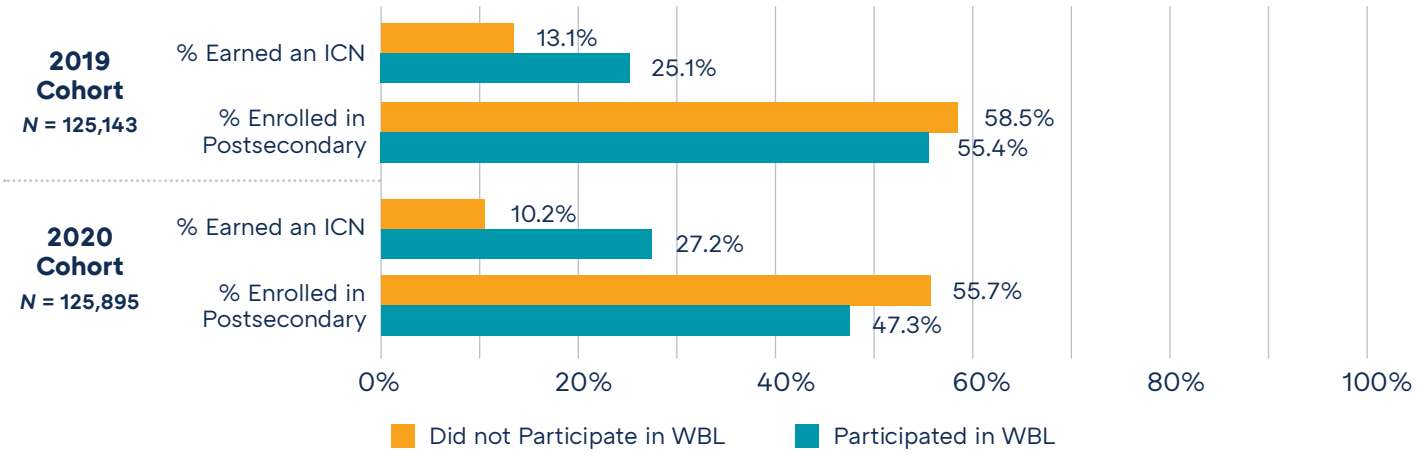
Chi-Square Results

Chi-square analyses related to this research question first explored the relationship between participation in WBL (inside or outside of CTE) and student outcomes, such as postsecondary enrollment and ICN earning. Figure 2 shows that for the graduates of 2020, although the effect was small, students who participated in any form of WBL during high school were significantly less likely to enroll in postsecondary (47.3% versus 55.7%) than students who did not participate in WBL (x^2 (1, N = 125,895) = 479.74, p < .001, φ = -.06). For the 2019 cohort, the direction of this relationship was significant and in the same direction (55.4% versus 58.5%), although the phi association was very small (x^2 (1, N = 125,143) = 67.75, p < .001, φ = -.02).

However, for both full graduate cohorts, students who participated in WBL earned industry credentials at significantly higher rates than students who did not. Graduates from the 2020 cohort who participated in WBL were significantly more likely to earn an ICN (27.2% versus 10.2%) when compared with students who did not participate in WBL (x^2 (1, N = 121,895) = 4,252.09, p < .001, φ = .19). This association between WBL participation and ICN earning was also significant for the graduates of 2019 (25.1% versus 13.1%), albeit with a smaller effect (x^2 (1, N = 125,143) = 1,983.94, p < .001, φ = .13). These analyses suggest that outcomes like postsecondary enrollment and ICN earning may be related to student participation in WBL; although, results from logistic regression analyses will provide further clarification on these relationships, controlling for other student demographics.

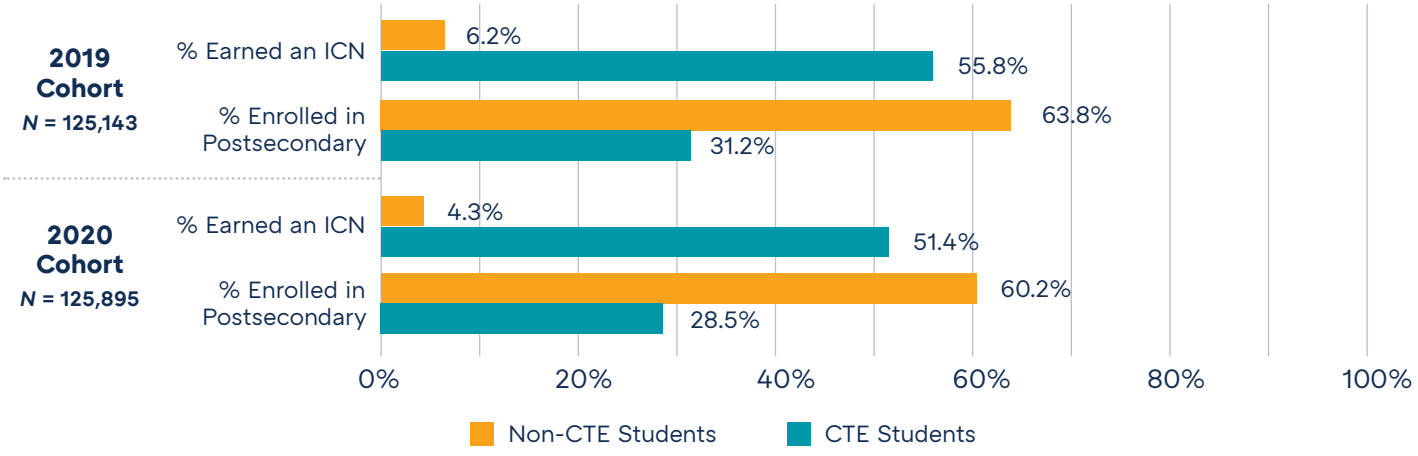
These analyses suggest that outcomes like postsecondary enrollment and ICN earning may be related to student participation in WBL; although, results from logistic regression analyses will provide further clarification on these relationships, controlling for other student demographics.

FIGURE 2. Postsecondary Enrollment and ICN Earning by Participation in WBL:
Full 2019 and 2020 Graduate Cohorts



Next, chi-square statistical tests were used to examine how student outcomes differed by CTE student status. Figure 3 shows that for the graduates of 2019, CTE students were significantly less likely to enroll in postsecondary education (31.2% versus 63.8%) compared to non-CTE students (x^2 (1, N = 125,143) = 8,006.07, p < .001, φ = -.25). This small-to-moderate effect was similar for the 2020 graduates (x^2 (1, N = 121,895) = 7,422.79, p < .001, φ = -.25), indicating that across both cohorts, students who participated in a CTE program were less likely to enroll in postsecondary by the fall after high school graduation. In contrast, Figure 3 shows that CTE students from both cohorts earned industry credentials at significantly higher rates than non-CTE students. Among the 2019 cohort, only 6.2% of non-CTE students earned an ICN by high school graduation, compared to over half (55.8%) of CTE students (x^2 (1, N = 125,143) = 35,394.84, p < .001, φ = .53). The difference in ICN rates was similar in the 2020 graduating class with a significant and slightly larger effect (x^2 (1, N = 121,895) = 35,999.83, p < .001, φ = .54). These analyses highlight the raw differences in outcomes for CTE versus non-CTE students in the present cohorts. The following logistic regression analyses will consider these associations in context, holding other factors constant.

FIGURE 3. Postsecondary Enrollment and ICN Earning by Participation in WBL:
Full 2019 and 2020 Graduate Cohorts



Logistic Regression Results

A series of logistic regression analyses modeled the relationships between WBL participation and outcomes like postsecondary enrollment and ICN earning. All models controlled for available student- and school-level characteristics, although the final models (tabled in Appendix C) report only those which remained significant at the 5% level in the context of other variables.

Postsecondary Enrollment

Table 1 in Appendix C displays the individual variables that were significantly associated with postsecondary enrollment, as well as those that remained significant in the final model at the 5% level. The odds ratio (Exp(ß)) column refers to the odds of each outcome occurring depending on each independent variable status. After controlling for other variables in the final model, students who participated in WBL had slightly higher odds (Exp(ß) = 1.069) of enrolling in postsecondary when compared to students who did not participate in WBL. Additionally, regarding differences in postsecondary enrollment by CTE student status, non-CTE students had 3 times higher odds (Exp(ß) = 3.012) than CTE students of enrolling in postsecondary. These findings suggest that among the full graduate student cohorts, participation in any form of WBL is associated with slightly higher odds of postsecondary enrollment, while non-CTE students had notably higher odds of postsecondary enrollment compared to CTE students.

Participation in any form of WBL is associated with slightly higher odds of postsecondary enrollment, while non-CTE students had notably higher odds of postsecondary enrollment compared to CTE students.

Industry Credential Earning

A second logistic regression analysis modeled industry credential earning by participation in WBL and CTE student status (Appendix C, Table 2). Importantly, participation in WBL was not significantly associated with ICN earning (p = .657). Meanwhile, CTE students had 24.269 times higher odds (Exp(ß) = 24.269) than non-CTE students of earning an ICN, even after accounting for other student characteristics in the model. Although WBL participation was not significantly associated with ICN earning after controlling for the meaningful impact of CTE student status and other student demographics, analyses discussed in Sections 2 and 3 will explore this association within the CTE and non-CTE student groups.

SECTION 2:
CTE Students Only

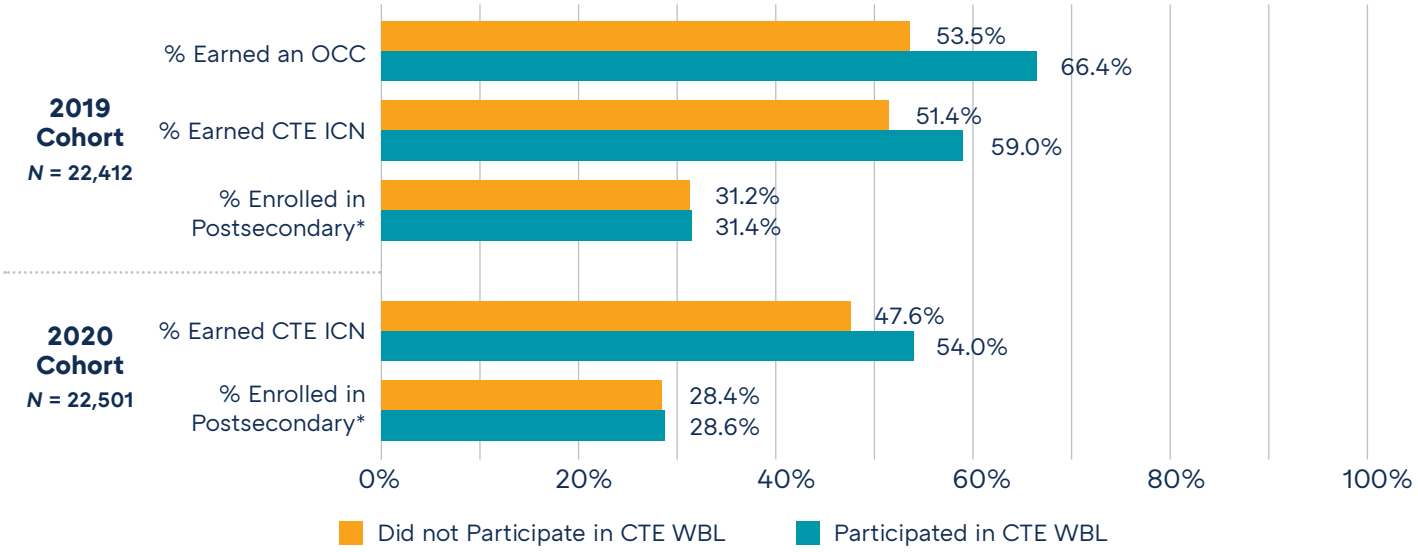
While the previous section examined associations between variables for all students in the 2019 and 2020 graduating classes, analyses were also conducted separately for CTE and non-CTE students. This decision was made because PIMS data related to WBL and industry credentials are reported and stored separately for CTE and non-CTE students, with notable differences between data sources. This discrepancy in the data potentially limits the ability to make generalized conclusions about WBL and student outcomes. In order to engage with the particularities of each data source, analyses in Section 2 are limited to CTE students only. While non-CTE student analyses are reported in Section 3, Table 2 in report 1 of this series descriptively breaks down characteristics for CTE and non-CTE students distinctly, including key demographic factors and levels of WBL engagement for each population (Miller, Riccardo, & Hutchison, 2023-a). Percentages reported in text are for the 2019 and 2020 cohorts, respectively (2019% - 2020%).

Are CTE students who engage in CTE WBL opportunities more likely to enroll in postsecondary education or earn a non-degree credential than CTE students who do not engage in WBL?

Chi-Square Results

Using chi-square analyses, associations between participation in CTE WBL and the project's outcomes of interest were examined. For both the graduating classes of 2019 and 2020, no significant association was found between CTE WBL participation and college enrollment. However, the relationship between participation in CTE WBL and ICN earning was significant for both cohorts; Figure 4 shows that CTE students in both cohorts who participated in WBL were more likely to earn an ICN (59% - 54%) than CTE students who did not participate in WBL during their program (47.6% - 51.4%). The phi association of this relationship was significant but small for both cohorts (x^2 (1, N = 22,412) = 114.58, $p < .001$, $\varphi = .07$; x^2 (1, N = 22,501) = 89.59, $p < .001$, $\varphi = .06$). Students who participated in CTE WBL were also significantly more likely to earn an OCC (66.4%) via achievement on a NOCTI/NIMS assessment when compared to CTE students who did not participate in CTE WBL (53.5%). This relationship, also depicted in Figure 4, showed a small effect (x^2 (1, N = 22,412) = 332.71, $p < .001$, $\varphi = .12$). This finding suggests that, among the full CTE population, there may be a relationship between participation in WBL and earning an OCC. This warrants further investigation into which other programmatic elements may be associated with OCC achievement, which is explored next in the logistic regression analyses. It should also be noted that while these analyses look at the full CTE student population, outcomes and WBL participation differ meaningfully between career clusters/CTE programs. See Table 1 in Appendix D for a chi-square breakdown by career clusters.

FIGURE 4. Postsecondary Enrollment, ICN, and OCC Earning by Participation in CTE WBL: *2019 and 2020 CTE Students Only*



No statistically significant difference

Logistic Regression Results

A series of logistic regression models estimated the effects of participation in CTE WBL on three separate outcomes of interest for CTE students: postsecondary enrollment, industry credential (ICN) earning, and occupational competency certificate (OCC) earning. An OCC describes a PA certificate earned through successful completion and achievement on a NOCTI or NIMS (National Institute for Metalworking Skills) credentialing test.

Two logistic regression models examined each outcome of interest, controlling for significant student demographic characteristics. The first model estimated the odds of achieving the outcome, based on participation in any CTE WBL, for the full CTE student cohort. The second model restricted the population to only CTE WBL participants and described the effect of specific CTE WBL opportunities on the outcome (summarized in Table 2 in Appendix D). This method allows for the effects of both general participation in CTE WBL and specific WBL opportunities to be considered independently, creating a more complete picture of how CTE WBL might be associated with academic outcomes.

Additionally, the timing of WBL participation was considered for analyses modeling outcomes for only CTE WBL participants. While dosage data was not readily available for CTE students, timing of participation in WBL (junior vs. senior year) may provide additional insight into how WBL participation is associated with the study's outcomes. Final models include all variables that remained significant at the 5% level within the context of other explanatory variables (found in Appendix C). A list and explanation of all CTE WBL opportunities can be found in Appendix A. Note that the apprenticeship opportunity was not included in these models due to an overall small number of students who participated in the opportunity during the years studied.

Postsecondary Enrollment

First, a binary logistic regression analysis was used to examine the association between general participation in CTE WBL and postsecondary enrollment (Appendix C, Table 3). Results showed a small but significant negative effect for participation in any kind of CTE WBL; non-participants in WBL had approximately 9% higher odds (Exp(ß) = 1.085) of enrolling in postsecondary education compared to CTE WBL participants.

The second logistic regression model, conducted amongst only CTE WBL participants (Appendix C, Table 4), examined the effects of participation in specific CTE WBL opportunities on postsecondary enrollment. Results showed that students who participated in an internship opportunity had 53% higher odds of enrolling in postsecondary compared to students who participated in other opportunities. However, non-participants in cooperative work, job exploration, agriculture, and school-sponsored enterprise experiences had higher odds of enrolling in postsecondary education compared to participants in these opportunities (36%, 11%, 12%, and 31% higher odds, respectively). Additionally, students who participated in CTE WBL during their senior year had 18% higher odds of enrolling in postsecondary compared to those who only participated during their junior year, indicating a significant effect for the timing of WBL participation. Overall, participation in CTE WBL is associated with slightly lower odds of postsecondary enrollment and this conclusion is supported by the second model's finding that of all WBL opportunities, participation in all but internships is associated with lower odds of postsecondary enrollment.

Overall, participation in CTE WBL is associated with slightly lower odds of postsecondary enrollment.

Industry Credential (ICN) Earning

Two additional logistic regression models examined the associations between participation in CTE WBL and ICN earning. The first model found that, among the full CTE student population, WBL participants had approximately 43% higher odds of earning an ICN when compared to non-participants (Appendix C, Table 5). This result indicates a substantial benefit to industry-credential earning for students who participate in WBL during their CTE program.

The second logistic regression model (for CTE WBL participants only) estimated the relationship between participation in specific CTE WBL opportunities and ICN earning (Appendix C, Table 6). Results showed that participation in the following three CTE WBL opportunities was associated with higher odds of earning an ICN compared to participation in other opportunities: cooperative work, internships, and job exploration (1.45, 1.43, and 1.66 times higher odds, respectively). However, non-participation in agriculture experiences, school sponsored enterprises, and work-based experiences was associated with higher odds of earning an ICN (2.45, 1.19 and 3.37 times higher odds, respectively) compared to participation in these opportunities. Across all opportunities, students who participated in CTE WBL during their senior year had 2.34 times higher odds of earning an ICN compared to students who only participated in WBL during their junior year.

Occupational Competency Certificate (OCC) Earning – 2019 Cohort Only

Next, two logistic regression models examined the potential associations between participation in CTE WBL and CTE students' odds of earning an OCC for achievement on a NOCTI/NIMS end-of-program credentialing test. Analyses for this outcome were limited only to NOCTI/NIMS test-takers, meaning that results model the odds of a student earning an OCC given that they took the test. Note that not all CTE students take a NOCTI or NIMS assessment; Appendix D details differences in alignment between career cluster pathways and NOCTI/NIMS test-taking. The first model was conducted for the full 2019 cohort of CTE students who took a NOCTI/NIMS test (Appendix C, Table 7). The results indicated that participation in CTE WBL was associated with 39% higher odds of earning an OCC when compared with non-participants who took the test, holding other demographics factors constant. This suggests a potential benefit to test achievement for WBL participants compared to their non-participating peers.

The second model reduced the population to only CTE WBL participants from the 2019 graduate cohort who took a NOCTI or NIMS credentialing test (Appendix C, Table 8). Results from this model estimate that participation in cooperative work experiences and internships was associated with significantly higher odds of earning an OCC (76% and 68%, respectively) compared to participants in other types of WBL opportunities. Particularly, students who participated in opportunities other than agriculture experiences had 2.37 times higher odds of earning an OCC than participants in agriculture experiences. Notably, there was no significant effect of timing (participation during junior vs. senior year) for CTE WBL participation on OCC earning. These findings clarify the respective relationship between test-takers' participation in individual WBL opportunities and NOCTI/NIMS achievement, considering the previously noted positive effect of WBL participation during CTE. The full model, with all significant student characteristics included, can be found in Appendix C, Table 8.

SECTION 3:
Non-CTE Students Only

Are non-CTE students who engage in non-CTE WBL opportunities more likely to enroll in postsecondary education or earn a non-degree credential than non-CTE students who do not engage in WBL?

This section compares outcomes for two cohorts of non-CTE student graduates, broken down by their participation in WBL during the last two years of high school. Outcomes of interest for the non-CTE population include postsecondary enrollment (by Oct 1 following high school graduation) and industry credential earning by high school graduation. Data for non-CTE students relied on a different PIMS collection than the CTE population, called the Student Award Fact Template for Industry-Recognized Credentials and Work-Based Learning Experiences for Non-CTE Students. Although CTE students can appear in the Student Award Fact template if they either earned an industry credential or participated in WBL outside of an approved CTE program, *this section presents data for the non-CTE population only.* This section does not explore occupational competency certificate (OCC) earning as an outcome for non-CTE students, as NOCTI/NIMS tests are typically end-of-CTE-program assessments with very low rates of participation among the non-CTE population (n = 40 in 2019 cohort). Also note that certain key demographic differences and findings for non-CTE students are reported in report 1 of this series.

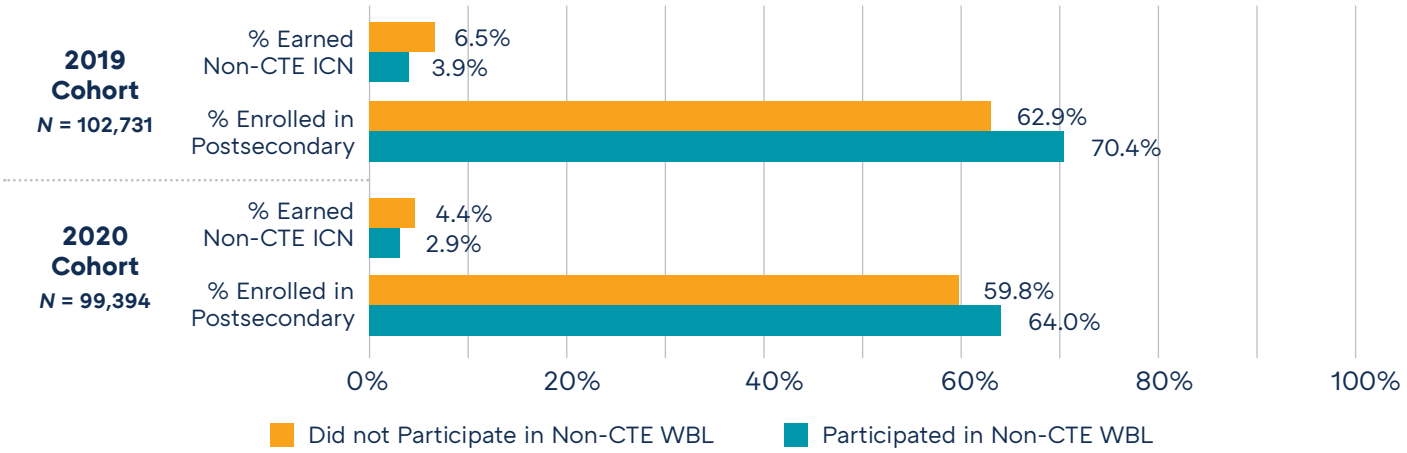
This section does not explore occupational competency certificate (OCC) earning as an outcome for non-CTE students, as NOCTI/NIMS tests are typically end-of-CTE-program assessments with very low rates of participation among the non-CTE population.

Chi-Square Results

Figure 5 presents the results of the chi-square analyses comparing postsecondary enrollment and industry credential earning for the non-CTE student populations, based on their participation in non-CTE WBL during the last two years of high school. A majority of non-CTE students in both cohorts enrolled in postsecondary by Oct 1 following their high school graduation, regardless of whether they participated in WBL. Still, the chi-square results indicated that non-CTE students who participated in WBL had slightly higher rates of enrollment than non-CTE students who did not participate in WBL. The 2019 cohort had the greatest difference, with 70.4% of non-CTE WBL participants ultimately enrolling in postsecondary compared to 62.9% of non-participants in WBL (x^2 (1, N = 102,731) = 282.06, p < .001, φ = .05). The association between WBL participation and postsecondary enrollment was similarly small for the 2020 cohort (x^2 (1, N = 99,394) = 69.44, p < .001, φ = .03).

In contrast, the rate of industry credential earning among the overall non-CTE population was very low for both the 2019 (6.2%) and 2020 cohorts (4.3%), even before considering their participation in non-CTE WBL. Chi-square results in Figure 5 suggest that non-CTE students who participated in WBL earned industry credentials at even lower rates than students who did not participate in WBL. Although these results are statistically significant for both the 2019 (x^2 (1, N = 102,731) = 134.06, p < .001, φ = -.04) and 2020 cohorts (x^2 (1, N = 99,394) = 58.48, p < .001, φ = -.02), the very small difference in proportions suggests these small associations may not be meaningful. The logistic regression analysis in this section will clarify and interpret these differences in context.

FIGURE 5. Postsecondary Enrollment and ICN Earning by Participation in Non-CTE WBL: ***2019 and 2020 Non-CTE Students Only***



What "dosage" of non-CTE WBL is meaningful?

Next, analyses explored whether there is a "dosage" or amount of WBL (outside the realm of CTE) that is meaningfully associated with outcomes for the non-CTE student population in Pennsylvania. Dosage variables for non-CTE students differ from the timing elements used in the previous analyses section in key ways. Unlike the CTE Student Fact template, data used for analysis from the Student Award Fact Template for Industry-Recognized Credentials and Work-Based Learning Experiences for Non-CTE Students reports all WBL opportunities that non-CTE students participated in during their last two years of high school. Therefore, a continuous measurement of non-CTE WBL dosage was compiled and used for relevant analyses in the following section. Table 1 below shows that although the majority of the combined cohorts did not participate in WBL (88.4%), over 11% of non-CTE students participated in at least one WBL opportunity.

TABLE 1. Non-CTE WBL Continuous Dosage by Cohort

	Number of Non-CTE WBL Opportunities Taken													
	0		1		2		3		4		5+		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
2019 Cohort	89,776	87.4	11,359	11.1	1,121	1.1	363	0.4	53	0.1	59	0.0	102,731	100.0
2020 Cohort	88,838	89.4	8,534	8.6	1,555	1.6	368	0.4	65	0.1	34	0.0	99,394	100.0
Total	**178,614**	**88.4**	**19,893**	**9.8**	**2,676**	**1.3**	**731**	**0.4**	**118**	**0.1**	**93**	**0.0**	**202,125**	**100.0**

Note: Participation in 5+ opportunities was combined in table to mask low cell counts.
Maximum number of Non-CTE WBL opportunities taken by students was 12.

Logistic Regression Results

Binary logistic regression analyses examined the associations between non-CTE WBL participation and two outcomes of interest: postsecondary enrollment and non-CTE ICN earning. A total of four models were created to assess how participation in and dosage of non-CTE WBL opportunities might be related to both outcomes, while holding other student demographic characteristics constant. First, analyses for the full non-CTE student population modeled the odds of each outcome for WBL participants compared to non-participants. Next, the population was reduced to non-CTE WBL participants so that the effect of WBL dosage could be addressed. This was done to account for the fact that the majority of non-CTE students did not participate in WBL, and dosage analysis for the entire non-CTE population would be heavily skewed in the negative direction. Together, these analyses illustrated how participation in WBL and WBL dosage are related to postsecondary enrollment and non-CTE ICN earning, allowing for a more thorough exploration of the potential benefits of participation in non-CTE WBL. The final models include all variables that remained significant at the 5% level within the context of other explanatory variables (Appendix C).

Postsecondary Enrollment

Table 9 in Appendix C displays the final logistic regression model for the full non-CTE student cohorts, which models the association between participation in non-CTE WBL and postsecondary enrollment. Holding all student demographic factors constant, students who participated in a WBL experience had 15% higher odds (Exp(ß) = 1.151) of enrolling in postsecondary when compared to students who did not participate in WBL.

Additionally, Table 10 in Appendix C shows the final model measuring the association between WBL dosage, measured as the number of non-CTE WBL opportunities in which students participated, and postsecondary enrollment. Focusing only on non-CTE WBL participants, there was no significant relationship between WBL dosage and postsecondary enrollment, while holding other student factors constant. Taken together, these two models suggest that while participation in at least one non-CTE WBL opportunity is associated with higher rates of postsecondary enrollment, participation in more WBL opportunities is not associated with changes in postsecondary enrollment.

Non-CTE Industry Credential (ICN) Earning

Two additional logistic regression models examined the associations between participation in non-CTE WBL and non-CTE industry credential (ICN) earning. First, Table 11 in Appendix C shows the final model for the full non-CTE student population. Results indicated that non-CTE students who did not participate in WBL had approximately 2 times higher odds (Exp(ß) = 1.929) of earning an ICN when compared to WBL participants. Note that there is a disproportionate number of positive cases of the outcome in the data (only 5% of 202,125 non-CTE students earned an ICN). Likewise, only 11.6% of non-CTE students participated in WBL, a substantial number of students (*n* = 23,511) but small percentage of the student population compared to non-participants.

Additionally, the second model reduced the population to non-CTE WBL participants only (*n* = 23,511) to examine the association between WBL dosage and ICN earning (Appendix C, Table 12). The model estimates that WBL participants had 33% higher odds of earning an ICN with each additional WBL opportunity that was taken. This finding indicates potentially positive effects for industry credential achievement as non-CTE students participate in higher numbers of WBL opportunities.

Discussion

This study is the fourth report in a series on work-based learning (WBL) in Pennsylvania secondary schools. The series followed two cohorts of high school students from the graduating classes of 2019 (*N* = 121,895) and 2020 (*N* = 125,143) to potential postsecondary enrollment by Oct 1 of their graduating year. Binary logistic regression modeled the relationships between participation in WBL and outcomes like postsecondary enrollment and non-degree credential earning (e.g., earning an industry-recognized credential or a PDE-awarded occupational competency certificate for achievement on a NOCTI/NIMS credentialing test), controlling for other student- and program-level demographic variables. Analyses spanned three stages and are discussed below in turn: first, the full graduate cohorts; second, only CTE students; and last, non-CTE students only.

Full Graduate Cohorts

Results for the full graduating cohorts suggest that, holding other demographic variables constant, students who participate in WBL during high school have 1.069 times higher odds of enrolling in postsecondary than non-participants. Despite being a relatively small potential effect, this finding suggests that participation in any WBL opportunity (inside or outside of a CTE program) may be associated with slightly higher levels of postsecondary enrollment for students, even after controlling for differences by CTE student status and other significant predictors (listed in Appendix C). Notably, non-CTE students were found to have three times higher odds of enrolling in postsecondary than CTE students. Previous literature on WBL in Pennsylvania has tended to focus on opportunities taken within CTE programs, given the more robust WBL data for CTE students compared to non-CTE students. As such, this finding is a strength of the current study, as it speaks to the potential of WBL opportunities in general to benefit students from both populations.

In contrast, among the full graduating population, participation in WBL was not found to be a significant predictor of earning an industry-recognized credential (ICN). However, the final model estimated that CTE students had 24.26 times higher odds of earning an industry credential than non-CTE students. This finding is consistent with previous research in this WBL series (Miller, Riccardo, & Hutchison, 2023-a), as CTE students in the combined cohorts earned industry credentials at a meaningfully higher rate (53.6%)

than non-CTE students (5.3%). Although WBL was not a significant predictor of ICN earning among the full cohorts, WBL was found to be differentially associated with this outcome for the CTE or non-CTE student populations individually. The following sections clarify this finding for the respective student populations.

CTE Students Only

CTE students from the combined cohort (*N* = 44,913) were analyzed separately to isolate the differential effect of WBL for this student population. Holding other student demographic characteristics constant, students who participated in at least one WBL opportunity during their CTE program had lower odds of enrolling in postsecondary than non-participants. As previously discussed, CTE students in general have lower odds of postsecondary enrollment compared to non-CTE students. This finding suggests that, even among other CTE students, participants in WBL opportunities are even less likely to pursue a postsecondary pathway within the timeframe of this study. However, CTE students who participated in WBL had 43% higher odds of earning an industry-recognized credential (ICN) by graduation. Given that CTE students generally earn these credentials at much higher rates than non-CTE students, it is notable that participation in WBL is associated with even higher odds of earning an ICN for this population. These findings are consistent with previous literature, suggesting that CTE students are less likely to prioritize postsecondary degrees in favor of more immediate term non-degree credentials and sooner workforce entry (Miller & Riccardo, 2021).

However, CTE students who participated in WBL had 43% higher odds of earning an industry-recognized credential (ICN) by graduation. Given that CTE students generally earn these credentials at much higher rates than non-CTE students, it is notable that participation in WBL is associated with even higher odds of earning an ICN for this population. These findings are consistent with previous literature, suggesting that CTE students are less likely to prioritize postsecondary degrees in favor of more immediate term non-degree credentials and sooner workforce entry (Miller & Riccardo, 2021).

Many CTE students (*n* = 15,740) take a NOCTI/NIMS credentialing test at the end of their CTE programs. Students who achieve a proficient or advanced score on these tests receive a PDE-awarded certificate, referred to herein as an occupational competency certificate (OCC). Logistic regression results indicated that, among NOCTI/NIMS test-takers, CTE students who participated in WBL had about 40% higher odds of earning an OCC. While students in certain CTE programs are more likely to take a NOCTI/NIMS test as an end-of-program assessment, this finding is notable because it suggests that, among students who take these assessments, participation in

WBL is associated with higher achievement. These combined results point to the potential of WBL having a positive effect on outcomes like non-degree credential earning among the CTE population.

Separately, logistic regression analyses modeled the respective odds of postsecondary enrollment, ICN, and OCC earning for CTE WBL participants only. Doing so allowed for a deeper investigation of which kinds of WBL opportunities are associated with significantly higher or lower odds of these outcomes (Table 2 in Appendix D). Participation in internships was associated with higher odds of postsecondary enrollment, ICN, and OCC earning. School-sponsored enterprise was associated with lower odds of postsecondary enrollment and ICN earning but was not related to OCC earning. Work-based experiences were only related to ICN earning, such that students with these experiences had lower odds of earning an ICN. Participation in a cooperative work experience was associated with higher odds of ICN and OCC earning. Job exploration was associated with higher odds of earning an ICN but was not significantly related to OCC earning. Students with agricultural experience had lower odds of all outcomes. These results highlight how participation in specific WBL opportunities is related to the outcomes of interest in very different ways.

It is important to note that, although analyses in this section looked at the full CTE student population, there are likely notable differences between career clusters.

It is important to note that, although analyses in this section looked at the full CTE student population, there are likely notable differences between career clusters. A previous report in this series found that WBL opportunities are more often taken in some CTE programs than others (Miller, Riccardo, & Hutchison, 2023-b). Likewise, Table 1 in Appendix D details how participation in the various WBL opportunities is differentially related to the outcomes of interest depending on the CTE program or career pathway in which students were enrolled. Future research should disaggregate the CTE population into their career pathways to better evaluate the relationship between WBL participation and student outcomes.

Finally, the final model for CTE WBL participants tested the effect of the "timing" of WBL opportunities. Results suggest that CTE students who participated in their senior year of high school had 18% higher odds of enrolling in postsecondary and over 2 times higher odds of earning an ICN compared to students who only participated during their junior year. The timing of WBL was not significantly related to OCC earning. These findings underscore how factors like the timing of WBL participation may differentially affect the relationship between WBL and outcomes for the CTE population. Although WBL "dosage" was not explored in this section due to limitations in the available data, timing results suggest that the implementation of WBL can potentially play a role in student trajectories.

Non-CTE Students Only

Finally, a series of logistic regression models were run for the non-CTE student population only. Results showed that participation in WBL was associated with approximately 15% higher odds of enrolling in postsecondary. This is notable, considering that non-CTE students in general are more likely to pursue a postsecondary track than CTE students. This finding suggests that WBL participants are even more likely to enroll than non-participants, holding other demographic characteristics constant.

In contrast, students who did *not* participate in WBL had almost two times higher odds of earning an industry credential. As previously noted, non-CTE students earn industry credentials at a much lower rate (5.3%) than CTE students, and only 7.6% of those ICN earners participate in WBL. This result suggests that the non-CTE students who pursue WBL opportunities are less likely to earn this non-degree credential by the time they graduate. Considering that WBL participants had higher odds of postsecondary enrollment, it is possible these students instead pursue postsecondary degree credentials.

Among WBL participants, separate models estimated the impact of WBL "dosage," defined as the number of WBL opportunities in which students reportedly participated. Results suggest that although general participation in WBL was associated with 15% higher odds of postsecondary enrollment, WBL dosage was not significantly related to enrollment. In other words, participation in more WBL opportunities does not affect the odds of postsecondary enrollment beyond the initial benefit that participation in one WBL opportunity brings. In contrast, results suggest that the odds of earning an industry credential increase by 21% with each additional opportunity in which students participate. These dosage findings, together with those reported for timing in the previous section, highlight how the details surrounding WBL implementation may differentially affect the relationship between WBL participation and student outcomes.

Conclusion

These results offer support for WBL as a potential intervention for student achievement as it relates to the outcomes of this study. More research is needed to fully support the recent prioritization of WBL across Pennsylvania and the United States. Specifically, while logistic regression shows statistically significant associations between explanatory variables and outcomes, it does not infer causation between the two. Likewise, more robust WBL data reporting would improve the informative value of future regression models. The findings of this report cautiously suggest that WBL has the potential to benefit certain student outcomes, such as postsecondary enrollment and non-degree credential earning.

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Appendix A: Definitions for CTE Work-Based Learning (WBL) Opportunities

Note. All definitions in Appendix A are adapted from the PIMS CTE Student Fact template.

Agriculture Experience: An agriculture experience is a "CTE program-related component providing an educational experience, and which operates as an integral part of a CTE agriculture program. These experiences take place at any time during the calendar year and require students to record, summarize, and use supervised agriculture experience record books.

Apprenticeship: An apprenticeship is a "CTE program-related field leaning component experience designed to link employers in need of an educated workforce with local education agencies seeking to provide quality work-based education.

Cooperative Work Experience: A cooperative work experience is a "CTE program-related learning component providing on-the-job experience in a CTE program. Through written arrangement between the school and employer, the student receives instruction, including required academic courses and related CTE instruction, by alteration of study in school with a job related to the CTE instruction.

Internship: An internship is a "CTE program-related field that provides planned supervised experiential learning with rotation periods of work observation and work exploration in a variety of employment situations ordinarily for short periods of time. Students are usually not paid for their experience; however, they do receive school credit. These experiences are primarily intended to develop career awareness rather than occupational competence.

Job Exploration: A job exploration experience is a "CTE program-related learning component providing off-campus, credit-bearing exploratory learning activities occurring in the community with the specific intent to provide realistic career exploration experiences for students.

Simulated Work Environment: A simulated work environment is a CTE program-related learning component providing an immersive experience in a protected educational setting that replicates workplace tools, processes, and/or environments. *Note: Reporting for this data element in PIMS began in 2019-20 SY.*

School-Sponsored Enterprise: A school-sponsored enterprise is a CTE program-related learning component for small businesses created and operated by students where the school implements a real, economically viable business venture. These typically are non-profit activities and can include activities such as house refurbishing and the repair of parks.

Work-Based Experience: A work-based experience is a CTE program-related learning component providing off-campus learning gained through training and instruction. Work-based experiences refer to technical skills occurring in a work setting.

Appendix B: Glossary of Terms and Operational Definitions

Career and Technology Education (CTE): Defined as "programs under public supervision and control which provide an organized process of learning experiences designed to develop integrated academic and occupational skills, knowledge, attitudes, work habits, and leadership ability for entry into and advancement within various levels of employment in occupational areas of agriculture, business, marketing and distribution, health, home economics and trade, and industry and for participation in postsecondary education and training" (Pennsylvania Department of Education, 2021-b).

CTE ICN Earning: For this study, secondary **CTE students** are coded as having earned a "CTE ICN" if they earned an industry-recognized credential by high school graduation as a direct result of their secondary CTE program, according to the PIMS *CTE Student Industry Credential Template*. This template "serves to record industry certifications earned by students during the reporting year as a direct result of the student's enrollment within a PDE-approved reimbursable secondary CTE program". A full list of approved industry credential codes can be found in PIMS Manual Vol. 2, Appendix Q.

CTE Student: For this study, the term CTE student describes a PA high school graduate, from the class of 2019 or 2020, for whom data was collected in the *PIMS CTE Student Fact template* for one or both of their last two years of high school. Students in this template must have been "actively enrolled in the technical component of a PDE-approved secondary reimbursable CTE program during the reporting year and have a completed and signed 'Annual Educational and Occupational Objectives for Students Enrolled in a PDE-Approved CTE Program' form (PDE-408) or a similar, locally-developed form directly related to the student's enrollment in the CTE program reported within PIMS".

Dosage: Refers generally to an amount. In this report, WBL dosage is referenced as an amount of non-CTE WBL specifically. A continuous measurement of WBL dosage is used in logistic regression models as a count of the number of WBL opportunities in which students participated outside of a CTE program.

Industry-Recognized Credential (ICN): Defined as "a portable, industry-recognized credential validating that a student successfully demonstrated skill competencies in a core set of content and performance standards in a specific set of work-related tasks. The tasks and assessment must connect to workforce demands" (Pennsylvania Department of Education, 2021-b). For this study, data reflecting the industry-recognized credentials earned by PA graduates are collected in two PIMS templates: 1) the PIMS *CTE Student Industry Credential Template*, and 2) the PIMS *Student Award Fact Template for Industry-Recognized Credentials and Work-Based Learning Experiences for Non-CTE Students*. For this reason, this study distinguishes between earning a "CTE ICN" or a "non-CTE ICN".

National Institute of Metalworking (NIMS): This credentialing agency is "a PDE-approved agency for student occupational competency testing in machining-related approved CTE programs and provides tests and student data for Pennsylvania. NIMS tests include both an online theory component and a performance component" (Pennsylvania Department of Education, 2021-b).

National Occupational Competency Testing Institute (NOCTI): This testing agency is "a PDE-approved agency for student occupational competency testing and provides job-ready tests and student data to Pennsylvania. NOCTI tests are composed of a multiple-choice component and a performance component. The online multiple-choice component measures the technical knowledge acquired by students. The performance component allows students to demonstrate their acquired skills by completing actual jobs using the tools, materials, machines, and equipment of the occupation" (Pennsylvania Department of Education, 2021-b).

Non-CTE ICN Earning: For this study, secondary **non-CTE students** are coded as having earned a "non-CTE ICN" if they earned an industry-recognized credential by high school graduation outside of a CTE program, according to the PIMS *Student Award Fact template for Industry-Recognized Credential and Work-Based Learning Experiences for Non-CTE Students*. This template "contains data related to the Industry-Recognized Credentials awarded to and Work-Based Learning Experiences engaged in by students in grades 7 through 12". Standards for reporting industry-recognized credentials to this template are provided in PDE's *Guidance for Identifying and Reporting Industry-Based Learning Credentials for Non-CTE Students.*

Non-CTE Student: For this study, the term non-CTE student describes a PA high school graduate, from the class of 2018-19 or 2019-20, for whom data was not collected in the PIMS *CTE Student Fact template* either of their last two years of high school.

Non-Degree Credential: For this study, non-degree credentials of interest include industry-recognized credentials (ICNs) and occupational competency certificates (OCCs) earned by high school graduation.

Occupational Competency Certificate (OCC): One of two types of non-degree credentials considered as an outcome for the present study. The term occupational competency certificate (OCC) refers to the two types of PDE-awarded certificates recognizing student achievement on the NOCTI/NIMS technical skills assessments: 1) the Pennsylvania Skills Certificate and 2) the Pennsylvania Certificate of Competency

Pennsylvania Certificate of Competency: For this study, Pennsylvania Certificates of Competency and Pennsylvania Skills Certificates are referred to generally as occupational competency certificates (OCCs). The Pennsylvania Certificate of Competency "was established by PDE to recognize CTE students who have achieved a competent skill level in their chosen technical area" (Pennsylvania Department of Education, 2021-a), as evidenced by their performance on the NOCTI/NIMS assessments.

> **For students taking NOCTI assessments:** The Pennsylvania Certificate of Competency is "awarded to students scoring at the competent level on both the multiple-choice and performance components or scoring at the advanced level on either the multiple-choice or performance components and at the competent level on the other component" (Pennsylvania Department of Education, 2021-a).
>
> **For students taking NIMS assessments:** "PDE and NIMS have partnered to provide 11 NIMS credentialing tests in Machining Level 1 areas. In order to achieve a Pennsylvania Certificate of Competency, a student must pass three [eligible] credentialing tests, including either *Measurement, Materials and Safety or Job Planning, Benchwork and Layout*" (Pennsylvania Department of Education, 2021-a).

Pennsylvania Skills Certificate: For this study, Pennsylvania Skills Certificates and Pennsylvania Certificates of Competency are generally referred to as occupational competency certificates (OCCs). The Pennsylvania Skills Certificate "was established by PDE to recognize CTE students who have demonstrated high achievement in their chosen technical area" (Pennsylvania Department of Education, 2021-a), as evidenced by their performance on the NOCTI/NIMS.

> **For students taking NOCTI assessments:** "A student must score at the advanced level on both the multiple-choice and performance components of the test to be eligible for the Pennsylvania Skill Certificate" (Pennsylvania Department of Education, 2021-a).
>
> **For students taking NIMS assessments:** "PDE and NIMS have partnered to provide 11 NIMS credentialing tests in Machining Level 1 areas. To achieve a Pennsylvania Skills Certificate, a student must pass four or more [eligible] credentialing tests, including either *Measurement, Materials and Safety or Job Planning, Benchwork and Layout*" (Pennsylvania Department of Education, 2021-a).

Postsecondary Enrollment (by Fall): Dichotomous outcome variable which indicates if a student enrolled at any postsecondary institution by October 1st following their high school graduation, according to data from the National Student Clearinghouse (NSC).

Postsecondary institutions reported to NSC Student Tracker Services award the following credential types:

C = certificate	L = professional
A = associate's	P = post doctorate
B = bachelor's	G = graduate/professional unspecified
D = doctorate	T = post baccalaureate certificate
M = master's	

Timing: Refers generally to when something occurred. In this report, the timing of WBL participation is reported for CTE students. Logistic regression models compare outcomes for students who participated in WBL during their senior year versus only their junior year of high school.

Work-Based Learning: Provides students with "an opportunity to reinforce their classroom learning, explore future career fields, and demonstrate their skills in a real-world setting" (Pennsylvania Department of Education, 2021-b). For this study, work-based learning opportunities **for CTE students** include the following, from the PIMS *CTE Student Fact template*: agriculture experiences, apprenticeships, cooperative work experiences, internships, job exploration, simulated work environments, school-sponsored enterprise, and work-based experiences (see Appendix A of this report). **For non-CTE students**, WBL opportunities reported in the PIMS *Student Award Fact template for Industry-Recognized Credential and Work-Based Learning Experiences for Non-CTE Students* should align to guidance outlined in Appendix A of the Industry-Based Learning Indicator for the Future Ready PA Index- Guidelines for Data Collection, Monitoring, and Reporting.

Appendix C: Logistic Regression Analysis Tables

TABLE 1. Final Logistic Regression Model Predicting Postsecondary Enrollment by the Fall after High School Graduation – Full Cohort (*N* = 247,038)

							95% C.I. for Exp(B)	
Variable	**B**	**SE(B)**	**Wald**	**df**	**p-value**	**Exp(B)**	**Lower**	**Upper**
CTE Status								
CTE Student	Reference							
Non-CTE Student	1.102	0.013	7526.182	1	< .001	3.011	2.937	3.087
WBL Participation								
No	Reference							
Yes	0.067	0.013	26.273	1	< .001	1.069	1.042	1.097
Cohort								
2020 Graduate	Reference							
2019 Graduate	0.178	0.009	385.37	1	< .001	1.195	1.174	1.216
Geographic School Locale								
Suburban	Reference							
City*	0.356	0.013	724.156	1	< .001	1.428	1.391	1.465
Rural*	0.412	0.013	1047.309	1	< .001	1.51	1.472	1.548
Town*	0.721	.0.16	2130.832	1	< .001	2.057	1.995	2.121
Race/Ethnicity								
White	Reference							
American Indian/ Alaskan Native*	0.262	0.117	5.04	1	0.025	1.3	1.034	1.635
Black/African American*	0.317	0.015	452.096	1	< .001	1.373	1.333	1.414
Hispanic*	0.386	0.017	525.672	1	< .001	1.471	1.423	1.52
Multiracial*	0.339	0.029	134.731	1	< .001	1.404	1.326	1.487
Asian	1.038	0.028	1360.381	1	< .001	2.822	2.671	2.982
Native Hawaiian or Pacific Islander	0.051	0.155	0.108	1	0.742	1.052	0.777	1.426
Gender								
Male	Reference							
Female	0.559	0.009	3760.691	1	< .001	1.749	1.718	1.781
Special Education								
Has an IEP	Reference							
No IEP	1.314	0.013	9613.335	1	< .001	3.721	3.625	3.821
Economic Disadvantage								
Yes	Reference							
No	0.765	0.01	6020.276	1	< .001	2.15	2.108	2.191
English Learner (EL)								
Yes	Reference							
No	1.034	0.03	1199.056	1	< .001	2.813	2.653	2.982
Constant	-6.15	0.129	2257.022	1	< .001	0.002		

Note: Variables are coded so that Exp(B) is always greater than or equal to 1

**Indicates variable for which the reference group was coded to have higher odds*

Table 2. Final Logistic Regression Model Predicting Industry-Recognized Credential Earning by High School Graduation – Full Cohort (*N* = 247,038)

							95% C.I. for Exp(B)	
Variable	**B**	**SE(B)**	**Wald**	**df**	**p-value**	**Exp(B)**	**Lower**	**Upper**
CTE Status								
Non-CTE Student	Reference							
CTE Student	3.187	0.016	42117.618	1	< .001	24.213	23.487	24.961
WBL Participation								
No	Reference							
Yes	0.007	0.017	0.197	1	.657	1.007	0.975	1.041
Cohort								
2020 Graduate	Reference							
2019 Graduate	0.283	0.014	410.955	1	< .001	1.327	1.291	1.364
Geographic School Locale								
Suburban	Reference							
City*	0.873	0.022	1533.747	1	< .001	2.394	2.292	2.501
Rural*	0.469	0.019	587.257	1	< .001	1.599	1.539	1.661
Town*	0.314	0.023	181.621	1	< .001	1.369	1.308	1.434
Race/Ethnicity								
White	Reference							
American Indian/ Alaskan Native*	0.160	0.182	0.777	1	.378	1.174	0.822	1.676
Black/African American*	0.104	0.024	18.872	1	< .001	1.110	1.059	1.163
Hispanic*	0.277	0.026	118.193	1	< .001	1.320	1.255	1.387
Multiracial*	0.251	0.049	26.725	1	< .001	1.285	1.169	1.413
Asian*	0.014	0.040	0.126	1	.722	1.014	0.938	1.097
Native Hawaiian or Pacific Islander*	0.424	0.287	2.187	1	.139	1.529	0.871	2.683
Special Education								
Has an IEP	Reference							
No IEP	0.130	0.018	52.604	1	< .001	1.138	1.099	1.179
Constant	-5.794	0.353	269.769	1	< .001	0.003		

Note: Variables are coded so that Exp(B) is always greater than or equal to 1

**Indicates variable for which the reference group was coded to have higher odds*

Table 3. Final Logistic Regression Model Predicting Postsecondary Enrollment by the Fall after High School Graduation – CTE Students Only (*N* = 44,913)

							95% C.I. for Exp(B)	
Variable	**B**	**SE(B)**	**Wald**	**df**	**p-value**	**Exp(B)**	**Lower**	**Upper**
WBL Participation								
Yes	Reference							
No	0.082	0.023	12.731	1	< .001	1.085	1.038	1.135
Cohort								
2020 Graduate	Reference							
2019 Graduate	0.152	0.22	48.267	1	< .001	1.164	1.115	1.215
Geographic School Locale								
Suburban	Reference							
City*	0.313	0.036	77.521	1	< .001	1.368	1.276	1.467
Rural*	0.362	0.030	147.526	1	< .001	1.436	1.354	1.522
Town*	0.530	0.037	203.838	1	< .001	1.699	1.580	1.827
CTC								
CTE Program Taken at CTC	Reference							
No	0.730	0.028	665.660	1	< .001	2.075	1.963	2.193
Race/Ethnicity								
White	Reference							
American Indian/ Alaskan Native	0.382	0.263	2.118	1	0.146	1.465	0.876	2.451
Black/African American	0.217	0.036	35.282	1	< .001	1.242	1.156	1.334
Hispanic	0.223	0.038	34.477	1	< .001	1.250	1.160	1.347
Multiracial*	0.073	0.074	0.974	1	0.324	1.076	0.930	1.244
Asian	1.252	0.085	218.81	1	< .001	3.498	2.963	4.129
Native Hawaiian or Pacific Islander	0.290	0.455	0.407	1	0.523	1.337	0.548	3.262
Gender								
Male	Reference							
Female	0.806	0.022	1337.18	1	< .001	2.240	2.145	2.339
Special Education								
Has an IEP	Reference							
No IEP	0.782	0.028	787.50	1	< .001	2.186	2.070	2.309
Economic Disadvantage								
Yes	Reference							
No	0.559	0.023	582.67	1	< .001	1.749	1.672	1.830
English Learner (EL)								
Yes	Reference							
No	.422	0.072	34.236	1	< .001	1.525	1.324	1.756
Constant	-4.008	0.127	1003.053	1	< .001	0.018		

Note: Variables are coded so that Exp(B) is always greater than or equal to 1

**Indicates variable for which the reference group was coded to have higher odds*

Table 4. Final Logistic Regression Model Predicting Postsecondary Enrollment by the Fall after High School Graduation – CTE WBL Participants Only (*N* = 16,036)

							95% C.I. for Exp(B)	
Variable	**B**	**SE(B)**	**Wald**	**df**	**p-value**	**Exp(B)**	**Lower**	**Upper**
Cooperative Work Experience								
Yes	Reference							
No	0.305	0.047	42.332	1	< .001	1.357	1.238	1.488
Internship								
No	Reference							
Yes	0.422	0.063	44.218	1	< .001	1.525	1.346	1.727
Job Exploration								
Yes	Reference							
No	0.099	0.044	5.002	1	.025	1.104	1.012	1.203
Agriculture Experience								
Yes	Reference							
No	0.193	0.065	8.785	1	.003	1.213	1.068	1.378
School-Sponsored Enterprise								
Yes	Reference							
No	0.267	0.049	29.800	1	< .001	1.306	1.187	1.438
Timing of WBL Participation								
No	Reference							
Participated in WBL Senior Year	0.164	0.059	7.716	1	.005	1.178	1.050	1.323
Cohort								
2020 Graduate	Reference							
2019 Graduate	0.156	0.038	16.737	1	< .001	1.168	1.084	1.259
Geographic School Locale								
Suburban	Reference							
City*	0.189	0.067	8.019	1	.005	1.208	1.060	1.376
Rural*	0.361	0.051	51.069	1	< .001	1.435	1.300	1.585
Town*	0.439	0.061	51.394	1	< .001	1.551	1.376	1.749
CTC								
CTE Program Taken at CTC	Reference							
No	0.843	0.054	242.756	1	< .001	2.324	2.090	2.585
Race/Ethnicity								
White	Reference							
American Indian/ Alaskan Native	0.052	0.450	0.013	1	.908	1.053	0.436	2.542
Black/African American*	0.073	0.069	1.106	1	.293	1.076	0.939	1.232
Hispanic	0.069	0.068	1.019	1	.313	1.071	0.937	1.225
Multiracial*	0.205	0.135	2.289	1	.130	1.227	0.941	1.600
Asian	1.217	0.164	55.114	1	< .001	3.377	2.449	4.657
Native Hawaiian or Pacific Islander*	0.047	0.700	0.004	1	.947	1.048	0.266	4.131
Gender								
Male	Reference							
Female	0.869	0.038	513.250	1	< .001	2.383	2.211	2.569
Special Education								
Has an IEP	Reference							
No IEP	0.735	0.049	222.766	1	< .001	2.085	1.893	2.296

							95% C.I. for Exp(B)	
Variable	**B**	**SE(B)**	**Wald**	**df**	**p-value**	**Exp(B)**	**Lower**	**Upper**
Economic Disadvantage								
Yes	Reference							
No	0.508	0.040	163.893	1	< .001	1.662	1.537	1.796
English Learner (EL)								
Yes	Reference							
No	0.501	0.136	13.453	1	< .001	1.650	1.263	2.156
Constant	-4.968	0.747	44.248	1	< .001	0.007		

Note: Variables are coded so that Exp(B) is always greater than or equal to 1

**Indicates variable for which the reference group was coded to have higher odds*

TABLE 5. Final Logistic Regression Model Predicting Industry Credential (ICN) Earning by High School Graduation – CTE Students Only (*N* = 44,913)

							95% C.I. for Exp(B)	
Variable	**B**	**SE(B)**	**Wald**	**df**	**p-value**	**Exp(B)**	**Lower**	**Upper**
WBL Participation								
No	Reference							
Yes	0.356	0.021	299.659	1	< .001	1.428	1.372	1.487
Cohort								
2020 Graduate	Reference							
2019 Graduate	0.174	0.19	79.709	1	< .001	1.190	1.145	1.236
Geographic School Locale								
Suburban	Reference							
City	0.112	0.032	12.120	1	< .001	1.119	1.050	1.191
Rural*	0.006	0.026	0.047	1	0.829	1.006	0.956	1.058
Town*	0.047	0.031	2.307	1	0.129	1.049	0.986	1.115
CTC								
No	Reference							
CTE Program Taken at CTC	1.023	0.027	1474.815	1	< .001	2.780	2.639	2.929
Race/Ethnicity								
White	Reference							
American Indian/ Alaskan Native*	0.216	0.240	0.812	1	0.368	1.241	0.776	1.986
Black/African American*	0.172	0.033	26.983	1	< .001	1.187	1.113	1.267
Hispanic*	0.225	0.033	47.526	1	< .001	1.252	1.174	1.334
Multiracial*	0.240	0.066	13.428	1	< .001	1.271	1.118	1.446
Asian	0.233	0.080	8.392	1	0.004	1.263	1.078	1.478
Native Hawaiian or Pacific Islander*	0.702	0.419	2.802	1	0.094	2.018	.887	4.591
Special Education								
Has an IEP	Reference							
No IEP	0.141	0.022	41.278	1	< .001	1.152	1.103	1.202
Constant	-2.569	0.496	26.811	1	< .001	0.077		

Note: Variables are coded so that Exp(B) is always greater than or equal to 1

**Indicates variable for which the reference group was coded to have higher odds*

TABLE 6. Final Logistic Regression Model Predicting Industry Credential (ICN) Earning by High School Graduation – CTE WBL Participants Only (*N* = 16,036)

							95% C.I. for Exp(B)	
Variable	**B**	**SE(B)**	**Wald**	**df**	**p-value**	**Exp(B)**	**Lower**	**Upper**
Cooperative Work Experience								
No	Reference							
Yes	0.368	0.043	74.677	1	< .001	1.445	1.329	1.570
Internship								
No	Reference							
Yes	0.359	0.065	30.360	1	< .001	1.431	1.260	1.626
Job Exploration								
No	Reference							
Yes	0.508	0.042	146.379	1	< .001	1.661	1.530	1.804
Agriculture Experience								
Yes	Reference							
No	0.897	0.065	30.360	1	< .001	2.452	2.157	2.786
School-Sponsored Enterprise								
Yes	Reference							
No	0.178	0.045	15.560	1	< .001	1.194	1.093	1.304
Work-Based Experience								
Yes	Reference							
No	1.213	0.061	392.963	1	< .001	3.365	2.984	3.794
Timing of WBL Participation								
No	Reference							
Participated in WBL Senior Year	0.850	0.056	232.742	1	< .001	2.340	2.098	2.610
Cohort								
2020 Graduate	Reference							
2019 Graduate	0.213	0.036	35.024	1	< .001	1.237	1.153	1.327
Geographic School Locale								
Suburban	Reference							
City	0.121	0.063	3.706	1	.054	1.128	0.998	1.276
Rural	0.265	0.047	32.215	1	< .001	1.304	1.190	1.429
Town*	0.004	0.055	0.005	1	.943	1.004	0.902	1.118
CTC								
No	Reference							
CTE Program Taken at CTC	0.750	0.051	213.671	1	< .001	2.117	1.914	2.341
Race/Ethnicity								
White	Reference							
American Indian/ Alaskan Native	0.184	0.401	0.210	1	.647	1.202	0.548	2.639
Black/African American*	0.223	0.064	12.059	1	< .001	1.250	1.102	1.417
Hispanic*	0.282	0.059	22.485	1	< .001	1.325	1.180	1.489
Multiracial*	0.151	0.122	1.512	1	.219	1.162	0.915	1.478
Asian*	0.004	0.163	0.001	1	.982	1.004	0.730	1.381
Native Hawaiian or Pacific Islander*	1.008	0.622	2.630	1	.105	2.741	0.810	9.274
Special Education								
Has an IEP	Reference							
No IEP	0.90	0.40	4.905	1	.027	1.094	1.010	1.184
Constant	-5.175	0.684	57.222	1	< .001	0.006		

Note: Variables are coded so that Exp(B) is always greater than or equal to 1

**Indicates variable for which the reference group was coded to have higher odds*

TABLE 7. Final Logistic Regression Model Predicting Occupational Competency Certificate (OCC) Earning by High School Graduation – 2019 Cohort CTE Students Only (*N* = 15,740)

							95% C.I. for Exp(B)	
Variable	**B**	**SE(B)**	**Wald**	**df**	**p-value**	**Exp(B)**	**Lower**	**Upper**
WBL Participation								
No	Reference							
Yes	0.331	0.048	47.695	1	< .001	1.393	1.268	1.530
Geographic School Locale								
Suburban	Reference							
City*	0.190	0.073	6.832	1	.009	1.209	1.049	1.394
Rural*	0.088	0.061	2.099	1	.147	1.092	0.969	1.231
Town*	0.129	0.074	3.039	1	.081	1.138	0.984	1.317
CTC								
No	Reference							
CTE Program Taken at CTC	0.970	0.062	248.320	1	< .001	2.637	2.338	2.975
Race/Ethnicity								
White	Reference							
American Indian/ Alaskan Native*	0.176	0.452	0.152	1	.697	1.193	0.491	2.895
Black/African American*	0.765	0.069	122.850	1	< .001	2.149	1.877	2.460
Hispanic*	0.195	0.077	6.393	1	.011	1.215	1.045	1.414
Multiracial*	0.141	0.160	0.777	1	.378	1.151	0.842	1.574
Asian*	0.040	0.171	0.054	1	.816	1.041	0.744	1.455
Native Hawaiian or Pacific Islander	0.255	1.075	0.056	1	.812	1.291	0.157	10.607
Gender								
Male	Reference							
Female	0.440	0.047	88.612	1	< .001	1.553	1.417	1.701
Special Education								
Has an IEP	Reference							
No IEP	1.001	0.048	434.356	1	< .001	2.721	2.476	2.989
Economic Disadvantage								
Yes	Reference							
No	0.240	0.046	26.775	1	< .001	1.271	1.161	1.393
English Learner (EL)								
Yes	Reference							
No	0.920	0.126	53.474	1	< .001	2.509	1.961	3.211
Constant	-2.655	0.553	23.069	1	< .001	0.070		

Note: Variables are coded so that Exp(B) is always greater than or equal to 1

**Indicates variable for which the reference group was coded to have higher odds*

TABLE 8. Final Logistic Regression Model Predicting Occupational Competency Certificate (OCC) Earning by High School Graduation – 2019 Cohort CTE WBL Participants Only (*N* = 5,650)

							95% C.I. for Exp(B)	
Variable	**B**	**SE(B)**	**Wald**	**df**	**p-value**	**Exp(B)**	**Lower**	**Upper**
Cooperative Work Experience								
No	Reference							
Yes	0.565	0.093	37.102	1	< .001	1.759	1.467	2.110
Internship								
No	Reference							
Yes	0.516	0.160	10.370	1	.001	1.675	1.224	2.292
Agriculture Experience								
Yes	Reference							
No	0.862	0.125	47.406	1	< .001	2.368	1.853	3.027
CTC								
No	Reference							
CTE Program Taken at CTC	0.632	0.099	40.778	1	< .001	1.881	1.549	2.283
Race/Ethnicity								
White	Reference							
American Indian/ Alaskan Native*	0.292	0.695	0.177	1	.674	1.340	0.343	5.229
Black/African American*	0.856	0.126	46.222	1	< .001	2.353	1.839	3.011
Hispanic*	0.409	0.141	8.429	1	.004	1.505	1.142	1.983
Multiracial	0.008	0.313	0.001	1	.981	1.008	0.545	1.862
Asian	0.101	0.404	0.062	1	.803	1.106	0.501	2.440
Native Hawaiian or Pacific Islander*	0.681	1.189	0.327	1	.567	1.975	0.192	20.319
Gender								
Male	Reference							
Female	0.365	0.085	18.404	1	< .001	1.440	1.219	1.702
Special Education								
Has an IEP	Reference							
No IEP	1.030	0.087	140.227	1	< .001	2.801	2.362	3.322
English Learner (EL)								
Yes	Reference							
No	0.772	0.268	8.293	1	.004	2.165	1.280	3.662
Constant	-3.390	1.411	5.772	1	.016	0.034		

Note: Variables are coded so that Exp(B) is always greater than or equal to 1

**Indicates variable for which the reference group was coded to have higher odds*

TABLE 9. Final Logistic Regression Model Predicting Postsecondary Enrollment by the Fall after High School Graduation - Non-CTE Students Only (*N* = 202,125)

							95% C.I. for Exp(B)	
Variable	**B**	**SE(B)**	**Wald**	**df**	**p-value**	**Exp(B)**	**Lower**	**Upper**
WBL Participation								
No	Reference							
Yes	0.141	0.016	74.468	1	< .001	1.151	1.115	1.188
Cohort								
2019 Graduate	Reference							
2020 Graduate	0.185	0.01	338.279	1	< .001	1.203	1.18	1.227
Geographic School Locale								
Suburban	Reference							
City*	0.429	0.015	868.582	1	< .001	1.536	1.493	1.581
Rural*	0.411	0.014	812.538	1	< .001	1.509	1.467	1.552
Town*	0.766	0.017	1931.92	1	< .001	2.152	2.079	2.226
Race/Ethnicity								
White	Reference							
American Indian/ Alaskan Native*	0.4	0.128	9.726	1	0.002	1.492	1.16	1.918
Black/African American*	0.424	0.016	681.387	1	< .001	1.527	1.48	1.577
Hispanic*	0.509	0.019	751.799	1	< .001	1.664	1.605	1.726
Multiracial*	0.394	0.032	154.117	1	< .001	1.483	1.394	1.578
Asian	0.987	0.03	1097.109	1	< .001	2.683	2.531	2.844
Native Hawaiian or Pacific Islander	0.003	0.165	0	1	0.987	1.003	0.726	1.385
Gender								
Male	Reference							
Female	0.5	0.01	2443.943	1	< .001	1.648	1.616	1.681
Special Education								
Has an IEP	Reference							
No IEP	1.425	0.015	8695.966	1	< .001	4.157	4.034	4.283
Economic Disadvantage								
Yes	Reference							
No	0.804	0.011	5383.813	1	< .001	2.235	2.187	2.283
English Learner (EL)								
Yes	Reference							
No	1.104	0.032	1158.824	1	< .001	3.016	2.83	3.214
Constant	-5.708	0.142	1625.735	1	< .001	0.003		

Note: Variables are coded so that Exp(B) is always greater than or equal to 1

**Indicates variable for which the reference group was coded to have higher odds*

TABLE 10. Final Logistic Regression Model Predicting Postsecondary Enrollment by the Fall after High School Graduation - Non-CTE WBL Participants Only (*N* = 23,511)

							95% C.I. for Exp(B)	
Variable	**B**	**SE(B)**	**Wald**	**df**	**p-value**	**Exp(B)**	**Lower**	**Upper**
WBL Dosage								
# of WBL Opportunities Taken	0.006	0.027	0.049	1	0.824	1.006	0.954	1.06
Cohort								
2019 Graduate	Reference							
2020 Graduate	0.352	0.031	126.869	1	< .001	1.422	1.338	1.512
Geographic School Locale								
Suburban	Reference							
City*	0.484	0.055	77.906	1	< .001	1.623	1.458	1.808
Rural*	0.533	0.046	132.716	1	< .001	1.705	1.557	1.867
Town*	0.52	0.057	81.806	1	< .001	1.681	1.502	1.882
Race/Ethnicity								
White	Reference							
American Indian/ Alaskan Native*	0.592	0.424	1.944	1	0.163	1.807	0.787	4.153
Black/African American*	0.221	0.057	15.219	1	< .001	1.247	1.116	1.394
Hispanic*	0.329	0.064	26.468	1	< .001	1.39	1.226	1.575
Multiracial*	0.69	0.105	43.405	1	< .001	1.993	1.624	2.447
Asian	0.963	0.092	109.643	1	< .001	2.619	2.187	3.137
Native Hawaiian or Pacific Islander*	0.257	0.556	0.214	1	0.644	1.293	0.435	3.843
Gender								
Male	Reference							
Female	0.621	0.031	396.73	1	< .001	1.861	1.751	1.978
Special Education								
Has an IEP	Reference							
No IEP	1.573	0.043	1323.911	1	< .001	4.819	4.428	5.246
Economic Disadvantage								
Yes	Reference							
No	0.934	0.035	706.873	1	< .001	2.543	2.374	2.725
English Learner (EL)								
Yes	Reference							
No	1.307	0.138	89.985	1	< .001	3.695	2.821	4.841
Constant	-6.451	0.733	77.549	1	< .001	0.002		

Note: Variables are coded so that Exp(B) is always greater than or equal to 1

**Indicates variable for which the reference group was coded to have higher odds*

TABLE 11. Final Logistic Regression Model Predicting Industry Credential Earning by High School Graduation - Non-CTE Students Only (*N* = 202,125)

							95% C.I. for Exp(B)	
Variable	**B**	**SE(B)**	**Wald**	**df**	**p-value**	**Exp(B)**	**Lower**	**Upper**
WBL Participation								
Yes	Reference							
No	0.657	0.038	305.432	1	< .001	1.929	1.792	2.076
Cohort								
2019 Graduate	Reference							
2020 Graduate	0.406	0.02	391.852	1	< .001	1.5	1.441	1.562
Geographic School Locale								
Suburban	Reference							
City*	1.669	0.047	1266.404	1	< .001	5.308	4.842	5.819
Rural*	0.862	0.035	608.338	1	< .001	2.369	2.212	2.537
Town*	0.397	0.037	118.508	1	< .001	1.488	1.385	1.598
Race/Ethnicity								
White	Reference							
American Indian/ Alaskan Native*	0.073	0.276	0.07	1	0.791	1.076	0.626	1.849
Black/African American	0.245	0.034	52.66	1	< .001	1.277	1.196	1.365
Hispanic*	0.559	0.051	122.236	1	< .001	1.748	1.584	1.93
Multiracial*	0.131	0.071	3.402	1	0.065	1.14	0.992	1.311
Asian*	0.034	0.047	0.516	1	0.473	1.373	0.642	2.936
Native Hawaiian or Pacific Islander*	0.317	0.388	0.669	1	0.413	1.373	0.642	2.936
Special Education								
Has an IEP	Reference							
No IEP	0.174	0.033	27.698	1	< .001	1.191	1.116	1.27
Economic Disadvantage								
Yes	Reference							
No	0.108	0.024	20.355	1	< .001	1.114	1.063	1.167
Constant	-7.647	0.495	238.676	1	< .001	0		

Note: Variables are coded so that Exp(B) is always greater than or equal to 1

**Indicates variable for which the reference group was coded to have higher odds*

TABLE 12. Final Logistic Regression Model Predicting Industry Credential Earning by High School Graduation - Non-CTE WBL Participants Only (*N* = 23,511)

							95% C.I. for Exp(B)	
Variable	**B**	**SE(B)**	**Wald**	**df**	**p-value**	**Exp(B)**	**Lower**	**Upper**
WBL Dosage								
# of WBL Opportunities Taken	0.193	0.048	15.911	1	< .001	1.213	1.103	1.333
Cohort								
2019 Graduate	Reference							
2020 Graduate	0.338	0.075	20.6	1	< .001	1.403	1.212	1.624
Geographic School Locale								
Suburban	Reference							
City	0.408	0.116	12.449	1	< .001	1.504	1.199	1.887
Rural*	1.28	0.192	44.405	1	< .001	3.596	2.468	5.24
Town	0.246	0.124	3.964	1	0.046	1.279	1.004	1.63
Race/Ethnicity								
White	Reference							
American Indian/ Alaskan Native*	0.071	1.025	0.005	1	0.945	1.073	0.144	8.007
Black/African American	0.062	0.123	0.254	1	0.615	1.064	0.837	1.352
Hispanic*	0.528	0.172	9.447	1	< .001	1.695	1.211	2.374
Multiracial*	0.006	0.246	0.001	1	0.98	1.006	0.622	1.629
Asian*	0.64	0.207	9.553	1	0.002	1.897	1.264	2.846
Native Hawaiian or Pacific Islander+	–	–	–	–	–	–	–	–
Economic Disadvantage								
No	Reference							
Yes	0.234	0.084	7.833	1	< .001	1.403	1.212	1.624
Constant	-24.06	9593.1	0	1	0.998	0		

Note: Variables are coded so that Exp(B) is always greater than or equal to 1

**Indicates variable for which the reference group was coded to have higher odds*

+Cell counts too low for Exp(B) to be meaningful in the model

Appendix D: CTE Student Outcomes by Career Cluster

For both cohorts, outcomes for CTE students differed by career cluster in notable ways. Although roughly a third of CTE students overall enrolled in postsecondary by Oct 1 (31.2% - 28.5%), students in Architecture & Construction (15.0% - 11.1%) and Transportation, Distribution & Logistics (12.2% - 10.3%) programs enrolled at remarkably lower rates. Students in the Business, Management & Administration (54.3% - 55.1%), Health Science (51.2% - 47.7%), and Science, Technology, Engineering & Mathematics (56.7% - 51.5%) clusters enrolled at the highest rates.

While students in some clusters were more likely to enroll in postsecondary, others differed notably in rates of earning an industry-recognized credential (ICN) by high school graduation. Roughly half of the overall CTE population earned a CTE ICN, but students in the Agriculture, Food & Natural Resources (26.5% - 25.8%), Business, Management & Administration (22.0% - 10.2%), and Marketing, Sales & Service (17.3% - 13.3%) clusters were least likely to earn these credentials. In contrast, students in Health Science (71.9% - 68.3%), Law, Public Safety and Security (73.4% - 68.1%), and Transportation, Distribution & Logistics (68.5% - 66.9%) were the most likely to earn an ICN by graduation.

Finally, for CTE students in the 2019 cohort, OCC earning and NOCTI/NIMS test-taking differed by career cluster. While 57.7% of the overall CTE population earned an OCC by high school graduation via achievement on a NOCTI/NIMS credentialing test, students in Agriculture, Food & Natural Resources (33.5%) and Business, Management & Administration (31.3%) programs earned an OCC at the lowest rates. The most likely clusters to earn an OCC were Human Resources (63.2%), Information Technology (63.8%), and Law, Public Safety and Security (63.5%). Of course, OCC earning is dependent on having taken a NOCTI/NIMS exam, and test-taking likewise differed by career cluster in notable ways. The majority of the CTE population (70.2%) took either a NOCTI or NIMS credentialing test, but students in Agriculture, Food & Natural Resources (45.7%) and Business, Management & Administration (52.1%) programs were the least likely to do so. The career clusters with the highest rates of test-taking were Information Technology (77.0%) and Manufacturing (78.3%), demonstrating how rates of OCC earning are likely linked to test-taking.

TABLE 1. Significant* Chi-squares within CTE Career Cluster: Postsecondary Enrollment, CTE ICN, and OCC earning by WBL Opportunity

	Cooperative Work Experience	Internship	Job Exploration	Agriculture Experience	School-Sponsored Enterprise	Work Based Experience	Simulated Work Environment+
Agriculture, Food & Natural Resources	pe **icn** **occ**	icn occ	**pe** **icn** **occ**	**pe** occ	icn	occ	icn
Architecture & Construction	pe **icn** **occ**		**icn** occ		pe icn occ	icn	icn
Arts, A/V, Technology & Communications	icn		**icn** occ		pe **occ**		icn
Business Management & Administration	**icn**					pe	
Health Science	**icn** **occ**	pe **occ**	pe icn occ		pe occ		icn
Hospitality & Tourism	occ		icn occ		icn occ	icn	
Human Resources	pe icn **occ**	pe **icn** occ	**icn** occ			pe **icn**	icn
Information Technology	pe icn		**icn** occ		pe		
Law, Public Safety & Security			pe icn				
Manufacturing	pe **icn** **occ**		pe **icn**				icn
Marketing, Sales & Service					**icn**		
STEM			pe				
Transportation, Distribution & Logistics	icn **occ**		icn **occ**			icn	

Within each career cluster…

For combined cohort, WBL opportunity was significantly associated with *higher* or *lower* rates of:

pe = postsecondary enrollment icn = CTE ICN earning occ = OCC earning

bold means $|\varphi| > 0.10$

*$\alpha = .05$

+limited to 2020 cohort, so excludes OCC as outcome

Note: Significant relationships only reported for chi-squares with cell counts of at least n = 20.

TABLE 2. Direction of Significant CTE WBL Opportunities by Outcomes

	Internship	School-sponsored Enterprise	Work Based Experience	Cooperative Work Experience	Job Exploration	Agricultural Experience
Enrolled in Postsec	↑	↓		↑		↓
Earned ICN	↑	↓	↑		↑	↓
Earned OCC	↑			↑		↓

↑ WBL opportunity is associated with higher odds of outcome

↓ WBL opportunity is associated with lower odds of outcome

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POL PK-20 Policy

ECE Early Childhood Education

K12 K-12 Education

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