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A LONGITUDINAL STUDY OF STUDENT ACCESS, PARTICIPATION, AND OUTCOMES

Career and Technical Education in Washington State

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EXECUTIVE SUMMARY

Career and technical education (CTE) is a vital component of state education systems aimed at preparing students for success in both postsecondary education and the workforce. High-quality CTE programming prepares youth and adults for college and careers by combining academic and technical skill instruction with opportunities to earn college credit and gain practical work experience. Students who complete a program sequence may also earn industry-recognized credentials or gain preferred access to a registered apprenticeship.

In this study, we leveraged the Washington Education Research and Data Center's (ERDC) P20W data system to provide a comprehensive landscape analysis of CTE in the state over the last decade. We followed more than 750,000 Washington students through high school and into postsecondary education and employment between 2013–14 and 2023–24 to understand their access to and participation in CTE programming, as well as the high school graduation, postsecondary, and labor market outcomes they achieved.

This study has five key **findings** related to student access, participation, and outcomes:

1. **At the state level, the provision of CTE has changed very little since 2013–14.** Pathways in the Business & Marketing program area made up the largest share of pathways offered in 2023–24. Rural schools, low-income schools, and small schools offered fewer pathways, on average, and rural schools were more likely to offer pathways in Agriculture Education. The stability of CTE offerings across the state is somewhat surprising given changes in the state's economy over this time.
2. **There is widespread participation in CTE in general, and it has increased over time.** Overall, 94 percent of students in the 2024 cohort earned at least one CTE credit overall, which is a state graduation requirement. Between 2017 and 2024, the percentage of students in the cohort who earned four or more credits in CTE overall increased from 42 to 56 percent. Participation rates were highest in the Health Sciences; Arts, Audio/Video Technology & Communications; and Agriculture, Food & Natural Resources clusters, and these clusters have experienced the fastest growth since 2017.
3. **Most students explore CTE broadly, but fewer pursue in-depth study within a single pathway, and attainment rates are lower for some student groups.** In total, 84 percent of students in the 2024 cohort earned at least two CTE credits across all pathways, compared to 45 percent of students who earned at least two CTE credits within a single pathway. Credit attainment rates were also lower for nonbinary students; students who identified as American Indian or Alaska Native, Black, Native Hawaiian, or Pacific Islander; students who have experienced

economic hardship; students who participated in special education services; and students who participated in a multilingual learner program.

4. **Earning more credits in CTE is related to an increased likelihood of high school graduation.** Compared to students who only took up to one credit in CTE (meeting the state's graduation requirement), observationally similar students who earned more than one credit overall were 5.7 to 12.0 percentage points more likely to graduate from high school.
5. **Students who focused their CTE studies in a single pathway were generally more likely to experience strong postsecondary or labor market outcomes six years following high school, with outcomes varying by cluster.** Students who earned more than one credit in a single pathway in the Agriculture, Finance, Manufacturing, and Transportation clusters were more likely to have completed a degree or credential and earn a living wage six years following high school graduation. Students who focused their studies in a single pathway in the Arts & A/V cluster were more likely to experience negative earnings outcomes six years after high school.

Based on these findings, we offer three **recommendations** to strengthen students' opportunities to engage and succeed in CTE programming.

1. **Consider increasing credit attainment within a single pathway for all student groups.** Students who earned more than one credit within a single pathway achieved the strongest postsecondary and labor market outcomes. Just over half of students achieved this threshold, and there were disparities across student groups. While encouraging deeper engagement within a single pathway may improve outcomes, many students are still exploring their interests and may not yet have clear career goals—making early specialization unrealistic for all. However, the persistent gaps in participation suggest these patterns are not solely the result of individual choice. Efforts should be undertaken to understand and address local barriers to student participation. The state might also consider adjustments to the CTE Graduation Pathway requirement that promote depth within a pathway, while still allowing room for exploration and flexibility.
2. **Expand opportunities to engage male students in CTE.** The positive effects of CTE on graduating from high school, completing a postsecondary certificate, increasing annual earnings, and earning a living wage were even stronger for male students. Expanding access to and engagement in CTE could therefore serve as a powerful strategy for addressing gender-based disparities in education and employment. This is especially important given that boys and men lag behind girls and women, in Washington state and nationally, on many indicators of educational attainment and employment.

3. **Strengthen alignment between CTE pathways and local needs and opportunities.** CTE pathways should be closely aligned with the evolving needs of the local economy. While some regional variation exists, statewide CTE offerings have remained largely static over the past decade—despite major economic shifts, including significant growth in the tech-driven information industry. To better support student success and economic mobility, future research should assess how well CTE pathways align with high-demand, high-wage occupations and available postsecondary training opportunities—and identify ways to strengthen it.

CONTENTS

Figures

Tables

INTRODUCTION

Career and technical education (CTE) is a vital component of state education systems aimed at preparing students for success in both postsecondary education and the workforce. High-quality CTE programming prepares youth and adults for college and careers by combining academic and technical skill instruction with opportunities to earn college credit and gain practical work experience. Students who complete a program sequence may also earn industry-recognized credentials or gain preferred access to a registered apprenticeship.

Most high school students take at least some CTE during high school. In the latest nationally representative survey data, 85 percent of high school graduates in 2019 took at least one CTE course during high school, with 44 percent earning at least two CTE credits and 26 percent at least three CTE credits in the same subject area[1] (National Center for Education Statistics, 2024). While participation in CTE is generally strong, research highlights disparities associated with student demographics. For example, a recent study from the Washington State Education Research and Data Center (ERDC) highlights participation gaps by gender and race in STEM-focused clusters in the state. Male and Asian students were more likely than others to enroll in courses in STEM clusters (Karimi, 2023).

Several studies have identified a positive relationship between CTE participation and student outcomes (e.g., Arneson et al., 2020; Cowan et al., 2020; Dougherty, 2016). These findings are strengthened by a growing body of causal evidence from studies using quasi-experimental or experimental designs to estimate the impact of CTE on student outcomes.

- A study using a quasi-experimental design found that earning two or more credits in the same career cluster—a group of courses aligned with related industries and occupations—had a positive impact on high school graduation (Brodersen et al., 2021).
- Students who earn two or more credits in the same cluster are also more likely to enroll in postsecondary education, especially in a two-year college (Brodersen et al., 2021; Lindsay et al., 2021; Mean, 2020; Witzen, 2019). Few studies follow students through college completion, but those that do similarly find CTE positively impacts two-year, but not four-year, postsecondary degree attainment (Brodersen et al., 2021; Lindsay et al., 2021; Witzen, 2019).
- CTE participation is also associated with increased employment rates and earnings (Hollenbeck & Huang, 2006; Lee et al., 2016; Lindsay et al., 2021; Mean, 2020). A study of CTE completers in Maryland using a quasi-experimental design found that CTE completers earned higher wages than non-completers six years after high school graduation (Witzen, 2019).

[1] These national statistics are only available within subject areas, which are very broadly defined. Subject areas do not equate to an intentionally defined sequence of courses and may include students taking multiple unrelated courses (e.g., construction and woodworking). These rates would likely be much lower if calculated within a defined sequence of CTE courses, as we do in this study.

CTE in Washington state

Recognizing the contributions that CTE can make to student learning, Washington state has introduced participation expectations for all high school students. Beginning with the class of 2019, all students must complete at least one credit of "occupational education" as a graduation requirement (Washington State Subject and Credit Requirements, 2019). Beginning with the class of 2020, all graduates must additionally complete one of three Graduation Pathway requirements, which include the Armed Services Vocational Aptitude Battery (ASVAB) test, Career & Technical Education (CTE) Course Sequence, and ELA & Math Pathways.

What does this study do?

In this study, we leveraged the Washington ERDC P20W data system to provide a comprehensive landscape analysis of CTE in the state over the last decade. We followed more than 750,000 Washington students through high school and into postsecondary education and employment between 2013–14 and 2023–24 to understand their access to and participation in CTE programming, as well as the high school graduation, postsecondary, and labor market outcomes they achieved.

Students experience CTE coursework and programming in multiple ways. This study contributes to our understanding of these varied pathways and experiences by examining students' longitudinal credit accumulation during high school across all CTE coursework and within individual CTE pathways (see box 1 for definitions). We examined the relationship between different levels of CTE attainment, overall and within individual pathways, and student outcomes to understand how much CTE a student needs to achieve positive outcomes.

In the following sections, we first describe the report data, sample, and research methodology. Next, we present findings organized by student access to CTE, participation in CTE, and student outcomes. We conclude with recommendations and next steps.

Box 1. How is CTE structured in Washington?

Technical coursework in Washington state is organized into six **program areas** that reflect the state economy. Each program area comprises one or more career **clusters** that correspond to a set of related industries in a field. Overall, the state has recognized 16 cluster areas, with some mapping to multiple program areas.

Each cluster includes multiple **pathways** (also referred to as programs of study) made up of state-approved course sequences that prepare students to pursue advanced education or entry-level employment in a specific occupation or field. There were 64 recognized pathways across the state in 2023–24.

Program area	Cluster
Agriculture Education	• Agriculture, Food, & Natural Resources
Business & Marketing	• Arts, Audio/Video Technology & Communications • Business, Management & Administration • Finance • Hospitality & Tourism • Information Technology • Law, Public Safety, Corrections & Security • Marketing
Family & Consumer Sciences	• Arts, Audio/Video Technology & Communications • Education & Training • Health Sciences • Hospitality & Tourism • Human Services
Health Sciences	• Health Sciences • Human Services
Skilled & Technical Sciences	• Architecture & Construction • Arts, Audio/Video Technology & Communications • Government & Public Administration • Information Technology • Law, Public Safety, Corrections & Security • Manufacturing • Transportation Distribution & Logistics
STEM	• Science, Technology, Engineering and Mathematics

Note: Some clusters are included in more than one program area.

Source: Authors' analysis of OSPI CEDARS Appendix S data.

RESEARCH DESIGN

Data sources

This study leveraged ERDC's P20W data system to provide a comprehensive picture of student access to CTE, student participation in CTE programming, and the high school graduation, postsecondary, and labor market outcomes that students achieve. We used the following data on all students in grades 9–12 who enrolled in Washington public schools between the 2013–14 and 2023–24 school years (table 1):

Table 1. Data sources

Type of data	Data description	Data sources
K–12	• Demographics • Assessment • Course enrollment records (including CTE and non-CTE) • High school graduation and exit • Provision of CTE courses, pathways, clusters, and program areas (school-level) • School characteristics	• Washington Office of Superintendent of Public Instruction's (OSPI) Comprehensive Education Data and Research System (CEDARS) • OSPI Assessment Data System • National Center for Education Statistics (NCES)
CTE course sequences	• Alignment of Classification of Instructional Programs (CIP) codes with program areas, clusters, and pathways	• CEDARS Appendix S
Running Start	• Enrollment in Running Start coursework (CTE and non-CTE)	• Public Centralized Higher Education Enrollment System (PCHEES) • State Board of Community and Technical Colleges (SBCTC)
Postsecondary	• Enrollment • Persistence • Completion	• National Student Clearinghouse (NSC)[2] • PCHEES • SBCTC
Employment	• Employment • Earnings • Earning a living wage	• Washington unemployment insurance (UI) wage and employment data • MIT Living Wage Calculator

[2] PCHEES and SBCTC data were provided for all in-state public colleges and universities. NSC data were appended for all other students, whether they enrolled in postsecondary education in Washington or elsewhere. Nearly all postsecondary institutions that participate in federal financial aid programs submit data to NSC.

ERDC connects student-level records across sources and provides a common research ID allowing us to follow individual students from high school into postsecondary education, whether in Washington state or elsewhere, and to employment in Washington state. To access these data, we set up a data-sharing agreement with ERDC, and this study was approved by the Washington State Institutional Review Board. We worked in collaboration with ERDC and the Washington Office of Superintendent of Public Instruction (OSPI) to ensure the data were understood and used appropriately.

Data limitations

There are two main limitations of our data. First, we are missing student course data from the Spokane School District during the 2022–23 school year, which represents roughly 2.0 percent of the schools and 2.6 percent of the students in our sample. This could cause some underreporting of students' access to and participation in CTE programming, although the effect of these limitations is quite small.[3]

Second, Washington's unemployment insurance (UI) wage and employment data include records for all individuals employed in wage-paying positions for employers based in Washington state. Individuals employed outside Washington state are not included in these data. Additionally, some individuals employed in Washington state may not appear in the data, such as business owners, self-employed workers, and federal employees (including postal workers, federal civilian employees, and military personnel). This may lead to some underreporting of employment outcomes to the extent that CTE clusters are aligned to these areas. For example, if students in the Arts, Audio/Video Technology & Communications cluster pursue freelance work as videographers and photographers, and if students in the Government & Public Relations cluster pursue careers in the military, we may underreport their earnings.[4]

[3] The average number of CTE pathways reported at the state level in 2023 would increase from 8.94 to 8.96 if we carried forward information about the provision of CTE in Spokane schools in 2022 to 2023. Similarly, if we updated CTE credit attainment values for students who attended Spokane schools in the 2023 and 2024 cohorts (average of 2.2 and 2.7 CTE credits, respectively) with values for students who attended Spokane schools in the 2022 cohort (average of 3.0 CTE credits), the statewide average total CTE credits earned would increase from 4.65 to 4.70 (2023 cohort) and 4.75 to 4.76 (2024 cohort).

[4] We can't know the direction of the effect of this underreporting on estimates. If excluded individuals earn less than those who are included, then we overestimate the effects. Conversely, if excluded individuals earn more than those who are included, then we underestimate the effects.

How we identified CTE program areas, clusters, pathways, and courses

To understand what CTE programming students have access to at their schools and how they participate in these programs, we first need to define how individual courses are aligned to CTE program areas, clusters, and pathways.

CTE course sequences in Washington state are maintained in the Comprehensive Education Data and Research System (CEDARS) appendix S. We collected and compiled these appendices across all study years to compile a crosswalk of Classification of Instructional Programs (CIP) codes and CTE program areas, clusters, and pathways.[5] Using CIP codes, these crosswalk data were then merged to student-level course data from CEDARS and used to identify student enrollment in CTE coursework and to calculate the total credits students earn across all CTE offerings and within individual pathways.[6] Credits were totaled by individual course IDs, and not by CIP codes. Therefore, students could earn credits for different courses marked with the same CIP code.

Analysis of school-level CTE offerings

Sample

To provide a comprehensive overview of where CTE courses are available across the state, the dataset for the school-level analysis included all public schools in Washington, serving grades 9–12, where at least five students were enrolled in coursework during the school year. This included traditional high schools, alternative schools, reengagement schools, institutional education, special education schools, and Tribal schools.[7] Our school-level dataset included 605 to 661 schools, annually, between 2013–14 and 2023–24. See appendix A, tables A1 and A2 for more details.

[5] All CTE courses have a CIP code that should uniquely assign the course to a program area, cluster, and pathway. Upon compiling the Appendix S data, we reviewed the alignment between CIP codes, program areas, clusters, and pathways over time. A small number of CIP codes (17 of 283) were inconsistently mapped to different program areas, clusters, or pathways. For example, a course may have been mapped to the same program area and pathway across all years, but its cluster changed. Because we calculated students' credit attainment within the same program area, cluster, and pathway cumulatively across all years of enrollment, an inconsistency in cluster classification, to continue the example, could undercount the total credits that a student attempted and earned in a given CTE pathway. In consultation with OSPI, we reviewed these inconsistencies and made minor updates to ensure alignment between CIP codes, program areas, clusters, and pathways was consistent over time.

[6] CTE course sequences are defined at the state level using CIP codes. Individual districts select their own course codes, which they map to the CIP codes. Accordingly, the combination of courses that make up a CTE pathway can vary by school, as each district maps its own local course codes to the CIP codes.

[7] Reengagement schools include a subset of reengagement programs across the state that are large enough to have dedicated district spaces (not all reengagement programs are classified as reengagement schools). Institutional education includes juvenile detention facilities and residential facilities such as residential habilitation centers. Special education schools are public schools that focus on serving the educational needs of students with disabilities.

Methods

To understand the provision of CTE programming across the state and how it is changing, we started by calculating the average number of CTE program areas, clusters, and pathways offered at individual schools between 2013–14 and 2023–24. Schools were counted as offering an individual CTE program area, cluster, or pathway in a school year if at least one student enrolled in a course that could be mapped by CIP code to that program area, cluster, or pathway. Schools were still counted as offering a CTE course even if no students earned credit from the course in that year—as long as at least one student attempted credits for the course.

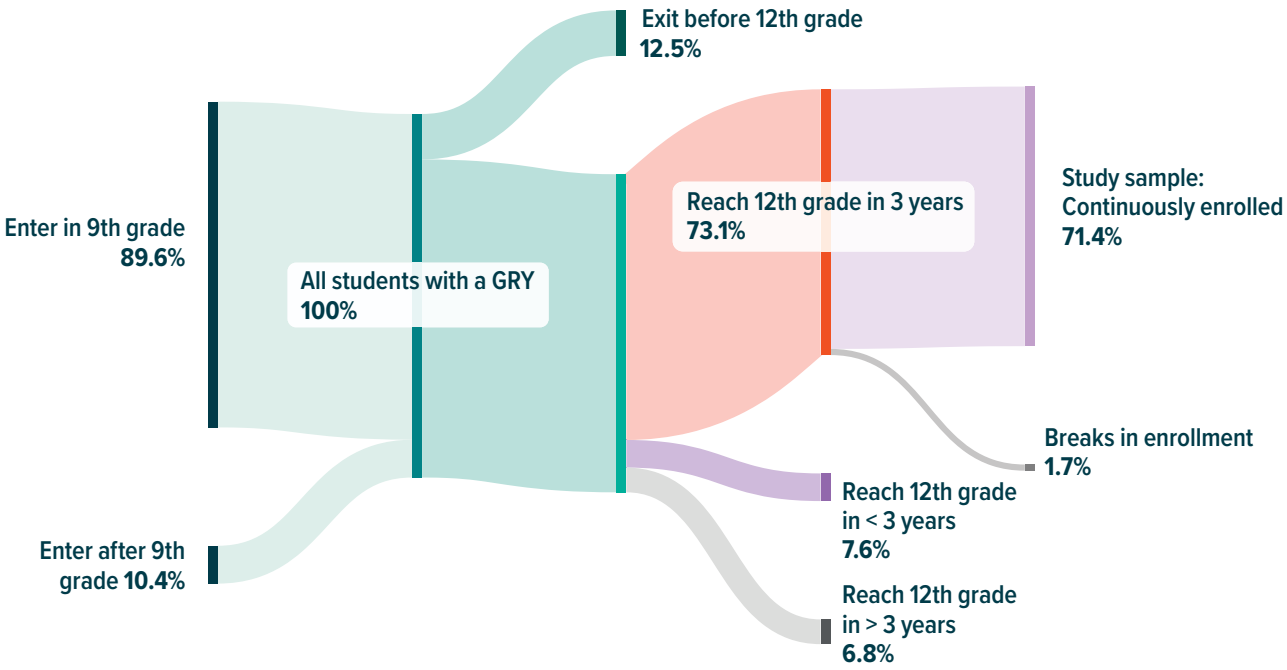
To understand how the provision of CTE varies across schools and time, we examined these data by school year and disaggregated by CTE program area and school characteristics, including school locale, type, size, number of teachers endorsed to teach CTE, and student income status.

Analysis of student participation in CTE

Sample

To understand student participation in CTE programming during high school, we created cohort samples that included only students who were continuously enrolled in any Washington public school from grade 9 through grade 12. This approach allowed us to examine students' cumulative exposure to CTE and make meaningful comparisons among those who had similar opportunities to engage with these programs. Cohorts were defined by a student's graduation requirements year (GRY), which was assigned with the expectation that students will graduate four years after their initial enrollment in grade 9. While all enrolled students—regardless of when they enter high school—were assigned a GRY, we limited our analysis to those who maintained continuous enrollment from grades 9 through 12. Among students with a GRY between 2017 and 2024, 71.4 percent met this criterion and were included in our study (figure 1). See appendix A, table A3 for characteristics of students included in the 2024 cohort.

Figure 1. Most students were enrolled continuously from grade 9 through grade 12



Note: Figure includes 764,210 students with a graduation requirements year (GRY) between 2017 and 2024. Nearly 90 percent of students entered a Washington public high school in grade 9, while 10 percent entered in grade 10 or later. Of the full sample, 87.5 percent reached grade 12 at some point, 73.1 percent did so within three years, and 71.4 percent were continuously enrolled from grade 9 through grade 12. Just under 8 percent reached grade 12 in fewer than three years, and just under 7 percent took more than three years.

Source: Authors' analysis of ERDC P20W Integrated Data System.

Methods

After combining course sequence data and student-level course data,[8] we calculated the total number of CTE credits a student attempted and earned during high school overall and within each individual pathway.[9] We then summarized these data to understand the percentage of a cohort who attained the following credit thresholds overall and within a single pathway:

- At least 0.5 credit
- At least 1.0 credit
- At least 2.0 credits
- At least 3.0 credits
- At least 4.0 credits

These credit threshold percentages were calculated by cohort to examine changes in CTE attainment over time and were disaggregated by student and school characteristics and CTE cluster.

Analysis of student outcomes

Sample

To understand the relationship between different levels of CTE attainment and student outcomes, we started with the same cohort samples used in the participation analysis. This ensured we were making comparisons among students who had similar opportunities to engage in CTE programming. Our analyses of short-term outcomes included all cohorts between 2017 and 2024 where the outcome could be observed. We examined long-term outcomes for students in the 2017 cohort. See appendix B, tables B1 and B2 for a complete description of the samples used for each outcome.

[8] Student-level course data include CTE coursework taken by a student at their high school (as reported in OSPI CEDARS data) as well as CTE coursework completed through the Running Start program at Washington community and technical colleges and universities (as reported in SBCTC and PCHEES course enrollment data). A Running Start course was classified as CTE if its CIP code matched the course sequence data outlined in Appendix S. In such cases, we assigned the corresponding high school course's average credit value to the Running Start course. These Running Start CTE courses are part of a broader set of CTE offerings that allow students to earn college credit—including Advanced Placement, Cambridge International, CTE Dual Credit, College in the High School, and International Baccalaureate—all of which were included in this analysis.

[9] Nearly all CIP codes in the course sequence data are uniquely mapped to a program area, cluster, and pathway. A small number of courses are mapped to a specific program area and cluster but not a specific pathway within the program area and cluster. Per OSPI, these courses can be counted toward any pathway in the cluster and program area. To ensure we included these courses in pathway credit totals, we counted them in the pathway in which the student earned the most credits cumulatively during high school.

Methods

We estimated a series of Ordinary Least Squares (OLS) regression models to examine the relationship between different levels of CTE credit attainment and high school graduation, postsecondary, and labor market outcomes. These analyses allowed us to better isolate the relationship between CTE attainment and the outcome that can be attributed to CTE, after accounting for other factors correlated with student participation in CTE and the outcome.

Because nearly all students in Washington take some CTE coursework, and because we were interested in understanding how the relationship between CTE and outcomes varied for different levels of CTE credit attainment, we created treatment indicators that included the following three groups:

- Students who earned **more than one and up to two credits** in CTE
- Students who earned **more than two and up to three credits** in CTE
- Students who earned **more than three credits** in CTE

We then compared outcomes for these students against students who earned one or fewer credits in CTE.

We created these treatment indicators based on student CTE credit attainment overall, CTE credit attainment within any single pathway, and CTE credit attainment within a single pathway by each of the 16 clusters. In total, we created 18 different treatment indicators and estimated a separate model with each indicator for each outcome. See appendix B for a full description of the different treatment indicators and our methodology.

ACCESS TO CTE PATHWAYS

CTE pathways are state-approved course sequences that prepare students to pursue advanced education or entry-level employment in a specific occupation or field. There were 64 recognized pathways across the state in 2023–24. However, individual schools offer just a subset of these pathways. This section examines how CTE pathways are distributed across Washington schools and how access to different pathways varies by school characteristics and region.

The number of pathways offered at schools serving students in grades 9–12—and the program areas in which those pathways are categorized—provide important context for understanding overall student participation and outcomes. For example, we might expect to see differences in pathway availability based on school resources and regional labor market needs. Meanwhile, differences in the number and type of pathways offered at a school may also shape whether students find a CTE pathway aligned with their interests, which could in turn influence whether they pursue CTE coursework beyond the minimum graduation requirement.

State-level approval and provision of CTE pathways

At the state level, the number of approved CTE pathways has changed very little since 2013–14

As of the 2023–24 school year, Washington had approved 64 CTE pathways across 16 career clusters and six program areas (table 2). This is only a slight increase from the 62 pathways approved in 2013–14, with two new pathways added in the Business & Marketing program area in 2020–21 and 2021–22. Since then, there have been no other changes to the total number of pathways, clusters, or program areas approved across the state.

Pathways in Business & Marketing account for the largest share of approved pathways in the state (34%), followed by Skilled & Technical Sciences (23%), and Family & Consumer Sciences (19%). There are fewer distinct pathways within the STEM (3%) and Health Sciences (8%) program areas.

Table 2. Pathways in the Business & Marketing program area made up the largest share of pathways offered in 2023–24

Program area	Number of clusters in program area	Number of approved pathways in program area	Approved pathways in program area as a percentage of total approved pathways
Business & Marketing	7	22	34%
Skilled & Technical Sciences	7	15	23%
Family & Consumer Sciences	5	12	19%
Agriculture Education	1	8	13%

Program area	Number of clusters in program area	Number of approved pathways in program area	Approved pathways in program area as a percentage of total approved pathways
Health Sciences	1	5	8%
STEM	1	2	3%

Note: Some clusters are included in more than one program area.
Source: Authors' analysis of OSPI CEDARS Appendix S data.

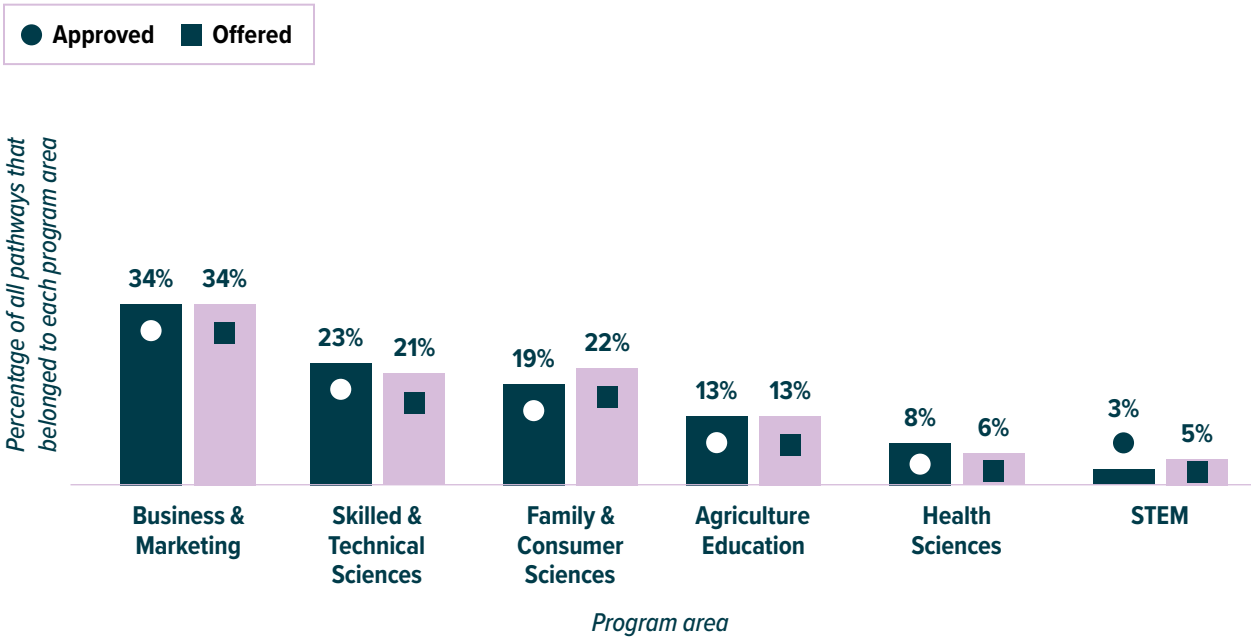
The types of CTE pathways offered at the local level generally mirror what has been approved by the state

In 2023–24, the distribution of pathways by program area offered across the state closely mirrored what the state had approved, with some small differences. Pathways in the Family & Consumer Sciences and the STEM program areas were slightly overrepresented in offerings (figure 2)—for example, STEM pathways made up 3 percent of the total available pathways and 5 percent of the total offered pathways—while pathways in the Skilled & Technical Sciences and Health Sciences program areas were slightly underrepresented.

A pathway was "offered" at a school if at least one student attempted credits in any course that was part of the pathway during the school year.

A pathway was "offered" in a program area if at least one student attempted a course that was part of any pathway within the program area during the school year.

Figure 2. The program area breakdown of total pathways offered in 2023–24 across the state mirrors the breakdown of pathways approved by the state

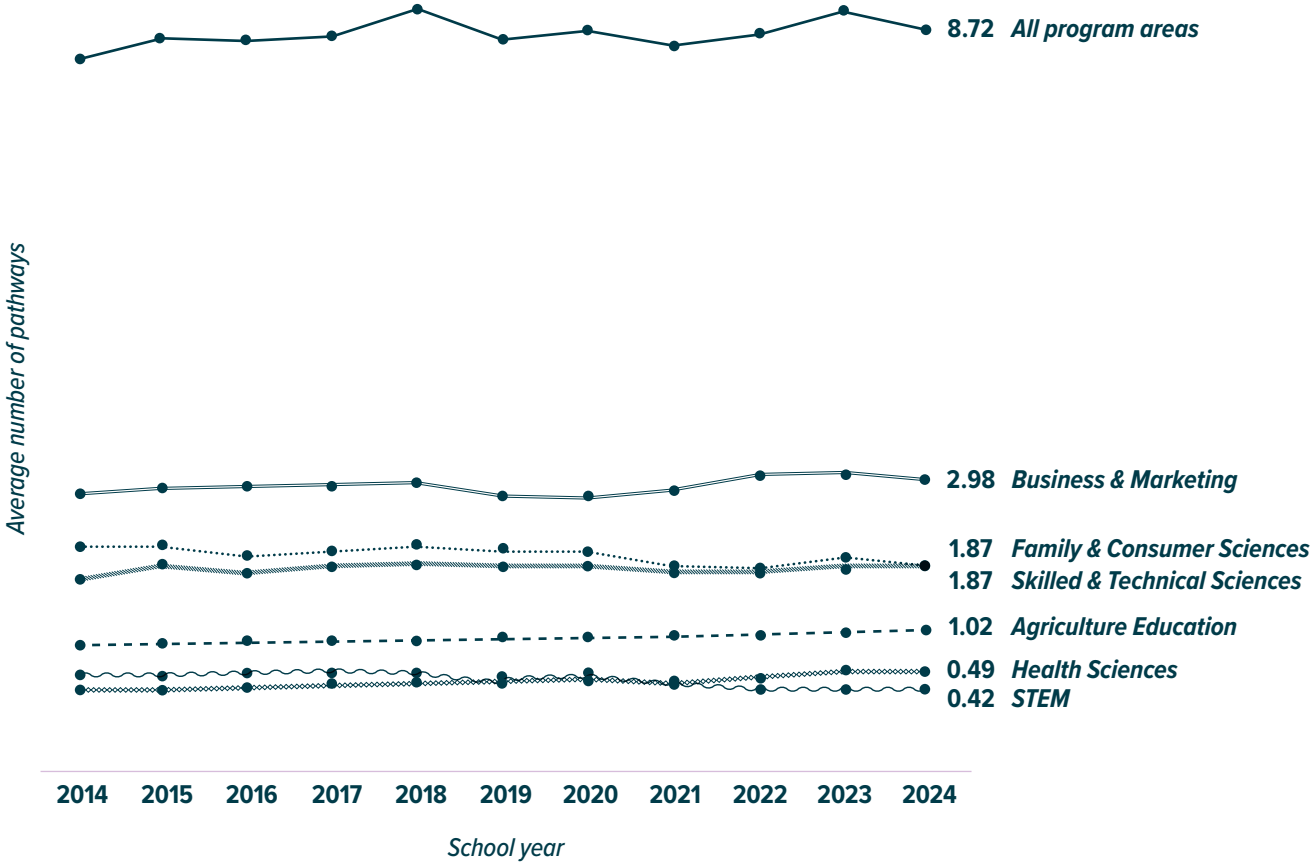


Source: Authors' analysis of OSPI CEDARS Appendix S data and ERDC P20W Integrated Data System.

The average number of CTE pathways offered at Washington schools, overall and within program areas, has remained stable since 2013–14

Overall, the average number of pathways offered at Washington schools serving students in grades 9–12 remained stable between 2013–14 and 2023–24, increasing only from 8.35 to 8.72. Some program areas experienced changes over time, but they were small and not very meaningful (figure 3; see appendix A, table A4). For example, schools offered nearly three pathways, on average, in Business and Marketing (out of a possible 22 pathways) in both 2013–14 and 2023–24. The stability of offerings is notable, as we might expect to see changes given the shifting needs of Washington's economy. However, these findings reflect only the availability of CTE pathways and do not measure trends in student participation.

Figure 3. The average number of pathways offered by high schools in each program area has remained relatively stable



Note: Figure includes all school types, including alternative schools, institutions, juvenile detention centers, reengagement schools, special education schools, traditional public schools, Tribal schools, and vocational/technical schools. A school is included if at least one student at that school enrolled in coursework during the school year. See appendix A, table A4, for more details.

Source: Authors' analysis of ERDC P20W Integrated Data System.

School characteristics associated with CTE pathway offerings

The number of pathways offered at a school is related to school locale, size, and income

The number of pathways available to students was highest among suburban schools, high-income schools, and large schools (figure 4; also see appendix A, tables A5 and A6). Schools in rural locales, low-income schools, and smaller schools offered fewer pathways, on average. In the 2023–24 school year, suburban schools offered an average of 11.4 pathways, while rural schools offered six pathways, on average. Similarly, high-income schools offered 11.5 pathways compared to six pathways at low-income schools. The largest gaps in CTE pathway offerings were related to size: The largest schools offered close to 18 pathways, while the smallest schools offered slightly fewer than two pathways. This may be attributed to different resources available to larger and smaller schools. It may also be a feature of the type of school in the small size category: 48 percent of schools in the small size category were alternative schools, compared to only 4 percent of schools in the large size category. The small size category also included more schools categorized as institutions, juvenile detention centers, reengagement schools, and special education schools.

Figure 4. Access to CTE pathways in 2023–24 was highest in suburban schools, high-income schools, and large schools

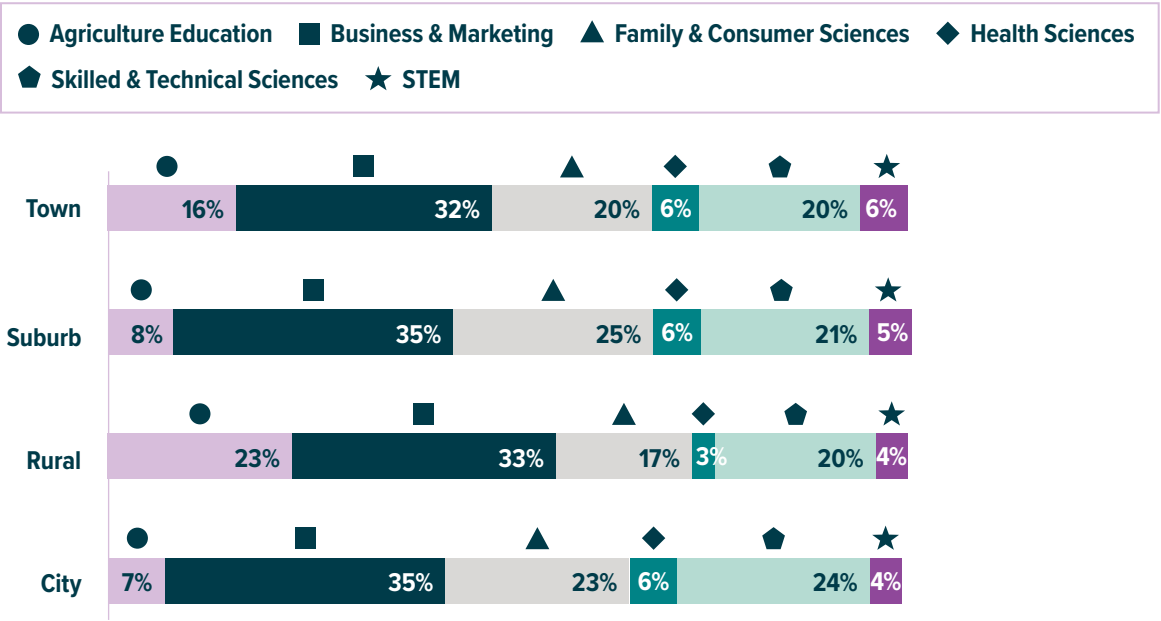
Note: School locale was defined using NCES locale codes. School income categories were based on the percentage of students eligible for free or reduced-price lunch (FRPL). High-income schools are schools in the lowest third of percentage of students eligible for FRPL (0–42.36%). Middle-income schools are schools in the middle third of percentage of students eligible for FRPL (42.47–64.30%). Low-income schools are schools in the highest third of percentage of students eligible for FRPL (64.31–100%). Schools were classified as large (420–3,198 students), medium (85–419 students), or small (6–84 students) based on whether they were in the top, middle, or lowest third of enrollment size in 2023–24. See appendix A, table A5, for more details.

Source: Authors' analysis of ERDC P20W Integrated Data System.

Rural schools and small schools offer a higher share of pathways in Agriculture Education and a smaller share of pathways in Family & Consumer Sciences and Health Sciences

While most schools across Washington offer a similar distribution of pathways across the program areas, rural schools offer more opportunities in Agriculture Education and fewer opportunities in Health Sciences and Family & Consumer Sciences (figure 5; also see appendix A, table A7). This may reflect an alignment between CTE offerings and local labor market needs in rural areas, where agriculture-related industries are often more prevalent and it can be challenging to find CTE educators with the necessary training for other content areas.

Figure 5. Rural schools had a higher share of pathways in the Agriculture Education program area than schools in other locales in 2023–24



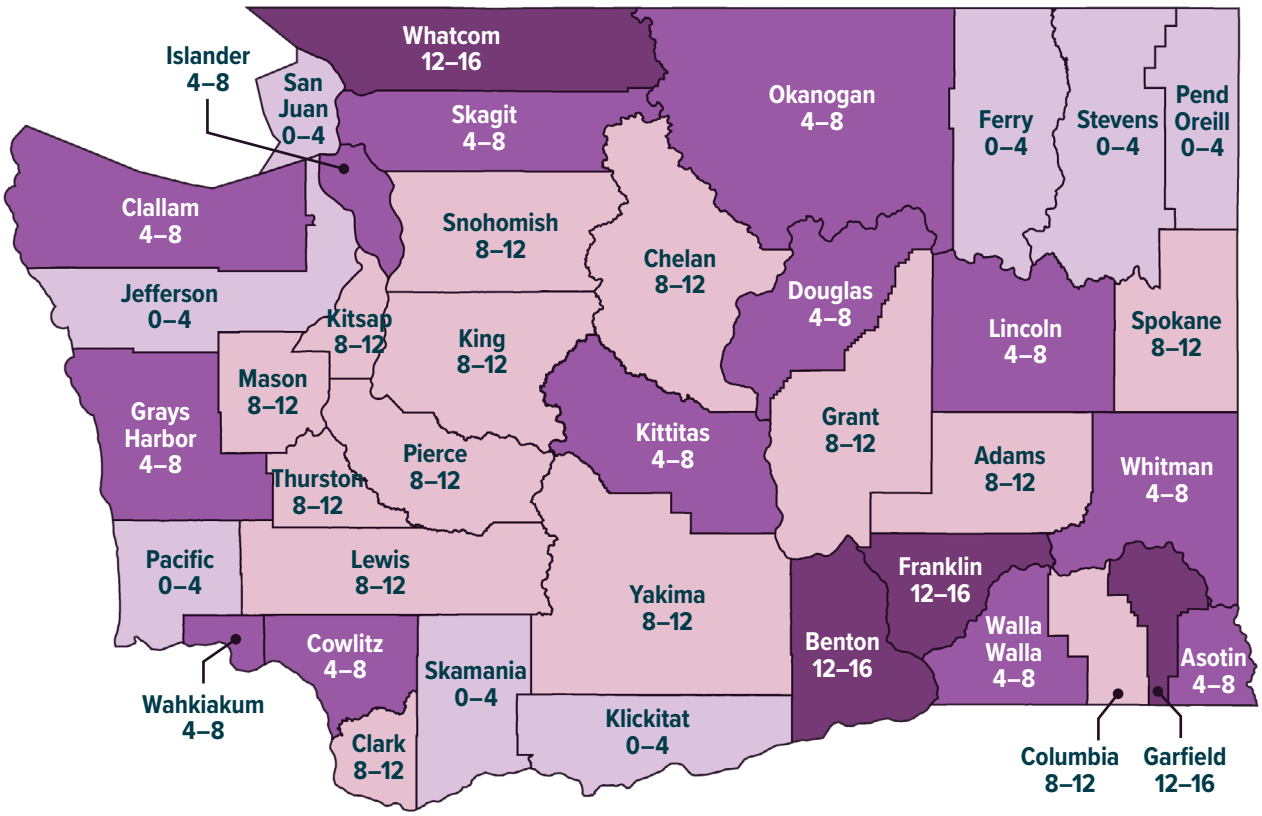
Note: School locale was defined using National Center for Education Statistics locale codes.
Source: Authors' analysis of ERDC P20W Integrated Data System.

Regional variation in CTE pathway offerings

CTE pathway offerings are generally higher in population centers, but there is variation across the state

The average number of pathways offered by a school varies regionally, with the most pathways typically offered in counties near large population centers, such as Benton, Franklin, King, and Spokane (figure 6). The provision of CTE across more rural parts of the state is varied. Schools in the northeast corner offered the fewest number of pathways, on average, while schools in central Washington and on the peninsula offered slightly more options.

Figure 6. Average number of CTE pathways offered in the 2023–24 school year, by county

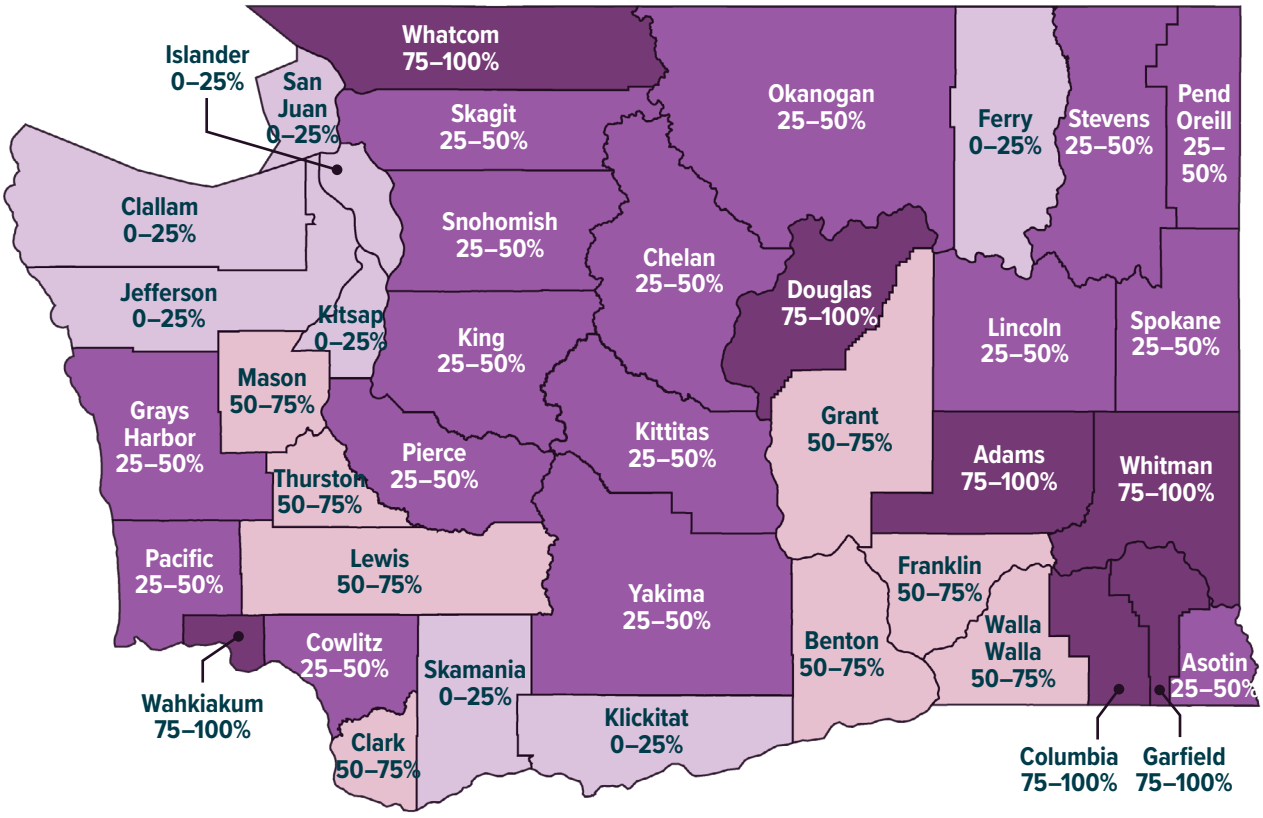


Source: Authors' analysis of ERDC P20W Integrated Data System and National Center for Education Statistics Common Core of Data (school location).

There is regional variation in the type of CTE programs offered, especially in the Agriculture Education and Health Sciences program areas

Pathways in **Agriculture Education** were more common in central and eastern Washington, with over three-quarters of schools in counties such as Adams, Douglas, and Whitman offering courses in this area. In contrast, urban and coastal counties like Clallam, King, Kitsap, and Pierce had fewer schools offering agriculture-related pathways (figure 7).

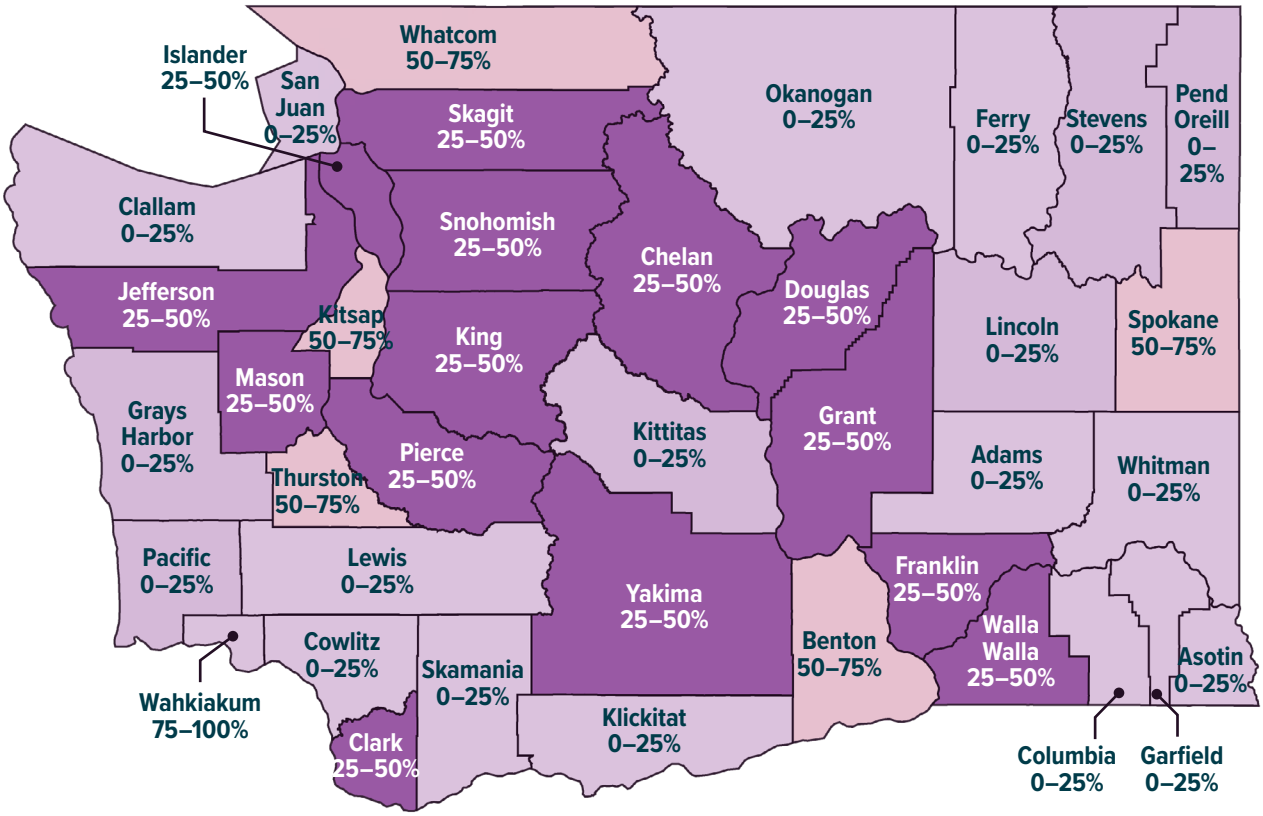
Figure 7. Percentage of schools in each county offering courses in the Agriculture Education program area



Source: Authors' analysis of ERDC P20W Integrated Data System and National Center for Education Statistics Common Core of Data (school location).

Health Sciences pathways were concentrated in a different set of regions, with greater access in counties such as Benton, Kitsap, Spokane, Thurston, and Whatcom (figure 8). Meanwhile, several rural and coastal counties—including Clallam, Ferry, Pacific, and Wahkiakum—had few or no schools offering Health Sciences courses. These differences may reflect variation in school size, resource availability, and proximity to local health care systems that can support partnerships and work-based learning opportunities.

Figure 8. Percentage of schools in each county offering courses in the Health Sciences program area



Source: Authors' analysis of ERDC P20W Integrated Data System and NCES Common Core of Data (school location).

Other program areas—Business & Marketing, Family & Consumer Sciences, and Skilled & Technical Sciences—generally followed similar geographic patterns as the overall number of pathways offered (figure 6). Most counties have at least some schools offering courses in pathways in each of these program areas, with offerings more limited in counties where overall CTE availability is lower.

STUDENT PARTICIPATION IN CTE

CTE pathways are made up of state-approved course sequences intended to prepare students for advanced education or entry-level employment in a specific occupation or field. However, in practice, students engage in CTE programming in a variety of ways—not always building skills sequentially within a defined sequence of courses. The outcomes associated with CTE participation may vary depending on how a student engages in CTE. To better understand student engagement, this analysis focused on two different forms of participation:

- **Credit attainment across all pathways,** which captures the total engagement and breadth of a student's experience with CTE and includes all CTE courses taken across all pathways
- **Credit attainment within a single pathway,** which captures the depth of a student's CTE experience in CTE and only includes CTE courses taken within the same pathway

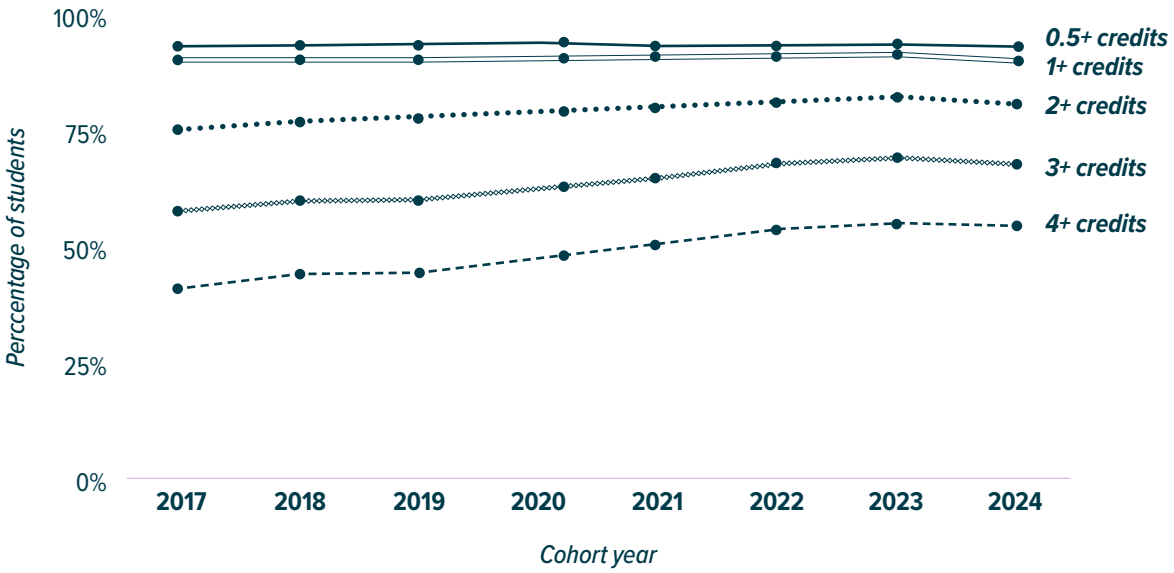
CTE participation across and within pathways

There is widespread participation in CTE in general, and it has increased over time

Nearly all students enrolled continuously from grade 9 through 12 earn at least some credit in CTE during high school. In the 2024 cohort, 96 percent of students earned at least 0.5 credits in CTE, and 94 percent earned at least one credit, meeting the state's CTE graduation requirement. Even beyond the graduation requirement, there is still broad participation in CTE, with more than half of the 2024 cohort earning at least four credits across all pathways.

Total CTE credit accumulation has increased over time—especially at higher credit thresholds—though tapered slightly in the 2024 cohort (figure 9; also see appendix A, tables A8 and A9). Between the 2017 and 2024 cohorts, the percentage of students earning four or more credits in CTE overall increased from 42 to 56 percent. Understanding trends in these different thresholds is important, since earning more CTE credit across all pathways is related to stronger high school graduation outcomes, and students who earned more than three credits across all pathways were more likely to achieve stronger employment outcomes than students who only earned up to one credit.

Figure 9. The percentage of students earning two or more CTE credits overall has increased steadily since the 2017 cohort



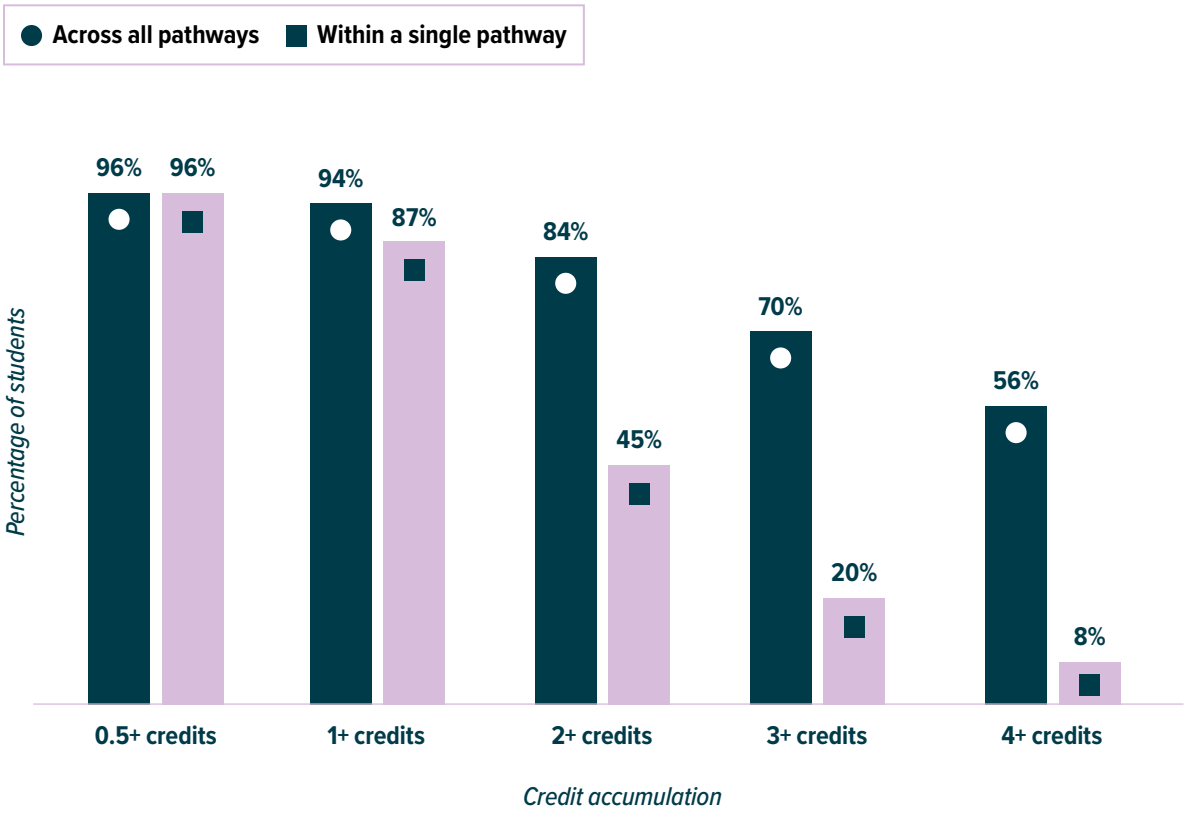
Note: Sample includes students continuously enrolled from grades 9 through 12. See appendix A, tables A8 and A9, for further details.

Source: Authors' analysis of ERDC P20W Integrated Data System.

Most students explore CTE broadly, and fewer pursue in-depth study within a single pathway

Credit attainment across all pathways is much higher than credit attainment within a single pathway (figure 10). In the most recent cohort, 84 percent of students earned at least two CTE credits across all pathways, compared to 45 percent within a single pathway. More than half of students earned at least four CTE credits overall, but just 8 percent earned at least four credits within a single pathway.

Figure 10. A smaller percentage of students accumulated two or more credits within a single pathway compared to overall credit accumulation



Note: Sample includes students continuously enrolled from grades 9 through 12. See appendix A, table A9, for more details.

Source: Authors' analysis of ERDC P20W Integrated Data System.

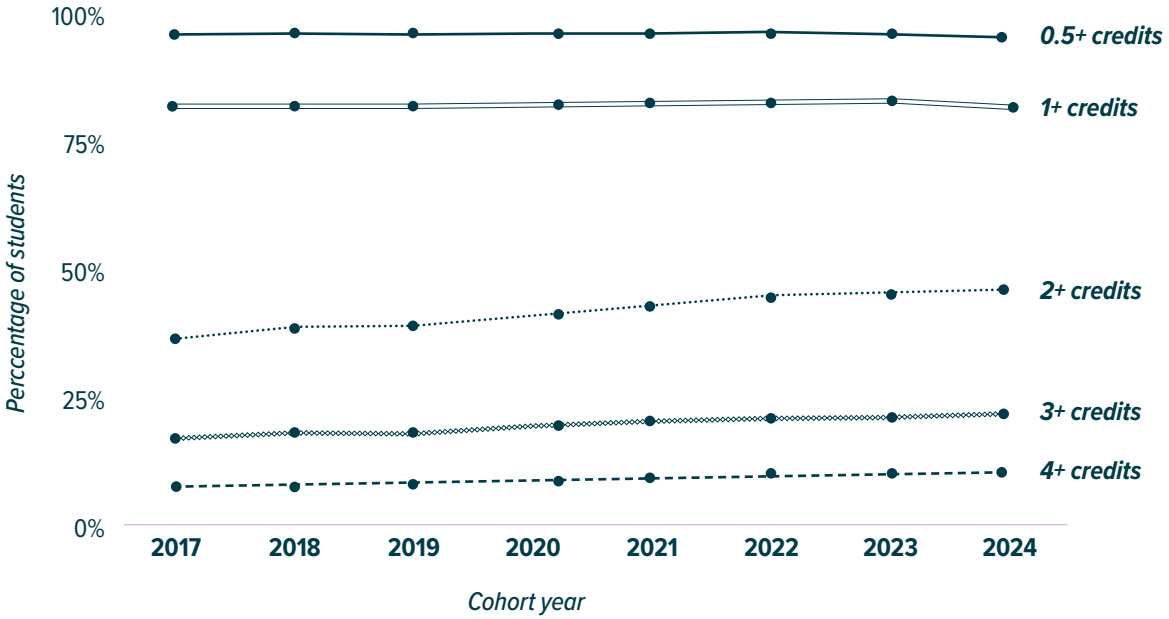
Many courses are worth 0.5 credits, so the decline in credit attainment from students who earn one or more credits to students who earn two or more credits may be the result of students completing the first two courses in a pathway and deciding not to continue. As we later show, this pattern matters for student outcomes, since some students who accumulate more CTE credits within a single pathway see stronger postsecondary and labor market outcomes after graduation.

The percentage of students earning multiple credits within the same pathway has been increasing

Since the 2017 cohort, the percentage of students earning multiple credits within a single pathway has increased. Growth was greatest for students earning at least two credits in a single pathway—climbing from 35 percent in 2017 to 45 percent in 2024 (figure 11; also see appendix A, tables A8 and A9). Some of this growth may be attributed to the CTE Graduation Pathway, which became an option for the 2020 cohort. To meet the CTE Graduation Pathway requirements, students must complete two or more CTE

credits in the same CTE program area, including either a dual credit course or a course leading to an industry-recognized credential. The percentage of students meeting those criteria has increased from 48 to 58 percent between the 2021 and 2024 cohorts (appendix A, table A9).[10]

Figure 11. The percentage of students earning two or more credits in a single pathway has increased over time



Note: See appendix A, table A9, for more details.
Source: Authors' analysis of ERDC P20W Integrated Data System.

CTE participation by student identities, experiences, and school characteristics

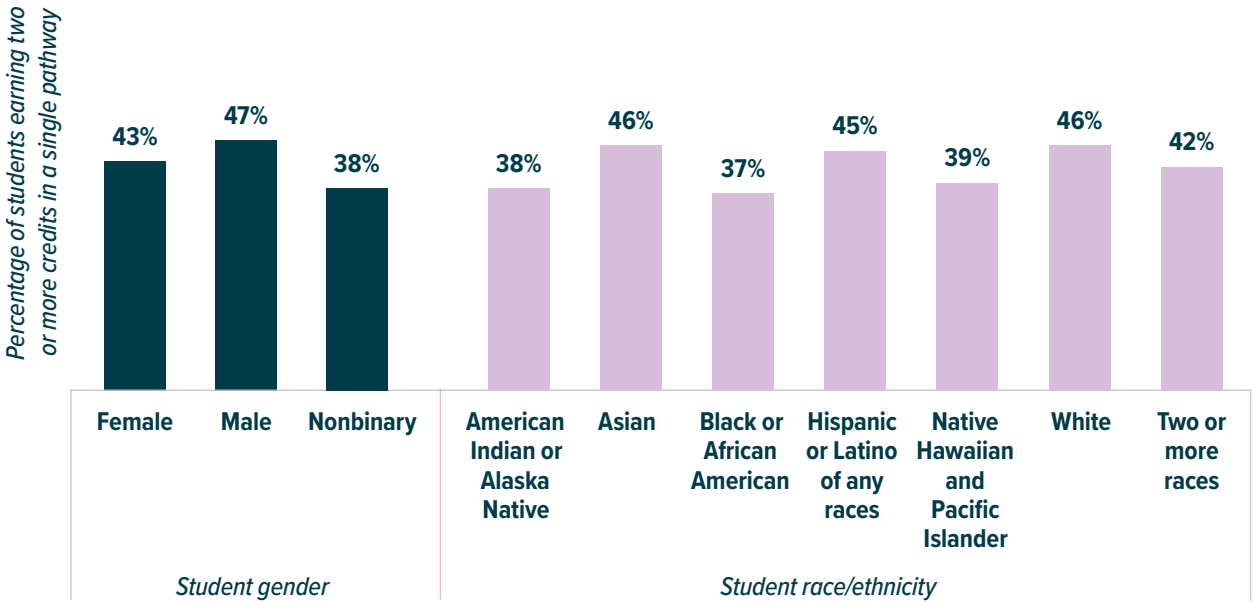
Students from historically underserved groups earned two or more credits within a pathway at lower rates than their peers

Because nearly all students in Washington take some CTE, there is little variation in which students earn up to one credit. The likelihood that a student continues to earn two or more credits in CTE, however, differs by student identities and experiences. These credit attainment gaps matter because students who earn more than one credit in CTE generally see stronger outcomes—and the returns can continue to accrue as students earn additional credits.

[10] Another way for students to meet the CTE Graduation Pathway requirement is by completing a Core Plus program in manufacturing, construction, or maritime fields, but we were unable to examine this pathway option in this study.

In the 2024 cohort, students who identified as male, Asian, Hispanic/Latino, or white were the most likely to earn two or more credits within a single pathway. Nonbinary students and students who identified as American Indian or Alaska Native, Black, and Native Hawaiian and Pacific Islander earned two more credits in a single pathway at the lowest rates (figure 12; also see appendix A, table A11). We find similar disparities in credit attainment across pathways (see appendix A, table A10, for participation across pathways and appendix A, table A11, for participation within a single pathway).

Figure 12. A higher proportion of students in the 2024 cohort who were male, Asian, Hispanic or Latino, or white earned two or more credits within a single pathway

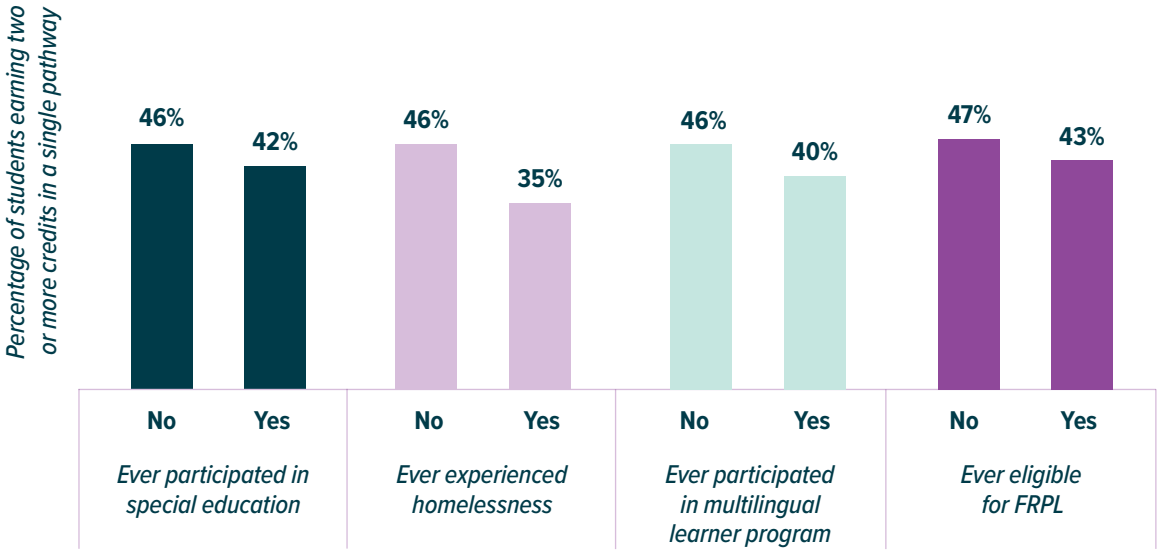


Note: Race and ethnicity categories follow federal reporting guidelines and may not fully capture the diversity of student identities. These broad groupings can mask important differences in experiences among more specific racial and ethnic groups. See also appendix A, table A11, for more details.
Source: Authors' analysis of ERDC P20W Integrated Data System.

Students who experienced economic hardship, participated in special education services, or participated in a multilingual learner program earned two or more credits within a single pathway at lower rates than their peers. These differences were largest between students who ever experienced homelessness (35%) and never experienced homelessness[11] (46%) during high school and by English learner status: 40 percent of students who ever participated in an English learners program during high school achieved the credit threshold compared to 46 percent of students who never participated. Differences by participation in special education and eligibility for free or reduced-price lunch were slightly smaller (figure 13; also see appendix A, table A11). We find similar disparities in credit attainment across pathways.

[11] As defined in McKinney-Vento Act, Section 752(2).

Figure 13. Students who experienced economic hardship, participated in special education services, or participated in a multilingual learner program earned two or more credits within a single pathway at lower rates than their peers



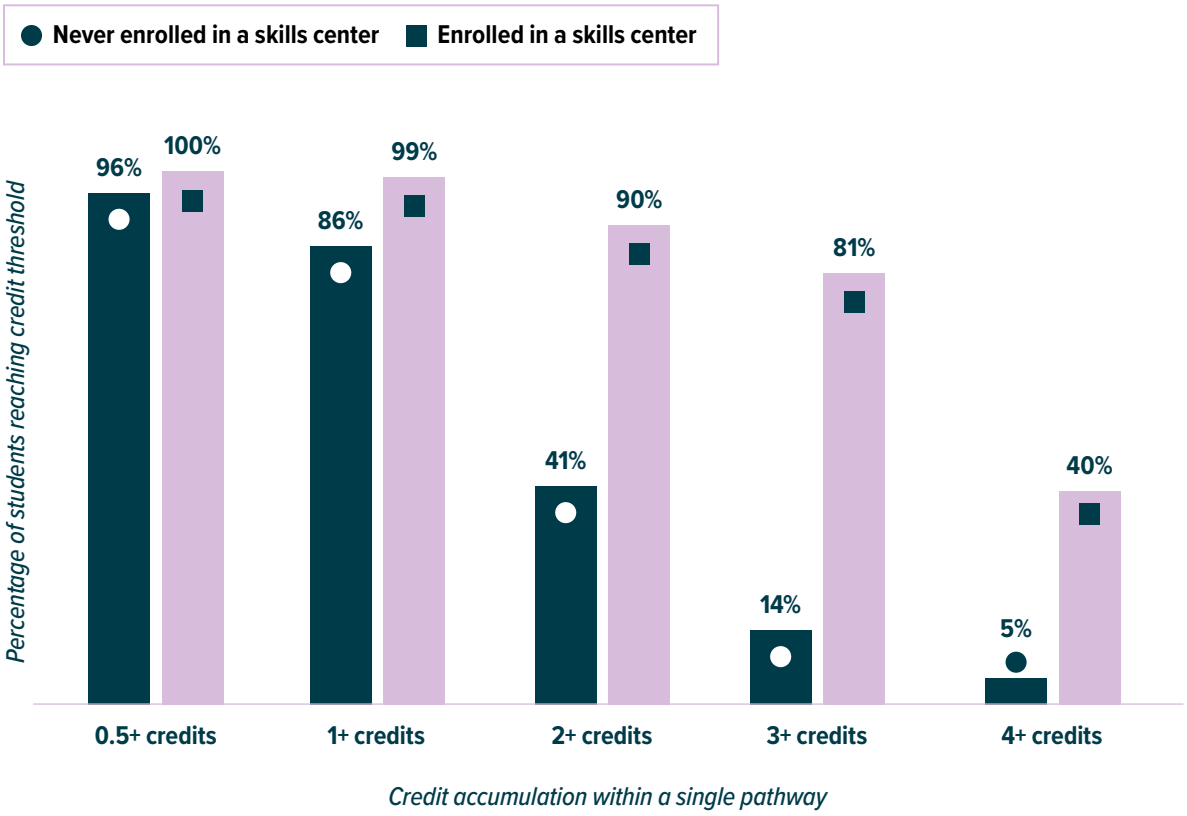
Note: See appendix A, table A11, for more details.

Source: Authors' analysis of ERDC P20W Integrated Data System.

Students who enrolled in a CTE Skills Center were much more likely to attain higher credit thresholds within a single pathway

In the 2024 cohort, students who enrolled in a skills center for at least one semester had the highest CTE credit attainment within a single pathway, with 90 percent earning two or more credits (figure 14; also see appendix A, table A11). This is not surprising given the goal of skills centers, but the data provide confirmation that attending a skills center is associated with sustained credit attainment within a pathway. Unlike students who never enrolled in a skills center, credit attainment does not fall precipitously after reaching the one-credit threshold.

Figure 14. Students who enrolled in a skills center for at least one semester attained CTE credits within a pathway at much higher rates



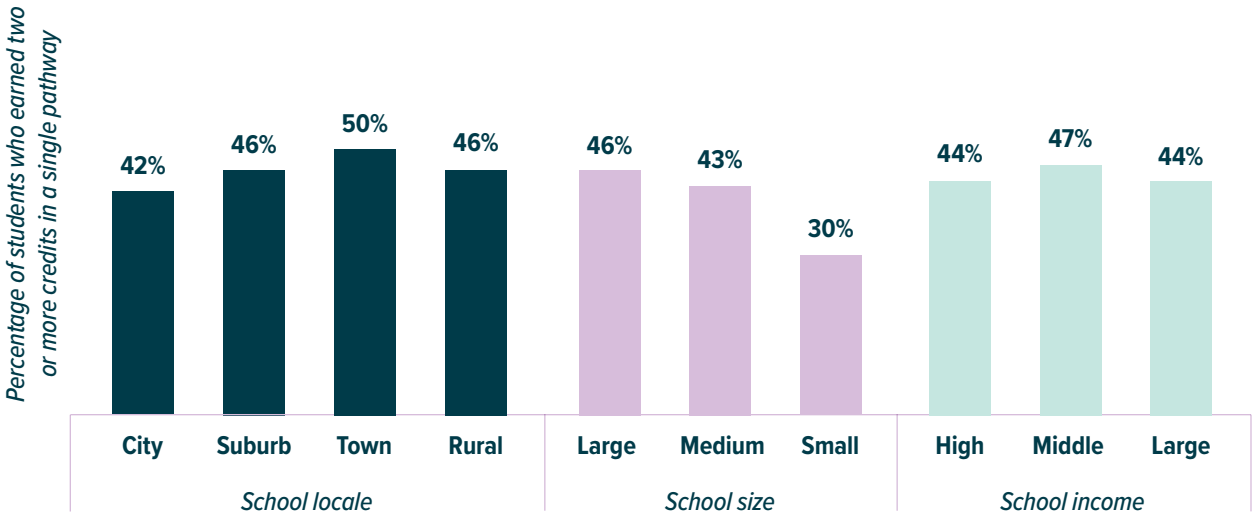
Note: See appendix A, table A11, for more details.

Source: Authors' analysis of ERDC P20W Integrated Data System.

Students enrolled at different types of schools attained CTE credits at similar rates, regardless of the number of pathways offered

We previously showed that rural schools, small schools, and low-income schools offered fewer CTE pathways, on average. Fewer pathway offerings could decrease the likelihood that students find a pathway they are passionate about and limit the number of students who earn two or more credits in a single pathway. However, the data generally show a different pattern. Students who attended rural schools attained CTE credits at rates on par with students in suburban schools and at a higher rate than students in city schools. Attainment rates were not meaningfully different by school income (figure 15; also see appendix A, table A11). However, students in small schools participated at lower rates than their peers in medium and large schools. Notably, nearly half of schools in the small school category were alternative schools, compared to only 4 percent in the larger school category, which may help explain differences in CTE participation.

Figure 15. CTE credit attainment was relatively consistent across school locale and income, but students at smaller schools were less likely to earn two or more credits in a single pathway



Note: School locale was defined using NCES locale codes. School income categories were based on the percentage of students eligible for FRPL. High-income schools are schools in the lowest third of percentage of students eligible for FRPL (0–42.36%). Middle-income schools are schools in the middle third of percentage of students eligible for FRPL (42.37–64.30%). Low-income schools are schools in the highest third of percentage of students eligible for FRPL (64.31–100%). Schools were classified as large (420–3,198 students), medium (85–419 students), or small (6–84 students) based on whether they were in the top, middle, or lowest third of enrollment size in 2023–24. Small schools included a higher percentage of alternative schools compared to large schools. See appendix A, table A11, for more details.

Source: Authors' analysis of ERDC P20W Integrated Data System.

CTE participation by clusters

Participation rates are highest in the clusters for Health Sciences; Arts, Audio/Video Technology & Communications; and Agriculture, Food, & Natural Resources, and these clusters have experienced the fastest growth since 2017

Across the 16 CTE clusters in Washington, **Health Sciences** and **Arts, Audio/Video Technology & Communications** saw the highest levels of participation and those rates have increased rapidly since the 2017 cohort. In the 2024 cohort, 73 percent of students earned at least 0.5 credits in Health Sciences (up from 63% in 2017) and 62 percent earned at least 0.5 credits in Arts, Audio/Video Technology & Communications (up from 53% in 2017).

The clusters with the highest percentage of students who earned at least two credits in a single pathway were also **Arts, Audio/Video Technology & Communications** (9% of the 2024 cohort), **Health Sciences** (7.5%), as well as **Agriculture, Food, & Natural Resources** (6%), and these clusters have also seen the fastest growth at the two-credit threshold since 2017. In contrast, participation at the 0.5 and two credit

thresholds was much lower in **Government & Public Administration** (2% and 1%) and in **Transportation, Distribution, & Logistics** (6% and 2%).

Although **STEM** pathways made up only about 5 percent of the pathways offered statewide, student participation up to one credit within a STEM pathway was strong: 23 percent of the 2024 cohort earned at least 0.5 credits in a STEM pathway, and 16 percent earned at least one credit. A much smaller share of students earned at least two credits (3%).

Student credit attainment in some CTE clusters varied by student identities and school experiences

Participation patterns across CTE clusters varied by student demographics, particularly by gender, and to a lesser extent by race/ethnicity and socioeconomic status. Some of the observed differences in participation by student race/ethnicity and socioeconomic status may be due to geographic variation in CTE programming and student demographics across the state and not solely student preferences.

Female and nonbinary students were more likely than male students to earn two or more credits in Health Sciences, Education & Training, and Human Services (figure 16; also see appendix A, table A12). Male students were more likely to earn two or more credits in Manufacturing, Information Technology, Transportation & Logistics, STEM. and Architecture & Construction.

Figure 16. Gender differences in CTE participation were notable in the Health Sciences and Education & Training clusters, where female and nonbinary students earned two or more credits at a higher rate

Note: See appendix A, table A12, for more details.

Source: Authors' analysis of ERDC P20W Integrated Data System.

Differences by student race and ethnicity were less pronounced but still notable in some clusters. Participation in **Information Technology** was substantially higher among Asian students (13%) compared to the overall cohort (4%). In **Agriculture, Food, & Natural Resources,** participation was higher among students who were American Indian/Alaska Native (8%), white (7%), and eligible for free or reduced-price lunch (7%), and lower among Asian and Black students (2%). These demographic patterns generally align with those of rural areas of the state, which also disproportionately offer pathways in Agriculture, Food, & Natural Resources.

STUDENT OUTCOMES

In this section, we discuss our findings from descriptive analyses examining the percentage of students in our samples achieving outcomes and regression analyses examining the relationship between different thresholds of CTE attainment—measured overall across all CTE programming, within any single pathway, and within a single pathway in each of the 16 clusters. Outcomes include high school graduation, postsecondary enrollment and completion, and employment and earnings outcomes. For all available cohorts, we examined the relationship between CTE and high school graduation and postsecondary enrollment and employment outcomes in the year following high school. For students in the 2017 cohort, we also examined the relationship between CTE and postsecondary completion, employment, and earnings during and through the 2022–23 academic year (six years following high school).

Box 2. Overview of treatment and comparison groups used in regression analyses

We estimated 18 different models (each with its own treatment indicator) for each outcome to test the relationship of each treatment indicator in isolation to the outcome.

- Analyses of **overall CTE credit attainment** compare students who earned more than one credit in CTE overall (defined in three different attainment categories) to students who earned one or fewer credits in CTE overall. This includes students who earned zero credits in CTE overall.
- Analyses of **CTE credit attainment** within a single pathway compare students who earned more than one credit in any single CTE pathway (defined in three different attainment categories) to students who earned one or fewer credits in any single CTE pathway. This includes students who earned zero credits in a single CTE pathway.
- Analyses of **CTE credit attainment within a single pathway in a specific cluster** (e.g., a pathway within the Manufacturing cluster) compare students who earned more than one credit in a single pathway in that cluster (e.g., Manufacturing; defined in three different attainment categories) to students who earned one or fewer credits in the same single pathway in that cluster. This includes students who earned zero credits in that specific pathway and cluster.

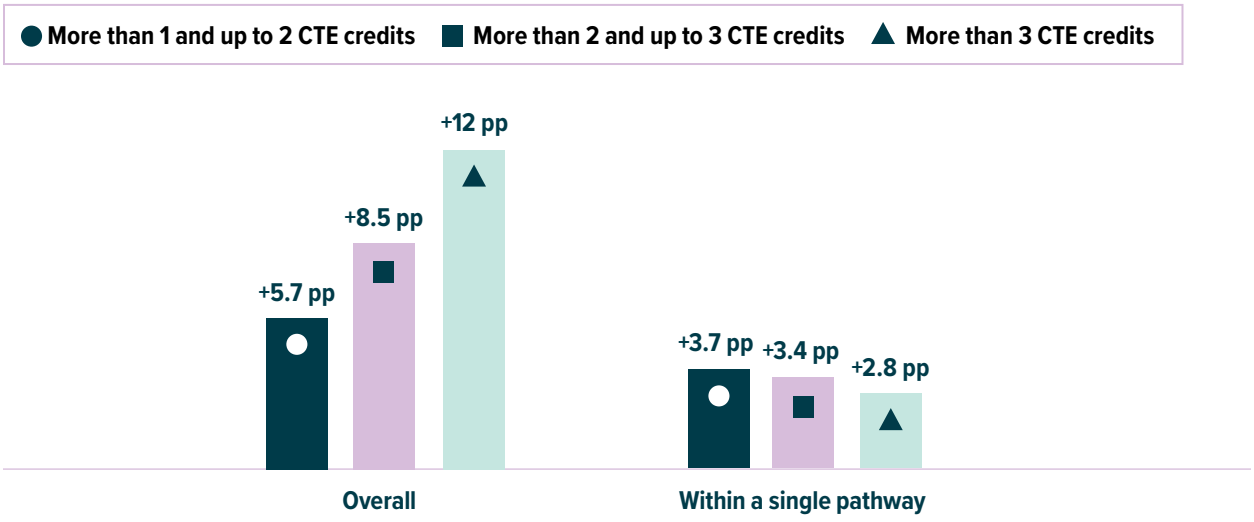
See appendix B for a complete description of methodology.

The relationship between CTE credit attainment and short-term outcomes for all cohorts

Earning more credits in CTE is related to an increased likelihood of on-time high school graduation. This trend is growing over time and is strongest for male students

Across our sample, 94 percent of students who were enrolled continuously from grade 9 through grade 12 graduated from high school on time. In our regression analyses, we found that students who earned more than one CTE credit overall were more likely to graduate high school than observationally similar students who earned one credit or less, and the likelihood of high school graduation continued to increase with the amount of CTE a student takes.[12] Students who earned more than one and up to two CTE credits across all pathways were 5.7 percentage points more likely to graduate high school and students who earned more than three CTE credits were 12.0 percentage points more likely to graduate high school (figure 17; appendix C, tables C1 and C6).

Figure 17. Students who earned more credits in CTE across all pathways were more likely to graduate high school



Note: Vertical bars present statistically significant coefficients (alpha = 0.05) from OLS regression analyses that examine the relationship between different levels of CTE credit attainment overall on high school graduation. The bars represent the change in the probability that a student achieves the outcome, after adjusting for differences attributed to student demographics, academic achievement, experiences with dual credit and advanced

[12] To not overstate the effect of CTE on high school graduation, we restrict our sample to students enrolled continuously from grades 9–12. This ensures that we are comparing students who had comparable opportunities to engage with CTE. Otherwise, students who took more CTE coursework will also be students who were enrolled longer and more likely to graduate. While an imperfect analysis, we do find that our findings hold when we don't restrict our sample to students enrolled continuously from grades 9–12 but instead adjust for different enrollment patterns. Future research can more carefully examine how participation in CTE annually impacts students' retention in high school.

coursework, schools attended, and cohort year. Students who earned one CTE credit or fewer are the reference category. See appendix C, tables C1 and C6 for more details.

Source: Authors' analysis of ERDC P20W Integrated Data System.

The effect of CTE on high school graduation has been steadily increasing across all CTE attainment levels since the 2020 cohort. For students in the 2024 cohort, the returns to CTE are generally 1 to 7 percentage points larger than the average across all cohorts: Students who earned more than three CTE credits in the 2024 cohort were 18.0 percentage points more likely to graduate than students who earned one credit or fewer (appendix C, table C3).[13]

The effect of CTE on high school graduation is also consistently larger for male students and has also continued to grow over recent cohorts. On average, high school graduation rates are lower for male students (93%) in our sample compared to female students (95%). However, the effect of taking more CTE for male students is on average 2.4 to 5.8 percentage points larger than the effects for non-male students. Because male students typically graduate high school at lower rates, CTE appears to be closing high school graduation gaps between male and non-male students (appendix C, table C4).

Notably, the additive effects on high school graduation of earning more CTE credits across all pathways do not hold for students who increase the amount of CTE credits they earn within a single pathway. On average, students who earned more than one credit in the same CTE pathway are about 3 percentage points more likely to graduate than observationally similar students who earned one credit or less in the same pathway. This effect size is relatively stable across the different credit attainment thresholds (figure 17; appendix C, tables C1 and C6).

One hypothesis for this finding is that students who focus their courses in a single CTE pathway have found something meaningful connecting them to high school. These students may now be more likely to graduate, regardless of how much additional coursework they take in the same pathway. Students who are taking more coursework across pathways may continue to experience additive effects as they develop deeper engagement with high school through cumulative CTE experiences.

In addition, high school graduation outcomes are likely to differ between the two comparison groups (the reference groups in these regression findings). The regression-adjusted graduation rate for students who earned up to one credit across all CTE pathways (the comparison group for the "across all pathways" analysis) is 85 percent, compared to the regression-adjusted graduation rate for students who earned up to one credit within a single pathway (the comparison group for the "within the same pathway" analysis)

[13] As previously shown, average total CTE credit accumulation has increased in recent cohorts. As more students take more CTE, it is possible that some students who already had a higher propensity to graduate high school are now selecting into the CTE group. If students' propensity to graduate high school is latent (unmeasurable in our data), it is possible that some of the growth in student participation in CTE is driving the continued increase in the return to CTE on high school graduation.

of 92 percent. This means that students who attain higher credit thresholds within a single pathway are all likely to graduate at high rates, around 95 to 96 percent. Students who attain higher credit thresholds overall have predicted graduation rates from 91 (students who earned more than one and up to two credits overall) to 97 percent (students who earned more than three credits overall).

Students who earned more CTE credits were slightly less likely to enroll in postsecondary education and slightly more likely to be employed in the year following high school

Overall, 61 percent of Washington public high school graduates in our sample enrolled in some form of postsecondary education in the year following high school, and 74 percent of grade 12 students were employed in Washington state in the year following high school.[14] In our regression analysis, we found that students who earned more than three credits across all CTE pathways were 1.6 percentage points less likely to enroll in postsecondary education and 2.1 percentage points more likely to be employed than students who earned up to one credit across all CTE pathways. There is a similar balance between postsecondary enrollment and employment for credit accumulation within a single pathway. Across all attainment thresholds, students who earned more than one credit in a single pathway were about 1.6 percentage points less likely to enroll in college and about one percentage point more likely to be employed compared to students who earned up to one credit in a single CTE pathway (appendix C, tables C1 and C6).[15] However, as we later show, there is substantial variation in postsecondary enrollment and employment outcomes across the different clusters.

The relationship between CTE credit attainment within a CTE cluster and short-term outcomes for all cohorts

Students who earned more than one credit in a single pathway in the Finance, Marketing, Health Sciences, and Information Technology clusters were more likely to enroll in postsecondary education

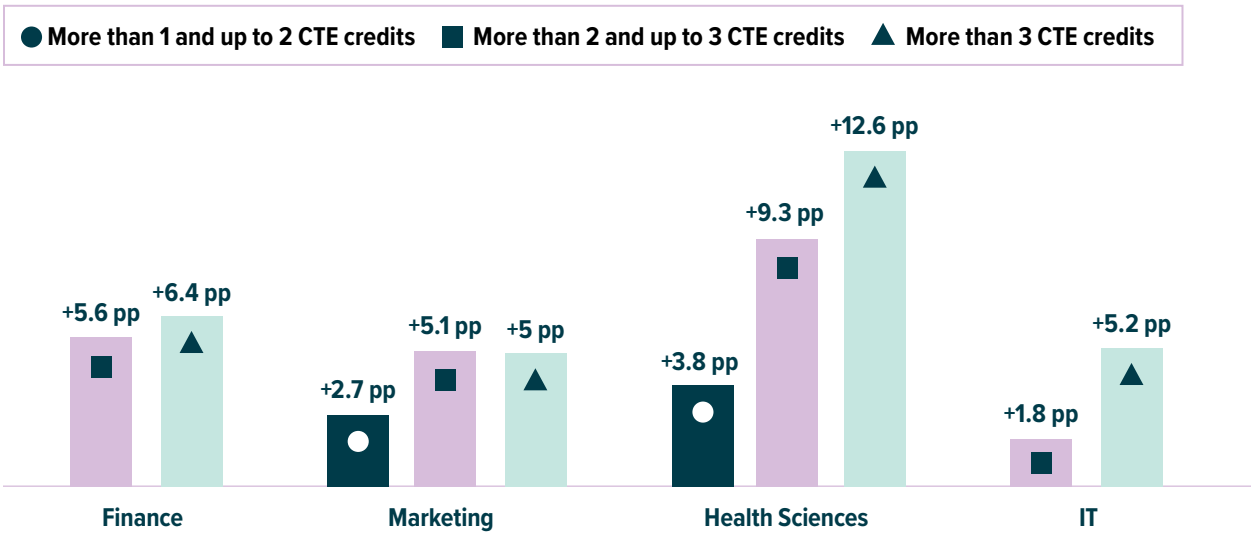
Students who earned more than one credit in the **Marketing** and **Health Science** clusters, and more than two credits within the **Finance** and **IT** clusters were more likely to enroll in postsecondary education in the year following high school graduation than observationally similar students who earned one or fewer credits in a single pathway in those clusters (figure 18). Students who earned more than three credits in **Business** (+4.3 percentage points) were also more likely to enroll in postsecondary education,

[14] Postsecondary enrollment outcomes are reported for students in our sample who graduated from high school, while employment outcomes are based on all students in the full sample, regardless of graduation status. See appendix B, table B2 for a detailed description of the analytic samples.

[15] Lower postsecondary enrollment rates among students who earned more credits in CTE are not explained by these students taking longer to enroll in postsecondary education: The relationship between all levels of CTE credit attainment—overall and within a single pathway—and time from high school graduation to postsecondary enrollment is generally small (a few days to a week) and not statistically different from students who earned one credit or less in CTE overall or within a single pathway.

but the relationship was negative for students who earned more than one and up to three credits in the cluster. Outcomes for Business, Finance, and IT were driven by enrollments in two-year institutions. Credit accumulation in the Health Sciences cluster led to increased enrollments in both two-year and four-year institutions, and outcomes for Marketing were driven by enrollment in four-year institutions (appendix C, tables C16, C20, C24, C30, C36).

Figure 18. Students who focused their CTE studies in Finance, Marketing, Health Sciences, and Information Technology were more likely to enroll in any postsecondary education



Note: Vertical bars present statistically significant coefficients (alpha = 0.05) from OLS regression analyses that examine the relationship between different levels of CTE credit attainment by cluster on postsecondary enrollment. The bars represent the change in the probability that a student achieves the outcome, after adjusting for differences attributed to student demographics, academic achievement, experiences with dual credit and advanced coursework, schools attended, and cohort year. Students who earned one CTE credit or fewer are the reference category. Only statistically significant results are displayed. Missing bars indicate that the relationship between the level of CTE attainment and the outcome is not significantly different from that of the reference category. See appendix C, tables C16, C20, C24, C30, and C36, for more details.

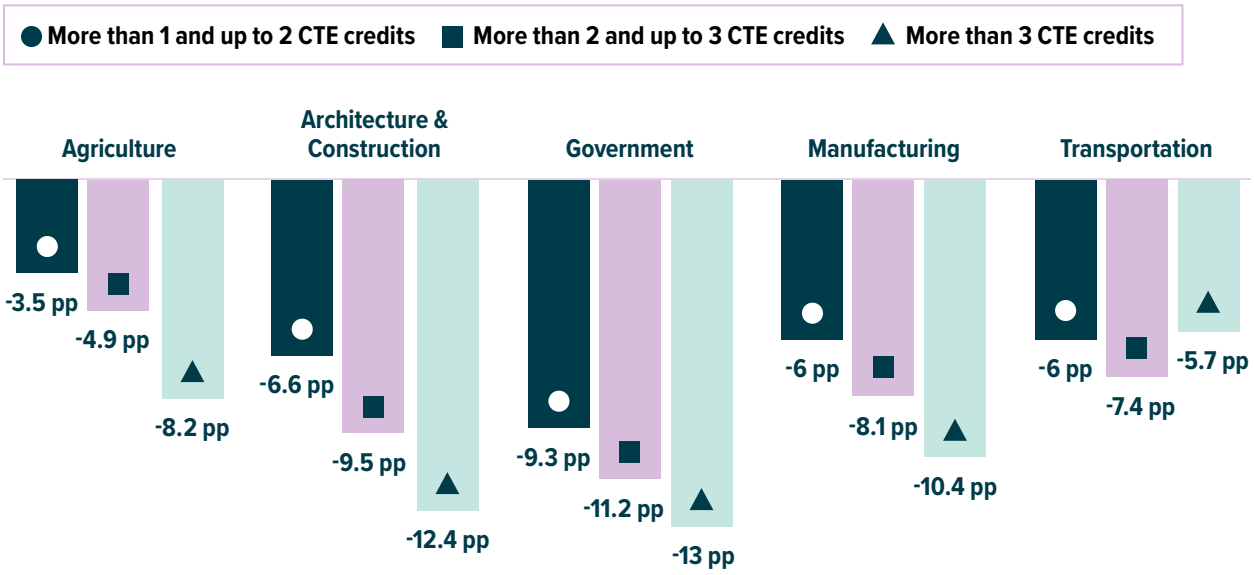
Source: Authors' analysis of ERDC P20W Integrated Data System.

Students who earned more than one credit in a single pathway in the Agriculture, Architecture & Construction, Government, Manufacturing, and Transportation clusters were less likely to enroll in postsecondary education

Postsecondary enrollment rates were likely to be lower for students who earned more than one credit in a single pathway in the **Agriculture, Architecture & Construction, Government, Manufacturing,** and **Transportation** clusters compared to students who earned zero to one credit in the same pathways. For example, students who earned more than one and up to two credits in a single pathway in the Agriculture cluster were 3.5 percentage-points less likely to enroll in postsecondary education in the year following high school than observationally similar students who earned zero to one credit in the same pathway (figure 19; appendix C, tables C10, C12, C22, C34, C40).

The relationship between credit accumulation in the **Education & Training** cluster and any postsecondary enrollment was null because students who earned more than one credit and up to three credits in Education & Training were about 2.2 percentage points more likely to enroll in a two-year institution and about 2.2 percentage points less likely to enroll in a four-year institution (appendix C, table C18).

Figure 19. Postsecondary enrollment rates are lowest for students who focused their CTE studies in Agriculture, Architecture & Construction, Government, Manufacturing, and Transportation



Note: Vertical bars present statistically significant coefficients (alpha = 0.05) from OLS regression analyses that examine the relationship between different levels of CTE credit attainment by cluster on postsecondary enrollment. The bars represent the change in the probability that a student achieves the outcome, after adjusting for differences attributed to student demographics, academic achievement, experiences with dual credit and advanced coursework, schools attended, and cohort year. Students who earned one CTE credit or fewer are the reference category. See appendix C, table C18, for more details.

Source: Authors' analysis of ERDC P20W Integrated Data System.

These findings may not be surprising, given the different educational and workforce pathways required for students pursuing occupations in these fields. As we show below, students from the 2017 cohort who focused their studies in four of these five clusters (Agriculture, Architecture & Construction, Manufacturing, and Transportation) with a lower likelihood of initial postsecondary enrollment were more likely to have higher earnings six years following high school. Students who focused their studies in the Government cluster did not have stronger employment outcomes; however, these students may have been more likely to enlist in the miliary, which would exclude them from our employment data.

Students who earned more than one credit in a single pathway in Agriculture, Architecture & Construction, Health Sciences, and Manufacturing were more likely to earn higher wages in the year following high school

In the year following high school, students in our sample who were employed in Washington earned an average income of $13,222 in 2023 dollars. In our regression analysis, we found that students who earned more than one credit in a single pathway within the **Agriculture** (+$810 to +$2,989), **Architecture & Construction** (+$1,861 to +$3,311), **Manufacturing** (+$1,875 to +$4,720), and **Transportation** (+$2,282 to +$3,391) clusters were more likely to earn higher wages than observationally similar students who earned one or fewer credits in the same pathway (appendix C, tables C10, C12, C34, C40).

Students who earned more than one credit in **Human Services** (-$888 to -$2,542) and **Marketing** ($640 to -$1495) and more than two credits in **Government** (-$1,534 to -$1,639) were more likely to earn lower wages than observationally similar students who earned one or fewer credits in the same pathway (appendix C, tables C22, C28, C36).

See table 3 for a summary of short-term outcomes overall and by CTE cluster.

Table 3. Summary of short-term outcomes overall and by CTE cluster

▲ **Positive impact –** Positive and statistically significant relationship with the outcome and none of the CTE credit attainment levels have a negative and significant relationship with the outcome.

▼ **Negative impact –** Negative and statistically significant relationship with the outcome and none of the CTE credit attainment levels have a positive and significant relationship with the outcome.

— **Mixed impact –** Both a positive and negative statistically significant relationship with the outcome or if exactly two CTE credit attainment levels are not statistically significant (and the other credit attainment level has either a positive or negative statistically significant relationship with the outcome).

○ **Null impact –** All three CTE credit attainment levels have no relationship with the outcome.

Credit accumulation	High school graduation	Postsecondary enrollment in the year following high school graduation	Postsecondary enrollment in a two-year institution in the year following high school graduation	Postsecondary enrollment in a four-year institution in the year following high school graduation	Employed in year following high school exit	Annual earnings in year following high school exit	Earned living wage
Total credits earned **across all pathways**	▲	—	—	▼	▲	▲	—
Total credits earned **within a single pathway**	▲	▼	—	▼	▲	▲	▲

▲ **Positive impact –** Positive and statistically significant relationship with the outcome and none of the CTE credit attainment levels have a negative and significant relationship with the outcome.

▼ **Negative impact –** Negative and statistically significant relationship with the outcome and none of the CTE credit attainment levels have a positive and significant relationship with the outcome.

— **Mixed impact –** Both a positive and negative statistically significant relationship with the outcome or if exactly two CTE credit attainment levels are not statistically significant (and the other credit attainment level has either a positive or negative statistically significant relationship with the outcome).

○ **Null impact –** All three CTE credit attainment levels have no relationship with the outcome.

Total credit accumulation within a single pathway by cluster	High school graduation	Postsecondary enrollment in the year following high school graduation	Postsecondary enrollment in a two-year institution in the year following high school graduation	Postsecondary enrollment in a four-year institution in the year following high school graduation	Employed in year following high school exit	Annual earnings in year following high school exit	Earned living wage
Agriculture, Food, & Natural Resources	▲	▼	▼	▼	○	▲	▲
Architecture & Construction	▲	▼	▼	▼	—	▲	▲
Arts, A/V Technology & Communications	▲	▼	▼	▼	—	▼	▼
Business, Management & Administration	—	—	—	○	○	○	▲
Education & Training	▲	○	▲	▼	▲	▲	○
Finance	—	▲	▲	○	○	—	—
Government & Public Administration	▲	▼	▼	—	▼	▼	▼
Health Sciences	—	▲	▲	▲	▲	▲	▼

Total credit accumulation within a single pathway by cluster	High school graduation	Postsecondary enrollment in the year following high school graduation	Postsecondary enrollment in a two-year institution in the year following high school graduation	Postsecondary enrollment in a four-year institution in the year following high school graduation	Employed in year following high school exit	Annual earnings in year following high school exit	Earned living wage
Hospitality & Tourism	▲	▼	—	—	—	—	—
Human Services	▲	▼	▼	—	○	▼	—
Information Technology	—	▲	▲	▼	▼	▼	○
Law, Public Safety, Corrections & Security	▲	○	—	○	—	▼	▼
Manufacturing	▲	▼	▼	▼	—	▲	▲
Marketing	—	▲	—	▲	—	▼	○
Science, Technology, Engineering & Mathematics	▲	—	—	—	○	—	○
Transportation Distribution & Logistics	▲	▼	▼	▼	○	▲	▲

Note: Table summarizes the regression results presented in appendix C. For each cluster, the table consolidates the three regression coefficients—representing different CTE credit attainment levels of more than one and up to two, more than two and up to three, and more than three credits—into a single indicator representing the overall impact of credit attainment.

Source: Authors' analysis of ERDC P20W Integrated Data System.

The relationship between CTE credit attainment and long-term outcomes for the 2017 cohort

The effect of earning more CTE credits on completing a postsecondary credential was slightly larger for students who focused their studies in a single CTE pathway than for their peers who focused their efforts more broadly

Among the 2017 cohort—students who started high school in grade 9 during the 2013–14 school year and graduated in 2016–17—43 percent earned any postsecondary credential by 2022–23: 4.3 percent earned a certificate, 13.6 percent earned an associate degree, and 32.3 percent earned a bachelor's degree.

Students who earned more than one CTE credit overall were 1.4 to 2.1 percentage points less likely to earn any degree or credential within six years of high school graduation. This finding is driven by lower attainment rates for bachelor's degrees: Student who earned up to one CTE credit overall were 1.8 to 2.7 percentage points less likely to have earned a bachelor's degree by 2022–23 than students who earned more than one CTE credit overall (appendix C, table C2).

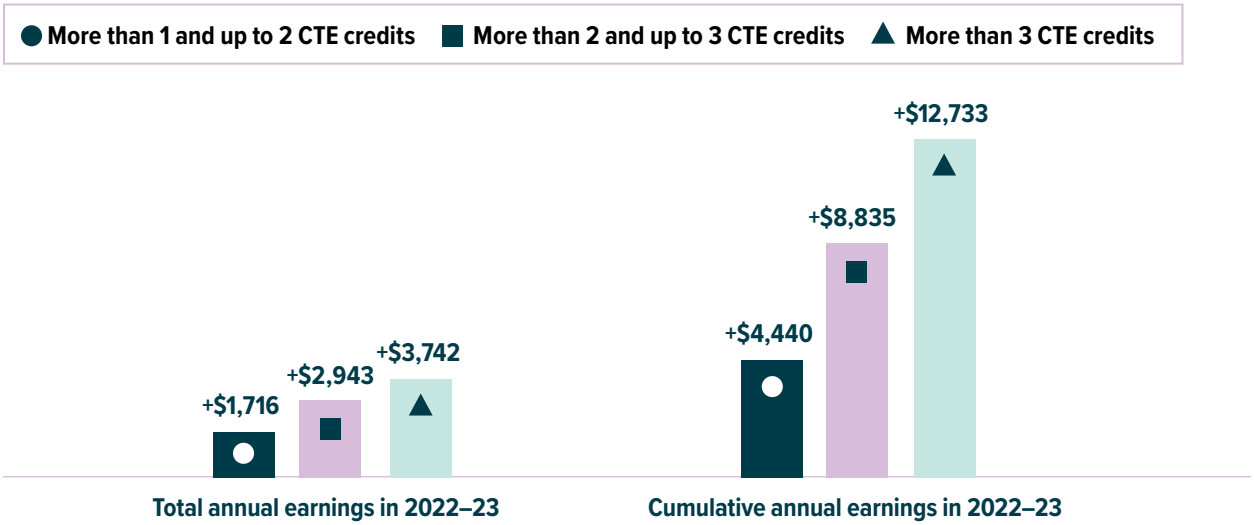
Students who earned more than one CTE credit within the same pathway were no more or less likely to earn any postsecondary degree or credential. However, these students were 0.6 to 2.2 percentage points more likely to earn a certificate by 2022–23, compared to observationally similar students who earned one CTE credit or less within the same pathway (appendix C, table C7). The return on earning CTE credit was again slightly higher for male students: Male students who earned more than one credit in a single pathway during high school were 1.3 to 2.9 percentage points more likely to have earned a certificate than female students who earned more than one credit in a single pathway in CTE during high school (appendix C, table C9). This finding is due in part to the different clusters male and female students chose to pursue. As we show below, the likelihood of earning a certificate is greatest for students who focus their studies in the Manufacturing and Transportation clusters—clusters that see higher participation from male students than female students.

Students who earned more CTE credits within a single pathway were also more likely to have higher annual and cumulative earnings and more likely to earn a living wage. These outcomes were stronger for male students

Among students from the 2017 cohort who were employed in Washington in 2022-23, the average individual earned $38,992 that year, and just 27 percent of the cohort earned a living wage (at least $51,646 in 2023 dollars) in the same year.

Students who earned more than one credit in a single pathway earned $1,716 to $3,742 more in 2022–23, and about $4,440 to $12,733 more cumulatively from 2017–18 through 2022–23 compared to observationally similar students who earned one credit or less in a single CTE pathway (figure 20; appendix C, table C7). Again, earnings gains from CTE were typically higher for male students, who earned an additional $2,467 to $3,543 in annual earnings for more than two CTE credits in the same pathway (appendix C, table C9).

Figure 20. Students who earned more CTE credits within a single pathway were more likely to have higher annual and cumulative earnings



Note: Vertical bars present statistically significant coefficients (alpha = 0.05) from OLS regression analyses that examine the relationship between different levels of CTE credit attainment in a single pathway on annual and cumulative earnings. The bars represent the change in the probability that a student achieves the outcome, after adjusting for differences attributed to student demographics, academic achievement, experiences with dual credit and advanced coursework, schools attended, high school graduation, and college enrollment, and college completion. Students who earned one CTE credit or fewer are the reference category. See appendix C, table C7, for more details.

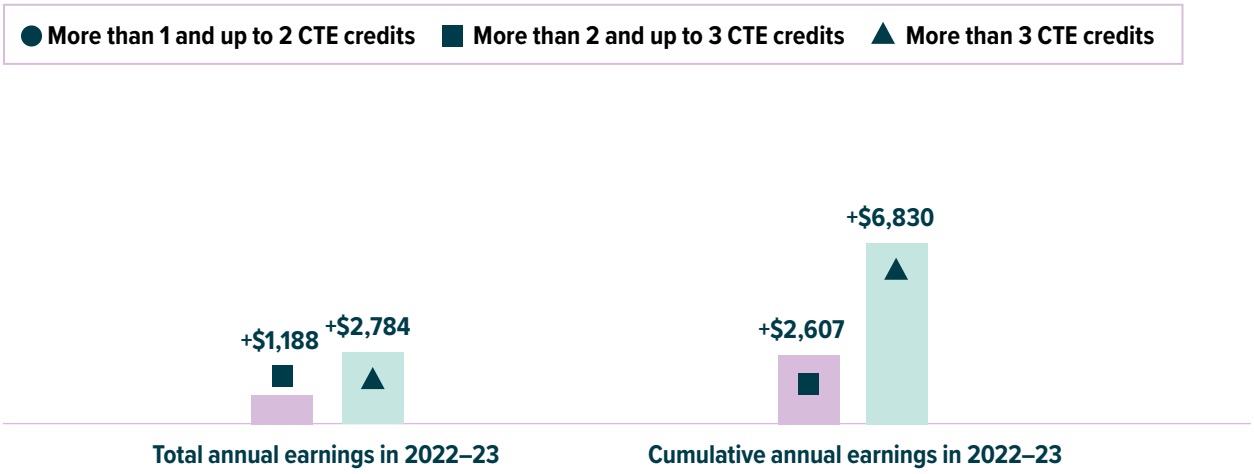
Source: Authors' analysis of ERDC P20W Integrated Data System.

Higher earnings parlayed to increased likelihood of earning a living wage. Students who earned more than one credit in a single pathway were 2.6 to 6.1 percentage points more likely to earn a living wage in 2022–23, and again, these effects were even stronger for male students (+2.4 to +6.3pp; appendix C, tables C7 and C9).

The effects of earning more CTE credits on six-year labor market outcomes were smaller for students who took a more exploratory approach to CTE

Regression-adjusted wages for students who earned more than one credit in CTE overall were not statistically different from regression-adjusted wages for observationally similar students who earned one credit or fewer in CTE overall. The effect on earnings was only statistically different for students who earned more than two and more than three CTE credits overall, across all CTE pathways. Students who earned more than three CTE credits overall earned $2,784 more annually in 2022–23 and $6,830 more cumulatively through 2022–23, on average, than observationally similar peers who earned one or fewer credits total (figure 21; appendix C, table C2). These gains are about 74 percent and 54 percent of the annual and cumulative earnings gains experienced, on average, for students who earned more than three credits in the same CTE pathway (appendix C, table C7).

Figure 21. Students who earned more CTE credits overall were more likely to have higher annual and cumulative earnings



Note: Vertical bars present statistically significant coefficients (alpha = 0.05) from OLS regression analyses that examine the relationship between different levels of CTE credit attainment overall on annual and cumulative earnings. The bars represent the change in the probability that a student achieves the outcome, after adjusting for differences attributed to student demographics, academic achievement, experiences with dual credit and advanced coursework, schools attended, cohort year, high school graduation, college enrollment, and college completion. Students who earned one CTE credit or fewer are the reference category. See appendix C, table C2 for more details.

Source: Authors' analysis of ERDC P20W Integrated Data System.

The relationship between CTE credit attainment within a CTE cluster and long-term outcomes for the 2017 cohort

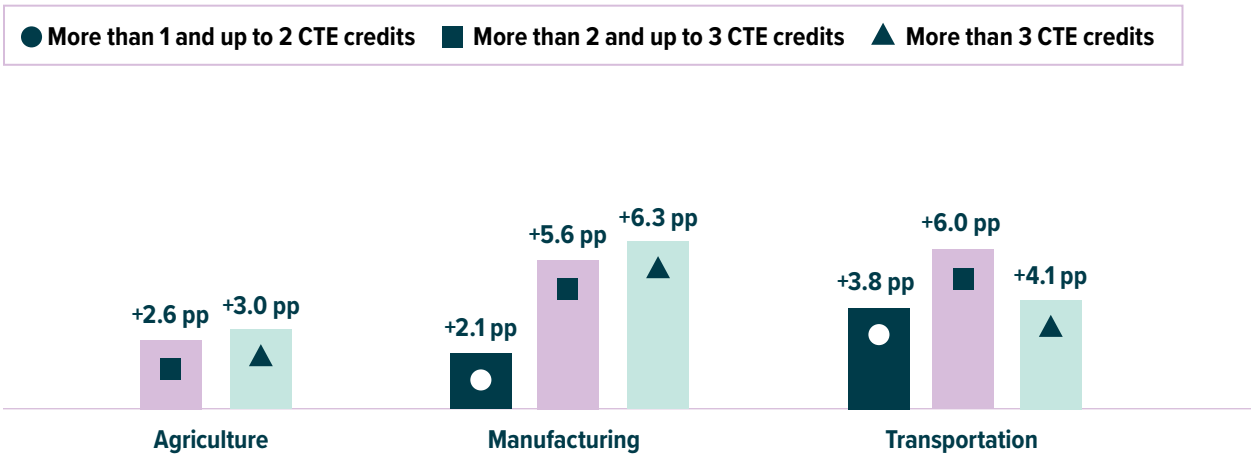
Students who earned more than one credit in a single pathway in the Agriculture, Finance, Manufacturing, and Transportation clusters were more likely to have completed a degree or credential six years following high school graduation

Six years out, students who focused their high school CTE studies in a single pathway in the Agriculture, Finance, Manufacturing, and Transportation clusters were more likely to have earned any degree or credential, compared to observationally similar students who earned one or fewer credits in a single pathway in these clusters.

Postsecondary completion outcomes for students who focused their studies in the Agriculture, Manufacturing, and Transportation clusters were driven by certificates. Students who earned more than two credits in a single pathway in **Agriculture** were 2.6 to 3.0 percentage points more likely to earn a certificate than students who earned up to one credit in a single pathway in the same cluster. Students who earned more than one credit in a single pathway in **Manufacturing** were 2.1 to 6.3 percentage points more likely to earn a certificate than students who earned up to one credit in a single pathway in the

same cluster, and students who earned more than one credit in **Transportation** were 3.8 to 6.0 percentage points more likely to earn a certificate than students who earned up to one credit in a single pathway in the cluster. That these findings hold, even though students who focused their studies in these clusters during high school were less likely to initially enroll in postsecondary education, suggests the workforce and training pathways may be nonlinear for students who pursue occupations aligned to these clusters (figure 22; appendix C, tables C11, C35, and C41).

Figure 22. Students who focused their studies in Agriculture, Manufacturing, and Transportation were more likely to earn a certificate six years following high school graduation



Note: Vertical bars present statistically significant coefficients (alpha = 0.05) from OLS regression analyses that examine the relationship between different levels of CTE credit attainment by cluster on certificate attainment. The bars represent the change in the probability that a student achieves the outcome, after adjusting for differences attributed to student demographics, academic achievement, experiences with dual credit and advanced coursework, schools attended, high school graduation and postsecondary and labor market pathways following high school. Students who earned one CTE credit or fewer are the reference category. See table appendix C, tables C11, C35, and C41 for more details.

Source: Authors' analysis of ERDC P20W Integrated Data System.

Postsecondary completion outcomes for students who focused their studies in **Finance** were driven by associate and bachelor's degrees. Students who earned more than two credits in the Finance cluster were 7.8 and 3.1 percentage points more likely to earn an associate or bachelor's degree, and students who earned more than three credits were 11.8 and 11.5 percentage points more likely to earn an associate or bachelor's degree compared to observationally similar students who earned one or fewer credits in a single pathway in the Finance cluster (appendix C, tables C17 and C21).

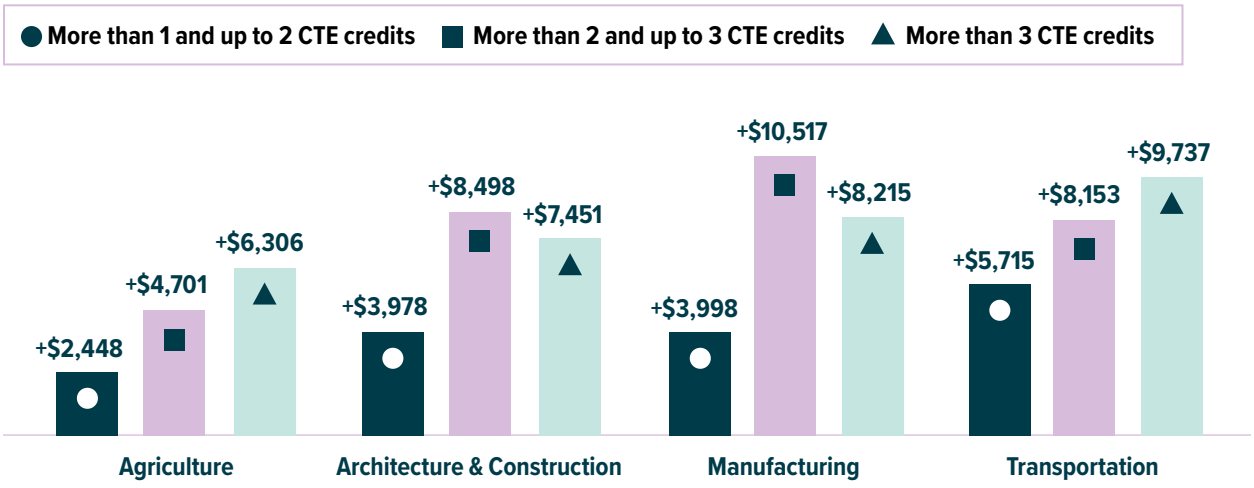
Students who focused their studies in the **Health Sciences** cluster were less likely (-2.9 to -5.6 percentage points) to earn a degree or credential after six years, despite these students being more likely to enroll in postsecondary education following high school (+3.8 to +12.6 percentage points) and more likely to persist to their second year of postsecondary education (+1.4 to +2.3 percentage points). This is explained

by students who earned more than two credits in the Health Sciences cluster in high school being 2.3 to 4.8 percentage points more likely to still be enrolled in postsecondary education—six years following high school graduation—than students who earned up to two credits in the Health Sciences cluster. Notably, this is the only cluster where students were more likely to be enrolled in postsecondary education six years later (appendix C, tables C24 and C25; persistence and six-year enrollment outcomes available by request).

Students who earned more than one credit in a single pathway in the Agriculture, Architecture & Construction, Manufacturing, and Transportation clusters were more likely to have higher earnings six years following high school

Students who were likely to have experienced some of the lowest postsecondary enrollment rates in the first year following high school were more likely to have some of the highest earnings six years later. Compared to students who earned up to one credit in a single pathway in the same cluster, observationally similar students who earned more than one credit in a single pathway in the **Agriculture, Architecture & Construction, Manufacturing,** or **Transportation** clusters had some of the highest annual earnings six years after high school. Correspondingly, these students were also much more likely to earn a living wage in 2022–23 (figure 23; appendix C, tables C11, C13, C35, C41).

Figure 23. Six-year annual earnings were strongest for students who earned more than one credit in Agriculture, Architecture & Construction, Manufacturing, and Transportation

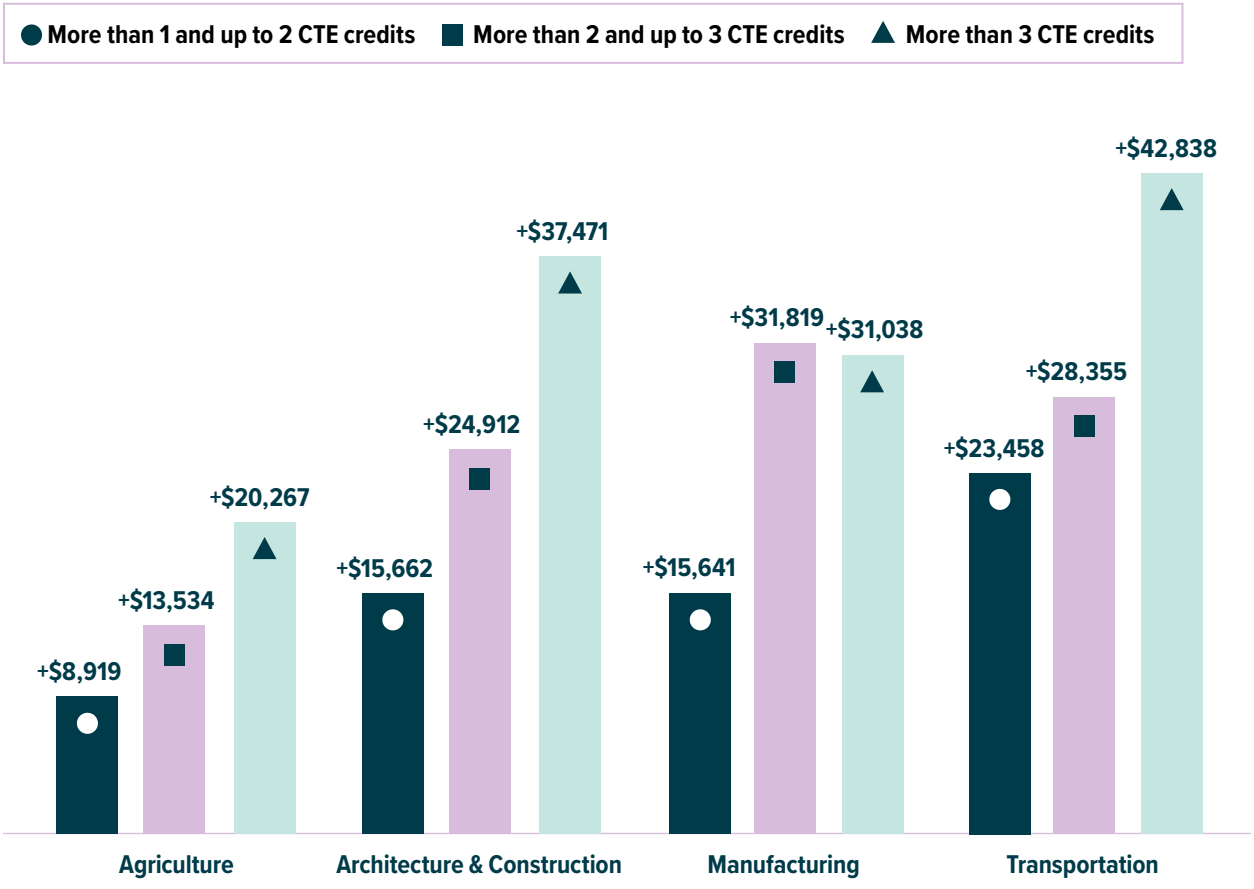


Note: Vertical bars present statistically significant coefficients (alpha = 0.05) from OLS regression analyses that examine the relationship between different levels of CTE credit attainment by cluster on annual earnings. The bars represent the change in the probability that a student achieves the outcome, after adjusting for differences attributed to student demographics, academic achievement, experiences with dual credit and advanced coursework, schools attended, high school graduation, college enrollment, and college completion. Students who earned one CTE credit or fewer are the reference category. See appendix C, tables C11, C13, C35, C41, for more details.

Source: Authors' analysis of ERDC P20W Integrated Data System.

Students who pursued studies in these pathways were also more likely to have higher cumulative earnings through the six years following high school. On average, students in the 2017 cohort who worked in Washington at any time between 2017–18 and 2022–23 earned a total of $111,607 during that time. Compared to observationally similar students who earned one credit or fewer in a single pathway in the cluster, students who earned more than a credit in the **Agriculture, Architecture & Construction, Manufacturing,** or **Transportation** clusters had much higher cumulative earnings. For instance, students who earned more than three credits in a single pathway in the Transportation cluster earned an estimated $42,838 more cumulatively than observationally similar students who earned one credit or fewer in a single pathway in the Transportation cluster (figure 24; appendix C, tables C11, C13, C35, C41).

Figure 24. The effect of CTE attainment on cumulative earnings was strongest for students who earned more than one credit in Agriculture, Architecture & Construction, Manufacturing, and Transportation

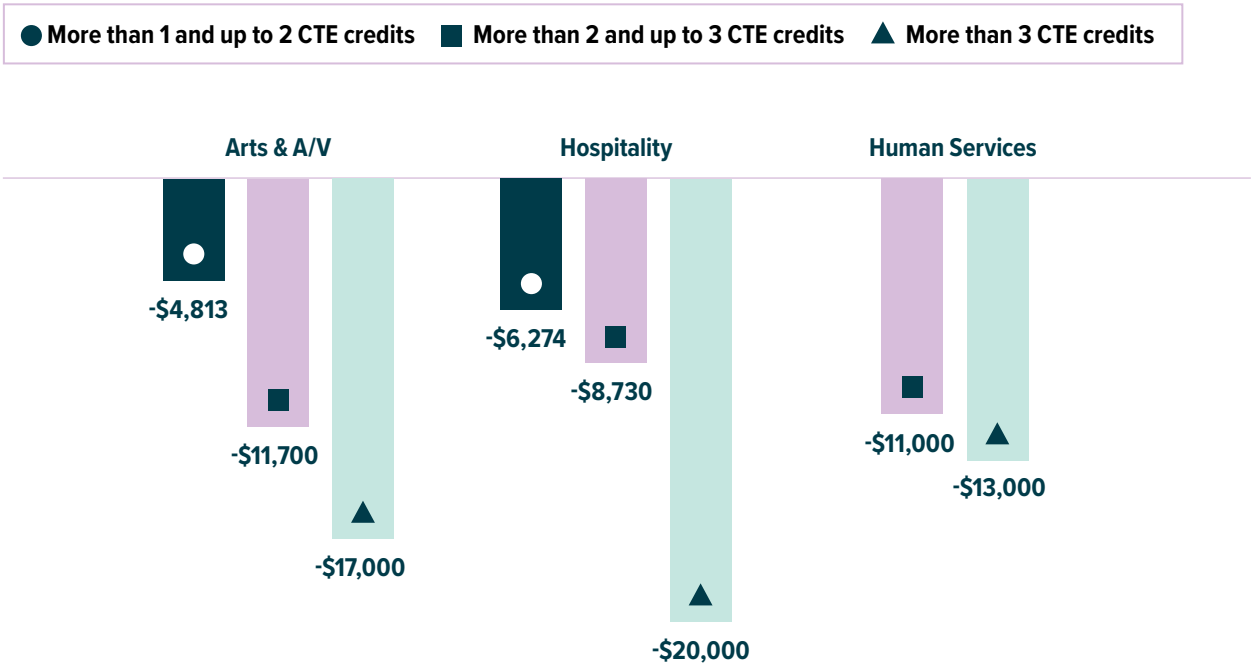


Note: Vertical bars present statistically significant coefficients (alpha = 0.05) from OLS regression analyses that examine the relationship between different levels of CTE credit attainment by cluster on cumulative earnings from 2017–18 through 2022–23. The bars represent the change in expected earnings, after adjusting for differences attributed to student demographics, academic achievement, experiences with dual credit and advanced course-work, schools attended, high school graduation, college enrollment, and college completion. Students who earned one CTE credit or fewer are the reference category. See appendix C, tables C11, C13, C35, C41, for more details.

Source: Authors' analysis of ERDC P20W Integrated Data System.

Students who focused their CTE studies in **Arts, Audio/Visual Technology & Communications** (-$4,813 to -$17,000), **Hospitality & Tourism** (-$6,274 to -$20,000), and **Human Services** (-$11,000 to -$13,000) clusters were more likely to experience lower cumulative earnings than their observationally similar peers who earned one or fewer credits in a single pathway in the same cluster (figure 25; appendix C, tables C15, C27, C29).

Figure 25. Students who focused their studies in Arts & A/V, Hospitality, and Human Services were more likely to have lower cumulative earnings six years following high school



Note: Vertical bars present statistically significant coefficients (alpha = 0.05) from OLS regression analyses that examine the relationship between different levels of CTE credit attainment by cluster on cumulative earnings from 2017–18 through 2022–23. The bars represent the change in expected earnings, after adjusting for differences attributed to student demographics, academic achievement, experiences with dual credit and advanced course-work, schools attended, high school graduation, college enrollment, and college completion. Students who earned one CTE credit or fewer are the reference category. See appendix C, tables C15, C27, C29.for more details.

Source: Authors' analysis of ERDC P20W Integrated Data System.

See table 4 for a summary of long-term outcomes overall and by CTE cluster.

Table 4. Summary of long-term outcomes overall and by CTE cluster

▲ **Positive impact –** Positive and statistically significant relationship with the outcome and none of the CTE credit attainment levels have a negative and significant relationship with the outcome.

▼ **Negative impact –** Negative and statistically significant relationship with the outcome and none of the CTE credit attainment levels have a positive and significant relationship with the outcome.

— **Mixed impact –** Both a positive and negative statistically significant relationship with the outcome or if exactly two CTE credit attainment levels are not statistically significant (and the other credit attainment level has either a positive or negative statistically significant relationship with the outcome).

○ **Null impact –** All three CTE credit attainment levels have no relationship with the outcome.

Credit accumulation	Completion of any degree or credential by 2022–23	Completion of certificate by 2022–23	Completion of associate degree by 2022–23	Completion of bachelor's degree by 2022–23	Annual earnings in 2022–23	Cumulative earnings through 2022–23	Earned a living wage in 2022–23
Total credits earned **across all pathways**	▼	—	○	▼	▲	▲	▲
Total credits earned **within a single pathway**	—	▲	—	—	▲	▲	▲

▲ **Positive impact –** Positive and statistically significant relationship with the outcome and none of the CTE credit attainment levels have a negative and significant relationship with the outcome.

▼ **Negative impact –** Negative and statistically significant relationship with the outcome and none of the CTE credit attainment levels have a positive and significant relationship with the outcome.

— **Mixed impact –** Both a positive and negative statistically significant relationship with the outcome or if exactly two CTE credit attainment levels are not statistically significant (and the other credit attainment level has either a positive or negative statistically significant relationship with the outcome).

○ **Null impact –** All three CTE credit attainment levels have no relationship with the outcome.

Total credit accumulation within a single pathway by cluster	Completion of any degree or credential by 2022–23	Completion of certificate by 2022–23	Completion of associate degree by 2022–23	Completion of bachelor's degree by 2022–23	Annual earnings in 2022–23	Cumulative earnings through 2022–23	Earned a living wage in 2022–23
Agriculture, Food, & Natural Resources	—	▲	○	○	▲	▲	▲
Architecture & Construction	○	○	○	○	▲	▲	▲
Arts, A/V Technology & Communications	○	—	○	○	▼	▼	▼
Business, Management & Administration	—	○	—	—	▲	▲	▲
Education & Training	—	○	○	▼	○	○	○
Finance	▲	○	▲	▲	▲	▲	▲
Government & Public Administration	○	○	○	○	○	○	—
Health Sciences	▼	○	—	▼	—	○	○
Hospitality & Tourism	○	○	—	○	—	▼	○

Total credit accumulation within a single pathway by cluster	Completion of any degree or credential by 2022–23	Completion of certificate by 2022–23	Completion of associate degree by 2022–23	Completion of bachelor's degree by 2022–23	Annual earnings in 2022–23	Cumulative earnings through 2022–23	Earned a living wage in 2022–23
Human Services	○	—	○	○	—	▼	○
Information Technology	○	—	—	—	▲	▲	▲
Law, Public Safety, Corrections & Security	○	○	—	○	—	○	○
Manufacturing	—	▲	○	○	▲	▲	▲
Marketing	○	○	○	○	—	○	—
Science, Technology, Engineering & Mathematics	○	—	○	—	▲	—	▲
Transportation Distribution & Logistics	▲	▲	○	○	▲	▲	▲

Note: Table summarizes the regression results presented in appendix C. For each cluster, the table consolidates the three regression coefficients—representing different CTE credit attainment levels of more than one and up to two, more than two and up to three, and more than three credits—into a single indicator representing the overall impact of credit attainment.

Source: Authors' analysis of ERDC P20W Integrated Data System.

RECOMMENDATIONS AND NEXT STEPS

This study provides a current understanding of the landscape of CTE in Washington state. A growing number of students participate in CTE programming during high school, and these experiences are linked to strong high school graduation, postsecondary, and labor market outcomes for many students. We provide a set of three recommendations to further support student engagement and experiences in CTE and strengthen the connection between CTE and high-wage, in-demand occupations in Washington state.

Consider increasing credit attainment within a single pathway for all student groups

In this study, the strongest postsecondary and labor market outcomes were achieved by students who earned more than one credit within a single pathway. Typically, the benefits of CTE continued to accrue for students as they earned more credits within the same pathway. However, in the 2024 cohort, just over half (55%) of students earned more than a single credit in the same pathway, 15 percent earned more than two and up to three credits, and just 10 percent earned more than three credits in the same pathway.

Students who identified as nonbinary, Black or African American, Native Hawaiian and Pacific Islander, and students who experienced economic disadvantage, participated in special education services, or participated in a multilingual learner program were even less likely to achieve these higher credit thresholds.

While encouraging students to focus their coursework within a single pathway may improve outcomes, many students are still exploring their interests and may not yet have a clear sense of their career goals. As such, expecting early specialization from all students may not be realistic. However, the large and persistent gaps in participation across student groups suggest these patterns are not solely the result of individual student choice.

Efforts should be undertaken to understand and address local barriers to student participation. The state might also consider adjustments to the CTE Graduation Pathway requirement that would encourage students to deepen their engagement within a single pathway, rather than broadly within a program area. Any adjustments, however, should balance benefits of focusing within a pathway with the value of exploration and flexibility.

Expand opportunities to engage male students in CTE

Given that the effects of CTE on high school graduation, completing a postsecondary certificate, annual earning, and earning a living wage six years after high school were even stronger for male students, expanding access to and engagement in CTE could be a powerful strategy for addressing gender-based disparities in education and employment.

This is particularly important, as boys and men lag girls and women in Washington state and nationally on many indicators of educational attainment and employment. In Washington, boys have lower GPAs,

are less likely to take advanced coursework and are less likely to graduate high school on time (Goldhaber & Liddle, 2023). Nationally, men are less likely to enroll in postsecondary education and less likely to complete a credential (Reeves & Secker, 2024). Further, wages for men without a college degree have been stagnant for the last four and half decades (American Institute of Boys and Men, 2024). Opportunities to further engage male students in CTE programming during high school may contribute to narrowing these disparities and increasing economic opportunity and mobility for men.

Strengthen alignment between CTE pathways and local needs and opportunities

CTE pathways should be closely aligned with the evolving needs of the local economy. While we observed some regional variation in CTE programming across the state—reflecting local economic conditions—statewide CTE offerings have remained largely unchanged over the past decade. This lack of change stands in contrast to significant changes to Washington's economy over the same period.

Between 2014 and 2024, Washington's real gross domestic product (GDP), adjusted for inflation, grew from $456.2 billion to $702 billion. This growth was led by very large gains in the information industry from $42.6 billion to $150.88 billion—driven by the tech industry. Other large gains were seen in professional and business services ($48.14 to $89.79 billion) and real estate, rental, and leasing ($61.78 to $88.11 billion). In contrast, manufacturing decreased slightly from $63.7 billion to $55.71 billion (U.S. Bureau of Economic Analysis, 2025).

Looking ahead, Washington's economy is projected to add more than 500,000 new jobs between 2023 and 2032, with an additional 900,000 job openings expected due to retirements. Most of the projected opportunities for these 1.5 million jobs will be concentrated in six key industries: advanced computing and technology, construction and skilled trades, health care, education, business and management, and clean technology. Many of these opportunities will require postsecondary credentials, including industry-recognized certifications, degrees, and apprenticeships (Washington Roundtable, 2025).

To strengthen the alignment between CTE pathways and emerging opportunities, we suggest two areas for future research:

1. **Assess alignment between CTE pathways, labor market needs, and postsecondary opportunities.** To improve student outcomes and ensure equitable access to economic opportunity, the state should assess and strengthen the alignment between high school CTE pathways, regional labor market needs, and available postsecondary training options. Our analysis found that students who focused their CTE studies in Manufacturing and Transportation were more likely to experience higher earnings six years following high school, while those who focused their students in Arts, Audio/Visual Technology & Communications were more likely to experience lower earnings; and yet, student participation in the Arts, Audio/Visual Technology & Communications cluster has experienced some of the highest growth since 2017.

Key questions to explore include:

- Do a district's CTE pathways prepare students for high-wage, in-demand occupations in their region?
- Do those occupations require additional postsecondary training, and are those opportunities accessible to students?
- How can the state support districts to offer pathways that lead to strong economic outcomes?
- What strategies can strengthen pathways currently associated with weaker outcomes?

2. Examine student pathways from high school through postsecondary and workforce.

To better align CTE with long-term student success, the state should invest in a comprehensive analysis of the pathways that students take after high school, whether into postsecondary education, apprenticeships, or the workforce. Understanding these trajectories can inform curriculum design, program development, and policy decisions at the secondary and postsecondary levels.

Key questions to explore include:

- Are students who focused their studies in CTE during high school continuing in related fields in postsecondary education, apprenticeships, or employment?
- What are the most common pathways students follow, and how do they vary by industry, region, or student demographics?
- Are there opportunities to strengthen the connections between high school CTE and high-wage, high-demand occupations?

CONCLUSION

This study described a vibrant and complex system of CTE across Washington state. More than 18,000 individual CTE courses were offered across the state in 2023–24, comprising a total of 64 different pathways across 16 career clusters and six program areas. Student participation in CTE has continued to grow, overall and within single pathways, but some students are participating at lower levels. This includes students who identify as nonbinary; Black or African American, Native Hawaiian and Pacific Islander students; students who have experienced economic hardship; students who have participated in special education services; and students who have participated in a multilingual learner program.

Students who earned more than one credit in CTE were more likely to graduate high school, and those who focused their CTE studies in a single pathway—particularly in the Agriculture, Architecture & Construction, Business, Finance, Manufacturing, and Transportation clusters—experienced stronger postsecondary and labor market outcomes six years following high school.

CTE programs in Washington could benefit from two main improvement efforts: increasing participation in CTE (for all students and especially for male students and those who are currently underserved by CTE programs) and improving the alignment between CTE pathways and local labor market needs and opportunities. These efforts would continue to strengthen student experiences with CTE and improve the high school graduation, postsecondary, and labor market outcomes they achieve.

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APPENDIX A. DESCRIPTIVE DATA TABLES

Table A1. Count of schools included in the school-level dataset by year

	2013–14	2014–15	2015–16	2016–17	2017–18	2018–19	2019–20	2020–21	2021–22	2022–23	2023–24
Count of schools	605	619	623	620	618	632	629	645	661	650	657

Note: Table includes all school types, including alternative schools, institutions, juvenile detention centers, reengagement schools, special education schools, traditional public schools, Tribal schools, and vocational/technical schools. A school is included if at least one student at that school enrolled in coursework during the school year.

Source: Authors' analysis of ERDC P20W Integrated Data System.

Table A2. Count and characteristics of schools in the 2023–24 school year

Group	Category	2023–24	
		Total schools in category	Percentage of all schools
All schools	All schools	657	100%
School locale	City	191	29%
	Rural	179	27%
	Suburb	160	24%
	Town	109	17%

Group	Category	2023–24	
		Total schools in category	Percentage of all schools
School type	Alternative school	170	26%
	Institution	11	2%
	Juvenile detention center	10	2%
	Reengagement school	37	6%
	Special education school	12	2%
	Traditional public school	396	60%
	Tribal or derived as Tribal	4	1%
School size	6–84 students	178	27%
	85–419 students	235	36%
	420–3,198 students	233	35%
Number of students per CTE teacher	0.25–50.00 students per CTE teacher	198	30%
	50.10–82.00 students per CTE teacher	173	26%
	82.05–914.00 students per CTE teacher	144	22%
Percentage of students ever eligible for free or reduced-price lunch	0%–42.36% (high-income schools)	172	26%
	42.37%–64.30% (middle-income schools)	235	36%
	64.31%–100% (low-income schools)	239	36%
Percentage of students who ever participated in a multilingual learner program	0%–0.9%	147	22%
	1%–5.9%	192	29%
	6%–100%	307	47%

Group	Category	2023–24	
		Total schools in category	Percentage of all schools
Percentage of students who ever participated in special education	0%–9.9%	170	26%
	10%–15.9%	247	38%
	16%–100%	229	35%

Note: Table includes all school types, including alternative schools, institutions, juvenile detention centers, reengagement schools, special education schools, traditional public schools, Tribal schools, and vocational/technical schools. A school is included if at least one student at that school enrolled in coursework during the school year. School locale was defined using NCES locale codes. School categories—such as size, student-to-CTE teacher ratio, percentage of students eligible for free or reduced-price lunch, participation in multilingual learner programs, and special education enrollment—are classified based on whether the school falls into the top third, middle third, or bottom third of all schools for each category during the school year.

Source: Authors' analysis of ERDC P20W Integrated Data System.

Table A3. Count and characteristics of students in the 2024 cohort year

Group	Category	Count of students	Percentage of cohort
All students	All students	74337	100%
Student gender	Female	36013	48%
	Male	37919	51%
	Nonbinary	405	1%
Student race/ethnicity[a]	American Indian or Alaska Native	961	1%
	Asian	6445	9%
	Black or African American	3435	5%
	Hispanic or Latino of any race(s)	18992	26%
	Native Hawaiian and Pacific Islander	902	1%
	White	37465	50%
	Two or more races	6137	8%

Group	Category	Count of students	Percentage of cohort
Ever participated in special education	No	64732	87%
	Yes	9605	13%
Ever experienced homelessness	No	69867	94%
	Yes	4470	6%
Ever participated in a multilingual learner program	No	67529	91%
	Yes	6808	9%
Ever eligible for FRPL	No	35350	48%
	Yes	38987	52%
High school GPA	>0–1.99	12237	16%
	2–2.99	22989	31%
	3.0–3.49	14489	19%
	3.5–4.0	24304	33%
Student meets or exceeds standard for English language arts[b]	No	19607	26%
	Yes	49169	66%
Student meets or exceeds standard for math[b]	No	42131	57%
	Yes	25907	35%
Student enrolled in a skill center sometime between 9–12 grade	No	67811	91%
	Yes	6526	9%

Group	Category	Count of students	Percentage of cohort
Student attendance by school type[c]	Alternative school	3389	5%
	Institution	54	0%
	Juvenile detention center	*	*
	Reengagement school	409	1%
	Special education school	*	*
	Traditional public school	70018	94%
	Tribal or derived as Tribal	130	0%
Student attendance by school locale[c]	City	25690	35%
	Rural	9058	12%
	Suburb	29922	40%
	Town	9232	12%
Student attendance by high school enrollment size[c]	6–84 students	993	1%
	85–419 students	7238	10%
	420–3,198 students	65794	89%
Student attendance by percentage of 12th graders at school who meet or exceed ELA standards[b,c]	0%–49.9%	13662	18%
	50% to 74.9%	44180	59%
	75% to 100%	16113	22%
Student attendance by percentage of 12th graders at school who meet or exceed math standards[b,c]	0%–49.9%	59920	81%
	50% to 74.9%	13453	18%
	75% to 100%	582	1%

Group	Category	Count of students	Percentage of cohort
Student attendance by percentage of 12th graders at school at school who received FRPL[c]	0%–42.36% (high-income schools)	31265	42%
	42.37%–64.30% (middle-income schools)	25923	35%
	64.31%–100% (low-income schools)	16837	23%

Note: Table includes all school types, including alternative schools, institutions, juvenile detention centers, reengagement schools, special education schools, traditional public schools, Tribal schools, and vocational/technical schools. A school is included if at least one student at that school enrolled in coursework during the school year. School locale was defined using NCES locale codes. School categories—such as size, student-to-CTE teacher ratio, percentage of students eligible for free or reduced-price lunch, participation in multilingual learner programs, and special education enrollment—are classified based on whether the school falls into the top third, middle third, or bottom third of all schools for each category during the school year.

[a] Race and ethnicity categories follow federal reporting guidelines and may not fully capture the diversity of student identities. These broad groupings can mask important differences in experiences among more specific racial and ethnic groups.

[b] To meet or exceed the graduation standard on the high school Smarter Balanced Assessment, a student must achieve a score of at least 2,548 in English language arts (ELA) or at least 2,595 in math. See https://sbe.wa.gov/our-work/graduation-requirements/graduation-pathway-options#Res%20State%20Assessment for more details.

[c] School-level characteristics are based on the school in which the student was enrolled during their grade 12 year.

Source: Authors' analysis of ERDC P20W Integrated Data System.

Table A4. The average provision of CTE program areas, clusters, and pathways between 2013–14 and 2023–24

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Number of schools	605	619	623	620	618	632	629	645	661	650	657
Average number of program areas offered	2.83	2.93	2.93	2.97	3.02	2.91	2.92	2.86	2.89	2.93	2.88
Average number of clusters offered	5.30	5.48	5.47	5.51	5.60	5.50	5.55	5.35	5.42	5.59	5.43
Average number of pathways offered	8.35	8.62	8.60	8.67	8.98	8.59	8.70	8.52	8.70	8.94	8.72

Average number of pathways offered within program area	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Agriculture Education	0.90	0.84	0.85	0.89	0.93	0.92	0.96	0.96	1.00	1.00	1.02
Business & Marketing	2.81	2.88	2.90	2.89	2.97	2.84	2.83	2.88	3.06	3.13	2.98
Family & Consumer Sciences	2.06	2.09	2.04	2.02	2.08	2.01	2.02	1.89	1.88	1.96	1.92
Health Sciences	0.30	0.35	0.36	0.38	0.42	0.44	0.44	0.44	0.46	0.49	0.49
Skilled & Technical Sciences	1.70	1.87	1.84	1.86	1.95	1.86	1.90	1.83	1.84	1.94	1.87
STEM	0.59	0.59	0.61	0.62	0.62	0.52	0.55	0.52	0.46	0.42	0.42

Average number of clusters offered within program area	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Agriculture Education	0.38	0.39	0.39	0.39	0.40	0.39	0.40	0.40	0.40	0.41	0.41
Business & Marketing	2.02	2.03	2.06	2.06	2.07	1.88	1.87	1.98	2.12	2.18	2.10
Family & Consumer Sciences	1.46	1.52	1.49	1.50	1.51	1.48	1.50	1.42	1.43	1.48	1.43
Health Sciences	0.26	0.30	0.30	0.31	0.33	0.33	0.35	0.34	0.34	0.36	0.36
Skilled & Technical Sciences	1.23	1.33	1.29	1.33	1.38	1.41	1.41	1.37	1.38	1.44	1.39
STEM	0.45	0.44	0.46	0.46	0.47	0.41	0.41	0.39	0.39	0.38	0.36

Note: Year represents the spring of the school year (e.g., 2014 = 2013–14 school year). Table includes all school types, including alternative schools, institutions, juvenile detention centers, reengagement schools, special education schools, traditional public schools, Tribal schools, and vocational/technical schools. A school is included if at least one student at that school enrolled in coursework during the school year.

Source: Authors' analysis of ERDC P20W Integrated Data System.

Table A5. The average number of CTE pathways per school, by school characteristics, in 2013–14 through 2023–24

Group	Category	2013–14	2014–15	2015–16	2016–17	2017–18	2018–19	2019–20	2020–21	2021–22	2022–23	2023–24
All schools	All schools	8.4	8.6	8.6	8.7	9.0	8.6	8.7	8.5	8.7	8.9	8.7
School locale	City	9.5	9.6	9.3	9.2	9.8	9.1	9.6	9.5	9.3	9.7	9.7
	Rural	5.8	6.0	6.1	6.0	6.1	5.7	6.1	5.8	6.0	6.1	6.0
	Suburb	10.3	10.7	10.8	11.2	11.6	11.3	10.9	10.9	11.4	11.6	11.4
	Town	8.2	8.2	7.8	8.3	8.3	8.5	8.2	7.9	8.2	8.7	8.3

Group	Category	2013–14	2014–15	2015–16	2016–17	2017–18	2018–19	2019–20	2020–21	2021–22	2022–23	2023–24
School type	Alternative school	2.6	2.4	2.4	2.5	2.6	2.4	2.5	2.3	2.8	3.1	3.0
	Institution	0.6	0.4	0.8	0.4	1.3	1.1	1.1	0.8	0.5	0.4	0.5
	Juvenile detention center	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.4	0.1	0.1
	Reengagement school	0.2	0.4	0.4	1.0	0.9	0.9	0.7	0.7	0.6	0.6	1.0
	Special education school	0.3	0.7	0.5	0.6	0.1	0.1	0.3	0.1	0.3	0.6	0.7
	Traditional public school	12.0	12.6	12.7	12.7	13.2	12.7	12.7	12.7	12.5	12.7	12.5
	Tribal or derived as Tribal	1.0	2.3	2.0	2.0	2.8	1.3	3.0	1.6	5.8	3.8	5.3
School size	6–84 students	1.2	1.4	1.1	1.2	1.7	1.6	1.6	1.7	1.7	1.6	1.7
	85–419 students	5.3	5.0	5.1	5.3	5.3	5.3	5.3	4.9	5.2	5.5	5.2
	420–3,198 students	16.4	17.0	16.9	16.9	17.3	17.1	17.1	17.5	17.8	18.4	17.7
Number of students per CTE teacher	0.25–50.00 students per CTE teacher	6.7	6.6	6.5	6.6	7.0	6.9	7.0	7.0	8.2	8.1	7.9
	50.10–82.00 students per CTE teacher	13.0	13.0	13.2	12.3	13.1	13.4	14.1	13.5	13.5	14.3	13.7
	82.05–914.00 students per CTE teacher	11.8	11.8	12.2	12.5	13.0	12.6	11.8	12.3	11.8	11.3	11.1

Group	Category	2013–14	2014–15	2015–16	2016–17	2017–18	2018–19	2019–20	2020–21	2021–22	2022–23	2023–24
Percentage of students ever eligible for free or reduced-price lunch	0%–42.36% (high-income schools)	10.1	10.6	10.7	10.5	11.5	10.5	10.9	10.5	11.3	12.0	11.5
	42.37%–64.30% (middle-income schools)	9.0	8.9	9.1	9.3	8.9	8.9	9.0	8.6	8.7	8.8	9.5
	64.31%–100% (low-income schools)	5.7	5.9	5.6	5.9	6.0	6.1	6.1	6.1	6.6	6.9	6.0
Percentage of students who ever participated in a multilingual learner program	0%–0.9%	6.0	5.7	5.1	4.9	4.6	4.0	4.2	4.3	4.3	4.2	4.3
	1%–5.9%	10.3	11.2	11.1	10.6	10.7	9.6	9.6	9.8	9.6	9.5	9.4
	6%–100%	11.0	11.1	11.6	10.9	10.7	11.0	10.9	10.4	10.4	10.7	10.5
Percentage of students who ever participated in special education	0%–9.9%	7.4	7.6	7.9	7.9	8.5	7.3	7.0	7.2	7.8	9.1	8.5
	10%–15.9%	11.7	12.3	12.3	11.8	12.5	12.9	13.1	12.4	12.8	12.1	12.2
	16%–100%	4.5	4.9	5.0	5.7	5.7	5.6	5.7	5.9	5.3	5.3	5.2

Note: School characteristics are from the school where the CTE course was offered/taken. School categories—such as size, student-to-CTE teacher ratio, percentage of students eligible for free or reduced-price lunch, participation in multilingual learner programs, and special education enrollment—are classified based on whether the school falls into the top third, middle third, or bottom third of all schools for each category during the school year.

Source: Authors' analysis of ERDC P20W Integrated Data System.

Table A6. The average number of CTE pathways in 2023–24 per school, by school characteristics and school locale

Group	Category	City		Rural		Suburb		Town	
		Number of schools	Average number of CTE pathways	Number of schools	Average number of CTE pathways	Number of schools	Average number of CTE pathways	Number of schools	Average number of CTE pathways
All schools	All schools	191	9.7	179	6.0	160	11.4	109	8.3
School size	6–84 students	42	2.0	81	2.2	16	0.1	33	1.3
	85–419 students	66	4.6	68	6.6	59	4.4	39	4.9
	420–3,198 students	80	18.2	30	15.2	84	18.4	37	18.1
Number of students per CTE teacher	0.25–50.00 students per CTE teacher	35	10.5	93	5.9	34	9.7	31	9.6
	50.10–82.00 students per CTE teacher	53	15.3	44	9.3	45	16.5	31	13.3
	82.05–914.00 students per CTE teacher	50	11.8	13	8.8	60	12.2	19	8.2
Percentage of students ever eligible for free or reduced-price lunch	0%–42.36% (high-income schools)	46	13.1	35	6.1	67	13.4	21	12.6
	42.37%–64.30% (middle-income schools)	70	10.6	75	7.7	53	11.4	33	9.0
	64.31%–100% (low-income schools)	72	6.9	69	4.2	39	7.9	55	6.2

Group	Category	City		Rural		Suburb		Town	
		Number of schools	Average number of CTE pathways	Number of schools	Average number of CTE pathways	Number of schools	Average number of CTE pathways	Number of schools	Average number of CTE pathways
Percentage of students who ever participated in a multilingual learner program	0%–0.9%	25	4.0	81	4.0	14	5.2	24	5.2
	1%–5.9%	53	9.6	39	7.3	61	11.1	36	9.1
	6%–100%	110	11.2	59	8.0	84	12.6	49	9.1
Percentage of students who ever participated in special education	0%–9.9%	53	9.9	40	5.0	47	11.7	28	6.3
	10%–15.9%	60	15.0	68	8.8	67	14.2	49	11.3
	16%–100%	75	5.5	71	4.0	45	6.8	32	5.3

Note: School characteristics are from the school where the CTE course was offered/taken. School locale was defined using NCES locale codes. School categories—such as size, student-to-CTE teacher ratio, percentage of students eligible for free or reduced-price lunch, participation in multilingual learner programs, and special education enrollment—are classified based on whether the school falls into the top third, middle third, or bottom third of all schools for each category during the school year.

Source: Authors' analysis of ERDC P20W Integrated Data System.

Table A7. Distribution of CTE pathways across program areas, by school type, 2023–24

Group	Category	All pathways offered	Percentage of pathways that are part of program area					
		All pathways	Agriculture Education	Business & Marketing	Family & Consumer Sciences	Health Sciences	Skilled & Technical Sciences	STEM
Offerings	Composition of total pathways available		13%	34%	19%	8%	23%	3%
All schools	Pathways offered across all schools	5727	12%	34%	22%	6%	21%	5%
School locale	City	1862	7%	35%	23%	6%	24%	4%
	Rural	1080	23%	33%	17%	3%	20%	4%
	Suburb	1826	8%	35%	25%	6%	21%	5%
	Town	901	16%	32%	20%	6%	20%	6%
School type	Alternative school	510	7%	43%	23%	5%	17%	5%
	Institution	5	0%	0%	60%	0%	20%	20%
	Juvenile detention center	1	100%	0%	0%	0%	0%	0%
	Reengagement school	37	3%	41%	32%	3%	16%	5%
	Special education school	8	13%	50%	25%	0%	13%	0%
	Traditional public school	4954	12%	34%	22%	6%	21%	5%
	Tribal or derived as Tribal	21	19%	29%	33%	5%	14%	0%

Group	Category	All pathways offered	Percentage of pathways that are part of program area					
		All pathways	Agriculture Education	Business & Marketing	Family & Consumer Sciences	Health Sciences	Skilled & Technical Sciences	STEM
School size	6–84 students (small school)	306	25%	31%	16%	2%	23%	3%
	85–419 students (medium school)	1211	16%	33%	23%	3%	20%	5%
	420–3,198 students (large school)	4130	10%	35%	22%	7%	21%	5%
Number of students per CTE teacher	0.25–50.00 students per CTE teacher	1556	16%	32%	22%	4%	21%	5%
	50.10–82.00 students per CTE teacher	2375	13%	34%	21%	7%	20%	5%
	82.05–914.00 students per CTE teacher	1591	6%	38%	23%	6%	23%	4%
Percentage of students ever eligible for free or reduced-price lunch	0%–42.36% (high-income schools)	1973	9%	36%	22%	6%	21%	5%
	42.37%–64.30% (middle-income schools)	2239	13%	33%	22%	5%	22%	5%
	64.31%–100% (low-income schools)	1435	13%	35%	23%	5%	19%	5%

Group	Category	All pathways offered	Percentage of pathways that are part of program area					
		All pathways	Agriculture Education	Business & Marketing	Family & Consumer Sciences	Health Sciences	Skilled & Technical Sciences	STEM
Percentage of students who ever participated in a multilingual learner program	0%–0.9%	627	23%	32%	16%	3%	22%	5%
	1%–5.9%	1798	10%	35%	22%	6%	22%	5%
	6%–100%	3222	10%	35%	23%	6%	21%	5%
Percentage of students who ever participated in special education	0%–9.9%	1452	9%	36%	21%	7%	23%	5%
	10%–15.9%	3005	12%	34%	22%	6%	20%	5%
	16%–100%	1190	14%	33%	23%	4%	22%	4%

Note: School characteristics are from the school where the CTE course was offered/taken. School locale was defined using NCES locale codes. School categories—such as size, student-to-CTE teacher ratio, percentage of students eligible for free or reduced-price lunch, participation in multilingual learner programs, and special education enrollment—are classified based on whether the school falls into the top third, middle third, or bottom third of all schools for each category during the school year.

Source: Authors' analysis of ERDC P20W Integrated Data System.

Table A8. Trends in CTE participation (2017 through 2020)

	Credit accumulation	Cohort year = 2017		Cohort year = 2018		Cohort year = 2019		Cohort year = 2020	
		N	% of cohort	N	% of cohort	N	% of cohort	N	% of cohort
Within a single pathway	0.5+ credits	61446	97%	64087	97%	64972	97%	64955	97%
	1+ credits	52086	82%	55340	84%	56126	84%	56576	85%
	2+ credits	22388	35%	24730	37%	25531	38%	26672	40%
	3+ credits	9731	15%	10894	17%	10789	16%	11822	18%
	4+ credits	3382	5%	3891	6%	4057	6%	4525	7%
Across all pathways	0.5+ credits	61465	97%	64098	97%	64989	97%	64968	97%
	1+ credits	59279	93%	62007	94%	62766	94%	62923	94%
	2+ credits	49309	78%	52449	79%	53311	79%	53991	81%
	3+ credits	37526	59%	40674	62%	41506	62%	43114	64%
	4+ credits	26435	42%	29363	45%	30224	45%	32117	48%
Graduation pathway	2 credits within the same program area	33347	53%	36278	55%	37240	56%	38547	58%
	2 credits within the same program area and at least one is dual credit	23963	38%	25987	39%	26430	39%	27891	42%
	2 credits within the same program area and at least one offers IRC	*	*	*	*	*	*	*	*
	Met requirements for Graduation Pathway Option 1	*	*	*	*	*	*	*	*

Note: Students have two options to meet the requirements for the CTE Graduation Pathway. To meet the requirements for Option 1, students must complete two or more CTE credits in the same program area, including a dual credit course or one leading to an industry-recognized credential. Option 2 involves completing a Core Plus program in Manufacturing, Construction, or Maritime fields; this pathway was not examined in the current study.

Source: Authors' analysis of ERDC P20W Integrated Data System.

Table A9. Trends in CTE participation (2021 through 2024)

	Credit accumulation	Cohort year = 2021		Cohort year = 2022		Cohort year = 2023		Cohort year = 2024	
		N	% of cohort	N	% of cohort	N	% of cohort	N	% of cohort
Within a single pathway	0.5+ credits	66591	97%	67532	97%	67029	97%	71597	96%
	1+ credits	58854	86%	60613	87%	61109	89%	64902	87%
	2+ credits	28882	42%	30351	44%	30781	45%	33503	45%
	3+ credits	12762	19%	13268	19%	13422	19%	14936	20%
	4+ credits	5245	8%	5624	8%	5552	8%	6202	8%
Across all pathways	0.5+ credits	66609	97%	67545	97%	67038	97%	71607	96%
	1+ credits	64557	94%	65716	95%	65487	95%	69496	94%
	2+ credits	56491	82%	58346	84%	58734	85%	61982	84%
	3+ credits	45825	67%	48748	70%	49336	72%	52025	70%
	4+ credits	34902	51%	38085	55%	38800	56%	41253	56%
Graduation pathway	2 credits within the same program area	41656	61%	44630	64%	41656	61%	44630	64%
	2 credits within the same program area and at least one is dual credit	30913	45%	34169	49%	30913	45%	34169	49%
	2 credits within the same program area and at least one offers IRC	11954	17%	20960	30%	26376	38%	32448	44%
	Met requirements for Graduation Pathway Option 1	32810	48%	37455	54%	39525	57%	43097	58%

Note: Students have two options to meet the requirements for the CTE Graduation Pathway. To meet the requirements for Option 1, students must complete two or more CTE credits in the same program area, including a dual credit course or one leading to an industry-recognized credential. Option 2 involves completing a Core Plus program in Manufacturing, Construction, or Maritime fields; this pathway was not examined in the current study.

Source: Authors' analysis of ERDC P20W Integrated Data System.

Table A10. CTE participation by student and school characteristics across all pathways, 2024 cohort

Group	Category	All students in the cohort	Student earned at least 0.50 credits across all pathways	Student earned at least 1 credit across all pathways	Student earned at least 2 credits across all pathways	Student earned at least 3 credits across all pathways	Student earned at least 4 credits across all pathways
		Count of students	% of cohort	% of cohort	% of cohort	% of cohort	% of cohort
Overall	Overall	74337	96%	94%	84%	70%	56%
Student gender	Female	36013	96%	93%	82%	68%	53%
	Male	37919	97%	94%	85%	73%	58%
	Nonbinary	405	93%	88%	72%	56%	40%
Student race/ ethnicity[a]	American Indian or Alaska Native	961	90%	84%	70%	54%	41%
	Asian	6445	98%	96%	85%	70%	54%
	Black or African American	3435	96%	92%	80%	63%	47%
	Hispanic or Latino of any race(s)	18992	97%	94%	85%	73%	60%
	Native Hawaiian and Pacific Islander	902	95%	90%	80%	65%	49%
	White	37465	96%	94%	84%	70%	56%
	Two or more races	6137	96%	93%	81%	67%	51%
Ever participated in special education	No	64732	97%	94%	84%	71%	56%
	Yes	9605	93%	89%	78%	65%	50%

Group	Category	All students in the cohort	Student earned at least 0.50 credits across all pathways	Student earned at least 1 credit across all pathways	Student earned at least 2 credits across all pathways	Student earned at least 3 credits across all pathways	Student earned at least 4 credits across all pathways
		Count of students	% of cohort	% of cohort	% of cohort	% of cohort	% of cohort
Ever experienced homelessness	No	69867	97%	94%	84%	71%	56%
	Yes	4470	94%	88%	75%	59%	44%
Ever participated in a multilingual program	No	67529	97%	94%	84%	70%	56%
	Yes	6808	95%	91%	81%	68%	53%
Ever eligible for FRPL	No	35350	97%	95%	86%	72%	57%
	Yes	38987	96%	92%	82%	68%	54%
High school GPA	>0–1.99	12237	93%	85%	70%	54%	40%
	2–2.99	22989	98%	96%	89%	77%	63%
	3.0–3.49	14489	98%	96%	88%	76%	63%
	3.5–4.0	24304	97%	95%	83%	68%	53%
Student meets or exceeds standard for English language arts[b]	No	19607	96%	93%	84%	72%	58%
	Yes	49169	98%	96%	86%	72%	57%

Group	Category	All students in the cohort	Student earned at least 0.50 credits across all pathways	Student earned at least 1 credit across all pathways	Student earned at least 2 credits across all pathways	Student earned at least 3 credits across all pathways	Student earned at least 4 credits across all pathways
		Count of students	% of cohort	% of cohort	% of cohort	% of cohort	% of cohort
Student meets or exceeds standard for math[b]	No	42131	97%	95%	86%	74%	60%
	Yes	25907	98%	96%	84%	70%	54%
Student enrolled in a skill center for a semester sometime between 9–12 grade	No	67811	96%	93%	82%	68%	52%
	Yes	6526	100%	100%	99%	97%	90%
School type[c]	Alternative school	3389	86%	79%	63%	47%	34%
	Institution	54	54%	43%	22%	*	*
	Juvenile detention center	*	*	*	*	*	*
	Reengagement school	409	69%	49%	20%	9%	4%
	Special education school	17	*	*	*	*	*
	Traditional public school	70018	97%	95%	85%	72%	57%
	Tribal or derived as Tribal	130	66%	62%	54%	28%	12%

Group	Category	All students in the cohort	Student earned at least 0.50 credits across all pathways	Student earned at least 1 credit across all pathways	Student earned at least 2 credits across all pathways	Student earned at least 3 credits across all pathways	Student earned at least 4 credits across all pathways
		Count of students	% of cohort	% of cohort	% of cohort	% of cohort	% of cohort
School locale[c]	City	25690	96%	93%	82%	67%	52%
	Rural	9058	96%	93%	82%	69%	55%
	Suburb	29922	97%	95%	85%	72%	57%
	Town	9232	96%	94%	86%	75%	63%
High school total enrollment[c]	0–84 students	993	77%	67%	50%	35%	24%
	85–419 students	7238	90%	85%	72%	57%	45%
	420–3,198 students	65794	98%	95%	85%	72%	57%
Percentage of grade 12 students at school who meet or exceed ELA standards[b,c]	0.0%–49.9%	13662	94%	90%	78%	65%	52%
	50.0% to 74.9%	44180	97%	94%	85%	72%	57%
	75.0% to 100%	16113	98%	96%	86%	71%	55%
Percentage of grade 12 students at school who meet or exceed math standards[b,c]	0.0%–49.9%	59920	96%	93%	83%	70%	56%
	50.0% to 74.9%	13453	98%	96%	86%	71%	55%
	75.0% to 100%	582	99%	98%	93%	85%	72%

Group	Category	All students in the cohort	Student earned at least 0.50 credits across all pathways	Student earned at least 1 credit across all pathways	Student earned at least 2 credits across all pathways	Student earned at least 3 credits across all pathways	Student earned at least 4 credits across all pathways
		Count of students	% of cohort	% of cohort	% of cohort	% of cohort	% of cohort
Percentage of students at school who received FRPL[c]	0%–42.36% (high-income schools)	31265	97%	95%	84%	70%	54%
	42.37%–64.30% (middle-income schools)	25923	97%	94%	85%	73%	59%
	64.31%–100% (low-income schools)	16837	95%	92%	81%	68%	54%

[a] Race and ethnicity categories follow federal reporting guidelines and may not fully capture the diversity of student identities. These broad groupings can mask important differences in experiences among more specific racial and ethnic groups.

[b] To meet or exceed the graduation standard on the high school Smarter Balanced Assessment, a student must achieve a score of at least 2,548 in English language arts (ELA) or at least 2,595 in math. See https://sbe.wa.gov/our-work/graduation-requirements/graduation-pathway-options#Res%20State%20Assessment for more details.

[c] School-level characteristics are based on the school in which the student was enrolled during their 12th grade year. School locale was defined using NCES locale codes. School categories—such as size, student-to-CTE teacher ratio, percentage of students eligible for free or reduced-price lunch, participation in multilingual learner programs, and special education enrollment—are classified based on whether the school falls into the top third, middle third, or bottom third of all schools for each category during the school year.

Source: Authors' analysis of ERDC P20W Integrated Data System.

Table A11. CTE participation by student and school characteristics within a single pathway, 2024 cohort

Group	Category	All students in the cohort	Student earned at least 0.50 credits in a single pathway	Student earned at least 1 credit in a single pathway	Student earned at least 2 credits in a single pathway	Student earned at least 3 credits in a single pathway	Student earned at least 4 credits in a single pathway
		Count of students	% of cohort	% of cohort	% of cohort	% of cohort	% of cohort
Overall	Overall	74337	96%	87%	45%	20%	8%
Student gender	Female	36013	96%	86%	43%	19%	8%
	Male	37919	97%	89%	47%	21%	9%
	Nonbinary	405	93%	80%	38%	13%	4%
Student race/ ethnicity[a]	American Indian or Alaska Native	961	90%	77%	38%	18%	7%
	Asian	6445	98%	90%	46%	20%	8%
	Black or African American	3435	96%	84%	37%	15%	6%
	Hispanic or Latino of any race(s)	18992	97%	88%	45%	21%	9%
	Native Hawaiian and Pacific Islander	902	95%	83%	39%	12%	5%
	White	37465	96%	88%	46%	21%	9%
	Two or more races	6137	96%	86%	42%	18%	7%
Ever participated in special education	No	64732	97%	88%	46%	20%	8%
	Yes	9605	93%	82%	42%	19%	8%

Group	Category	All students in the cohort	Student earned at least 0.50 credits in a single pathway	Student earned at least 1 credit in a single pathway	Student earned at least 2 credits in a single pathway	Student earned at least 3 credits in a single pathway	Student earned at least 4 credits in a single pathway
		Count of students	% of cohort	% of cohort	% of cohort	% of cohort	% of cohort
Ever experienced homelessness	No	69867	97%	88%	46%	21%	9%
	Yes	4470	94%	79%	35%	14%	5%
Ever participated in a multilingual learner program	No	67529	97%	88%	46%	20%	8%
	Yes	6808	95%	84%	40%	18%	7%
Ever eligible for FRPL	No	35350	97%	90%	47%	21%	9%
	Yes	38987	96%	85%	43%	19%	8%
High school GPA	>0.0–1.99	12237	93%	74%	28%	11%	4%
	2–2.99	22989	98%	91%	48%	22%	9%
	3.0–3.49	14489	98%	91%	51%	24%	10%
	3.5–4.0	24304	97%	89%	47%	21%	9%
Student meets or exceeds standard for English language arts[b]	No	19607	96%	87%	45%	21%	9%
	Yes	49169	98%	90%	47%	21%	9%

Group	Category	All students in the cohort	Student earned at least 0.50 credits in a single pathway	Student earned at least 1 credit in a single pathway	Student earned at least 2 credits in a single pathway	Student earned at least 3 credits in a single pathway	Student earned at least 4 credits in a single pathway
		Count of students	% of cohort	% of cohort	% of cohort	% of cohort	% of cohort
Student meets or exceeds standard for math[b]	No	42131	97%	89%	47%	21%	9%
	Yes	25907	98%	90%	46%	20%	8%
Student enrolled in a skill center for a semester sometime between 9–12 grade	No	67811	96%	86%	41%	14%	5%
	Yes	6526	100%	99%	90%	81%	40%
School type[c]	Alternative school	3389	86%	70%	33%	16%	7%
	Institution	54	54%	37%	*	*	*
	Juvenile detention center	*	*	*	*	*	*
	Reengagement school	409	69%	28%	4%	*	*
	Special education school	*	*	*	*	*	*
	Traditional public school	70018	97%	89%	46%	20%	8%
	Tribal or derived as Tribal	130	66%	59%	29%	*	*

Group	Category	All students in the cohort	Student earned at least 0.50 credits in a single pathway	Student earned at least 1 credit in a single pathway	Student earned at least 2 credits in a single pathway	Student earned at least 3 credits in a single pathway	Student earned at least 4 credits in a single pathway
		Count of students	% of cohort	% of cohort	% of cohort	% of cohort	% of cohort
School locale[c]	City	25690	96%	86%	42%	18%	7%
	Rural	9058	96%	88%	46%	20%	8%
	Suburb	29922	97%	88%	46%	21%	9%
	Town	9232	96%	89%	50%	24%	10%
High school total enrollment[c]	0–84 students	993	77%	59%	30%	15%	6%
	85–419 students	7238	90%	79%	43%	20%	7%
	420–3,198 students	65794	98%	89%	46%	20%	9%
Percentage of grade 12 students at school who meet or exceed ELA standards[b,c]	0.0%–49.9%	13662	94%	83%	42%	20%	9%
	50.0%–74.9%	44180	97%	88%	46%	20%	9%
	75.0%–100%	16113	98%	90%	45%	20%	7%
Percentage of grade 12 students at school who meet or exceed math standards[b,c]	0.0%–49.9%	59920	96%	87%	45%	21%	9%
	50.0%–74.9%	13453	98%	90%	44%	18%	7%
	75.0%–100%	582	99%	97%	60%	29%	12%

Group	Category	All students in the cohort	Student earned at least 0.50 credits in a single pathway	Student earned at least 1 credit in a single pathway	Student earned at least 2 credits in a single pathway	Student earned at least 3 credits in a single pathway	Student earned at least 4 credits in a single pathway
		Count of students	% of cohort	% of cohort	% of cohort	% of cohort	% of cohort
Percentage of students at school who received FRPL[c]	0%–42.36% (high-income schools)	31265	97%	88%	44%	19%	7%
	42.37%–64.30% (middle-income schools)	25923	97%	88%	47%	21%	9%
	64.31%–100% (low-income schools)	16837	95%	86%	44%	21%	9%

[a] Race and ethnicity categories follow federal reporting guidelines and may not fully capture the diversity of student identities. These broad groupings can mask important differences in experiences among more specific racial and ethnic groups.

[b] To meet or exceed the graduation standard on the high school Smarter Balanced Assessment, a student must achieve a score of at least 2,548 in English language arts (ELA) or at least 2,595 in math. See https://sbe.wa.gov/our-work/graduation-requirements/graduation-pathway-options#Res%20State%20Assessment for more details.

[c] School-level characteristics are based on the school in which the student was enrolled during their 12th grade year. School locale was defined using NCES locale codes. School categories—such as size, student-to-CTE teacher ratio, percentage of students eligible for free or reduced-price lunch, participation in multilingual learner programs, and special education enrollment—are classified based on whether the school falls into the top third, middle third, or bottom third of all schools for each category during the school year.

Source: Authors' analysis of ERDC P20W Integrated Data System.

Table A12. CTE participation within a single pathway by cluster and student gender, 2024 cohort

Cluster	Category	Student earned at least 0.50 credits in a single pathway in this cluster	Student earned at least 1 credit in a single pathway in this cluster	Student earned at least 2 credits in a single pathway in this cluster	Student earned at least 3 credits in a single pathway in this cluster	Student earned at least 4 credits in a single pathway in this cluster
		Percentage of cohort	Percentage of cohort	Percentage of cohort	Percentage of cohort	Percentage of cohort
Agriculture, Food, & Natural Resources	Overall	31.2%	23.5%	5.9%	1.8%	0.6%
	Female and nonbinary	31.7%	23.7%	5.6%	1.7%	0.5%
	Male	30.8%	23.4%	6.2%	1.9%	0.7%
Architecture & Construction	Overall	9.4%	5.1%	1.8%	1.0%	0.5%
	Female and nonbinary	4.3%	1.8%	0.5%	0.2%	0.1%
	Male	14.4%	8.2%	3.1%	1.7%	0.9%
Arts, Audio/Video Technology & Communications	Overall	61.6%	35.7%	9.0%	2.8%	0.9%
	Female and nonbinary	63.2%	35.4%	9.1%	3.0%	0.9%
	Male	60.0%	36.1%	9.0%	2.6%	0.8%
Business, Management & Administration	Overall	20.9%	11.8%	3.6%	2.1%	0.5%
	Female and nonbinary	20.7%	12.1%	4.1%	2.5%	0.6%
	Male	21.0%	11.6%	3.1%	1.8%	0.4%

Cluster	Category	Student earned at least 0.50 credits in a single pathway in this cluster	Student earned at least 1 credit in a single pathway in this cluster	Student earned at least 2 credits in a single pathway in this cluster	Student earned at least 3 credits in a single pathway in this cluster	Student earned at least 4 credits in a single pathway in this cluster
		Percentage of cohort	Percentage of cohort	Percentage of cohort	Percentage of cohort	Percentage of cohort
Education & Training	Overall	12.1%	10.2%	5.7%	1.1%	0.2%
	Female and nonbinary	15.9%	13.6%	7.7%	1.6%	0.3%
	Male	8.3%	7.0%	3.9%	0.6%	0.1%
Finance	Overall	23.6%	14.0%	3.2%	1.1%	1.0%
	Female and nonbinary	22.0%	12.9%	3.2%	1.1%	1.0%
	Male	25.1%	15.0%	3.1%	1.0%	0.9%
Government & Public Administration	Overall	2.1%	1.7%	0.9%	0.6%	0.3%
	Female and nonbinary	1.5%	1.2%	0.6%	0.4%	0.2%
	Male	2.7%	2.2%	1.2%	0.7%	0.4%
Health Sciences	Overall	72.5%	25.9%	7.5%	3.3%	1.5%
	Female and nonbinary	79.0%	31.5%	10.6%	5.1%	2.3%
	Male	66.3%	20.5%	4.5%	1.6%	0.7%
Hospitality & Tourism	Overall	24.1%	11.0%	2.4%	0.9%	0.4%
	Female and nonbinary	26.1%	12.0%	2.7%	1.0%	0.5%
	Male	22.2%	10.1%	2.2%	0.8%	0.3%

Cluster	Category	Student earned at least 0.50 credits in a single pathway in this cluster	Student earned at least 1 credit in a single pathway in this cluster	Student earned at least 2 credits in a single pathway in this cluster	Student earned at least 3 credits in a single pathway in this cluster	Student earned at least 4 credits in a single pathway in this cluster
		Percentage of cohort	Percentage of cohort	Percentage of cohort	Percentage of cohort	Percentage of cohort
Human Services	Overall	25.1%	8.9%	1.3%	0.6%	0.3%
	Female and nonbinary	31.8%	12.9%	2.1%	1.0%	0.5%
	Male	18.7%	5.1%	0.5%	0.1%	0.1%
Information Technology	Overall	34.7%	16.6%	3.8%	1.2%	0.4%
	Female and nonbinary	28.3%	11.7%	2.0%	0.6%	0.2%
	Male	40.9%	21.2%	5.5%	1.8%	0.6%
Law, Public Safety, Corrections & Security	Overall	9.1%	4.4%	1.2%	0.9%	0.4%
	Female and nonbinary	9.3%	4.7%	1.0%	0.8%	0.3%
	Male	8.9%	4.1%	1.3%	1.1%	0.5%
Manufacturing	Overall	15.4%	8.9%	2.9%	1.3%	0.6%
	Female and nonbinary	7.5%	3.4%	0.7%	0.3%	0.1%
	Male	23.0%	14.1%	4.9%	2.3%	1.0%
Marketing	Overall	19.7%	10.7%	1.7%	0.5%	0.1%
	Female and nonbinary	18.3%	9.9%	1.6%	0.5%	0.1%
	Male	20.9%	11.5%	1.8%	0.5%	0.1%

Cluster	Category	Student earned at least 0.50 credits in a single pathway in this cluster	Student earned at least 1 credit in a single pathway in this cluster	Student earned at least 2 credits in a single pathway in this cluster	Student earned at least 3 credits in a single pathway in this cluster	Student earned at least 4 credits in a single pathway in this cluster
		Percentage of cohort	Percentage of cohort	Percentage of cohort	Percentage of cohort	Percentage of cohort
Science, Technology, Engineering, and Mathematics	Overall	23.0%	15.7%	3.3%	0.9%	0.3%
	Female and nonbinary	15.4%	10.1%	1.6%	0.4%	0.1%
	Male	30.3%	21.1%	4.8%	1.3%	0.4%
Transportation, Distribution & Logistics	Overall	6.3%	4.2%	2.3%	1.6%	0.8%
	Female and nonbinary	2.1%	1.1%	0.5%	0.4%	0.2%
	Male	10.4%	7.2%	3.9%	2.8%	1.4%

Note: Female and nonbinary students are combined to mitigate need for complementary suppression.

Source: Authors' analysis of ERDC P20W Integrated Data System.

APPENDIX B. REGRESSION OVERVIEW

We estimated a series of OLS regression models to examine the relationship between different levels of participation in CTE and high school graduation, postsecondary, and labor market outcomes. These analyses allowed us to better isolate the relationship between CTE accumulation and the outcome that can be attributed to CTE, after accounting for other factors that are correlated with CTE and outcome.

We created the following treatment indicators based on student CTE credit accumulation overall, within a single pathway, and within a single pathway by each of the 16 clusters:

- Students who earned **more than one and up to two credits** in CTE
- Students who earned **more than two and up to three credits** in CTE
- Students who earned **more than three credits** in CTE

Outcomes for these students were compared against students who earned one or fewer credits in CTE. In total, we created 18 different treatment indicators and estimated them in separate models for each outcome.

Table B1. Overview of CTE credit attainment treatment indicators

Focus	Treatment group 1	Treatment group 2	Treatment group 3	Comparison group
Overall CTE attainment	Students who earned more than one and up to two credits across **all CTE pathways**	Students who earned more than two and up to three credits across **all CTE pathways**	Students who earned more than three credits across **all CTE pathways**	All students who earned one or fewer credits across all CTE pathways (includes students who earned zero credits across all pathways)
CTE attainment within any single pathway	Students who earned more than one and up to two credits **within any single pathway**	Students who earned more than two and up to three credits **within any single pathway**	Students who earned more than three credits **within any single pathway**	All students who earned one or fewer credits in **any single pathway** (includes students who earned zero credits in a single pathway)

Focus	Treatment group 1	Treatment group 2	Treatment group 3	Comparison group
CTE attainment within any single pathway in the Agriculture, Food, & Natural Resources cluster	Students who earned more than one and up to two credits **within any single pathway in the Agriculture, Food, & Natural Resources cluster**	Students who earned more than two and up to three credits **within any single pathway in the Agriculture, Food, & Natural Resources cluster**	Students who earned more than three credits **within any single pathway in the Agriculture, Food, & Natural Resources cluster**	All students who earned one or fewer credits in **any single pathway in the Agriculture, Food, & Natural Resources cluster** (includes students who earned zero credits in a single pathway in the agriculture, food, & natural resources cluster)

Note: While only Agriculture, Food, & Natural Resources is shown in the table, we calculated treatment indicators using the same approach for all 16 clusters.
Source: Authors.

Our basic model regressed the outcome of interest on our treatment indicator while adjusting for a set of student-level variables including:

- **Student demographics,** including gender, race/ethnicity, whether the student ever received free or reduced-price lunch services or special education services, was classified as a multilingual learner, or was reported as homeless during high school. Additionally, we included an indicator to capture whether the student was ever employed during high school and their total earnings during high school.
- **Academic achievement,** including high school grade-point average, math and English language assessments, and an indicator for whether the student ever enrolled in calculus during high school.
- **Experiences with coursework that offers students an opportunity to earn college credit in high school,** including an indicator capturing whether a student ever enrolled in a CTE course with an opportunity to earn college credit during high school (defined as any Advanced Placement, Cambridge International, CTE Dual Credit, College in the High School, International Baccalaureate, or Running Start course with a CTE designation) and whether a student ever enrolled in a course with an opportunity to earn college credit without a CTE designation during high school.
- **Whether a student ever enrolled in specific school types,** including CTE Skills Centers, juvenile detention center, reengagement school, or special education school.

Our employment and earnings models also adjusted for differences due to high school graduation, college enrollment, and college completion, and degree and certificate attainment models adjusted for differences due to student postsecondary and labor market pathways following high

school (e.g., whether a student was enrolled in postsecondary education, employed in Washington state, or both, in the years between high school and the outcome measurement).

In addition to these controls, we included three additional measures to strengthen the rigor of our analyses:

1. We included a fixed effect for the high school where the student spent the majority of their time between grades 9 and 12. This fixed effect allowed for a "within school" analysis, such that we were always making comparisons between students who attended the same school and had similar opportunities to engage with CTE programming. Our school fixed effect also accounted for any fixed school-level characteristics, such as locale, alignment between CTE programming, local labor market needs, and postsecondary opportunities that may have driven our results.
2. In our analyses that included multiple cohorts, we included a cohort year indicator to account for any macrotrends that may have affected all students in Washington state. For example, changes in postsecondary enrollment and employment opportunities due to the COVID-19 pandemic were accounted for with the cohort year indicator.
3. To this point, we have accounted for all observable and measurable student-level characteristics that are determinants of CTE participation and our outcomes, as well as all observable and unobservable school-level characteristics that may be deterministic of our outcomes. Because our data are observational, we could not account for all unobservable student-level characteristics that may bias our findings. For example, to the extent that students who earn more CTE credits possess higher levels of intrinsic motivation or ability (in ways that we could not measure in our data), our analyses may overstate the relationship between CTE and our outcomes. To address this possibility, we also included an adjustment in our models that accounted for the inverse probability that a student was included in any of the treatment categories.[16] This approach could account for some of the unobservable determinants of student participation in CTE that may otherwise bias our findings.

[16] We estimated a multinomial logistic regression to calculate inverse probability weights that a student would be included in any of the three treatment categories or the comparison group. Our ideal model specification would use these as probability weights in our model. However, student-level probability weights cannot be included in a model with school-level fixed effects, as fixed effects require all weights to be constant within the panel. As a result, we were faced with three less-perfect options: estimate fixed effects regressions without any weighting adjustment, estimate fixed effects regressions entering the weighting variable as a control variable, and estimate OLS regressions that replace the school fixed effects with school indicator variables (omitting one group) and include the weighting variable as a weight. We estimated these three models and found results are generally consistent. In our analyses, we present the second model: fixed effects with the weighting variable as a control. The fixed effects regression is desirable because it ensures comparisons are made within schools and correctly specifies standard errors given this clustering.

We estimated these models for the following outcomes and samples as described below.

Table B2. Short-term outcomes and samples

Outcome	Sample	All available cohorts	All available cohorts (N)	Restricted cohorts 2017–2022 (N)
High school graduation within four years of a student's first 9th grade year (on-time graduation)	All students continuously enrolled from 9th–12th grade	2017–2024	520,538	386,413
College enrollment in year following high school graduation	All students continuously enrolled from 9th–12th grade who graduated high school in 12th grade[17]	2017–2023	429,566	365,488
Employment in year following high school exit	All students continuously enrolled from 9th–12th grade	2017–2022	386,263	No change
Annual earnings in year following high school exit	All students continuously enrolled from 9th–12th grade who were employed in the year following high school	2017–2022	284,912	No change
Earned a living wage* in first year following high school exit	All students continuously enrolled from 9th–12th grade who were employed in the year following high school	2017–2022	284,912	No change

*We used MIT's living wage calculator to estimate the living wage for one adult with no dependents in Washington state. In 2023 dollars, this threshold was equivalent to $51,646 (Glasmeier, 2025).

Source: Authors' analysis of ERDC P20W Integrated Data System.

[17] College outcomes are restricted to high school graduates because National Student Clearinghouse data are only collected for high school graduates.

Table B3. Long-term outcomes and samples (2017 cohort only)

Outcome	Sample	N
Completion of any degree or certificate within 6 years of high school graduation	All students continuously enrolled from 9th–12th grade who graduated high school in 2017	57,788
Annual earnings in 2022–23 (6 years following high school exit)	All students continuously enrolled from 9th–12th grade who were employed in 2022–23	61,501
Cumulative annual earnings through 2022–23 (6 years following high school exit)	All students continuously enrolled from 9th–12th grade who were ever employed in Washington after high school	57,024
Earned a living wage* in 2022–23 (6 years following high school exit)	All students continuously enrolled from 9th–12th grade who were employed in 2022–23	43,141

*We used MIT's living wage calculator to estimate the living wage for one adult with no dependents in Washington state. In 2023 dollars, this threshold was equivalent to $51,646 (Glasmeier, 2025).

Source: Authors' analysis of ERDC P20W Integrated Data System.

APPENDIX C. REGRESSION TABLES

Table C1. The relationship between CTE attainment across all pathways and short-term student outcomes

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	High school graduation	Postsecondary enrollment in the year following high school graduation	Postsecondary enrollment in a two-year institution in the year following high school graduation	Postsecondary enrollment in a four-year institution in the year following high school graduation	Employed in year following high school exit	Annual earnings in year following high school exit	Earned living wage
Student earned more than 1 and up to 2 CTE credits across all pathways	0.057***	−0.001	0.005	−0.006*	0.009***	250.939**	0.000
	(0.001)	(0.003)	(0.003)	(0.003)	(0.003)	(79.765)	(0.001)
Student earned more than 2 and up to 3 CTE credits across all pathways	0.085***	−0.003	0.007*	−0.009***	0.015***	262.581**	0.001
	(0.001)	(0.003)	(0.003)	(0.003)	(0.003)	(80.916)	(0.001)
Student earned more than 3 CTE credits across all pathways	0.120***	−0.016***	0.005	−0.020***	0.021***	717.422***	0.002*
	(0.001)	(0.003)	(0.003)	(0.003)	(0.003)	(82.947)	(0.001)
Observations	520538	429566	429566	429566	386263	284912	284912
Adjusted R-squared	0.249	0.235	0.026	0.268	0.209	0.244	0.061

Note: Table displays coefficients and standard errors from OLS regression analyses with school fixed effects that examine the relationship between different levels of CTE credit attainment overall on short-term student outcomes. * p<0.05; ** p<0.01; *** p<0.001 communicate the results of t-tests that examine whether the coefficient is different from zero. Models 1–4 adjust for differences attributed to student demographics, academic achievement, experiences with dual credit and advanced coursework, schools attended, and cohort year. Models 5–7 adjust for differences attributed to high school graduation and college enrollment. Students who earned one CTE credit or fewer overall are the reference category.

Source: Authors' analysis of ERDC P20W Integrated Data System.

Table C2. The relationship between CTE attainment across all pathways and long-term student outcomes

	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	Completion of any degree or credential by 2022–23	Completion of certificate by 2022–23	Completion of associate degree by 2022–23	Completion of bachelor's degree by 2022–23	Annual earnings in 2022–23	Cumulative earnings through 2022–23	Earned a living wage in 2022–23
Student earned more than 1 and up to 2 CTE credits across all pathways	−0.019***	−0.001	−0.007	−0.018***	405.134	1583.496	0.011
	(0.006)	(0.003)	(0.005)	(0.006)	(469.370)	(1039.501)	(0.008)
Student earned more than 2 and up to 3 CTE credits across all pathways	−0.021***	0.004	−0.010	−0.027***	1188.398*	2607.184*	0.021*
	(0.006)	(0.003)	(0.006)	(0.006)	(485.636)	(1076.945)	(0.008)
Student earned more than 3 CTE credits across all pathways	−0.014*	0.008*	−0.005	−0.022***	2783.509***	6830.208***	0.047***
	(0.006)	(0.004)	(0.006)	(0.006)	(515.664)	(1146.441)	(0.009)
Observations	57784	57784	57784	57784	43141	57024	43141
Adjusted R-squared	0.506	0.012	0.104	0.462	0.145	0.468	0.094

Note: Table displays coefficients and standard errors from OLS regression analyses with school fixed effects that examine the relationship between different levels of CTE credit attainment overall on long-term student outcomes. * p<0.05; ** p<0.01; *** p<0.001 communicate the results of t-tests that examine whether the coefficient is different from zero. All models adjust for differences attributed to student demographics, academic achievement, experiences with dual credit and advanced coursework, and schools attended. Models 8–11 also for differences due to student postsecondary and labor market pathways following high school (e.g., whether a student was enrolled in postsecondary education, employed in Washington state, or both, in the years between high school and the outcome measurement). Models 12–14 adjust for differences due to high school graduation, college enrollment, and college completion. Students who earned one CTE credit or fewer overall are the reference category.

Source: Authors' analysis of ERDC P20W Integrated Data System.

Table C3. The relationship between CTE attainment across all pathways and high school graduation by cohort

	(1)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	All cohorts (2017–2024)	**2017 cohort**	**2018 cohort**	**2019 cohort**	**2020 cohort**	**2021 cohort**	**2022 cohort**	**2023 cohort**	**2024 cohort**
Student earned more than 1 and up to 2 CTE credits across all pathways	0.057***	0.053***	0.058***	0.054***	0.048***	0.051***	0.052***	0.071***	0.070***
	(0.001)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)
Student earned more than 2 and up to 3 CTE credits across all pathways	0.085***	0.077***	0.084***	0.077***	0.069***	0.079***	0.091***	0.105***	0.119***
	(0.001)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)
Student earned more than 3 CTE credits across all pathways	0.120***	0.113***	0.115***	0.107***	0.101***	0.113***	0.129***	0.143***	0.177***
	(0.001)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)
Observations	520538	61501	58510	66297	66489	67969	65647	67470	66655
Adjusted R-squared	0.249	0.263	0.238	0.264	0.238	0.226	0.247	0.233	0.301

Note: Table displays coefficients and standard errors from OLS regression analyses with school fixed effects that examine the relationship between different levels of CTE credit attainment overall on high school graduation. * p<0.05; ** p<0.01; *** p<0.001 communicate the results of t-tests that examine whether the coefficient is different from zero. Models adjust for differences attributed to student demographics, academic achievement, experiences with dual credit and advanced coursework, and schools attended. Model 1 includes indicators for cohort year. Students who earned one CTE credit or fewer overall are the reference category.

Source: Authors' analysis of ERDC P20W Integrated Data System.

Table C4. The relationship between CTE attainment across all pathways and short-term student outcomes moderated by gender

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	High school graduation	Postsecondary enrollment in the year following high school graduation	Postsecondary enrollment in a two-year institution in the year following high school graduation	Postsecondary enrollment in a four-year institution in the year following high school graduation	Employed in year following high school exit	Annual earnings in year following high school exit	Earned living wage
Student earned more than 1 and up to 2 CTE credits across all pathways	0.047***	−0.005	0.006	−0.010**	0.013***	299.844**	0.000
	(0.002)	(0.004)	(0.004)	(0.003)	(0.003)	(103.310)	(0.001)
Student earned more than 2 and up to 3 CTE credits across all pathways	0.070***	−0.005	0.007	−0.012***	0.015***	146.429	0.000
	(0.002)	(0.004)	(0.004)	(0.003)	(0.003)	(103.931)	(0.001)
Student earned more than 3 CTE credits across all pathways	0.096***	−0.008*	0.016***	−0.023***	0.026***	264.516**	−0.001
	(0.001)	(0.003)	(0.003)	(0.003)	(0.003)	(97.748)	(0.001)
Male	−0.037***	−0.020***	0.009*	−0.030***	−0.009*	1064.321***	0.005***
	(0.002)	(0.004)	(0.004)	(0.004)	(0.004)	(117.466)	(0.001)
Student earned more than 1 and up to 2 CTE credits across all pathways * Male	0.024***	0.008	−0.004	0.011*	−0.009	−30.116	0.001
	(0.002)	(0.005)	(0.005)	(0.005)	(0.005)	(152.467)	(0.001)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	High school graduation	Postsecondary enrollment in the year following high school graduation	Postsecondary enrollment in a two-year institution in the year following high school graduation	Postsecondary enrollment in a four-year institution in the year following high school graduation	Employed in year following high school exit	Annual earnings in year following high school exit	Earned living wage
Student earned more than 2 and up to 3 CTE credits across all pathways * Male	0.038***	0.003	–0.004	0.007	–0.003	381.813*	0.002
	(0.002)	(0.005)	(0.005)	(0.005)	(0.005)	(148.816)	(0.001)
Student earned more than 3 CTE credits across all pathways * Male	0.058***	–0.019***	–0.027***	0.007	–0.011**	1105.098***	0.007***
	(0.002)	(0.004)	(0.005)	(0.004)	(0.004)	(126.817)	(0.001)
Observations	520538	429566	429566	429566	386263	284912	284912
Adjusted R-squared	0.251	0.235	0.026	0.268	0.209	0.244	0.061

Note: Table displays coefficients and standard errors from OLS regression analyses with school fixed effects that examine the relationship between different levels of CTE credit attainment overall on short-term student outcomes. * p<0.05; ** p<0.01; *** p<0.001 communicate the results of t-tests that examine whether the coefficient is different from zero. Models 1–4 adjust for differences attributed to student demographics, academic achievement, experiences with dual credit and advanced coursework, schools attended, and cohort year. Models 5–7 adjust for differences attributed to high school graduation and college enrollment. Students who earned one CTE credit or fewer overall are the reference category.

Source: Authors' analysis of ERDC P20W Integrated Data System.

Table C5. The relationship between CTE attainment across all pathways and long-term student outcomes moderated by gender

	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	Completion of any degree or credential by 2022–23	Completion of certificate by 2022–23	Completion of associate degree by 2022–23	Completion of bachelor's degree by 2022–23	Annual earnings in 2022–23	Cumulative earnings through 2022–23	Earned a living wage in 2022–23
Student earned more than 1 and up to 2 CTE credits across all pathways	−0.020**	−0.000	−0.008	−0.019**	198.976	427.706	0.012
	(0.007)	(0.004)	(0.007)	(0.007)	(613.734)	(1354.074)	(0.011)
Student earned more than 2 and up to 3 CTE credits across all pathways	−0.028***	0.003	−0.012	−0.034***	540.210	251.406	0.011
	(0.007)	(0.004)	(0.007)	(0.007)	(625.628)	(1385.380)	(0.011)
Student earned more than 3 CTE credits across all pathways	−0.029***	0.002	−0.006	−0.032***	1182.578	703.482	0.018
	(0.007)	(0.004)	(0.007)	(0.007)	(606.984)	(1345.633)	(0.010)
Male	−0.039***	−0.003	−0.011	−0.029***	6156.489***	11355.752***	0.097***
	(0.008)	(0.005)	(0.008)	(0.008)	(679.846)	(1492.923)	(0.012)
Student earned more than 1 and up to 2 CTE credits across all pathways * Male	0.006	−0.001	0.003	0.004	698.322	3404.122	0.003
	(0.011)	(0.006)	(0.010)	(0.010)	(881.736)	(1947.681)	(0.015)

	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	Completion of any degree or credential by 2022–23	Completion of certificate by 2022–23	Completion of associate degree by 2022–23	Completion of bachelor's degree by 2022–23	Annual earnings in 2022–23	Cumulative earnings through 2022–23	Earned a living wage in 2022–23
Student earned more than 2 and up to 3 CTE credits across all pathways * Male	0.019 (0.011)	0.003 (0.006)	0.004 (0.010)	0.017 (0.010)	1723.782* (868.279)	6336.173** (1925.629)	0.029* (0.015)
Student earned more than 3 CTE credits across all pathways * Male	0.037*** (0.009)	0.015** (0.005)	0.002 (0.009)	0.024** (0.009)	3716.798*** (750.950)	14249.027*** (1659.516)	0.069*** (0.013)
Observations	57784	57784	57784	57784	43141	57024	43141
Adjusted R-squared	0.506	0.013	0.104	0.462	0.146	0.469	0.095

Note: Table displays coefficients and standard errors from OLS regression analyses with school fixed effects that examine the relationship between different levels of CTE credit attainment overall on long-term student outcomes. * p<0.05; ** p<0.01; *** p<0.001 communicate the results of t-tests that examine whether the coefficient is different from zero. All models adjust for differences attributed to student demographics, academic achievement, experiences with dual credit and advanced coursework, and schools attended. Models 8–11 also for differences due to student postsecondary and labor market pathways following high school (e.g., whether a student was enrolled in postsecondary education, employed in Washington state, or both, in the years between high school and the outcome measurement). Models 12–14 adjust for differences due to high school graduation, college enrollment, and college completion. Students who earned one CTE credit or fewer overall are the reference category.

Source: Authors' analysis of ERDC P20W Integrated Data System.

Table C6. The relationship between CTE attainment within a single pathway and short-term student outcomes

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	High school graduation	Postsecondary enrollment in the year following high school graduation	Postsecondary enrollment in a two-year institution in the year following high school graduation	Postsecondary enrollment in a four-year institution in the year following high school graduation	Employed in year following high school exit	Annual earnings in year following high school exit	Earned living wage
Student earned more than 1 and up to 2 CTE credits in a single CTE pathway	0.037***	−0.017***	−0.005**	−0.012***	0.009***	253.265***	0.001
	(0.001)	(0.002)	(0.002)	(0.001)	(0.002)	(47.410)	(0.000)
Student earned more than 2 and up to 3 CTE credits in a single CTE pathway	0.034***	−0.016***	0.002	−0.018***	0.010***	875.573***	0.003***
	(0.001)	(0.002)	(0.003)	(0.002)	(0.002)	(71.907)	(0.001)
Student earned more than 3 CTE credits in a single CTE pathway	0.028***	−0.016***	0.011***	−0.027***	0.011***	1166.372***	0.002*
	(0.001)	(0.003)	(0.003)	(0.003)	(0.003)	(93.627)	(0.001)
Observations	520538	429566	429566	429566	386263	284912	284912
Adjusted R-squared	0.236	0.235	0.026	0.268	0.209	0.244	0.061

Note: Table displays coefficients and standard errors from OLS regression analyses with school fixed effects that examine the relationship between different levels of CTE credit attainment in a single pathway on short-term student outcomes. * p<0.05; ** p<0.01; *** p<0.001 communicate the results of t-tests that examine whether the coefficient is different from zero. Models 1–4 adjust for differences attributed to student demographics, academic achievement, experiences with dual credit and advanced coursework, schools attended, and cohort year. Models 5–7 adjust for differences attributed to high school graduation and college enrollment. Students who earned one CTE credit or fewer in a single pathway are the reference category.

Source: Authors' analysis of ERDC P20W Integrated Data System.

Table C7. The relationship between CTE attainment within a single pathway and long-term student outcomes

	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	Completion of any degree or credential by 2022–23	Completion of certificate by 2022–23	Completion of associate degree by 2022–23	Completion of bachelor's degree by 2022–23	Annual earnings in 2022–23	Cumulative earnings through 2022–23	Earned a living wage in 2022–23
Student earned more than 1 and up to 2 CTE credits in a single pathway	–0.002	0.006**	–0.002	–0.009*	1716.183***	4440.258***	0.026***
	(0.004)	(0.002)	(0.004)	(0.004)	(303.998)	(688.375)	(0.005)
Student earned more than 2 and up to 3 CTE credits in a single pathway	0.004	0.020***	0.003	–0.009	2942.550***	8834.509***	0.047***
	(0.006)	(0.004)	(0.006)	(0.006)	(501.740)	(1148.368)	(0.009)
Student earned more than 3 CTE credits in a single pathway	0.020*	0.022***	0.017*	0.001	3742.479***	12733.267***	0.061***
	(0.009)	(0.005)	(0.009)	(0.009)	(706.584)	(1619.628)	(0.012)
Observations	57784	57784	57784	57784	43141	57024	43141
Adjusted R-squared	0.506	0.013	0.104	0.461	0.145	0.468	0.094

Note: Table displays coefficients and standard errors from OLS regression analyses with school fixed effects that examine the relationship between different levels of CTE credit attainment within a single pathway on long-term student outcomes. * p<0.05; ** p<0.01; *** p<0.001 communicate the results of t-tests that examine whether the coefficient is different from zero. All models adjust for differences attributed to student demographics, academic achievement, experiences with dual credit and advanced coursework, and schools attended. Models 8–11 also for differences due to student postsecondary and labor market pathways following high school (e.g., whether a student was enrolled in postsecondary education, employed in Washington state, or both, in the years between high school and the outcome measurement). Models 12–14 adjust for differences due to high school graduation, college enrollment, and college completion. Students who earned one CTE credit or fewer within a single pathway are the reference category.

Source: Authors' analysis of ERDC P20W Integrated Data System.

Table C8. The relationship between CTE attainment within a single pathway and short-term student outcomes moderated by gender

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	High school graduation	Postsecondary enrollment in the year following high school graduation	Postsecondary enrollment in a two-year institution in the year following high school graduation	Postsecondary enrollment in a four-year institution in the year following high school graduation	Employed in year following high school exit	Annual earnings in year following high school exit	Earned living wage
Student earned more than 1 and up to 2 CTE credits within a single pathway	0.029***	−0.012***	0.003	−0.014***	0.010***	−21.013	−0.001
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(64.965)	(0.001)
Student earned more than 2 and up to 3 CTE credits within a single pathway	0.021***	0.003	0.016***	−0.013***	0.013***	333.711***	−0.001
	(0.001)	(0.003)	(0.003)	(0.003)	(0.003)	(91.356)	(0.001)
Student earned more than 3 CTE credits within a single pathway	0.013***	0.015***	0.036***	−0.020***	0.021***	491.212***	−0.003**
	(0.002)	(0.004)	(0.004)	(0.004)	(0.004)	(115.994)	(0.001)
Male	−0.002*	−0.016***	0.005*	−0.021***	−0.013***	1313.799***	0.006***
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(57.582)	(0.000)
Student earned more than 1 and up to 2 CTE credits within a single pathway * Male	0.016***	−0.010***	−0.015***	0.004	−0.002	566.456***	0.003***
	(0.001)	(0.003)	(0.003)	(0.003)	(0.003)	(88.581)	(0.001)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	High school graduation	Postsecondary enrollment in the year following high school graduation	Postsecondary enrollment in a two-year institution in the year following high school graduation	Postsecondary enrollment in a four-year institution in the year following high school graduation	Employed in year following high school exit	Annual earnings in year following high school exit	Earned living wage
Student earned more than 2 and up to 3 CTE credits within a single pathway * Male	0.025***	−0.036***	−0.027***	−0.010**	−0.006	1073.255***	0.008***
	(0.002)	(0.004)	(0.004)	(0.004)	(0.004)	(112.882)	(0.001)
Student earned more than 3 CTE credits within a single pathway * Male	0.029***	−0.056***	−0.045***	−0.011**	−0.018***	1280.962***	0.009***
	(0.002)	(0.004)	(0.004)	(0.004)	(0.004)	(128.913)	(0.001)
Observations	520538	429566	429566	429566	386263	284912	284912
Adjusted R-squared	0.236	0.235	0.026	0.268	0.209	0.245	0.061

Note: Table displays coefficients and standard errors from OLS regression analyses with school fixed effects that examine the relationship between different levels of CTE credit attainment within a single pathway on short-term student outcomes. * p<0.05; ** p<0.01; *** p<0.001 communicate the results of t-tests that examine whether the coefficient is different from zero. Models 1–4 adjust for differences attributed to student demographics, academic achievement, experiences with dual credit and advanced coursework, schools attended, and cohort year. Models 5–7 adjust for differences attributed to high school graduation and college enrollment. Students who earned one CTE credit or fewer within a single pathway are the reference category.

Source: Authors' analysis of ERDC P20W Integrated Data System.

Table C9. The relationship between CTE attainment within a single pathway and long-term student outcomes moderated by gender

	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	Completion of any degree or credential by 2022–23	Completion of certificate by 2022–23	Completion of associate degree by 2022–23	Completion of bachelor's degree by 2022–23	Annual earnings in 2022–23	Cumulative earnings through 2022–23	Earned a living wage in 2022–23
Student earned more than 1 and up to 2 CTE credits within a single pathway	−0.015**	−0.000	−0.004	−0.020***	1392.123***	1657.406	0.014
	(0.005)	(0.003)	(0.005)	(0.005)	(418.016)	(942.183)	(0.007)
Student earned more than 2 and up to 3 CTE credits within a single pathway	−0.015	0.005	−0.001	−0.014	1652.178**	3330.898*	0.018
	(0.008)	(0.005)	(0.007)	(0.007)	(619.908)	(1408.072)	(0.011)
Student earned more than 3 CTE credits within a single pathway	−0.001	0.009	0.017	−0.010	1789.407*	4676.552*	0.026
	(0.011)	(0.006)	(0.010)	(0.010)	(855.639)	(1948.808)	(0.015)
Male	−0.030***	−0.004	−0.011**	−0.022***	7741.971***	16267.822***	0.120***
	(0.004)	(0.002)	(0.004)	(0.004)	(342.937)	(765.620)	(0.006)
Student earned more than 1 and up to 2 CTE credits within a single pathway * Male	0.025***	0.013**	0.003	0.023***	649.980	5479.942***	0.024*
	(0.007)	(0.004)	(0.006)	(0.006)	(554.157)	(1249.200)	(0.010)
Student earned more than 2 and up to 3 CTE credits within a single pathway * Male	0.035***	0.029***	0.009	0.009	2467.245***	10486.592***	0.054***
	(0.009)	(0.005)	(0.008)	(0.008)	(721.960)	(1629.171)	(0.012)

	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	Completion of any degree or credential by 2022–23	Completion of certificate by 2022–23	Completion of associate degree by 2022–23	Completion of bachelor's degree by 2022–23	Annual earnings in 2022–23	Cumulative earnings through 2022–23	Earned a living wage in 2022–23
Student earned more than 3 CTE credits within a single pathway * Male	0.037*** (0.010)	0.021*** (0.006)	–0.001 (0.010)	0.017 (0.010)	3542.990*** (863.977)	14551.731*** (1947.749)	0.063*** (0.015)
Observations	57784	57784	57784	57784	43141	57024	43141
Adjusted R-squared	0.506	0.013	0.104	0.461	0.146	0.469	0.095

Note: Table displays coefficients and standard errors from OLS regression analyses with school fixed effects that examine the relationship between different levels of CTE credit attainment within a single pathway on long-term student outcomes. * p<0.05; ** p<0.01; *** p<0.001 communicate the results of t-tests that examine whether the coefficient is different from zero. All models adjust for differences attributed to student demographics, academic achievement, experiences with dual credit and advanced coursework, and schools attended. Models 8–11 also for differences due to student postsecondary and labor market pathways following high school (e.g., whether a student was enrolled in postsecondary education, employed in Washington state, or both, in the years between high school and the outcome measurement). Models 12–14 adjust for differences due to high school graduation, college enrollment, and college completion. Students who earned one CTE credit or fewer within a single pathway are the reference category.

Source: Authors' analysis of ERDC P20W Integrated Data System.

Table C10. The relationship between CTE attainment within a single pathway in the Agriculture, Food, & Natural Resources cluster and short-term student outcomes

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	High school graduation	Postsecondary enrollment in the year following high school graduation	Postsecondary enrollment in a two-year institution in the year following high school graduation	Postsecondary enrollment in a four-year institution in the year following high school graduation	Employed in year following high school exit	Annual earnings in year following high school exit	Earned living wage
Student earned more than 1 and up to 2 credits in Agriculture cluster	0.025***	−0.035***	−0.017***	−0.018***	0.006	810.477***	0.005***
	(0.001)	(0.003)	(0.003)	(0.003)	(0.003)	(94.846)	(0.001)
Student earned more than 2 and up to 3 credits in Agriculture cluster	0.031***	−0.049***	−0.022***	−0.027***	−0.001	1447.349***	0.007***
	(0.002)	(0.005)	(0.005)	(0.005)	(0.005)	(156.874)	(0.001)
Student earned more than 3 credits in Agriculture cluster	0.038***	−0.082***	−0.014	−0.068***	−0.011	2989.142***	0.015***
	(0.004)	(0.008)	(0.009)	(0.008)	(0.009)	(249.969)	(0.002)
Observations	520538	429566	429566	429566	386263	284912	284912
Adjusted R-squared	0.230	0.235	0.026	0.268	0.209	0.244	0.061

Note: Table displays coefficients and standard errors from OLS regression analyses with school fixed effects that examine the relationship between different levels of CTE credit attainment in a single pathway in the Agriculture, Food, & Natural Resources cluster on short-term student outcomes. * p<0.05; ** p<0.01; *** p<0.001 communicate the results of t-tests that examine whether the coefficient is different from zero. Models 1–4 adjust for differences attributed to student demographics, academic achievement, experiences with dual credit and advanced coursework, schools attended, and cohort year. Models 5–7 adjust for differences attributed to high school graduation and college enrollment. Students who earned one CTE credit or fewer in a single pathway in the Agriculture, Food, & Natural Resources cluster are the reference category.

Source: Authors' analysis of ERDC P20W Integrated Data System.

Table C11. The relationship between CTE attainment within a single pathway in the Agriculture, Food, & Natural Resources cluster and long-term student outcomes

	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	Completion of any degree or credential by 2022–23	**Completion of certificate by 2022–23**	**Completion of associate degree by 2022–23**	**Completion of bachelor's degree by 2022–23**	**Annual earnings in 2022–23**	**Cumulative earnings through 2022–23**	**Earned a living wage in 2022–23**
Student earned more than 1 and up to 2 credits in Agriculture cluster	0.011	0.005	−0.003	0.007	2448.381***	8919.013***	0.046***
	(0.008)	(0.005)	(0.007)	(0.007)	(633.934)	(1454.237)	(0.011)
Student earned more than 2 and up to 3 credits in Agriculture cluster	0.032*	0.026**	0.022	0.009	4700.883***	13533.936***	0.063***
	(0.013)	(0.008)	(0.013)	(0.013)	(1102.788)	(2547.421)	(0.019)
Student earned more than 3 credits in Agriculture cluster	0.012	0.030*	0.003	−0.006	6305.571***	20266.622***	0.156***
	(0.022)	(0.013)	(0.021)	(0.021)	(1801.624)	(4168.745)	(0.031)
Observations	57784	57784	57784	57784	43141	57024	43141
Adjusted R-squared	0.506	0.012	0.104	0.461	0.144	0.468	0.093

Note: Table displays coefficients and standard errors from OLS regression analyses with school fixed effects that examine the relationship between different levels of CTE credit attainment in a single pathway in the Agriculture, Food, & Natural Resources cluster on long-term student outcomes. * p<0.05; ** p<0.01; *** p<0.001 communicate the results of t-tests that examine whether the coefficient is different from zero. All models adjust for differences attributed to student demographics, academic achievement, experiences with dual credit and advanced coursework, and schools attended. Models 8–11 also for differences due to student postsecondary and labor market pathways following high school (e.g., whether a student was enrolled in postsecondary education, employed in Washington state, or both, in the years between high school and the outcome measurement). Models 12–14 adjust for differences due to high school graduation, college enrollment, and college completion. Students who earned one CTE credit or fewer in a single pathway in the Agriculture, Food, & Natural Resources cluster within a single pathway are the reference category.

Source: Authors' analysis of ERDC P20W Integrated Data System.

Table C12. The relationship between CTE attainment within a single pathway in the Architecture & Construction cluster and short-term student outcomes

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	High school graduation	**Postsecondary enrollment in the year following high school graduation**	**Postsecondary enrollment in a two-year institution in the year following high school graduation**	**Postsecondary enrollment in a four-year institution in the year following high school graduation**	**Employed in year following high school exit**	**Annual earnings in year following high school exit**	**Earned living wage**
Student earned more than 1 and up to 2 credits in Architecture & Construction cluster	0.028***	−0.066***	−0.036***	−0.030***	0.011	1861.172***	0.013***
	(0.003)	(0.007)	(0.007)	(0.006)	(0.007)	(202.540)	(0.002)
Student earned more than 2 and up to 3 credits in Architecture & Construction cluster	0.035***	−0.095***	−0.063***	−0.034***	0.010	2498.190***	0.012***
	(0.004)	(0.010)	(0.010)	(0.009)	(0.010)	(300.621)	(0.003)
Student earned more than 3 credits in Architecture & Construction cluster	0.029***	−0.124***	−0.100***	−0.026*	0.026*	3311.886***	0.017***
	(0.005)	(0.012)	(0.012)	(0.011)	(0.013)	(354.756)	(0.003)
Observations	520538	429566	429566	429566	386263	284912	284912
Adjusted R-squared	0.229	0.235	0.026	0.268	0.209	0.244	0.061

Note: Table displays coefficients and standard errors from OLS regression analyses with school fixed effects that examine the relationship between different levels of CTE credit attainment in a single pathway in the Architecture & Construction cluster on short-term student outcomes. * p<0.05; ** p<0.01; *** p<0.001 communicate the results of t-tests that examine whether the coefficient is different from zero. Models 1–4 adjust for differences attributed to student demographics, academic achievement, experiences with dual credit and advanced coursework, schools attended, and cohort year. Models 5–7 adjust for differences attributed to high school graduation and college enrollment. Students who earned one CTE credit or fewer in a single pathway in the Architecture & Construction cluster are the reference category.

Source: Authors' analysis of ERDC P20W Integrated Data System.

Table C13. The relationship between CTE attainment within a single pathway in the Architecture & Construction cluster and long-term student outcomes

	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	Completion of any degree or credential by 2022–23	**Completion of certificate by 2022–23**	**Completion of associate degree by 2022–23**	**Completion of bachelor's degree by 2022–23**	**Annual earnings in 2022–23**	**Cumulative earnings through 2022–23**	**Earned a living wage in 2022–23**
Student earned more than 1 and up to 2 credits in Architecture & Construction cluster	0.017 (0.016)	0.014 (0.010)	−0.016 (0.016)	0.012 (0.016)	3978.292** (1334.030)	15662.121*** (3106.806)	0.084*** (0.023)
Student earned more than 2 and up to 3 credits in Architecture & Construction cluster	0.028 (0.027)	0.012 (0.016)	0.003 (0.026)	0.031 (0.026)	8497.864*** (2239.061)	24911.752*** (5162.301)	0.099* (0.038)
Student earned more than 3 credits in Architecture & Construction cluster	−0.036 (0.035)	−0.030 (0.021)	−0.045 (0.033)	0.010 (0.034)	7450.893** (2747.133)	37470.982*** (6573.906)	0.095* (0.047)
Observations	57784	57784	57784	57784	43141	57024	43141
Adjusted R-squared	0.506	0.012	0.104	0.461	0.144	0.468	0.093

Note: Table displays coefficients and standard errors from OLS regression analyses with school fixed effects that examine the relationship between different levels of CTE credit attainment in a single pathway in the Architecture & Construction cluster on long-term student outcomes. * p<0.05; ** p<0.01; *** p<0.001 communicate the results of t-tests that examine whether the coefficient is different from zero. All models adjust for differences attributed to student demographics, academic achievement, experiences with dual credit and advanced coursework, and schools attended. Models 8–11 also for differences due to student postsecondary and labor market pathways following high school (e.g., whether a student was enrolled in postsecondary education, employed in Washington state, or both, in the years between high school and the outcome measurement). Models 12–14 adjust for differences due to high school graduation, college enrollment, and college completion. Students who earned one CTE credit or fewer in a single pathway in the Architecture & Construction cluster within a single pathway are the reference category.

Source: Authors' analysis of ERDC P20W Integrated Data System.

Table C14. The relationship between CTE attainment within a single pathway in the Arts, Audio/Video Technology & Communications cluster and short-term student outcomes

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	High school graduation	Postsecondary enrollment in the year following high school graduation	Postsecondary enrollment in a two-year institution in the year following high school graduation	Postsecondary enrollment in a four-year institution in the year following high school graduation	Employed in year following high school exit	Annual earnings in year following high school exit	Earned living wage
Student earned more than 1 and up to 2 credits in Arts & A/V cluster	0.021***	−0.021***	−0.007**	−0.014***	0.005*	−382.629***	−0.002***
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(72.351)	(0.001)
Student earned more than 2 and up to 3 credits in Arts & A/V cluster	0.015***	−0.042***	−0.014**	−0.028***	−0.009	−685.777***	−0.005***
	(0.002)	(0.005)	(0.005)	(0.005)	(0.005)	(150.474)	(0.001)
Student earned more than 3 credits in Arts & A/V cluster	−0.002	−0.068***	−0.004	−0.064***	−0.013	−1396.965***	−0.007***
	(0.004)	(0.009)	(0.009)	(0.008)	(0.008)	(255.771)	(0.002)
Observations	520538	429566	429566	429566	386263	284912	284912
Adjusted R-squared	0.230	0.235	0.026	0.268	0.209	0.244	0.061

Note: Table displays coefficients and standard errors from OLS regression analyses with school fixed effects that examine the relationship between different levels of CTE credit attainment in a single pathway in the Arts, Audio/Video Technology & Communications cluster on short-term student outcomes. * p<0.05; ** p<0.01; *** p<0.001 communicate the results of t-tests that examine whether the coefficient is different from zero. Models 1–4 adjust for differences attributed to student demographics, academic achievement, experiences with dual credit and advanced coursework, schools attended, and cohort year. Models 5–7 adjust for differences attributed to high school graduation and college enrollment. Students who earned one CTE credit or fewer in a single pathway in the Arts, Audio/Video Technology & Communications cluster are the reference category.

Source: Authors' analysis of ERDC P20W Integrated Data System.

Table C15. The relationship between CTE attainment within a single pathway in the Arts, Audio/Video Technology & Communications cluster and long-term student outcomes

	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	Completion of any degree or credential by 2022–23	**Completion of certificate by 2022–23**	**Completion of associate degree by 2022–23**	**Completion of bachelor's degree by 2022–23**	**Annual earnings in 2022–23**	**Cumulative earnings through 2022–23**	**Earned a living wage in 2022–23**
Student earned more than 1 and up to 2 credits in Arts & A/V cluster	–0.006	–0.007*	–0.004	–0.003	–1311.416**	–4813.456***	–0.022*
	(0.006)	(0.004)	(0.006)	(0.006)	(496.455)	(1127.040)	(0.009)
Student earned more than 2 and up to 3 credits in Arts & A/V cluster	–0.014	–0.006	–0.018	–0.005	–2958.365**	–1.17e+04***	–0.052**
	(0.013)	(0.008)	(0.013)	(0.013)	(1060.713)	(2428.328)	(0.018)
Student earned more than 3 credits in Arts & A/V cluster	–0.019	–0.007	0.012	–0.008	–4175.722*	–1.70e+04***	–0.091**
	(0.023)	(0.014)	(0.022)	(0.023)	(1829.123)	(4273.246)	(0.031)
Observations	57784	57784	57784	57784	43141	57024	43141
Adjusted R-squared	0.506	0.012	0.104	0.461	0.144	0.468	0.093

Note: Table displays coefficients and standard errors from OLS regression analyses with school fixed effects that examine the relationship between different levels of CTE credit attainment in a single pathway in the Arts, Audio/Video Technology & Communications cluster on long-term student outcomes. * p<0.05; ** p<0.01; *** p<0.001 communicate the results of t-tests that examine whether the coefficient is different from zero. All models adjust for differences attributed to student demographics, academic achievement, experiences with dual credit and advanced coursework, and schools attended. Models 8–11 also for differences due to student postsecondary and labor market pathways following high school (e.g., whether a student was enrolled in postsecondary education, employed in Washington state, or both, in the years between high school and the outcome measurement). Models 12–14 adjust for differences due to high school graduation, college enrollment, and college completion. Students who earned one CTE credit or fewer in a single pathway in the Arts, Audio/Video Technology & Communications cluster within a single pathway are the reference category.

Source: Authors' analysis of ERDC P20W Integrated Data System.

Table C16. The relationship between CTE attainment within a single pathway in the Business, Management & Administration cluster and short-term student outcomes

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	High school graduation	Postsecondary enrollment in the year following high school graduation	Postsecondary enrollment in a two-year institution in the year following high school graduation	Postsecondary enrollment in a four-year institution in the year following high school graduation	Employed in year following high school exit	Annual earnings in year following high school exit	Earned living wage
Student earned more than 1 and up to 2 credits in Business cluster	0.018***	−0.015***	−0.014**	−0.001	0.003	127.966	0.004***
	(0.002)	(0.005)	(0.005)	(0.004)	(0.005)	(136.682)	(0.001)
Student earned more than 2 and up to 3 credits in Business cluster	−0.013*	−0.035**	−0.026	−0.010	−0.002	629.308	0.026***
	(0.005)	(0.013)	(0.013)	(0.012)	(0.013)	(368.096)	(0.003)
Student earned more than 3 credits in Business cluster	−0.009***	0.043***	0.040***	0.003	0.008	200.360	−0.000
	(0.002)	(0.005)	(0.005)	(0.005)	(0.005)	(155.201)	(0.001)
Observations	520538	429566	429566	429566	386263	284912	284912
Adjusted R-squared	0.230	0.235	0.026	0.268	0.209	0.243	0.061

Note: Table displays coefficients and standard errors from OLS regression analyses with school fixed effects that examine the relationship between different levels of CTE credit attainment in a single pathway in the Business, Management & Administration cluster on short-term student outcomes. * p<0.05; ** p<0.01; *** p<0.001 communicate the results of t-tests that examine whether the coefficient is different from zero. Models 1–4 adjust for differences attributed to student demographics, academic achievement, experiences with dual credit and advanced coursework, schools attended, and cohort year. Models 5–7 adjust for differences attributed to high school graduation and college enrollment. Students who earned one CTE credit or fewer in a single pathway in the Business, Management & Administration cluster are the reference category.

Source: Authors' analysis of ERDC P20W Integrated Data System.

Table C17. The relationship between CTE attainment within a single pathway in the Business, Management & Administration cluster and long-term student outcomes

	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	Completion of any degree or credential by 2022–23	**Completion of certificate by 2022–23**	**Completion of associate degree by 2022–23**	**Completion of bachelor's degree by 2022–23**	**Annual earnings in 2022–23**	**Cumulative earnings through 2022–23**	**Earned a living wage in 2022–23**
Student earned more than 1 and up to 2 credits in Business cluster	0.017 (0.011)	–0.007 (0.007)	0.007 (0.011)	0.012 (0.011)	3192.207*** (911.542)	5706.818** (2077.184)	0.054*** (0.016)
Student earned more than 2 and up to 3 credits in Business cluster	–0.019 (0.032)	–0.022 (0.019)	–0.016 (0.031)	0.019 (0.031)	5954.072* (2653.939)	13149.628* (6033.317)	0.099* (0.046)
Student earned more than 3 credits in Business cluster	0.069*** (0.012)	0.000 (0.007)	0.046*** (0.012)	0.070*** (0.012)	–3.497 (1010.205)	2392.537 (2275.222)	0.021 (0.017)
Observations	57784	57784	57784	57784	43141	57024	43141
Adjusted R-squared	0.506	0.012	0.104	0.462	0.144	0.467	0.093

Note: Table displays coefficients and standard errors from OLS regression analyses with school fixed effects that examine the relationship between different levels of CTE credit attainment in a single pathway in the Business, Management & Administration cluster on long-term student outcomes. * p<0.05; ** p<0.01; *** p<0.001 communicate the results of t-tests that examine whether the coefficient is different from zero. All models adjust for differences attributed to student demographics, academic achievement, experiences with dual credit and advanced coursework, and schools attended. Models 8–11 also for differences due to student postsecondary and labor market pathways following high school (e.g., whether a student was enrolled in postsecondary education, employed in Washington state, or both, in the years between high school and the outcome measurement). Models 12–14 adjust for differences due to high school graduation, college enrollment, and college completion. Students who earned one CTE credit or fewer in a single pathway in the Business, Management & Administration cluster within a single pathway are the reference category.

Source: Authors' analysis of ERDC P20W Integrated Data System.

Table C18. The relationship between CTE attainment within a single pathway in the Education & Training cluster and short-term student outcomes

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	High school graduation	Postsecondary enrollment in the year following high school graduation	Postsecondary enrollment in a two-year institution in the year following high school graduation	Postsecondary enrollment in a four-year institution in the year following high school graduation	Employed in year following high school exit	Annual earnings in year following high school exit	Earned living wage
Student earned more than 1 and up to 2 credits in Education cluster	0.019***	0.001	0.023***	−0.022***	0.013***	369.866***	−0.001
	(0.001)	(0.003)	(0.003)	(0.003)	(0.003)	(93.868)	(0.001)
Student earned more than 2 and up to 3 credits in Education cluster	0.015***	0.001	0.022***	−0.021***	0.013*	544.391***	0.001
	(0.002)	(0.006)	(0.006)	(0.005)	(0.006)	(165.229)	(0.001)
Student earned more than 3 credits in Education cluster	−0.003	0.008	−0.000	0.008	0.012	690.553	0.003
	(0.006)	(0.013)	(0.014)	(0.013)	(0.014)	(409.407)	(0.004)
Observations	520538	429566	429566	429566	386263	284912	284912
Adjusted R-squared	0.230	0.235	0.026	0.268	0.209	0.243	0.061

Note: Table displays coefficients and standard errors from OLS regression analyses with school fixed effects that examine the relationship between different levels of CTE credit attainment in a single pathway in the Education & Training cluster on short-term student outcomes. * p<0.05; ** p<0.01; *** p<0.001 communicate the results of t-tests that examine whether the coefficient is different from zero. Models 1–4 adjust for differences attributed to student demographics, academic achievement, experiences with dual credit and advanced coursework, schools attended, and cohort year. Models 5–7 adjust for differences attributed to high school graduation and college enrollment. Students who earned one CTE credit or fewer in a single pathway in the Education & Training cluster are the reference category.

Source: Authors' analysis of ERDC P20W Integrated Data System.

Table C19. The relationship between CTE attainment within a single pathway in the Education & Training cluster and long-term student outcomes

	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	Completion of any degree or credential by 2022–23	**Completion of certificate by 2022–23**	**Completion of associate degree by 2022–23**	**Completion of bachelor's degree by 2022–23**	**Annual earnings in 2022–23**	**Cumulative earnings through 2022–23**	**Earned a living wage in 2022–23**
Student earned more than 1 and up to 2 credits in Education cluster	−0.022**	−0.001	0.008	−0.035***	315.738	1125.950	−0.007
	(0.008)	(0.005)	(0.007)	(0.007)	(651.915)	(1462.441)	(0.011)
Student earned more than 2 and up to 3 credits in Education cluster	−0.009	0.007	−0.009	−0.006	−1637.861	816.128	0.005
	(0.012)	(0.007)	(0.011)	(0.012)	(1034.368)	(2302.850)	(0.018)
Student earned more than 3 credits in Education cluster	−0.055	−0.020	0.003	−0.064*	−2121.930	1248.744	0.018
	(0.030)	(0.018)	(0.029)	(0.029)	(2779.091)	(5985.141)	(0.048)
Observations	57784	57784	57784	57784	43141	57024	43141
Adjusted R-squared	0.506	0.012	0.104	0.462	0.144	0.467	0.093

Note: Table displays coefficients and standard errors from OLS regression analyses with school fixed effects that examine the relationship between different levels of CTE credit attainment in a single pathway in the Education & Training cluster on long-term student outcomes. * p<0.05; ** p<0.01; *** p<0.001 communicate the results of t-tests that examine whether the coefficient is different from zero. Models 1–4 adjust for differences attributed to student demographics, academic achievement, experiences with dual credit and advanced coursework, schools attended, and cohort year. All models adjust for differences attributed to student demographics, academic achievement, experiences with dual credit and advanced coursework, and schools attended. Models 8–11 also for differences due to student postsecondary and labor market pathways following high school (e.g., whether a student was enrolled in postsecondary education, employed in Washington state, or both, in the years between high school and the outcome measurement). Models 12–14 adjust for differences due to high school graduation, college enrollment, and college completion. Students who earned one CTE credit or fewer in a single pathway in the Education & Training cluster within a single pathway are the reference category.

Source: Authors' analysis of ERDC P20W Integrated Data System.

Table C20. The relationship between CTE attainment within a single pathway in the Finance cluster and short-term student outcomes

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	High school graduation	Postsecondary enrollment in the year following high school graduation	Postsecondary enrollment in a two-year institution in the year following high school graduation	Postsecondary enrollment in a four-year institution in the year following high school graduation	Employed in year following high school exit	Annual earnings in year following high school exit	Earned living wage
Student earned more than 1 and up to 2 credits in Finance cluster	0.035***	0.005	0.005	0.000	0.007	−67.106	−0.004*
	(0.003)	(0.006)	(0.006)	(0.006)	(0.006)	(190.970)	(0.002)
Student earned more than 2 and up to 3 credits in Finance cluster	−0.011***	0.056***	0.062***	−0.006	0.005	306.003*	−0.002
	(0.002)	(0.004)	(0.005)	(0.004)	(0.004)	(132.700)	(0.001)
Student earned more than 3 credits in Finance cluster	−0.008*	0.064***	0.062***	0.002	0.008	307.093	−0.002
	(0.003)	(0.007)	(0.007)	(0.006)	(0.007)	(202.038)	(0.002)
Observations	520538	429566	429566	429566	386263	284912	284912
Adjusted R-squared	0.230	0.235	0.027	0.268	0.209	0.243	0.061

Note: Table displays coefficients and standard errors from OLS regression analyses with school fixed effects that examine the relationship between different levels of CTE credit attainment in a single pathway in the Finance cluster on short-term student outcomes. * p<0.05; ** p<0.01; *** p<0.001 communicate the results of t-tests that examine whether the coefficient is different from zero. Models 1–4 adjust for differences attributed to student demographics, academic achievement, experiences with dual credit and advanced coursework, schools attended, and cohort year. Models 5–7 adjust for differences attributed to high school graduation and college enrollment. Students who earned one CTE credit or fewer in a single pathway in the Finance cluster are the reference category.
Source: Authors' analysis of ERDC P20W Integrated Data System.

Table C21. The relationship between CTE attainment within a single pathway in the Finance cluster and long-term student outcomes

	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	Completion of any degree or credential by 2022–23	Completion of certificate by 2022–23	Completion of associate degree by 2022–23	Completion of bachelor's degree by 2022–23	Annual earnings in 2022–23	Cumulative earnings through 2022–23	Earned a living wage in 2022–23
Student earned more than 1 and up to 2 credits in Finance cluster	0.005	–0.002	–0.012	0.023	2977.386*	2337.970	0.017
	(0.016)	(0.010)	(0.016)	(0.016)	(1435.184)	(3125.898)	(0.025)
Student earned more than 2 and up to 3 credits in Finance cluster	0.061***	0.009	0.078***	0.031**	1800.339	6746.385***	0.050**
	(0.011)	(0.006)	(0.010)	(0.010)	(934.220)	(2039.349)	(0.016)
Student earned more than 3 credits in Finance cluster	0.135***	–0.003	0.118***	0.115***	3961.842**	14106.035***	0.079**
	(0.017)	(0.010)	(0.016)	(0.017)	(1460.477)	(3284.615)	(0.025)
Observations	57784	57784	57784	57784	43141	57024	43141
Adjusted R-squared	0.507	0.012	0.105	0.462	0.144	0.467	0.093

Note: Table displays coefficients and standard errors from OLS regression analyses with school fixed effects that examine the relationship between different levels of CTE credit attainment in a single pathway in the Finance cluster on long-term student outcomes. * p<0.05; ** p<0.01; *** p<0.001 communicate the results of t-tests that examine whether the coefficient is different from zero. All models adjust for differences attributed to student demographics, academic achievement, experiences with dual credit and advanced coursework, and schools attended. Models 8–11 also for differences due to student postsecondary and labor market pathways following high school (e.g., whether a student was enrolled in postsecondary education, employed in Washington state, or both, in the years between high school and the outcome measurement). Models 12–14 adjust for differences due to high school graduation, college enrollment, and college completion. Students who earned one CTE credit or fewer in a single pathway in the Finance cluster within a single pathway are the reference category.
Source: Authors' analysis of ERDC P20W Integrated Data System.

Table C22. The relationship between CTE attainment within a single pathway in the Government & Public Administration cluster and short-term student outcomes

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	High school graduation	**Postsecondary enrollment in the year following high school graduation**	**Postsecondary enrollment in a two-year institution in the year following high school graduation**	**Postsecondary enrollment in a four-year institution in the year following high school graduation**	**Employed in year following high school exit**	**Annual earnings in year following high school exit**	**Earned living wage**
Student earned more than 1 and up to 2 credits in Government cluster	0.014*	−0.093***	−0.087***	−0.005	−0.024*	−22.081	−0.007*
	(0.006)	(0.013)	(0.014)	(0.013)	(0.012)	(369.129)	(0.003)
Student earned more than 2 and up to 3 credits in Government cluster	0.036***	−0.112***	−0.126***	0.013	−0.044**	−1534.230**	−0.007
	(0.007)	(0.017)	(0.017)	(0.016)	(0.016)	(482.388)	(0.004)
Student earned more than 3 credits in Government cluster	0.032***	−0.130***	−0.101***	−0.029**	−0.055***	−1639.401***	−0.010***
	(0.005)	(0.011)	(0.011)	(0.011)	(0.011)	(345.545)	(0.003)
Observations	520538	429566	429566	429566	386263	284912	284912
Adjusted R-squared	0.229	0.235	0.026	0.268	0.209	0.243	0.061

Note: Table displays coefficients and standard errors from OLS regression analyses with school fixed effects that examine the relationship between different levels of CTE credit attainment in a single pathway in the Government & Public Administration cluster on short-term student outcomes. * p<0.05; ** p<0.01; *** p<0.001 communicate the results of t-tests that examine whether the coefficient is different from zero. Models 1–4 adjust for differences attributed to student demographics, academic achievement, experiences with dual credit and advanced coursework, schools attended, and cohort year. Models 5–7 adjust for differences attributed to high school graduation and college enrollment. Students who earned one CTE credit or fewer in a single pathway in the Government & Public Administration cluster are the reference category.

Source: Authors' analysis of ERDC P20W Integrated Data System.

Table C23. The relationship between CTE attainment within a single pathway in the Government & Public Administration cluster and long-term student outcomes

	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	Completion of any degree or credential by 2022–23	**Completion of certificate by 2022–23**	**Completion of associate degree by 2022–23**	**Completion of bachelor's degree by 2022–23**	**Annual earnings in 2022–23**	**Cumulative earnings through 2022–23**	**Earned a living wage in 2022–23**
Student earned more than 1 and up to 2 credits in Government cluster	0.021	0.020	–0.020	0.039	–4577.624	–2852.352	–0.087*
	(0.029)	(0.017)	(0.028)	(0.028)	(2486.302)	(5675.251)	(0.043)
Student earned more than 2 and up to 3 credits in Government cluster	0.016	0.025	0.013	–0.009	–58.857	–2215.136	0.037
	(0.031)	(0.019)	(0.030)	(0.031)	(2889.192)	(6410.386)	(0.050)
Student earned more than 3 credits in Government cluster	0.015	0.017	0.011	–0.012	–3304.665	–4911.762	–0.081
	(0.027)	(0.016)	(0.026)	(0.026)	(2556.037)	(5587.141)	(0.044)
Observations	57784	57784	57784	57784	43141	57024	43141
Adjusted R-squared	0.506	0.012	0.104	0.461	0.144	0.467	0.093

Note: Table displays coefficients and standard errors from OLS regression analyses with school fixed effects that examine the relationship between different levels of CTE credit attainment in a single pathway in the Government & Public Administration cluster on long-term student outcomes. * p<0.05; ** p<0.01; *** p<0.001 communicate the results of t-tests that examine whether the coefficient is different from zero. All models adjust for differences attributed to student demographics, academic achievement, experiences with dual credit and advanced coursework, and schools attended. Models 8–11 also for differences due to student postsecondary and labor market pathways following high school (e.g., whether a student was enrolled in postsecondary education, employed in Washington state, or both, in the years between high school and the outcome measurement). Models 12–14 adjust for differences due to high school graduation, college enrollment, and college completion. Students who earned one CTE credit or fewer in a single pathway in the Government & Public Administration cluster within a single pathway are the reference category.

Source: Authors' analysis of ERDC P20W Integrated Data System.

Table C24. The relationship between CTE attainment within a single pathway in the Health Sciences cluster and short-term student outcomes

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	High school graduation	Postsecondary enrollment in the year following high school graduation	Postsecondary enrollment in a two-year institution in the year following high school graduation	Postsecondary enrollment in a four-year institution in the year following high school graduation	Employed in year following high school exit	Annual earnings in year following high school exit	Earned living wage
Student earned more than 1 and up to 2 credits in Health Sciences cluster	0.010***	0.038***	0.022***	0.017***	0.006	–1.995	–0.001
	(0.001)	(0.003)	(0.003)	(0.003)	(0.003)	(95.222)	(0.001)
Student earned more than 2 and up to 3 credits in Health Sciences cluster	–0.004*	0.093***	0.066***	0.027***	0.018***	480.536***	–0.003*
	(0.002)	(0.005)	(0.005)	(0.005)	(0.005)	(142.897)	(0.001)
Student earned more than 3 credits in Health Sciences cluster	–0.013***	0.126***	0.075***	0.051***	0.029***	468.605**	–0.005**
	(0.003)	(0.006)	(0.006)	(0.005)	(0.006)	(171.508)	(0.001)
Observations	520538	429566	429566	429566	386263	284912	284912
Adjusted R-squared	0.230	0.236	0.027	0.268	0.209	0.243	0.061

Note: Table displays coefficients and standard errors from OLS regression analyses with school fixed effects that examine the relationship between different levels of CTE credit attainment in a single pathway in the Health Sciences cluster on short-term student outcomes. * p<0.05; ** p<0.01; *** p<0.001 communicate the results of t-tests that examine whether the coefficient is different from zero. Models 1–4 adjust for differences attributed to student demographics, academic achievement, experiences with dual credit and advanced coursework, schools attended, and cohort year. Models 5–7 adjust for differences attributed to high school graduation and college enrollment. Students who earned one CTE credit or fewer in a single pathway in the Health Sciences cluster are the reference category.

Source: Authors' analysis of ERDC P20W Integrated Data System.

Table C25. The relationship between CTE attainment within a single pathway in the Health Sciences cluster and long-term student outcomes

	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	Completion of any degree or credential by 2022–23	Completion of certificate by 2022–23	Completion of associate degree by 2022–23	Completion of bachelor's degree by 2022–23	Annual earnings in 2022–23	Cumulative earnings through 2022–23	Earned a living wage in 2022–23
Student earned more than 1 and up to 2 credits in Health Sciences cluster	−0.029***	−0.008	−0.014*	−0.022**	423.149	2121.924	−0.001
	(0.008)	(0.005)	(0.007)	(0.007)	(635.083)	(1443.756)	(0.011)
Student earned more than 2 and up to 3 credits in Health Sciences cluster	−0.056***	−0.012	−0.015	−0.046***	−1055.207	280.428	−0.027
	(0.011)	(0.007)	(0.011)	(0.011)	(922.032)	(2088.808)	(0.016)
Student earned more than 3 credits in Health Sciences cluster	−0.037*	−0.014	−0.020	−0.031*	−2788.738*	−4758.251	−0.041
	(0.015)	(0.009)	(0.014)	(0.014)	(1230.057)	(2788.847)	(0.021)
Observations	57784	57784	57784	57784	43141	57024	43141
Adjusted R-squared	0.506	0.012	0.104	0.462	0.144	0.467	0.093

Note: Table displays coefficients and standard errors from OLS regression analyses with school fixed effects that examine the relationship between different levels of CTE credit attainment in a single pathway in the Health Sciences cluster on long-term student outcomes. * p<0.05; ** p<0.01; *** p<0.001 communicate the results of t-tests that examine whether the coefficient is different from zero. All models adjust for differences attributed to student demographics, academic achievement, experiences with dual credit and advanced coursework, and schools attended. Models 8–11 also for differences due to student postsecondary and labor market pathways following high school (e.g., whether a student was enrolled in postsecondary education, employed in Washington state, or both, in the years between high school and the outcome measurement). Models 12–14 adjust for differences due to high school graduation, college enrollment, and college completion. Students who earned one CTE credit or fewer in a single pathway in the Health Sciences cluster within a single pathway are the reference category.

Source: Authors' analysis of ERDC P20W Integrated Data System.

Table C26. The relationship between CTE attainment within a single pathway in the Hospitality & Tourism cluster and short-term student outcomes

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	High school graduation	**Postsecondary enrollment in the year following high school graduation**	**Postsecondary enrollment in a two-year institution in the year following high school graduation**	**Postsecondary enrollment in a four-year institution in the year following high school graduation**	**Employed in year following high school exit**	**Annual earnings in year following high school exit**	**Earned living wage**
Student earned more than 1 and up to 2 credits in Hospitality cluster	0.025***	−0.028***	0.004	−0.032***	0.012*	61.101	−0.001
	(0.002)	(0.005)	(0.005)	(0.004)	(0.005)	(142.852)	(0.001)
Student earned more than 2 and up to 3 credits in Hospitality cluster	0.019***	−0.037***	−0.023*	−0.014	0.001	−449.429	−0.004
	(0.004)	(0.010)	(0.010)	(0.009)	(0.010)	(297.874)	(0.003)
Student earned more than 3 credits in Hospitality cluster	0.012*	−0.015	−0.003	−0.011	0.010	−1163.560***	−0.009**
	(0.005)	(0.012)	(0.012)	(0.011)	(0.012)	(351.825)	(0.003)
Observations	520538	429566	429566	429566	386263	284912	284912
Adjusted R-squared	0.230	0.235	0.026	0.268	0.209	0.243	0.061

Note: Table displays coefficients and standard errors from OLS regression analyses with school fixed effects that examine the relationship between different levels of CTE credit attainment in a single pathway in the Hospitality & Tourism cluster on short-term student outcomes. * p<0.05; ** p<0.01; *** p<0.001 communicate the results of t-tests that examine whether the coefficient is different from zero. Models 1–4 adjust for differences attributed to student demographics, academic achievement, experiences with dual credit and advanced coursework, schools attended, and cohort year. Models 5–7 adjust for differences attributed to high school graduation and college enrollment. Students who earned one CTE credit or fewer in a single pathway in the Hospitality & Tourism cluster are the reference category.

Source: Authors' analysis of ERDC P20W Integrated Data System.

Table C27. The relationship between CTE attainment within a single pathway in the Hospitality & Tourism cluster and long-term student outcomes

	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	Completion of any degree or credential by 2022–23	**Completion of certificate by 2022–23**	**Completion of associate degree by 2022–23**	**Completion of bachelor's degree by 2022–23**	**Annual earnings in 2022–23**	**Cumulative earnings through 2022–23**	**Earned a living wage in 2022–23**
Student earned more than 1 and up to 2 credits in Hospitality cluster	–0.008	0.005	–0.007	0.004	–513.453	–6273.892**	0.012
	(0.013)	(0.008)	(0.012)	(0.013)	(1039.165)	(2421.276)	(0.018)
Student earned more than 2 and up to 3 credits in Hospitality cluster	0.007	0.003	0.044*	–0.015	–3879.765*	–8729.842*	–0.052
	(0.023)	(0.013)	(0.022)	(0.022)	(1832.690)	(4258.467)	(0.032)
Student earned more than 3 credits in Hospitality cluster	–0.038	–0.003	0.009	–0.031	–3711.963	–2.09e+04***	–0.057
	(0.031)	(0.018)	(0.029)	(0.030)	(2490.865)	(5836.889)	(0.043)
Observations	57784	57784	57784	57784	43141	57024	43141
Adjusted R-squared	0.506	0.012	0.104	0.461	0.144	0.467	0.093

Note: Table displays coefficients and standard errors from OLS regression analyses with school fixed effects that examine the relationship between different levels of CTE credit attainment in a single pathway in the Hospitality & Tourism cluster on long-term student outcomes. * p<0.05; ** p<0.01; *** p<0.001 communicate the results of t-tests that examine whether the coefficient is different from zero. All models adjust for differences attributed to student demographics, academic achievement, experiences with dual credit and advanced coursework, and schools attended. Models 8–11 also for differences due to student postsecondary and labor market pathways following high school (e.g., whether a student was enrolled in postsecondary education, employed in Washington state, or both, in the years between high school and the outcome measurement). Models 12–14 adjust for differences due to high school graduation, college enrollment, and college completion. Students who earned one CTE credit or fewer in a single pathway in the Hospitality & Tourism cluster within a single pathway are the reference category.

Source: Authors' analysis of ERDC P20W Integrated Data System.

Table C28. The relationship between CTE attainment within a single pathway in the Human Services cluster and short-term student outcomes

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	High school graduation	Postsecondary enrollment in the year following high school graduation	Postsecondary enrollment in a two-year institution in the year following high school graduation	Postsecondary enrollment in a four-year institution in the year following high school graduation	Employed in year following high school exit	Annual earnings in year following high school exit	Earned living wage
Student earned more than 1 and up to 2 credits in Human Services cluster	0.017***	–0.008	–0.013*	0.006	0.009	–289.900	–0.002
	(0.002)	(0.005)	(0.005)	(0.005)	(0.005)	(155.740)	(0.001)
Student earned more than 2 and up to 3 credits in Human Services cluster	0.017***	–0.040***	–0.039***	0.000	0.001	–888.312**	–0.002
	(0.004)	(0.010)	(0.010)	(0.009)	(0.010)	(278.162)	(0.002)
Student earned more than 3 credits in Human Services cluster	0.008	–0.066***	–0.035**	–0.028**	–0.014	–2541.859***	–0.008**
	(0.005)	(0.012)	(0.012)	(0.011)	(0.012)	(339.704)	(0.003)
Observations	520538	429566	429566	429566	386263	284912	284912
Adjusted R-squared	0.229	0.235	0.026	0.268	0.209	0.244	0.061

Note: Table displays coefficients and standard errors from OLS regression analyses with school fixed effects that examine the relationship between different levels of CTE credit attainment in a single pathway in the Human Services cluster on short-term student outcomes. * p<0.05; ** p<0.01; *** p<0.001 communicate the results of t-tests that examine whether the coefficient is different from zero. Models 1–4 adjust for differences attributed to student demographics, academic achievement, experiences with dual credit and advanced coursework, schools attended, and cohort year. Models 5–7 adjust for differences attributed to high school graduation and college enrollment. Students who earned one CTE credit or fewer in a single pathway in the Human Services cluster are the reference category.

Source: Authors' analysis of ERDC P20W Integrated Data System.

Table C29. The relationship between CTE attainment within a single pathway in the Human Services cluster and long-term student outcomes

	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	Completion of any degree or credential by 2022–23	**Completion of certificate by 2022–23**	**Completion of associate degree by 2022–23**	**Completion of bachelor's degree by 2022–23**	**Annual earnings in 2022–23**	**Cumulative earnings through 2022–23**	**Earned a living wage in 2022–23**
Student earned more than 1 and up to 2 credits in Human Services cluster	–0.005	–0.001	–0.017	–0.002	–482.989	–1921.169	–0.005
	(0.012)	(0.007)	(0.011)	(0.011)	(981.613)	(2236.852)	(0.017)
Student earned more than 2 and up to 3 credits in Human Services cluster	–0.000	0.027*	–0.020	–0.017	–3819.252*	–1.11e+04**	–0.038
	(0.021)	(0.012)	(0.020)	(0.020)	(1727.460)	(3990.716)	(0.030)
Student earned more than 3 credits in Human Services cluster	0.006	0.010	0.007	–0.014	–1509.821	–1.33e+04*	–0.025
	(0.028)	(0.016)	(0.026)	(0.027)	(2449.551)	(5260.363)	(0.042)
Observations	57784	57784	57784	57784	43141	57024	43141
Adjusted R-squared	0.506	0.012	0.104	0.461	0.144	0.467	0.093

Note: Table displays coefficients and standard errors from OLS regression analyses with school fixed effects that examine the relationship between different levels of CTE credit attainment in a single pathway in the Human Services cluster on long-term student outcomes. * p<0.05; ** p<0.01; *** p<0.001 communicate the results of t-tests that examine whether the coefficient is different from zero. All models adjust for differences attributed to student demographics, academic achievement, experiences with dual credit and advanced coursework, and schools attended. Models 8–11 also for differences due to student postsecondary and labor market pathways following high school (e.g., whether a student was enrolled in postsecondary education, employed in Washington state, or both, in the years between high school and the outcome measurement). Models 12–14 adjust for differences due to high school graduation, college enrollment, and college completion. Students who earned one CTE credit or fewer in a single pathway in the Human Services cluster within a single pathway are the reference category.

Source: Authors' analysis of ERDC P20W Integrated Data System.

Table C30. The relationship between CTE attainment within a single pathway in the Information Technology cluster and short-term student outcomes

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	High school graduation	Postsecondary enrollment in the year following high school graduation	Postsecondary enrollment in a two-year institution in the year following high school graduation	Postsecondary enrollment in a four-year institution in the year following high school graduation	Employed in year following high school exit	Annual earnings in year following high school exit	Earned living wage
Student earned more than 1 and up to 2 credits in Information Technology cluster	0.011***	−0.000	0.011***	−0.011***	−0.010**	−268.237**	0.001
	(0.001)	(0.003)	(0.003)	(0.003)	(0.003)	(97.915)	(0.001)
Student earned more than 2 and up to 3 credits in Information Technology cluster	0.003	0.018**	0.020**	−0.003	−0.011	−409.616*	−0.001
	(0.003)	(0.006)	(0.007)	(0.006)	(0.007)	(208.528)	(0.002)
Student earned more than 3 credits in Information Technology cluster	−0.007	0.052***	0.076***	−0.025**	−0.027**	−883.772**	−0.002
	(0.004)	(0.010)	(0.010)	(0.009)	(0.010)	(322.405)	(0.003)
Observations	520538	429566	429566	429566	386263	284912	284912
Adjusted R-squared	0.229	0.235	0.026	0.268	0.209	0.243	0.061

Note: Table displays coefficients and standard errors from OLS regression analyses with school fixed effects that examine the relationship between different levels of CTE credit attainment in a single pathway in the Information Technology cluster on short-term student outcomes. * p<0.05; ** p<0.01; *** p<0.001 communicate the results of t-tests that examine whether the coefficient is different from zero. Models 1–4 adjust for differences attributed to student demographics, academic achievement, experiences with dual credit and advanced coursework, schools attended, and cohort year. Models 5–7 adjust for differences attributed to high school graduation and college enrollment. Students who earned one CTE credit or fewer in a single pathway in the Information Technology cluster are the reference category.

Source: Authors' analysis of ERDC P20W Integrated Data System.

Table C31. The relationship between CTE attainment within a single pathway in the Information Technology cluster and long-term student outcomes

	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	Completion of any degree or credential by 2022–23	**Completion of certificate by 2022–23**	**Completion of associate degree by 2022–23**	**Completion of bachelor's degree by 2022–23**	**Annual earnings in 2022–23**	**Cumulative earnings through 2022–23**	**Earned a living wage in 2022–23**
Student earned more than 1 and up to 2 credits in Information Technology cluster	−0.008	0.016***	0.022**	−0.022**	2808.041***	5594.033***	0.025*
	(0.008)	(0.005)	(0.008)	(0.008)	(669.126)	(1525.848)	(0.012)
Student earned more than 2 and up to 3 credits in Information Technology cluster	0.012	0.016	0.018	−0.006	2760.531	4117.027	0.021
	(0.017)	(0.010)	(0.017)	(0.017)	(1449.107)	(3378.089)	(0.025)
Student earned more than 3 credits in Information Technology cluster	0.023	0.014	0.043	0.007	9639.709***	19063.400***	0.076*
	(0.026)	(0.016)	(0.025)	(0.025)	(2206.266)	(4977.539)	(0.038)
Observations	57784	57784	57784	57784	43141	57024	43141
Adjusted R-squared	0.506	0.012	0.104	0.461	0.145	0.467	0.093

Note: Table displays coefficients and standard errors from OLS regression analyses with school fixed effects that examine the relationship between different levels of CTE credit attainment in a single pathway in the Information Technology cluster on long-term student outcomes. * p<0.05; ** p<0.01; *** p<0.001 communicate the results of t-tests that examine whether the coefficient is different from zero. All models adjust for differences attributed to student demographics, academic achievement, experiences with dual credit and advanced coursework, and schools attended. Models 8–11 also for differences due to student postsecondary and labor market pathways following high school (e.g., whether a student was enrolled in postsecondary education, employed in Washington state, or both, in the years between high school and the outcome measurement). Models 12–14 adjust for differences due to high school graduation, college enrollment, and college completion. Students who earned one CTE credit or fewer in a single pathway in the Information Technology cluster within a single pathway are the reference category.

Source: Authors' analysis of ERDC P20W Integrated Data System.

Table C32. The relationship between CTE attainment within a single pathway in the Law, Public Safety, Corrections & Security cluster and short-term student outcomes

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	High school graduation	Postsecondary enrollment in the year following high school graduation	Postsecondary enrollment in a two-year institution in the year following high school graduation	Postsecondary enrollment in a four-year institution in the year following high school graduation	Employed in year following high school exit	Annual earnings in year following high school exit	Earned living wage
Student earned more than 1 and up to 2 credits in Law, Public Safety, Corrections & Security	0.008*	0.013	0.019*	–0.005	–0.004	–524.234*	–0.004*
	–0.003	(0.007)	(0.008)	(0.007)	(0.007)	(0.002)	(0.002)
Student earned more than 2 and up to 3 credits in Law, Public Safety, Corrections & Security	0.009*	0.014	0.003	0.016	–0.015	–520.817*	–0.002
	–0.004	(0.009)	(0.009)	(0.008)	(0.009)	(0.002)	(0.002)
Student earned more than 3 credits in Law, Public Safety, Corrections & Security	0.010*	0.011	0.007	0.005	–0.038***	–943.842**	–0.011***
	–0.005	(0.010)	(0.011)	(0.010)	(0.011)	(0.003)	(0.003)
Observations	520538	429566	429566	429566	386263	284912	284912
Adjusted R-squared	0.229	0.235	0.026	0.268	0.209	0.243	0.061

Note: Table displays coefficients and standard errors from OLS regression analyses with school fixed effects that examine the relationship between different levels of CTE credit attainment in a single pathway in the Law, Public Safety, Corrections & Security cluster on short-term student outcomes. * p<0.05; ** p<0.01; *** p<0.001 communicate the results of t-tests that examine whether the coefficient is different from zero. Models 1–4 adjust for differences attributed to student demographics, academic achievement, experiences with dual credit and advanced coursework, schools attended, and cohort year. Models 5–7 adjust for differences attributed to high school graduation and college enrollment. Students who earned one CTE credit or fewer in a single pathway in the Law, Public Safety, Corrections & Security cluster are the reference category.

Source: Authors' analysis of ERDC P20W Integrated Data System.

Table C33. The relationship between CTE attainment within a single pathway in the Law, Public Safety, Corrections & Security cluster and long-term student outcomes

	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	Completion of any degree or credential by 2022–23	**Completion of certificate by 2022–23**	**Completion of associate degree by 2022–23**	**Completion of bachelor's degree by 2022–23**	**Annual earnings in 2022–23**	**Cumulative earnings through 2022–23**	**Earned a living wage in 2022–23**
Student earned more than 1 and up to 2 credits in Law, Public Safety, Corrections & Security	0.033 (0.018)	0.005 (0.010)	0.039* (0.017)	0.028 (0.017)	357.692 (1462.821)	213.173 (3309.084)	0.048 (0.025)
Student earned more than 2 and up to 3 credits in Law, Public Safety, Corrections & Security	0.019 (0.021)	0.001 (0.012)	–0.010 (0.020)	0.015 (0.020)	2310.115 (1664.286)	7045.590 (3871.597)	0.044 (0.029)
Student earned more than 3 credits in Law, Public Safety, Corrections & Security	0.016 (0.027)	–0.008 (0.016)	–0.004 (0.026)	–0.024 (0.026)	4546.245* (2310.818)	8918.693 (5266.512)	0.036 (0.040)
Observations	57784	57784	57784	57784	43141	57024	43141
Adjusted R-squared	0.506	0.012	0.104	0.461	0.144	0.467	0.093

Note: Table displays coefficients and standard errors from OLS regression analyses with school fixed effects that examine the relationship between different levels of CTE credit attainment in a single pathway in the Law, Public Safety, Corrections & Security cluster on long-term student outcomes. * p<0.05; ** p<0.01; *** p<0.001 communicate the results of t-tests that examine whether the coefficient is different from zero. All models adjust for differences attributed to student demographics, academic achievement, experiences with dual credit and advanced coursework, and schools attended. Models 8–11 also for differences due to student postsecondary and labor market pathways following high school (e.g., whether a student was enrolled in postsecondary education, employed in Washington state, or both, in the years between high school and the outcome measurement). Models 12–14 adjust for differences due to high school graduation, college enrollment, and college completion. Students who earned one CTE credit or fewer in a single pathway in the Law, Public Safety, Corrections & Security cluster within a single pathway are the reference category.

Source: Authors' analysis of ERDC P20W Integrated Data System.

Table C34. The relationship between CTE attainment within a single pathway in the Manufacturing cluster and short-term student outcomes

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	High school graduation	Postsecondary enrollment in the year following high school graduation	Postsecondary enrollment in a two-year institution in the year following high school graduation	Postsecondary enrollment in a four-year institution in the year following high school graduation	Employed in year following high school exit	Annual earnings in year following high school exit	Earned living wage
Student earned more than 1 and up to 2 credits in Manufacturing cluster	0.030***	−0.060***	−0.025***	−0.035***	0.006	1874.891***	0.012***
	(0.002)	(0.004)	(0.005)	(0.004)	(0.004)	(131.351)	(0.001)
Student earned more than 2 and up to 3 credits in Manufacturing cluster	0.029***	−0.081***	−0.037***	−0.045***	0.010	3913.228***	0.029***
	(0.003)	(0.007)	(0.007)	(0.006)	(0.007)	(200.072)	(0.002)
Student earned more than 3 credits in Manufacturing cluster	0.033***	−0.104***	−0.039***	−0.063***	0.017*	4719.890***	0.026***
	(0.004)	(0.008)	(0.008)	(0.008)	(0.008)	(241.231)	(0.002)
Observations	520538	429566	429566	429566	386263	284912	284912
Adjusted R-squared	0.230	0.236	0.026	0.268	0.209	0.246	0.062

Note: Table displays coefficients and standard errors from OLS regression analyses with school fixed effects that examine the relationship between different levels of CTE credit attainment in a single pathway in the Manufacturing cluster on short-term student outcomes. * p<0.05; ** p<0.01; *** p<0.001 communicate the results of t-tests that examine whether the coefficient is different from zero. Models 1–4 adjust for differences attributed to student demographics, academic achievement, experiences with dual credit and advanced coursework, schools attended, and cohort year. Models 5–7 adjust for differences attributed to high school graduation and college enrollment. Students who earned one CTE credit or fewer in a single pathway in the Manufacturing cluster are the reference category.

Source: Authors' analysis of ERDC P20W Integrated Data System.

Table C35. The relationship between CTE attainment within a single pathway in the Manufacturing cluster and long-term student outcomes

	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	Completion of any degree or credential by 2022–23	Completion of certificate by 2022–23	Completion of associate degree by 2022–23	Completion of bachelor's degree by 2022–23	Annual earnings in 2022–23	Cumulative earnings through 2022–23	Earned a living wage in 2022–23
Student earned more than 1 and up to 2 credits in Manufacturing cluster	0.034**	0.021***	0.015	0.006	3998.069***	15641.450***	0.071***
	(0.011)	(0.006)	(0.010)	(0.010)	(873.159)	(1991.640)	(0.015)
Student earned more than 2 and up to 3 credits in Manufacturing cluster	0.025	0.056***	–0.012	–0.010	10516.989***	31819.010***	0.203***
	(0.016)	(0.009)	(0.015)	(0.015)	(1294.178)	(2941.731)	(0.022)
Student earned more than 3 credits in Manufacturing cluster	0.036	0.063***	0.022	–0.027	8214.836***	31037.737***	0.185***
	(0.019)	(0.012)	(0.019)	(0.019)	(1629.245)	(3688.977)	(0.028)
Observations	57784	57784	57784	57784	43141	57024	43141
Adjusted R-squared	0.506	0.013	0.104	0.461	0.146	0.469	0.095

Note: Table displays coefficients and standard errors from OLS regression analyses with school fixed effects that examine the relationship between different levels of CTE credit attainment in a single pathway in the Manufacturing cluster on long-term student outcomes. * p<0.05; ** p<0.01; *** p<0.001 communicate the results of t-tests that examine whether the coefficient is different from zero. All models adjust for differences attributed to student demographics, academic achievement, experiences with dual credit and advanced coursework, and schools attended. Models 8–11 also for differences due to student postsecondary and labor market pathways following high school (e.g., whether a student was enrolled in postsecondary education, employed in Washington state, or both, in the years between high school and the outcome measurement). Models 12–14 adjust for differences due to high school graduation, college enrollment, and college completion. Students who earned one CTE credit or fewer in a single pathway in the Manufacturing cluster within a single pathway are the reference category.

Source: Authors' analysis of ERDC P20W Integrated Data System.

Table C36. The relationship between CTE attainment within a single pathway in the Marketing cluster and short-term student outcomes

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	High school graduation	Postsecondary enrollment in the year following high school graduation	Postsecondary enrollment in a two-year institution in the year following high school graduation	Postsecondary enrollment in a four-year institution in the year following high school graduation	Employed in year following high school exit	Annual earnings in year following high school exit	Earned living wage
Student earned more than 1 and up to 2 credits in Marketing cluster	0.007***	0.027***	−0.004	0.031***	0.006	−639.535***	−0.001
	(0.002)	(0.004)	(0.005)	(0.004)	(0.005)	(133.519)	(0.001)
Student earned more than 2 and up to 3 credits in Marketing cluster	−0.006	0.051***	−0.030**	0.081***	0.019	−1288.226***	−0.003
	(0.004)	(0.010)	(0.010)	(0.010)	(0.010)	(306.166)	(0.003)
Student earned more than 3 credits in Marketing cluster	−0.038***	0.050*	−0.022	0.073**	0.051*	−1495.240*	−0.002
	(0.011)	(0.025)	(0.025)	(0.023)	(0.024)	(735.208)	(0.006)
Observations	520538	429566	429566	429566	386263	284912	284912
Adjusted R-squared	0.229	0.235	0.026	0.268	0.209	0.243	0.061

Note: Table displays coefficients and standard errors from OLS regression analyses with school fixed effects that examine the relationship between different levels of CTE credit attainment in a single pathway in the Marketing cluster on short-term student outcomes. * p<0.05; ** p<0.01; *** p<0.001 communicate the results of t-tests that examine whether the coefficient is different from zero. Models 1–4 adjust for differences attributed to student demographics, academic achievement, experiences with dual credit and advanced coursework, schools attended, and cohort year. Models 5–7 adjust for differences attributed to high school graduation and college enrollment. Students who earned one CTE credit or fewer in a single pathway in the Marketing cluster are the reference category.
Source: Authors' analysis of ERDC P20W Integrated Data System.

Table C37. The relationship between CTE attainment within a single pathway in the Marketing cluster and long-term student outcomes

	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	Completion of any degree or credential by 2022–23	Completion of certificate by 2022–23	Completion of associate degree by 2022–23	Completion of bachelor's degree by 2022–23	Annual earnings in 2022–23	Cumulative earnings through 2022–23	Earned a living wage in 2022–23
Student earned more than 1 and up to 2 credits in Marketing cluster	0.004	–0.003	–0.011	0.002	1844.284*	1432.484	0.035*
	(0.010)	(0.006)	(0.010)	(0.010)	(901.438)	(1995.210)	(0.015)
Student earned more than 2 and up to 3 credits in Marketing cluster	–0.003	–0.026	–0.020	0.043	2915.607	–2190.321	0.062
	(0.024)	(0.014)	(0.023)	(0.024)	(2082.736)	(4730.550)	(0.036)
Student earned more than 3 credits in Marketing cluster	0.008	–0.002	–0.045	0.014	–2939.078	–1.40e+04	–0.027
	(0.053)	(0.032)	(0.051)	(0.052)	(4883.660)	(10716.667)	(0.084)
Observations	57784	57784	57784	57784	43141	57024	43141
Adjusted R-squared	0.506	0.012	0.104	0.461	0.144	0.467	0.093

Note: Table displays coefficients and standard errors from OLS regression analyses with school fixed effects that examine the relationship between different levels of CTE credit attainment in a single pathway in the Marketing cluster on long-term student outcomes. * p<0.05; ** p<0.01; *** p<0.001 communicate the results of t-tests that examine whether the coefficient is different from zero. All models adjust for differences attributed to student demographics, academic achievement, experiences with dual credit and advanced coursework, and schools attended. Models 8–11 also for differences due to student postsecondary and labor market pathways following high school (e.g., whether a student was enrolled in postsecondary education, employed in Washington state, or both, in the years between high school and the outcome measurement). Models 12–14 adjust for differences due to high school graduation, college enrollment, and college completion. Students who earned one CTE credit or fewer in a single pathway in the Marketing cluster within a single pathway are the reference category.

Source: Authors' analysis of ERDC P20W Integrated Data System.

Table C38. The relationship between CTE attainment within a single pathway in the Science, Technology, Engineering and Mathematics cluster and short-term student outcomes

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	High school graduation	**Postsecondary enrollment in the year following high school graduation**	**Postsecondary enrollment in a two-year institution in the year following high school graduation**	**Postsecondary enrollment in a four-year institution in the year following high school graduation**	**Employed in year following high school exit**	**Annual earnings in year following high school exit**	**Earned living wage**
Student earned more than 1 and up to 2 credits in STEM cluster	0.022***	−0.013***	−0.001	−0.012***	0.001	358.558**	−0.001
	(0.002)	(0.004)	(0.004)	(0.003)	(0.004)	(110.852)	(0.001)
Student earned more than 2 and up to 3 credits in STEM cluster	0.026***	0.002	0.006	−0.003	−0.006	−92.863	−0.001
	(0.003)	(0.008)	(0.008)	(0.007)	(0.008)	(235.184)	(0.002)
Student earned more than 3 credits in STEM cluster	0.010	0.021	−0.032*	0.056***	−0.016	42.245	−0.006
	(0.006)	(0.012)	(0.013)	(0.012)	(0.013)	(399.098)	(0.003)
Observations	520538	429566	429566	429566	386263	284912	284912
Adjusted R-squared	0.230	0.235	0.026	0.268	0.209	0.243	0.061

Note: Table displays coefficients and standard errors from OLS regression analyses with school fixed effects that examine the relationship between different levels of CTE credit attainment in a single pathway in the Science, Technology, Engineering and Mathematics cluster on short-term student outcomes. * p<0.05; ** p<0.01; *** p<0.001 communicate the results of t-tests that examine whether the coefficient is different from zero. Models 1–4 adjust for differences attributed to student demographics, academic achievement, experiences with dual credit and advanced coursework, schools attended, and cohort year. Models 5–7 adjust for differences attributed to high school graduation and college enrollment. Students who earned one CTE credit or fewer in a single pathway in the Science, Technology, Engineering and Mathematics cluster are the reference category.

Source: Authors' analysis of ERDC P20W Integrated Data System.

Table C39. The relationship between CTE attainment within a single pathway in the Science, Technology, Engineering and Mathematics cluster and long-term student outcomes

	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	Completion of any degree or credential by 2022–23	**Completion of certificate by 2022–23**	**Completion of associate degree by 2022–23**	**Completion of bachelor's degree by 2022–23**	**Annual earnings in 2022–23**	**Cumulative earnings through 2022–23**	**Earned a living wage in 2022–23**
Student earned more than 1 and up to 2 credits in STEM cluster	−0.005	0.006	−0.007	−0.010	1307.459	4213.908**	0.027*
	(0.008)	(0.005)	(0.008)	(0.008)	(683.293)	(1570.060)	(0.012)
Student earned more than 2 and up to 3 credits in STEM cluster	−0.009	0.032**	−0.017	−0.042*	3161.369*	3714.633	0.041
	(0.018)	(0.010)	(0.017)	(0.017)	(1541.938)	(3405.182)	(0.027)
Student earned more than 3 credits in STEM cluster	−0.001	0.004	−0.027	−0.012	4944.307*	4446.414	0.098*
	(0.026)	(0.015)	(0.025)	(0.025)	(2281.534)	(4996.181)	(0.039)
Observations	57784	57784	57784	57784	43141	57024	43141
Adjusted R-squared	0.506	0.012	0.104	0.461	0.144	0.467	0.093

Note: Table displays coefficients and standard errors from OLS regression analyses with school fixed effects that examine the relationship between different levels of CTE credit attainment in a single pathway in the Science, Technology, Engineering and Mathematics cluster on long-term student outcomes. * p<0.05; ** p<0.01; *** p<0.001 communicate the results of t-tests that examine whether the coefficient is different from zero. All models adjust for differences attributed to student demographics, academic achievement, experiences with dual credit and advanced coursework, and schools attended. Models 8–11 also for differences due to student postsecondary and labor market pathways following high school (e.g., whether a student was enrolled in postsecondary education, employed in Washington state, or both, in the years between high school and the outcome measurement). Models 12–14 adjust for differences due to high school graduation, college enrollment, and college completion. Students who earned one CTE credit or fewer in a single pathway in the Science, Technology, Engineering and Mathematics cluster within a single pathway are the reference category.

Source: Authors' analysis of ERDC P20W Integrated Data System.

Table C40. The relationship between CTE attainment within a single pathway in the transportation, distribution, and logistics cluster and short-term student outcomes

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	High school graduation	Postsecondary enrollment in the year following high school graduation	Postsecondary enrollment in a two-year institution in the year following high school graduation	Postsecondary enrollment in a four-year institution in the year following high school graduation	Employed in year following high school exit	Annual earnings in year following high school exit	Earned living wage
Student earned more than 1 and up to 2 credits in Transportation cluster	0.017***	−0.060***	−0.036***	−0.024***	0.005	2281.922***	0.009***
	(0.003)	(0.007)	(0.007)	(0.006)	(0.007)	(191.929)	(0.002)
Student earned more than 2 and up to 3 credits in Transportation cluster	0.026***	−0.074***	−0.059***	−0.015*	−0.003	2568.357***	0.012***
	(0.003)	(0.008)	(0.008)	(0.007)	(0.008)	(227.396)	(0.002)
Student earned more than 3 credits in Transportation cluster	0.021***	−0.057***	−0.034***	−0.022***	0.000	3390.993***	0.012***
	(0.003)	(0.007)	(0.007)	(0.007)	(0.007)	(203.623)	(0.002)
Observations	520538	429566	429566	429566	386263	284912	284912
Adjusted R-squared	0.229	0.235	0.026	0.268	0.209	0.245	0.061

Note: Table displays coefficients and standard errors from OLS regression analyses with school fixed effects that examine the relationship between different levels of CTE credit attainment in a single pathway in the transportation, distribution, and logistics cluster on short-term student outcomes. * p<0.05; ** p<0.01; *** p<0.001 communicate the results of t-tests that examine whether the coefficient is different from zero. Models 1–4 adjust for differences attributed to student demographics, academic achievement, experiences with dual credit and advanced coursework, schools attended, and cohort year. Models 5–7 adjust for differences attributed to high school graduation and college enrollment. Students who earned one CTE credit or fewer in a single pathway in the transportation, distribution, and logistics cluster are the reference category.

Source: Authors' analysis of ERDC P20W Integrated Data System.

Table C41. The relationship between CTE attainment within a single pathway in the transportation, distribution, and logistics cluster and long-term student outcomes

	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	Completion of any degree or credential by 2022–23	**Completion of certificate by 2022–23**	**Completion of associate degree by 2022–23**	**Completion of bachelor's degree by 2022–23**	**Annual earnings in 2022–23**	**Cumulative earnings through 2022–23**	**Earned a living wage in 2022–23**
Student earned more than 1 and up to 2 credits in Transportation cluster	0.040**	0.038***	–0.002	0.024	5715.270***	23458.272***	0.110***
	(0.015)	(0.009)	(0.015)	(0.015)	(1239.951)	(2834.861)	(0.021)
Student earned more than 2 and up to 3 credits in Transportation cluster	0.080***	0.060***	0.005	0.028	8152.776***	28355.085***	0.135***
	(0.018)	(0.011)	(0.017)	(0.018)	(1462.324)	(3382.962)	(0.025)
Student earned more than 3 credits in Transportation cluster	0.062***	0.041***	0.020	0.028	9737.012***	42837.907***	0.174***
	(0.017)	(0.010)	(0.016)	(0.017)	(1395.479)	(3223.438)	(0.024)
Observations	57784	57784	57784	57784	43141	57024	43141
Adjusted R-squared	0.506	0.013	0.104	0.461	0.146	0.470	0.095

Note: Table displays coefficients and standard errors from OLS regression analyses with school fixed effects that examine the relationship between different levels of CTE credit attainment in a single pathway in the transportation, distribution, and logistics cluster on long-term student outcomes. * p<0.05; ** p<0.01; *** p<0.001 communicate the results of t-tests that examine whether the coefficient is different from zero. All models adjust for differences attributed to student demographics, academic achievement, experiences with dual credit and advanced coursework, and schools attended. Models 8–11 also for differences due to student postsecondary and labor market pathways following high school (e.g., whether a student was enrolled in postsecondary education, employed in Washington state, or both, in the years between high school and the outcome measurement). Models 12–14 adjust for differences due to high school graduation, college enrollment, and college completion. Students who earned one CTE credit or fewer in a single pathway in the transportation, distribution, and logistics cluster within a single pathway are the reference category.

Source: Authors' analysis of ERDC P20W Integrated Data System.