

CAREER, TECHNICAL, AND WORKFORCE EDUCATION:

The State of the Evidence

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supported by Arnold Ventures

Executive Summary

Career and technical education (CTE) encompasses a wide range of programs and settings, from elective vocational courses in traditional high schools to structured career academies, postsecondary certificates, registered apprenticeships, and employer-driven sectoral training programs. The policy and research community has increasingly recognized CTE as a lever with potential to improve economic opportunity, reduce dropout rates, and meet employer demand for skilled workers. This report synthesizes the current state of quantitative and causal evidence on the effectiveness of CTE across secondary, postsecondary, and workforce training contexts, with a primary emphasis on the United States.¹ It is intended to inform policymakers seeking to expand or improve CTE investments and funders of research seeking to understand where additional evidence is most needed. For a broader overview of the history, theory, and evidence on secondary CTE, readers are directed to Bonilla, Dougherty, and Ecton (2025).

A central conclusion of the review is that CTE should not be treated as a single intervention. The strength of the evidence, likely mechanisms, costs, and scalability differ substantially across secondary CTE, postsecondary CTE, sectoral training, apprenticeships, and other work-based learning models. The evidence therefore argues against both blanket enthusiasm and blanket skepticism. Some models have credible evidence of improving economic mobility and could justify continued investment, while others are promising but require stronger causal evidence before large-scale expansion. Across settings, the most promising models tend to combine occupationally specific skill development, strong employer connections, clear pathways into further education or employment, and sufficient supports to help students complete their training and credentials.

Future investment and research should focus on quality differentiation and enhancement, not expansion alone. Key open questions include which models and occupational pathways generate durable earnings gains, which program components are essential, how costs compare across models, how impacts differ by student population and field, and how policy incentives can encourage institutions and employers to provide high-quality pathways. The highest-value research opportunities include long-term follow-up of secondary CTE participants, stronger causal evidence on postsecondary CTE credentials and apprenticeships, cost-benefit analyses across models, and studies of how to scale effective programs or program components with fidelity.

1. Note that in this review, we consider a wider range of programs under the broad moniker of CTE. Programs of study in secondary and postsecondary school are considered alongside sectoral training programs, apprenticeships, and other work-based learning models. This is a more expansive definition than is often in use. The rationale in this context is to provide a comprehensive review of evidence for programs intended to provide initial training that aligns with the potential for direct entry into an occupation or to retrain individuals to step into a new profession. Some may read this as a tacit implication that CTE in schools should then be thought of primarily as a tool for workforce training. However, we would argue that this is an unnecessary oversimplification; rather, combining these types of training in a single review is simply meant to acknowledge that scholars and policymakers interested in the overlaps between education and workforce development would likely benefit from a single review that puts these otherwise separate literatures in more direct conversation.

The evidence, at present, can support the following conclusions:

- **Intensive secondary CTE models improve completion and engagement.** Credible causal evidence supports positive impacts for structured, career-aligned programs in secondary schools, particularly career academies and technical high schools. Students who attend these programs show improved high school graduation rates and attendance. The strongest evidence comes from quasi-experimental designs: regression discontinuity studies of CTE-dedicated high schools in Massachusetts and Connecticut found approximately 10 percentage point improvements in graduation rates, and a lottery study of selective career academies in North Carolina found an 8% increase in graduation rates for male students (Brunner et al., 2023; Dougherty, 2018; Hemelt et al., 2019).
- **Workforce outcomes from multi-course, structured secondary CTE are positive in the short to medium term, particularly for males.** Evidence consistently shows employment and earnings benefits for students in structured CTE pathways, especially when programs involve multi-course sequences in a specific occupation and are accompanied by aligned work-based learning opportunities. Gains are most pronounced among males in skilled trades and manufacturing and may moderate over time (Bozick & Dalton, 2013; Brunner et al., 2023; Dougherty, 2018).
- **Sectoral training programs have strong causal evidence of positive impacts, but are costly and may be difficult to scale with fidelity.** Several well-designed randomized controlled trials (RCTs) demonstrate significant and durable earnings gains for low-income adults, with programs like Year Up, Project QUEST, and WorkAdvance producing some of the strongest causal evidence in the field (Fein & Dastrup, 2022; Hendra et al., 2016; Katz et al., 2022; Roder & Elliott, 2024; Schaberg, 2017; Schaberg & Greenberg, 2020). Because successful models often combine occupational training, employer partnerships, placement support, and case management, questions remain about their cost, replicability, and whether similar effects can be sustained when models are expanded or adapted. Less intensive programs have been found to produce smaller impacts, but are also less expensive to provide.
- **Other postsecondary CTE programs show promise, but evidence is less definitive.** The evidence base on postsecondary CTE is growing but remains less causally rigorous than that for secondary CTE. Most existing research on community colleges does not disaggregate CTE students from other enrollees, limiting CTE-specific conclusions. Existing evidence nonetheless suggests strong short-term economic returns in health care and technical fields.
- **Apprenticeships show consistent wage benefits, but evidence is largely descriptive and lacks domestic causal evidence.** Consistent observational associations link registered apprenticeships with higher wages and employment, but rigorous causal evidence remains limited in the U.S. context. International evidence is broader but mixed and must be interpreted cautiously given differences in institutional and economic context.

- **Differential impacts by gender, race/ethnicity, income, disability status academic preparation, and field/career cluster are consistent features of the evidence base.** Males, particularly those at or below median academic performance, show especially large benefits from skilled trades and manufacturing programs. Students with disabilities, especially males, see high school completion and labor market benefits in the most intensive CTE models (Brunner et al., 2026). The evidence for females and racially minoritized students is less consistent and warrants additional research attention. Evidence also suggests that occupational selection and sorting by gender, and some variation in program access by race and socioeconomic status, may explain differences in outcomes (Brunner et al., 2026; Carruthers et al., 2024; Carruthers et al., 2026).
- **Many research questions remain unanswered.** Key open questions include the long-term earnings trajectory of secondary CTE participants, the causal impact of postsecondary CTE credentials on labor market outcomes, better understanding the mechanisms that explain program effectiveness and components that drive it, and how to best structure programs for populations historically underserved by CTE. In particular, the role of work-based learning and internships and what form they take to produce positive outcomes is a critical area of need.

Framing the Evidence:

CTE as an Economic Mobility Strategy

CTE has continued to grow in prominence as a major policy strategy for improving economic mobility, responding to both the concerns about the limits of the traditional “college for all” model and to employer demand for workers with specific skills. Yet, “career and technical education” is not a single intervention. It includes elective courses in comprehensive high schools, intensive career academies and technical high schools, dual enrollment and early college pathways, postsecondary certifications and applied degrees, registered apprenticeships, sectoral training programs, employer-connected workforce models, and other work-based learning experiences. These approaches differ substantially in their intensity, target population, costs, institutional settings, and direct connection to the labor market. As a result, the central question is not whether CTE works in general, but *which models improve economic mobility, for whom, through what mechanisms, and under what policy and implementation conditions.*

This review synthesizes evidence on CTE and training with particular attention to outcomes that matter for economic mobility: employment, earnings, wage progression, credential completion, professional advancement, and longer-run educational and labor-market trajectories. Because many CTE models are expanding faster than the evidence base supporting them, the review distinguishes between models with strong causal evidence, models with promising but primarily descriptive evidence, and models where policy enthusiasm exceeds what current research can support. This distinction is especially important for funders and policymakers deciding whether to scale existing models, modify program design, or invest in new causal evidence.

The review prioritizes randomized experiments and quasi-experimental studies where available, while also drawing on high-quality descriptive and correlational evidence in areas where causal evidence remains sparse. This approach reflects the unevenness of the field: sectoral training programs have several well-designed randomized evaluations and secondary CTE has a growing quasi-experimental evidence base; conversely, postsecondary CTE and apprenticeships show promise but lack causal evidence in the United States. The goal is therefore both summative and diagnostic: to identify what the field knows now and where additional evidence would most improve policy and investment decisions.

BACKGROUND ON CTE AND TRAINING

The renewed emphasis on CTE reflects a changing labor market in which bachelor’s degrees continue to carry the highest average returns, but low completion rates and debt burdens raise questions about whether four-year college enrollment should be treated as the default pathway for all students. Since the 1970s, wage inequality has grown substantially in the United States, driven in part by skill-biased

technological change and the offshoring of manufacturing employment (Autor, 2014). At the same time, federal labor-market projections point to continued demand in several fields commonly served by CTE, including health care, information technology, construction, and installation, maintenance, and repair occupations (Bureau of Labor Statistics, 2025). The Bureau of Labor Statistics projects employment in health care occupations, computer and information technology occupations, construction and extraction occupations, and installation, maintenance, and repair occupations to grow as fast as or faster than the average for all occupations from 2024 to 2034, with substantial annual openings in each field. CTE sits at the intersection of these trends, offering pathways that, under the right conditions, can provide viable economic opportunities for students, whether as ends themselves or as tools to improve economic stability while students pursue additional training and education. Also relevant is that the occupations associated with these industries are also unlikely to be disrupted by artificial intelligence (AI) over this same time horizon.

Improvements in state administrative data systems and greater emphasis on CTE in policy and practice have yielded a growing body of causal evidence to complement the descriptive work of the late 20th century. Studies of vocational education from the 1960s through the 1990s focused on the ability of technical education to reveal or reduce socioeconomic inequality by providing students with training and skills in high school that they could directly take to the workplace. This was especially relevant at the time when fewer jobs required postsecondary education and training. In contrast, more recent studies are set in the context of an economy in which entry-level work increasingly requires either advanced technical skills gained in high school or some postsecondary training. At the same time, high schools and community colleges have expanded their program offerings and brought them into closer alignment with contemporary economic needs, including an expansion of health care, information technology (IT), and advanced manufacturing educational programs.

A critical conceptual shift in U.S. CTE has been the movement away from “tracking,” which historically involved assigning students to vocational or academic pathways based on perceived ability or behavior, toward models in which students choose CTE as a complement to academic preparation. Dougherty and Lombardi (2016) and Ecton and Wright-Kim (2026) discuss this evolution in greater depth. Perkins V reinforced the shift by emphasizing programs of study that integrate academic and technical content, connect to postsecondary pathways, and align with regional labor-market needs. Meanwhile, the growing diversity of programs under the CTE umbrella has made broad generalizations about CTE increasingly difficult.

Student choice also matters for interpreting the evidence. Many of the strongest causal studies rely on oversubscribed admissions processes or randomized evaluations among people who first chose to apply. Their estimates therefore capture effects for individuals who had already expressed interest in the program—often applicants near an admissions threshold—rather than the effects of assigning uninterested students to a vocational pathway. Positive findings from these studies should not be interpreted as support for compulsory tracking. Consistent with this distinction, Silliman and Virtanen (2022) find especially large returns among applicants with stronger stated preferences for vocational education.

A second important conceptual point concerns the methods used to evaluate CTE programs. The earliest studies were largely descriptive and correlational, comparing outcomes for CTE participants and non-participants, almost always measured as how many courses were taken, without adequately accounting for the selection processes that dictate who enrolled. Because students who choose, or are directed to, CTE may differ systematically from those who do not (whether in academic preparation, family background, career interests, and geographic location) simple comparisons can be biased and misleading. More recent work has benefited from linked administrative data and quasi-experimental designs that exploit lotteries, geographic discontinuities, policy rollouts, and admission thresholds. This report synthesizes the existing evidence on the efficacy and impact of CTE-related training, prioritizing findings from studies with strong causal identification where available, while also drawing on the best available descriptive and correlational evidence for questions where causal evidence is sparse.

The remainder of the report applies this evidence framework across secondary CTE, postsecondary CTE, sectoral training, apprenticeships, and other work-based learning models, with particular attention to labor-market outcomes, heterogeneity in impacts, program costs, and gaps where additional causal evidence is most needed.

SECONDARY CTE

The evidence on the efficacy and impact of secondary CTE has grown considerably since the start of the 21st century, driven partly by the growth in the use of methods that support causal inference, the expansion of administrative data capacities, and an increased awareness of the limitations of prior literature (Lindsay et al., 2024). There is now a convincing set of estimates demonstrating the impact of CTE, though each of the studies included in this evidence has caveats that emphasize why these impacts must be contextualized. While more insights exist into how technical education and training is occurring and impacting outcomes, interpreting the evidence requires making assumptions or piecing together elements of evidence from disparate settings to build a more complete understanding of what constitutes the effect of secondary CTE.

A core challenge in synthesizing this literature is the substantial heterogeneity across programs, settings, student populations, and outcomes. CTE in a career academy embedded in an urban comprehensive high school differs substantially from CTE in a dedicated technical high school in a suburb, from a work-based learning program in a rural district, or from a dual enrollment pathway at a community college. The “treatment” in any given study may reflect anything from exposure to a themed curriculum and a cohort of peers to intensive work-based learning experiences with employer partners (or a bundle of several factors). Interpreting studies and translating findings for policy thus requires careful attention to what specific program features are being evaluated and for whom. For a comprehensive overview and methodological review of the secondary CTE evidence base, readers are directed to Ecton and Wright-Kim (2026) and Lindsay et al. (2024).

Bonilla et al. (2025) and Ecton and Wright-Kim (2026) provide comprehensive overviews of the evidence on secondary and postsecondary CTE, respectively situating CTE within the broader history and theory in education research. Among studies that looked at high school completion as an outcome, research

on CTE-dedicated high schools in Massachusetts and Connecticut found admission to these schools improved graduation rates by approximately 10 percentage points relative to applicants who were not admitted, with similar findings from an oversubscribed IT-focused career academy in Wake County, North Carolina (Brunner et al., 2023; Dougherty, 2018; Hemelt et al., 2019). Bonilla (2020), examining California’s competitive CTE grants program, similarly found that expanding CTE reduced dropout rates, with particularly pronounced effects for female students. On academic achievement, Bonilla et al. (2025) note that CTE participation does not appear to impede academic performance: students in CTE-dedicated schools performed comparably to peers on high-stakes exit exams, and one study found test scores in core subjects were approximately 0.15 standard deviations higher among students attending CTE-dedicated schools (Brunner et al., 2023; Dougherty, 2018).

The review also sheds light on important patterns of heterogeneity in CTE outcomes. Examining state administrative data from Massachusetts, Ecton and Dougherty (2023) found meaningful differences across career clusters in postsecondary enrollment as well as early earnings outcomes, with health care and IT pathways associated with higher college enrollment and manufacturing and transportation pathways linked to stronger early-career earnings. This within-state comparative evidence reinforces the point that CTE is not a monolithic category, and that program-level variation matters enormously for understanding who benefits and how. On equity, Bonilla et al. (2025) document that while racial tracking in CTE may have diminished in the aggregate over recent decades, gender-based sorting into CTE pathways remains pronounced, with women disproportionately concentrated in health care and education programs and men in skilled trades, manufacturing, transportation, and technology programs. Students with disabilities represent another population for whom CTE may provide distinctive benefits: across disability types, students who participated in CTE were more likely to complete high school on time compared to similar peers who did not (Dougherty et al., 2018). Brunner et al. (2026) demonstrated that males with disabilities who just qualified for admission and attended CTE-dedicated high schools in Connecticut saw better school completion and workforce outcomes, relative to similar males with disabilities who were not admitted. These patterns of heterogeneity underscore why the research and policy community must attend carefully to which students are being served by which programs, rather than treating impacts on average as representative of all participants.

HIGH SCHOOL COMPLETION AND ACADEMIC ENGAGEMENT

The most methodologically rigorous causal evidence on high school completion comes from quasi-experimental studies of oversubscribed career academies and technical high schools. Brunner et al. (2023), studying Connecticut’s technical high school system using a regression discontinuity (RD) design, found substantial positive effects on high school graduation, driven in particular by males. Hemelt et al. (2019), use a lottery-based random assignment design that leverages oversubscribed applicant pools for admission to career academies, found comparable effects, including an 8% increase in high school graduation rates for male students in North Carolina CTE academies. Together, these studies suggest that the strongest evidence for secondary CTE comes from intensive, structured models that provide more than isolated course exposure. This interpretation is reinforced by nationally representative correlational evidence from

Kreisman and Stange (2020), who find that students see financial benefits from taking upper-level CTE coursework, but not necessarily introductory-level coursework, suggesting that students are more likely to benefit from CTE when they take multiple courses in a pathway and gain specialized experience within a field.

One of the most consistent findings in the secondary CTE literature is the connection between CTE participation and improved rates of high school completion. A range of studies using correlational research designs suggest that more CTE coursetaking is associated with improved school completion (Gottfried & Plasman, 2018; Plank et al., 2008; Stone & Aliaga, 2005). Among this work, Gottfried & Plasman (2018) used nationally representative data found that students whose early career CTE exposure led them to aligned, advanced CTE coursework saw the largest benefits. This correlational evidence complements the stronger causal evidence noted above (Brunner et al., 2026; Dougherty, 2018; Hemelt et al., 2019). Existing and emerging evidence also suggests that quasi-random access to CTE via the addition of new programming can improve high school completion or reduce dropout, though most of these studies find that the magnitude of the impact differs by the program content or student characteristics such as gender or socioeconomic status (Bonilla, 2020; Yoon & Dougherty, 2025).

Studies that also evaluate the role of CTE in moving test score and attendance outcomes have generally shown equivalent or better outcomes on each, and suggest that CTE can improve attendance early in high school – which may help explain later attainment effects (Bozick & Dalton, 2013; Brunner et al., 2023; Dougherty, 2018; Ecton & Dougherty, 2023; Edmunds et al., 2024; Gottfried & Plasman, 2018; Hemelt et al., 2019; Kelly & Price, 2009; Plasman & Gottfried, 2020). This finding has practical significance since it suggests that improved student engagement through applied, interest-based learning may be a key driver of CTE's effects on attainment, particularly for students who might otherwise disengage from required academic coursework (math, science, English, social studies). Descriptive evidence has pointed to increased student engagement as one possible mediator between CTE coursetaking and positive outcomes, including higher rates of homework completion, reduced disciplinary incidents, and better school attendance (Brunner et al., 2023; Dougherty, 2018; Hemelt et al., 2019; Kelly & Price, 2009; Plasman & Gottfried, 2020).

Studies have also examined the mechanisms through which secondary CTE affects academic engagement. Gottfried and Plasman (2018), using nationally representative longitudinal data and propensity score matching to control for selection into CTE, show that CTE coursetaking is associated with reduced absenteeism and disengagement, particularly for students who would not otherwise be college bound. Plasman and Gottfried (2020) have extended this inquiry to STEM-focused CTE specifically, finding that applied STEM courses can engage students who are at risk of disengaging from math and science. Nomi et al. (2025), evaluating Project Lead the Way using a difference-in-differences (DiD) design, find that participating students are more likely to declare STEM majors in college, suggesting that exposure to rigorous applied STEM content in high school can shape postsecondary field choices.

POSTSECONDARY TRANSITIONS

Whether secondary CTE participation leads to differences in college-going is unclear and requires nuance to interpret the mixed evidence. While most research generally points to there being no aggregate differences in college-going (Bonilla & Thim, 2025; Brunner et al., 2023; Gottfried & Plasman, 2018; Kemple & Willner, 2008), some studies report slight increases in two-year college attendance (Cellini, 2006; Hemelt et al., 2019; Theobald et al., 2019). Other studies find a potential tradeoff, with CTE students more likely to attend two-year colleges but less likely to attend four-year colleges (Ecton & Dougherty, 2023; Lindsay et al., 2024). This apparent contradiction largely resolves when CTE programs are disaggregated by type and occupational alignment, with evidence suggesting that whether a student continues from CTE into college likely depends on whether the occupations associated with those programs require some postsecondary education and training (Ecton & Dougherty, 2023; Kemple et al., 2023; Yoon & Dougherty, 2025).

Research has also identified that not all CTE produces equivalent outcomes; different CTE pathways can lead to different postsecondary trajectories. In general, it does not make sense to treat CTE as homogenous when considering pathways to life after high school, whether those outcomes exist in the workforce or postsecondary education. Many traditional vocational and skilled trades programs are designed to develop students for immediate entry into the workforce or a registered apprenticeship. In contrast, students in programs that have aligned college programs, such as health professions, engineering, or IT, are more likely to need additional training to obtain entry-level employment. Using Massachusetts data, Ecton and Dougherty (2023) found that some high school career clusters like education and applied STEM were related to greater postsecondary educational attainment, while others like manufacturing and transportation were more closely linked with higher earnings, and clusters like healthcare were associated with both higher earnings and higher college-going rates. This type of within-state comparative analysis is particularly valuable for policymakers, because it can speak directly to how policymakers should target investments within a given state.

Growth in dual enrollment and early college models has expanded in some places to include secondary CTE programs with aligned postsecondary pathways. Evidence suggests that these programs can improve college enrollment and credit attainment. In New York's P-TECH high school model, Rosen et al. (2023) found that the model, which includes pursuit of an associate's degree as part of an integrated experience in grades 9 through 14, improves college engagement and completion of an associate's degree, particularly for males. Dual enrollment models that have an emphasis on CTE in North Carolina have also been shown to increase credit completion and direct enrollment in college (Edmunds et al., 2024). In Tennessee, a statewide dual credit program attracted students across the academic achievement distribution, suggesting that CTE dual enrollment may be an especially promising way to provide early postsecondary access to students who may otherwise be least likely to take college-level courses (Hemelt & Swiderski, 2022).

WORKFORCE OUTCOMES FROM SECONDARY CTE

The longest-standing evidence for the efficacy of intensive secondary CTE pathways has been in workforce outcomes, and evidence continues to mount in ways that suggest potential benefits for participants. The evidence indicates short-to-medium-term benefits for employment and earnings for high school CTE participation (Bishop & Mane, 2004; Brunner et al., 2023; Kemple & Willner, 2008; Kreisman & Stange, 2020; Meer, 2007). These benefits align with what economic theory has long predicted: developing occupation- and industry-specific skills improves employability and wages, at least in the short term.

Several studies are worth highlighting for their methodological rigor and the specificity of their findings as they pertain to CTE and employment outcomes. Kemple and Willner (2008), drawing on a randomized controlled trial (RCT) with longitudinal follow-up from New York City's career academies, found that students randomly assigned to career academies earned 11% more than otherwise similar non-career-academy students, with an even larger 17% increase in earnings for male students. Kreisman and Stange (2020), using nationally representative data from the National Longitudinal Survey of Youth (NLSY) and propensity-score-adjusted regression methods to control for student background characteristics, document that secondary CTE coursetaking is associated with higher wages in the years immediately following high school, particularly for males and for students who do not go on to complete four-year degrees. Brunner et al. (2023), using a regression discontinuity (RD) design leveraging admission cutoffs for Connecticut's technical high schools and linking admitted and non-admitted students to quarterly unemployment insurance earnings records, provide some of the most credible causal evidence of secondary CTE's positive effect on earnings, showing large gains concentrated among males who disproportionately participate in skilled trades, manufacturing, and automotive-related programs.

As with the other outcomes for CTE, evidence on the workforce benefits of CTE varies by content area and may moderate over time (Ecton & Dougherty, 2023; Hampf & Woessmann, 2017; Hanushek et al., 2017). Whether and to what extent short-term benefits persist is an open question in the U.S. and abroad, though some research from European nations suggests that gains may persist, or that the magnitude of benefits early in the career may at least offset any lower earnings, relative to non-CTE participants, later in life. Silliman and Virtanen (2022) show large positive impacts in Finland on earnings over more than a decade, demonstrating that the lifetime value of near-term gains more than offsets any later higher earnings among college graduates. This finding contrasts with studies using older data and less-causal research designs that found that the net lifetime benefit to those who pursue technical secondary education may be less than those who pursue college-aligned programs (Hampf & Woessmann, 2017; Hanushek et al., 2017).

A new meta-analysis of 39 studies across national contexts by Kemper et al. (2026) concluded that vocational education and training has a net positive impact on earnings and employment, albeit modest in magnitude. These findings overlap with and are contextualized by syntheses from Dougherty and Ecton (2021) and Carruthers and Jepsen (2021), which add that there is general agreement that postsecondary technical education produces better outcomes than secondary training alone, but that earnings trajectories can be shallower relative to those with further academic education. Holzer (2025) similarly synthesizes recent evidence on workforce development in the U.S. and emphasizes the importance of employer engagement, program quality, and alignment with labor market demand as key moderators of program effectiveness.

Understanding Variation in Impacts: Gender, Race, and Socioeconomic Status

Understanding and attending to differences in the impact of CTE is critical as research is translated into policy and practice. Some of the most consistent findings in the secondary CTE literature concern gender. Program participation benefits are especially large for males, particularly those who were at the middle to lower-third of the academic performance distribution in middle school. The evidence suggests these males do especially well in skilled trades and manufacturing programs, and that work-based learning experiences may explain a substantial share of the benefits that accrue to males in these programs across multiple settings (Brunner et al., 2023; Ecton & Dougherty, 2023; Kemple & Willner, 2008; Page, 2012).

The concentration of CTE benefits among males in skilled trades programs raises important questions about access and representation. Historically, many CTE programs have been characterized by sex-typed enrollment patterns, with females disproportionately concentrated in health care and education programs and males in skilled trades and technology programs. These patterns largely reflect sex-based representation in the larger workforce, which then informs students' own career interests and aspirations. Such imbalances in the workforce and aligned education programs reflect historical barriers, cultural norms, and program recruitment practices. The policy and research question of whether changing the gender composition of CTE programs would improve outcomes for underrepresented students has not yet been well answered by the literature. As Ecton and Wright-Kim (2026) discuss, women, racially minoritized students, and students with disabilities have historically faced distinct challenges within CTE systems, and these disparities remain an important area for ongoing research and policy attention.

Evidence on racial and ethnic differences in CTE outcomes is more limited and less consistent than evidence on gender differences, but several studies have found that the overall benefits of CTE accrue in a similar manner among racially minoritized students. Ecton and Dougherty (2023) find that Black students in Massachusetts CTE programs show earnings gains comparable to those of their white peers in similar programs, though Black students are also less likely to be enrolled in the highest-earning program areas. Similar findings emerged from the Brunner et al. (2023) evaluation of Connecticut technical high schools. These equity gaps in completion extend to a broader pattern of heterogeneous returns across demographic groups that warrants sustained research attention (Carruthers et al., 2021).

Students with disabilities represent another population with potentially distinct experiences with and outcomes from CTE, yet they remain among the least studied. Some descriptive evidence suggests that CTE programs can be particularly beneficial for students with learning disabilities who may struggle with abstract academic content but engage more readily with applied learning. Gottfried and Plasman (2018) note that CTE participation is associated with reduced dropout among students with disabilities, as do Dougherty et al. (2018), but rigorous causal evidence on outcomes for this population is limited. The only

causal evidence at scale is offered by the regression discontinuity study of oversubscribed Connecticut technical high schools from Brunner et al. (2026) which shows that male students with disabilities who are admitted and attend these schools see substantial improvements in graduation and medium-term workforce outcomes. Also highlighted in this study was that 75% of all students with disabilities who applied to these schools were male, both making it difficult to identify precise impacts for females, and highlighting policy relevant, and potentially important, differences in the use of CTE by gender. This is a significant gap given that students with disabilities are disproportionately enrolled in CTE and face substantial labor market disadvantages.

Socioeconomic status intersects with both race and gender in shaping CTE outcomes. Most evidence suggests that students from lower-income families show especially large gains from intensive secondary CTE programs, a finding consistent with the theoretical argument that students who face the steepest barriers to four-year college completion benefit most from high-quality alternative pathways. Brunner et al. (2023) find that earnings effects for Connecticut technical high school lottery winners are particularly pronounced among students from economically disadvantaged families. This evidence aligns with Dougherty (2018) who used a similar method and smaller sample, as well as descriptive methods to demonstrate that students who qualified for free- or reduced-price meals saw larger benefits from CTE participation.

INPUTS, PROGRAM COSTS, AND MECHANISMS

Studies focused on understanding the impact of CTE have also explored the mechanisms that might explain those impacts. One potential mechanism is teacher quality. Chen et al. (2023) show that CTE teachers with higher scores on content-specific certification exams were associated with students who earned more in their first five years after high school, paralleling teacher quality research in academic subjects and suggesting that teacher content expertise matters in CTE. At the same time, CTE teacher supply may be especially fragile in high-demand fields. Kistler et al. (2024) find that turnover among CTE teachers may be especially high in programs aligned with high-demand, high-wage industries, such as health care and IT, where schools may compete with industry employers for workers with relevant technical expertise.

Work-based learning is another cross-cutting dimension of CTE experiences and programs that may help explain overall effects. In secondary CTE, WBL can include internships, employer-mentored or paid projects, clinical experiences, cooperative education, school-based enterprises, youth apprenticeship, and other structured opportunities to learn in or through workplaces. Several studies suggest that secondary CTE programs with WBL components are associated with larger outcome effects, particularly for males in skilled trades and manufacturing programs (Brunner et al., 2023; Ecton & Dougherty, 2023; Kemple & Willner, 2008; Page, 2012). Page (2012), using a principal stratification framework with data from the Career Academies randomized evaluation, shows that the earnings gains associated with career academy attendance were concentrated among students who complied with the full program of study, including work-based learning components. Similarly, Brunner et al. (2023) find that roughly 20% of the overall earnings benefits experienced by students in Connecticut technical high schools came from their paid work in the same industry while in high school.

These findings suggest that WBL may be an important mechanism through which intensive CTE programs affect labor-market outcomes, though most studies cannot fully separate the effect of WBL from the broader program models in which it is embedded. Recent descriptive evidence from Tennessee further illustrates how WBL is increasingly embedded in state CTE systems alongside early postsecondary opportunities and industry credentials, but this evidence should be interpreted as documenting program structure and participation rather than isolating the causal effect of WBL itself (Carruthers et al., 2026). More broadly, a recent systematic review and synthesis of work-based learning studies found promising evidence that WBL can improve learner outcomes, especially for internship-based programs and for academic advancement and socioemotional outcomes, but also found that the evidence base remains limited for adult WBL programs, apprenticeship models, and longer-term employment and earnings outcomes (Michaelson et al., 2026).

Industry-recognized credentials have become an increasingly prominent component of state and local CTE policy. Some states include credentials aligned with approved CTE programs as indicators in their federally required college- and career-readiness accountability systems under the Every Student Succeeds Act. However, the empirical evidence remains limited and does not support causal conclusions. Existing studies suggest that aligned credentials may be associated with short-term earnings gains, particularly in transportation, health care, construction, and information technology, while evidence is weaker for credentials in agriculture and business (Giani, 2022, 2023; Plasman, 2025; Sultana et al., 2026).

Credential value also appears to depend on alignment with students' CTE coursework and to vary across fields and demographic groups. Misaligned credentials show little evidence of labor-market value, whereas aligned credentials are associated with more favorable outcomes (Sultana et al., 2026). Credential attainment is also correlated with higher rates of high school completion (Glennie et al., 2025). Because these studies rely on conditional correlational designs, the estimated relationships may reflect unobserved differences between students who do and do not earn credentials, and evidence on whether short-term benefits persist remains limited.

Policymakers and practitioners also consider program costs and relative cost-effectiveness when making decisions about whether and how to invest in CTE programs. Evidence from Massachusetts, Connecticut, and the P-TECH model in New York City suggests two important takeaways. First, high-quality CTE can be substantially more expensive to provide than general education, due to the costs of specialized equipment, facilities, and industry-qualified teachers. Second, even these resource-intensive programs can break even or generate positive returns on public investment once the larger societal value of labor-market gains is factored in (Dougherty & Smith, 2025; Flack et al., 2025; Rosen et al., 2023). Systematic cost-effectiveness analysis of CTE programs remains underdeveloped and represents an important priority for future research.

SECTORAL TRAINING PROGRAMS

Sectoral job training programs are workforce initiatives that target specific industries and bring together partners usually consisting of employers, training providers, and community organizations. Unlike secondary CTE, which provides broader career exposure coupled with foundational skills, or postsecondary CTE, which offers certificates and applied degrees of varying levels of alignment with labor market demand, sectoral programs are generally short, employer-driven, and designed for workers seeking immediate entry into the labor market. Sectoral programs also differ from apprenticeships because they tend to be shorter-term, typically a year or less, and provide wraparound services for participants typically in partnership with community-based organizations (Schaberg & Greenberg, 2020).

The sectoral training literature is notable within the broader workforce development field because it includes several of the most methodologically rigorous evaluations of any workforce program, including randomized controlled trials with multi-year follow-up. The existence of this causal evidence base makes it possible to say with considerably greater confidence that sectoral training programs can produce meaningful labor market gains for participants, rather than simply observing that program completers have better outcomes than non-completers, which could reflect selection bias rather than program effects.

THE FLAGSHIP RANDOMIZED EVALUATIONS

Rigorous evaluations of prominent sectoral training programs consistently demonstrate large and sustained impacts on participants' labor market outcomes. The Sectoral Employment Impact Study (SEIS) provided early and influential causal evidence via a randomized controlled trial (RCT), randomly assigning individuals to three mature nonprofit providers, finding substantial earnings gains, particularly for low-income and minority adults (Maguire et al., 2010). The SEIS was among the first large-scale RCTs of a sectoral training model, demonstrating that the earnings gains associated with sectoral programs in observational studies were not simply an artifact of selection effects. Treated individuals earned significantly more than control group members at both one-year and two-year follow-up, with effects that were notably larger for participants with lower baseline earnings.

The WorkAdvance initiative tested a common model across four sites, combining occupational training with career readiness, placement, advancement services, and wraparound supports. Evaluations show increases in training completion, credential attainment, and sustained earnings effects over two, three, and more years of follow-up (Hendra et al., 2016; Schaberg, 2017; Schaberg & Greenberg, 2020). A subsequent analysis by Katz et al. (2022), published in the *Journal of Labor Economics*, used the WorkAdvance experimental data to examine why sectoral employment programs work, finding that the combination of occupational skill development, job placement assistance, and employer relationships, rather than any single component, drives the observed earnings gains. Katz and colleagues also found that WorkAdvance improved participants' access to jobs with higher wages and better working conditions, suggesting that sectoral programs may improve not just employment rates but job quality.

Project QUEST, a community-based program in San Antonio that provides long-term training and case management for entry into health care and other skilled sectors, has generated growing earnings impacts over more than a decade of follow-up, underscoring the long-term payoff of sustained engagement and intensive support (Roder & Elliott, 2018, 2019, 2021, 2024). The program's fourteen-year impact evaluation makes it one of the longest-running RCT-based follow-up studies in the workforce development field, and the sustained earnings gains provide unusually strong evidence that sectoral training can produce lasting economic benefits for participants. Over the 14-year follow-up period, Project QUEST produced substantial cumulative earnings gains for a population that was predominantly women, largely Latino or African American, and concentrated in health-care occupations—an important contrast with the broader CTE literature, in which gains are often larger for men—while participants also had higher employment rates in the later follow-up years (Roder & Elliott, 2024). This finding is particularly important because it counters concerns that workforce program effects typically fade out over time.

Year Up, a national program serving low-income young adults through a combination of technical training, wraparound services, and corporate internships, has produced lasting improvements in earnings and career advancement, with evidence of strong cost-benefit ratios (Fein & Hamadyk, 2018; Fein & Dastrup, 2022). Fein and Dastrup's (2022) long-term cost-benefit evaluation found that participants showed substantial and sustained earnings advantages relative to the control group six or more years after random assignment and that program benefits substantially exceeded costs, suggesting that public investment in the original, stand-alone Year Up model produces positive social returns, even in a program that cost up to \$30,000 per participant. However, these findings have not been fully replicated in a lower-cost, college-based adaptation developed to improve scalability. A small, randomized evaluation of Year Up's Professional Training Corps found no detectable effects on average earnings in the second or third follow-up years or on average months of college enrollment, although it modestly increased credential receipt. A separate experiment found that enhanced academic coaching increased completion of the initial training phase, but effects on subsequent college enrollment and earnings were generally modest and statistically insignificant (Fein & Maynard, 2022).

EVIDENCE FROM OTHER U.S. AND INTERNATIONAL PROGRAMS

Beyond the flagship demonstrations, a growing body of evidence has examined sectoral and sector-adjacent training models in diverse contexts. In the United States, state and local initiatives have tested accelerated and health care-focused models, including Illinois's Accelerated Training for Illinois Manufacturing (ATIM) program (Betesh et al., 2017), the San Diego Workforce Partnership's Bridge to Employment (Farrell et al., 2020), Seattle-King County's Health Career for All program (Glosser & Judkins, 2020), and Pima Community College's Pathways to Healthcare (Litwok & Gardiner, 2020). At the federal level, the multi-site Health Profession Opportunity Grants (HPOG) demonstration provided experimental evidence on the potential of health-sector pathways for low-income individuals (Peck et al., 2018). While most HPOG participants completed entry-level training, relatively few advanced into higher-wage roles, pointing to the importance of designing programs that target living-wage roles rather than focusing primarily on initial entry-level credentials.

International RCTs have added important dimensions to the sectoral evidence base. A large RCT in Uganda tested soft-skills-augmented vocational training for unemployed youth, finding positive impacts on both employment and earnings (Alfonsi et al., 2020). A Colombian trial by Barrera-Osorio et al. (2023) disentangled the relative value of hard versus soft skills in vocational training, showing that each plays a distinct and complementary role in improving labor market outcomes, a finding with direct implications for program design in the U.S. context, where debates persist about the relative value of technical skills versus professional skills training.

Broader Workforce Training Programs: Context and Comparison

To contextualize the sectoral training evidence, it is useful to briefly compare findings from other workforce training programs. Evidence on broader workforce training, including programs operated under the Workforce Innovation and Opportunity Act (WIOA) and its predecessors, has historically been mixed. Andersson et al. (2024), using longitudinal administrative data and careful nonexperimental methods to estimate impacts of WIOA Title I training programs on adult worker outcomes, find positive but modest average earnings effects, with substantial heterogeneity by training type and individual characteristics. This suggests that not all publicly funded workforce training is created equal, and that the targeted, employer-aligned design features of sectoral programs may be key to their relatively stronger performance.

Evidence on Job Corps, one of the largest and longest-running federal workforce-development programs, is instructive. Using a nationally representative randomized experiment with approximately 20 years of follow-up, Schochet (2021) found that the program's initial employment and earnings gains did not persist: there were no statistically significant long-run effects on employment or earnings for the full study sample. Estimates were more favorable for participants who were ages 20 to 24 at program entry, but these subgroup effects were only marginally significant and are sensitive to adjustments for the large number of outcomes and subgroups examined; estimates for participants ages 18 to 19 were negative in some follow-up years. Therefore, evidence from Job Corps suggests that it produced meaningful short-term gains but no clear long-run labor-market benefits on average, while possible differences in long-run effects by age remain suggestive rather than definitive. Youth employment programs more broadly, as summarized by Bloom and Miller (2018), show mixed results. These comparative findings underscore that program design, employer engagement, and alignment with genuine labor market demand appear to be key moderators of effectiveness, features more consistently present in the most effective sectoral programs.

APPRENTICESHIPS

Apprenticeships sit within the broader category of work-based learning, but they are distinct from less formal models such as internships, job shadowing, clinical placements, or employer-connected projects because they typically involve sustained paid employment and occupation-specific training. Registered Apprenticeships (RA) are the most formalized version of this model: they are approved by federal or state apprenticeship agencies, combine paid on-the-job training with related instruction, and culminate in a nationally recognized occupational credential. Unlike internships or other forms of work-based learning, RA programs are formalized, regulated, and often tied to long-term employment in occupations. Much of the empirical research on RA comes from European countries and Australia. While parallels exist between Western economies and the United States, apprenticeship systems operate within distinct institutional

contexts, particularly with respect to compensation structures and provisions for health care, paid leave, and childcare.

International evidence on apprenticeships is broader than the U.S. evidence base, although it remains heterogeneous in research design, institutional context, and the outcomes examined. Comparative reviews generally find that apprenticeship and dual-training systems can support smoother school-to-work transitions and more stable early employment than school-based vocational education, while emphasizing that program structures and labor-market institutions vary substantially across countries and that much of the underlying evidence is observational (Eichhorst et al., 2015; Wolter & Ryan, 2011). A systematic review of experimental evaluations in low- and middle-income countries reaches a more cautious conclusion: although access to skills-training programs increased employment and earnings on average, these gains were concentrated entirely in classroom-based vocational training, while the estimated effects of apprenticeship-only programs and programs combining vocational and apprenticeship training were not statistically distinguishable from zero (Agarwal & Mani, 2025).

More rigorous studies address narrower outcomes. In Chile, de Amesti and Claro (2021), using propensity-score matching, found that students in apprenticeship-based vocational education were 0.5 percentage points more likely to graduate on time and 3.3 percentage points more likely to enter higher education than similar students in school-based vocational education. Other causal international research focuses on employer behavior rather than outcomes for apprentices: Caicedo et al. (2022), exploiting discontinuities in Colombia's apprenticeship mandate, found substantial sectoral differences in firms' willingness to train, with firms in high-skill sectors more likely to avoid training apprentices and firms in lower-skill sectors more likely to seek them. Thus, international evidence provides support for some educational benefits and identifies important constraints on employer participation, but it does not yield a single broadly generalizable causal estimate of apprenticeships' long-term effects on workers' employment and earnings.

Gallup's (2024) systematic review synthesizes 30 years of U.S. research, concluding that while there is consistent observational evidence linking RA with higher earnings and employment, rigorous causal studies remain relatively few. The review draws on 36 peer-reviewed articles and 98 non-peer-reviewed sources from 1980 to 2021, and documents 70 percent growth in RA since 2011, reaching nearly 700,000 active apprentices in FY 2025. Historically concentrated in the building and skilled trades, apprenticeships are increasingly expanding into service-sector fields, yet construction apprentices consistently represented about 35 to 41 percent of all registered apprentices between fiscal years 2015 and 2025 (U.S. Department of Labor, n.d.).

RA programs are often promoted as a response to the growing bifurcation of the U.S. labor market between knowledge-sector jobs requiring higher education and service-sector jobs offering lower pay, fewer benefits, and less job security (Lerman, 2014b). Yet despite growth in RA participation, retention and completion rates remain a significant challenge: estimates range from 27 percent in Texas to 61 percent in Pennsylvania, with national averages generally below 50 percent (Reed et al., 2012; Kuehn, 2019). Most existing analyses are descriptive, focusing on linking apprentices to their completion and labor market outcomes, and current state and federal data structures track participation but lack the capacity to monitor individual progress, exits, and post-program outcomes in ways that support rigorous evaluation.

EVIDENCE ON APPRENTICE AND EMPLOYER OUTCOMES

In contrast to the predominantly descriptive U.S. literature, Jabbari et al. (2025) provide a rare quasi-experimental study evaluating LaunchCode's Bootcamp program, a five-month evening coding course followed by a three- to twelve-month paid apprenticeship with a local employer. Using an instrumental variables approach, they find substantial wage and STEM employment benefits for completers; however, completion was low: only 44 percent finished the course, and just 16 percent completed both the course and the apprenticeship program. This study illustrates both the promise of apprenticeship-style programs for economic mobility and the challenge of ensuring adequate completion, suggesting that program design features that improve retention may be as important as program content.

Descriptive analyses from the American Apprenticeship Initiative (AAI) suggest large post-program earnings increases: apprentices' annual earnings rose by nearly 50 percent on average, with especially large percentage gains for women (65 percent) and Hispanic participants (50 percent), though Black apprentices saw more modest growth (37 percent) (Walton et al., 2022). Earnings gains were most pronounced in nontraditional apprenticeship sectors, with IT apprentices more than doubling their earnings and health care apprentices nearly doubling theirs. Although these before-after comparisons cannot be interpreted causally, since earnings typically rise with age and experience regardless of program participation, they point to the potential of apprenticeships to expand access to higher-paying career pathways, particularly in sectors where such opportunities have historically been limited.

On the employer side, evidence from the United States and other countries suggests that firms can earn positive returns on apprentice training, although employer participation depends heavily on sector, training costs, labor-market institutions, and program design (Caicedo et al., 2022; Muehleemann & Wolter, 2014; Wolter & Ryan, 2011). Muehleemann and Wolter (2014) synthesize cost-benefit evidence from European apprenticeship systems and find that firms typically recoup training investments during the apprenticeship period through apprentices' productive contributions. Lerman (2014a) argues that similar returns are theoretically achievable in the U.S. context, though the institutional supports that facilitate positive returns in European contexts are less developed in the United States. The AAI evaluation by Kuehn et al. (2022) provides more direct U.S. evidence on employer returns, finding positive but variable returns across sectors and program designs. These questions about employer participation, training costs, and institutional supports are especially salient for youth apprenticeships, which require coordination among employers, secondary schools, and state workforce and education agencies.

YOUTH APPRENTICESHIPS AND STATE-LEVEL VARIATION

States have increasingly adapted apprenticeship models to serve students who are still enrolled in high school, but these programs vary substantially in scale, sponsorship, occupational focus, and integration with secondary and postsecondary education. Despite rapid expansion and substantial public investment, rigorous causal evidence on youth apprenticeship outcomes remains limited. Instead, most of what is known stems from a small number of states. Wisconsin operates the oldest and largest youth apprenticeship program in the country, serving more than 8,000 high school students and nearly 6,000

employers in 2022–2023 (Lerman & Tyson, 2023). Iowa has pursued a different model since 2016, embedding high schools themselves as registered apprenticeship sponsors (Marotta et al., 2020). By 2019, Iowa had added 4,500 apprentices ages 16 to 24, with high school apprenticeships concentrated in advanced manufacturing, information technology, health care, and childcare. Early completers earned average annual wages of \$42,000, although these descriptive outcomes cannot establish that the programs caused the observed earnings differences. Utah, operating at a smaller scale, has leveraged its CTE and dual-enrollment infrastructure to expand youth apprenticeships in information technology, health care, and advanced manufacturing through coordination across state education and workforce agencies (Reynolds et al., 2025).

The development of youth apprenticeship systems also presents substantial implementation challenges. State administrators report difficulties recruiting employers, creating appropriate placements, coordinating responsibilities across agencies and schools, and filling available apprenticeship positions with qualified students. Variation in program structure, small participant cohorts, incomplete longitudinal data, and the absence of evaluation requirements attached to many public investments have further limited opportunities for rigorous causal research. Consequently, the existing literature is more informative about how states organize and expand youth apprenticeships than about their effects on participants' educational attainment, employment, or earnings.

POSTSECONDARY CTE

Unlike secondary CTE, postsecondary CTE remains a topic with relatively limited causal evidence. Part of this stems from difficulty disaggregating CTE programs and students in postsecondary data, particularly since most postsecondary CTE occurs at institutions, especially community colleges, that also have traditional academic programs and that often do not require students to formally declare a major or program of study until later in their academic career. Even more challenging, student coursetaking-level data in non-credit and non-degree programs are often not included in many of the datasets used to support quantitative research (Sykes et al., 2014).

The enrollment picture for postsecondary CTE nonetheless reflects a sector of growing importance. In associate's degrees alone, more than 500,000 credentials in CTE fields were awarded by community colleges in 2023, in addition to those offered at bachelor's degree institutions, technical colleges, and other technical postsecondary institutions (U.S. Department of Education, 2023). From spring 2024 to spring 2025, overall postsecondary enrollment growth increased by 3.8 percent, but enrollment at public two-year institutions categorized as "high-vocational" was up 11.7 percent, the third consecutive year where vocationally focused institutions outperformed overall postsecondary enrollment growth (National Student Clearinghouse, 2025). These enrollment trends suggest growing student demand for postsecondary CTE, even as the research base has not kept pace. Ecton and Wright-Kim (2026) provide a broader discussion of the organizational landscape of postsecondary CTE, including community college baccalaureates, stackable credentials, non-credit workforce education, and the role of for-profit institutions, that contextualizes the evidence reviewed here.

Postsecondary CTE students are a distinctive population. Over a third of postsecondary CTE students could be considered lower-income, and these students are more likely to be from racial and ethnic minority groups, come from rural areas, and to have struggled academically compared to their peers in academic programs (Ecton & Wright-Kim, 2026). Given this, research focused specifically on postsecondary CTE outcomes would address an important shortcoming within the field, rather than simply including CTE students and programs in broader studies of the higher education ecosystem.

EVIDENCE ON STUDENT OUTCOMES

Limited evidence does suggest that student outcomes tend to be strong for students in postsecondary CTE programs, with descriptive evidence suggesting stronger short-term economic returns than in academic fields (Bahr, 2019; Jepsen et al., 2014; Soliz, 2023; Stevens et al., 2019). Stevens et al. (2019) use California community college administrative data and a value-added approach to document variation in labor market returns across fields of study, finding particularly strong returns in health care and technology-related CTE fields. One analysis identified average economic returns in California community colleges ranging from 14% for certificates to 45% for associate degrees, with the largest returns in the healthcare sector (Stevens et al., 2019). In general, earnings gains to community college credentials are larger for vocational subjects than other disciplines (Jepsen et al., 2014). There is also evidence that CTE coursework may yield significant economic gains even in the absence of an earned credential: one study found that former students reported earning higher hourly wages and improved work status after attending community college compared to before, regardless of whether they ultimately left with a credential.

Evidence also suggests differences in outcomes by race and ethnicity among postsecondary CTE students. Anderson et al. (2021), using nationally-representative data from the Beginning Postsecondary Students (BPS) longitudinal study, noted that Black and Latine students in CTE programs had average cumulative GPAs significantly lower than their white peers, and that credential completion among white students was over 10 percentage points higher than among Latine and Black students six years after starting a for-credit CTE program. These disparities represent a significant area for policy and research attention.

One question that has received more attention from causally-focused research is the responsiveness of student enrollment to local labor market conditions. Using mass layoffs as an exogenous shock, Foote et al. (2019) find that enrollment in short-term CTE-focused programs is more responsive to local job losses than enrollment in other programs, suggesting that students in CTE programs are particularly sensitive and responsive to labor market signals. Acton (2021) uses a similar approach and finds that students are less likely to enroll in fields of study related to industries that have seen local layoffs, suggesting that local labor market shocks affect students' field choices in complex ways that may suggest benefits of policy responses to guide students toward growing sectors when disruptions occur, and to revisit program sizes over time as employment trends shift. Particularly given the introduction of Short-term Pell and the realities of an era of technological disruption, students' responsiveness to labor market shocks is especially notable. Some systems of higher education, like Tennessee's Technical College system (see Carruthers & Sanford, 2018), are especially focused on nimbly aligning program offerings and enrollment to labor market needs. For policymakers, the observed responsiveness of student enrollment to labor market conditions may represent a policy opportunity.

For-profit postsecondary CTE programs generally lead to lower returns for students than equivalent programs at public institutions. Evidence suggests that government funding that shifted postsecondary CTE enrollment to public institutions at the expense of for-profit institutions may benefit students on net (McGuinness, 2026), particularly given evidence that for-profit postsecondary CTE programs are associated with lower earnings returns and higher student debt (Cellini et al., 2020; Cottom, 2017).

FUNDING, ACCESS, AND THE ROLE OF FINANCIAL AID

One challenge facing postsecondary CTE is that community and technical colleges are often less well-funded than their four-year peers (Romano & Palmer, 2016), which limits institutions' ability to expand capacity, particularly given the expenses of developing new CTE programs. However, research examining the 2009 recession-era Trade Adjustment Assistance Community College and Career Training (TAACCCT) grants found that increased funding improved community college enrollment and completion in CTE programs, suggesting that directed public investment can increase capacity and participation in postsecondary CTE (Soliz & Ecton, 2023).

Student-facing financial aid can also shape entry into postsecondary CTE pathways. The introduction of Tennessee Reconnect, a statewide last-dollar scholarship for adult students, increased enrollment in CTE programs, especially among part-time and male students (Collom, 2023). Quasi-experimental evidence from Virginia's G3 initiative similarly suggests that aid targeted to workforce-oriented programs can alter both enrollment and early student outcomes. G3, a last-dollar grant program for low- and moderate-income students in designated high-demand community college programs, increased FAFSA completion, total grant aid, and enrollment in eligible workforce fields, while reducing student borrowing and increasing short-term credential completion (Bonilla & Sparks, 2026; Sparks & Bonilla, 2026). Kentucky's Work Ready Kentucky Scholarship provides a related policy example, though evaluation evidence on the program remains in progress. Together, these policies suggest that targeted financial aid can shift students toward postsecondary CTE pathways, while raising a related question about whether expanded access to workforce-oriented credentials translates into durable labor-market gains.

SHORT-TERM TRAINING AND WORKFORCE PELL

Short-term CTE credentials are poised to receive increased attention with the recent passage of federal Workforce Pell, also called Short-Term Pell, which allows students to use Pell Grants for short-term nondegree programs that tend to be career-focused. While descriptive evidence suggests stronger short-term economic returns from CTE credentials than from academic programs in some settings, recent evidence cautions against assuming that all short-term credentials have labor-market value (Bahr, 2019; Carruthers & Sanford, 2018). Darolia et al. (2025), using evidence from Kentucky, find that very short-term rapid postsecondary certificates generate limited earnings returns on average, although returns vary by field and appear more promising in some health-related programs.

Experimental evidence on expanded aid for short-term programs is similarly cautionary. In two pilot-study RCTs sponsored by the Institute of Education Sciences, students offered Pell Grants for short-term

programs were substantially more likely to enroll and complete postsecondary credentials, but were no more likely to be employed or to earn more than peers who were not offered Workforce Pell grants by three years after expected program completion (Thomas et al., 2024). Together, Darolia et al. (2025) and Thomas et al. (2024) suggest that the central policy issue is not simply access to short-term training, but whether eligible credentials have labor-market value. Program design, eligible field definitions, institutional responses, and education-industry alignment all matter for whether aid expansions translate into durable economic gains, consistent with evidence that workers earn more when their field of education is aligned with their industry of employment (Odle & Russell, 2026). As Workforce Pell goes into effect nationwide in 2026, this is a particularly important area for ongoing research.

NONCREDIT WORKFORCE TRAINING

Noncredit workforce education is especially important within postsecondary CTE because it sits partly outside the credit-bearing structures that organize most higher education research. Community colleges often provide noncredit training that leads to industry-recognized credentials rather than college-issued certificates or degrees; these programs are typically shorter, lower cost, more occupationally specific, and more flexible in their admissions and enrollment criteria than credit-bearing programs, while also allowing colleges to respond more quickly to employer demand and changing regional labor-market needs (Arena, 2013; D'Amico et al., 2020; Frentzos, 2005; Grubb et al., 2003; Harmon & MacAllum, 2003; Van Noy et al., 2008; Xu & Ran, 2020). The scale of the sector is also substantial: in 2020–2021, approximately 4.1 million students enrolled in community college noncredit programs nationally, representing about 40 percent of total enrollment at two-year institutions, and roughly two-thirds of noncredit enrollments were explicitly focused on workforce training (American Association of Community Colleges, 2023; Xu et al., 2026; Xu et al., 2023). Recent quasi-experimental evidence from Virginia's FastForward programs suggests that these programs can generate labor-market value when they lead to industry-recognized credentials: Xu et al. (2026) find that earning such a credential increases employment and quarterly earnings on average, although returns vary substantially by field. These findings underscore both the importance of noncredit workforce education within postsecondary CTE and the need to evaluate programs at the level of the specific credential, field, and employer-recognized skill rather than treating noncredit training as a single category.

DUAL ENROLLMENT AND THE POSTSECONDARY CTE PIPELINE

CTE-focused dual enrollment represents an important bridge between secondary and postsecondary CTE. The causal research base on dual enrollment generally shows positive effects on high school graduation, college enrollment, persistence, and completion (Edmunds et al., 2020; Edmunds et al., 2017; Giani et al., 2014; Hemelt et al., 2020; Song et al., 2021). However, there is limited research on how dual enrollment specifically shapes students' trajectories within postsecondary CTE, including whether students who complete CTE dual enrollment courses are more likely to pursue postsecondary CTE credentials and realize labor market gains from them, and whether CTE-focused dual enrollment courses deliver systematically different outcomes from the general academic studies dual enrollment courses that are more common today.

Ultimately, postsecondary CTE remains a topic ripe for more causally focused research. Given that postsecondary CTE students are more likely to be low-income, first-generation, racially minoritized, older, and to have lower test scores before entering college than students in academic programs, more research could be used to understand student success specifically among CTE students, rather than simply including CTE students and programs in broader studies of the higher education ecosystem.

Priority Areas for Future Research

The review above points to several significant gaps in the existing evidence base. The following highlights key areas for future research investment, particularly for those interested in building a causal evidence base that can inform policy and practice decisions.

LONG-TERM OUTCOMES OF SECONDARY CTE

Despite a growing body of causal evidence on secondary CTE, most studies have relatively short follow-up periods, typically three to five years after high school graduation. The question of whether early earnings gains persist over workers' careers, or whether they fade as general human capital investments made by academic-track peers begin to compound, remains largely unanswered in the U.S. context. Studies with longer administrative data linkages, following CTE participants into their late 20s and 30s, would provide important evidence on the lifetime value of secondary CTE investments. This is particularly important given international findings suggesting that the long-run returns to vocational secondary education are contested (Hampf & Woessmann, 2017; Hanushek et al., 2017).

CAUSAL EVIDENCE ON LABOR MARKET OUTCOMES FROM POSTSECONDARY CTE

The most critical gap in the postsecondary CTE evidence base concerns labor market outcomes. While descriptive evidence suggests positive earnings returns from postsecondary CTE credentials, rigorous causal evidence on the earnings effects of specific postsecondary CTE programs and credentials is largely absent. This is partly a data problem, as many postsecondary CTE students are in non-credit programs not captured in standard administrative datasets, and partly a design problem. Research investments that improve postsecondary CTE data infrastructure and develop quasi-experimental designs exploiting variation in program availability, credential requirements, or institutional funding would substantially advance the field. The natural experiment created by the national rollout of Workforce Pell in 2026 represents a particularly important opportunity.

MECHANISMS AND PROGRAM DESIGN FEATURES

Even where causal evidence of program effectiveness exists, understanding why programs work, and which specific design features drive effectiveness, remains limited. The evidence that work-based learning is associated with larger benefits for males in skilled trades programs is suggestive, but more research is needed on the specific mechanisms through which CTE produces or fails to produce benefits. Experimental or quasi-experimental studies that vary specific program features, including the presence or absence of employer partnerships, the intensity of work-based learning, the use of industry-recognized credentials, or the structure of wraparound services, would provide valuable guidance for program design.

EQUITY AND POPULATION-SPECIFIC OUTCOMES

The evidence on differential impacts by gender, race, and socioeconomic status is suggestive but incomplete. Several important questions remain unanswered: Why do males benefit more than females from many secondary CTE programs, and are there program designs that produce larger benefits for females? What explains the relatively modest earnings gains for Black apprentices relative to other demographic groups? How do outcomes differ for students with disabilities, English language learners, and other specific subgroups that are often underrepresented in the CTE research literature? Studies with sufficient sample sizes to detect heterogeneous effects by student subgroup, and designs that can shed light on the mechanisms producing differential impacts, would substantially advance understanding of CTE equity.

APPRENTICESHIP EXPANSION AND CAUSAL EVIDENCE

Despite growing policy interest in apprenticeship expansion, the causal evidence base in the U.S. context remains thin. The LaunchCode evaluation by Jabbari et al. (2025) represents an important advance, but many questions remain about how apprenticeship outcomes vary across sectors, geographies, and participant populations. Researchers should take advantage of natural experiments created by state-level policy variation in apprenticeship governance, incentives, and investment to generate quasi-experimental evidence.

TEACHER AND INSTRUCTOR QUALITY IN CTE

The role of teacher quality in shaping CTE student outcomes is underexplored relative to its likely importance. More systematic research on the CTE teacher pipeline, including how teachers are recruited from industry, the effectiveness of alternative certification pathways, what predicts CTE teacher retention, and how teacher turnover affects student outcomes, would help address one of the most significant capacity constraints facing CTE programs, particularly in high-demand fields like health care and information technology.

CTE PROGRAM COSTS AND RETURN ON INVESTMENT

Cost-effectiveness analysis of CTE programs is notably underdeveloped. While evidence suggests that high-quality CTE can be cost-effective even when it is more expensive per pupil than general education, this evidence comes from a small number of programs in particular states. Systematic cost-benefit analysis across a wider range of program types and contexts, including postsecondary CTE and sectoral training programs, would help policymakers prioritize investments across program types and settings.

Conclusions

The evidence reviewed in this report supports a cautiously optimistic assessment of CTE as an economic mobility strategy, while also recognizing that “career education” is not a single intervention and should not be evaluated or funded as though it were. The strongest evidence points to three broad conclusions. First, intensive secondary CTE models, including career academies and technical high schools, can improve high school completion and generate short-term labor market gains, particularly for males in skilled trades and manufacturing programs. Second, sectoral training programs have one of the strongest causal evidence bases in the workforce development field, with multiple well-designed RCTs showing substantial earnings gains for low-income adults when programs combine occupational training, employer engagement, placement support, and wraparound services. Third, postsecondary CTE and apprenticeships remain highly policy-relevant and potentially valuable, however the U.S. causal evidence base is thinner particularly for specific credentials, program designs, and longer-term labor market outcomes.

These findings argue against both blanket enthusiasm and blanket skepticism. Some CTE models appear to produce meaningful economic benefits, but those benefits appear to depend heavily on program quality, labor-market alignment, employer involvement, and the population served. Models that combine technical skill development with strong advising, work-based learning, employer partnerships, and clear pathways into further education or employment appear more promising.

For policymakers and funders, the central implication is that the next phase of CTE investment should focus not only on expansion, but also on evidence-building and quality differentiation. In some areas, especially sectoral training and intensive secondary CTE models, the existing evidence is strong enough to justify continued investment while studying how to scale these models with fidelity. In other areas, including postsecondary CTE, short-term credentials, youth apprenticeships and registered apprenticeships, the priority should be to build stronger causal evidence, and to develop stronger evidence about which models improve earnings, for whom, and at what cost. Moreover, one of the most consistent themes throughout the research base on CTE is that context matters – different CTE programs aim to develop substantially different skills, and different student populations can expect to see substantially different returns to CTE. Given this, policy and funding structures should reflect this heterogeneity within CTE, rather than treating all CTE programs as a monolith. This policy and funding differentiation within CTE will require better linked data systems, longer follow-up periods, clearer measures of program quality, and research designs that can distinguish the effects of access, completion, field of study, employer partnerships, and credential value.

The most useful research will therefore be comparative and decision-oriented. Rather than asking only whether CTE works, policymakers and practitioners need evidence on which models and occupational pathways generate durable economic gains, which components are essential, which populations benefit

the most, and which policy incentives encourage institutions and employers to provide high-quality pathways. Investment in projects using linked secondary, postsecondary, and labor market data; evaluations of policy rollouts and funding reforms; cost-benefit analyses across different model types; and studies that examine socioeconomically disadvantaged populations would have high value for policy and practice. The evidence base has advanced substantially beyond largely descriptive research. As CTE-focused research enters its next phase, more causal research will help support CTE policy and practice that is grounded in evidence and leads to greater program quality, greater alignment to society's needs, and stronger long-term economic returns.

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