

Career and Technical Education

Current Policy, Prominent Programs, and Evidence

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Overview

In late 2017, MDRC was invited by Bloomberg Philanthropies to write a paper detailing the level and rigor of the available evidence supporting career and technical education (CTE).

Interest in the field of CTE has experienced a resurgence over the last decade, as the global economy has grown increasingly competitive while students have continued to leave school underprepared for well-paying twenty-first-century jobs. Together and separately the education and workforce sectors have sought to address these challenges and better prepare students for viable economic futures. The result has been many new, innovative programs at both the high school and postsecondary (college) levels that seek to give students technical training for specific career fields, general training to prepare them for the workplace, and work-based learning opportunities where they can develop connections to employers and the workforce. However, even as CTE programs have grown in popularity, the evidence base to support their reemergence has lagged.

This paper begins with an overview of the issues in the education system and the labor market that led to the current revival of CTE: It argues that the skills today's employers need are not the ones schools are providing adequately. This section is followed by one describing how various policies have fostered the growth of CTE. The third section of the paper provides detail on the major types of programs and their various components. Specifically, the paper defines what is meant by CTE instruction and training, career pathways, apprenticeships, and career-readiness skills. The evidence section that follows begins by discussing the value of various types of evidence. It then provides a literature review of the available evidence to support each of the program types detailed in the third section, touching on both the amount of evidence available in each area and its level of rigor.

The paper concludes by suggesting that while CTE instruction could bolster students' economic mobility by helping them gain postsecondary credentials and obtain higher-paying jobs, there are challenges involved in turning that promise into reality. Investments in data and evidence-based practices can give CTE a better chance at success.

“Career technical education must reposition itself, not just as a vocational alternative to college prep but as a pathway into postsecondary programs that links degrees and credentials to occupations.”

—*Independent Advisory Panel of the National Assessment of Career and Technical Education*¹

Introduction

The United States faces three challenges related to education and the labor market. The first is a need to remain economically competitive in a world where companies are hungry for skilled talent. The second is the competition American workers face from workers abroad for well-paying jobs. And the third is an education system that has failed to prepare all students equitably to succeed in college or other postsecondary education, and to be ready to meet the demands of the labor market.

People with bachelor’s degrees have done relatively well economically in the last several decades, but those with less than a four-year degree — the vast majority of the workforce, including most young adults — have struggled to find and keep jobs with middle-class wages.² This growing economic gap between those with college degrees and those without has contributed to overall increases in income inequality and class polarization. To address these challenges, policy-makers, educators, employers, and philanthropists have increasingly begun to invest in new models of career and technical education (CTE). These models aim to give students the chance to develop skills and get training that will provide access to so-called “middle-skill” jobs (those that require some postsecondary training but less than a four-year degree), while also meeting employers’ demands for qualified workers.

This paper begins with an overview of current education and labor-market challenges. Then it describes current government policies related to CTE and some prominent CTE programs and models. It reviews the available evidence about CTE’s effectiveness, and concludes with an assessment of potential future directions for CTE.

The Labor Market and the Education System

The American economy has a well-documented need for more workers trained in technical fields.³ Currently, there are almost 30 million middle-skill jobs in the U.S. economy that pay \$35,000 to \$95,000 a year. About half of these jobs require an associate’s degree, and the share that require more than a high school diploma is growing continually.⁴ Current projections suggest that by 2020 the United States will face a shortage of qualified workers for as many as 5

¹Independent Advisory Panel of the National Assessment of Career and Technical Education (2014).

²As of 2015, 65 percent of the population between 25 and 34 had less than a bachelor’s degree. Ryan and Bauman (2016); U.S. Census Bureau (2017).

³Goldin and Katz (2009); Krueger (1993).

⁴Carnevale, Jayasundera, and Hanson (2012).

million jobs that require a postsecondary education, almost half of which will require some college or an associate's degree.⁵ Already, there are as many as six million open positions in the labor market, and in 2016, 46 percent of employers in the United States reported difficulty filling open positions — the highest reported level in 12 years.⁶ Thirty-five percent of employers said that they had trouble hiring because they had trouble finding people with the right experience or skills.⁷

There is broad agreement about these current employment trends, but economists disagree about the cause of the shortages, and have different longer-term projections for the labor market. Some suggest that current shortages can be attributed to a “skills gap” in which workers lack the skills that employers seek.⁸ On the other hand, there is evidence that in the longer term, the United States faces a labor market characterized by “skill polarization,” in which large numbers of midlevel jobs are replaced by technology, resulting in many low-skilled, low-paying jobs at one end of the labor market, and fewer, high-paying, cognitively demanding jobs at the other.⁹ Although economists disagree about the opportunities that will be available in the labor market of the future, they agree somewhat more about the kinds of skills young people will need if they are to become workers with viable long-term employment prospects. They agree that they will need strong quantitative and analytic skills, creativity and proficiency in solving complex problems, and good interpersonal communication.¹⁰ Moreover, there is a growing demand specifically for workers who have a combination of strong analytic skills and noncognitive skills in areas such as teamwork and collaboration.¹¹

At the same time, there is growing concern that traditional high schools are ill-equipped to help all students develop the skills that they will need to make a successful transition to postsecondary education, which will in turn allow them to build sustainable careers with middle-class wages. The national high school graduation rate reached a record high of 84 percent in 2015-2016 (the last year for which rates are available) but many high school graduates — particularly those from lower-income families — still fail to make successful transitions to postsecondary education or the workforce.¹² For example, while 83 percent of high-income students enroll in two- or four-

⁵Job-opening estimates are based on projections about numbers of newly created jobs and vacancies due to retirements and other labor-market exits (for example, parents staying home with children). Shortage projections are based on an assumption that workers with postsecondary credentials will continue to be produced at the current rate. Carnevale, Smith, and Strohl (2013); U.S. House Committee on Education and the Workforce (2013).

⁶Ydstie (2017).

⁷ManpowerGroup (2018).

⁸Holzer (2013).

⁹Goos, Manning, and Salomons (2014); Lu (2015).

¹⁰Autor, Levy, and Murnane (2003); Lu (2015).

¹¹Deming (2017).

¹²National Center for Education Statistics (2018b).

year colleges in the fall after high school, just 63 percent of middle- and low-income students do.¹³

In addition, among those who do enroll, many fail to complete degrees. In community colleges in particular, just under 30 percent of first-time, full-time students complete associate's degrees within three years.¹⁴ Moreover, community colleges disproportionately enroll black and Hispanic students, who are more likely than whites to attend part time, and less likely to earn degrees.¹⁵ Many of these students struggle in part because of poor high school preparation.¹⁶ Nationally, close to half of all community college students must enroll in at least one developmental education (remedial) course, which can make it significantly harder for them to obtain degrees.¹⁷ Degree-attainment rates are then exacerbated by regional inequalities: Cities where few young adults earn more than a high school diploma also tend to be those with few high-wage jobs, creating pockets of economic disadvantage and increasing economic polarization nationally.¹⁸

The failure to complete some kind of postsecondary training has lasting economic consequences. The median annual wage for those with only a high school diploma is now nearly \$20,000 less than the median for those with a four-year degree.¹⁹ Yet much of this wage gap could be addressed by encouraging more students to complete postsecondary certificates and two-year degrees. Multiple studies have found increases in earnings associated with two-year degrees, although others have found that the wage benefits largely go to those with degrees and vocational certificates in health care or in fields related to science, technology, engineering, and mathematics (STEM).²⁰

In short, it is increasingly important for students to engage in education and training beyond high school, but many students face significant obstacles when they try. For this reason, the policy, education, employment, and philanthropic communities have begun to coalesce around the idea that students need clear pathways from high school, to postsecondary education and training, to the labor market, and help making the transitions from each to the next. CTE aims to help students develop skills beginning in high school that will prepare them for postsecondary education and the workforce, equipping them to enter careers that offer opportunities for growth and good wages.

¹³National Center for Education Statistics (2016).

¹⁴National Center for Education Statistics (2018a).

¹⁵Snyder and Dillow (2012).

¹⁶Attewell, Lavin, Domina, and Levey (2006).

¹⁷Attewell, Lavin, Domina, and Levey (2006); Horn, Nevill, and Griffith (2006); Bailey, Jeong, and Cho (2010).

¹⁸Ross and Bateman (2017).

¹⁹Julian and Kominski (2011).

²⁰Jacobson and Mokher (2009); Jepsen, Troske, and Coomes (2014); Jacobson, LaLonde, and Sullivan (2005); Dadgar and Trimble (2015).

The Current Policy Environment

Federal, state, and local policymakers see CTE as a strategy both for improving economic competitiveness and for reducing educational inequity — making it one of the few policy ideas to attract bipartisan support. For example, the U.S. Senate recently launched a Career and Technical Education Caucus (joining the existing U.S. House of Representatives CTE Caucus), and governors and mayors in both Republican and Democratic regions of the country have launched state and local CTE initiatives.

CTE is not a new idea; the Smith-Hughes Act first authorized federal funding for vocational training in public schools 100 years ago.²¹ This vocational training was expressly designed as a path for students who would not pursue bachelor’s degrees. Vocational education was a popular fixture of American public schooling until the 1970s, when civil rights groups, education reformers, and others argued that it was used to track poor and minority students into low-level jobs.²² As a result, it was used less and became stigmatized. In the early 1990s, several states and localities across the country launched “school-to-work” programs designed to prepare students for college and career and to connect academic learning with work-based learning experiences. The 1994 School-to-Work Opportunities Act provided federal funding for these types of programs, but it expired in 2001 and was not renewed. The 2001 No Child Left Behind Act required schools to push all students, including those in vocational education, toward academic proficiency. Since “voc-ed” students frequently tested near the bottom on mandated assessments, No Child Left Behind placed a spotlight on the poor academic quality of many vocational education programs, prodding their evolution into today’s CTE.²³

The 2006 reauthorization of the Carl D. Perkins Act further spurred the resurgence of CTE by providing funding for programs that combine rigorous academics with career exposure and training. It also replaced the term “vocational education” with “career and technical education.”²⁴

Much of the innovation and policy action related to CTE in recent years (in high school and in postsecondary programs) has happened at the state level. In 2016 alone, 42 states imple-

²¹Ottaviani (2018).

²²Oakes (2005).

²³No Child Left Behind required all students to be tested every year in grades 3 through 8, and at least once between grades 10 and 12. The reporting requirements of No Child Left Behind highlighted inequities across states and student subgroups, which then led to a push for high-level academic standards. As a result, many districts and policymakers made a priority of standards aligned with college and not careers, and many students ended up being underprepared for careers. See Hanford (2014).

²⁴The largest program authorized under Perkins is the Basic State Grants program, which provides formula funds to states for the development and implementation of secondary and postsecondary CTE programs. States received approximately \$1.12 billion in Perkins funding in fiscal year 2017. See Dortch (2012). In July 2018, the Strengthening Career and Technical Education for the 21st Century Act, which reauthorizes the Carl D. Perkins Career and Technical Education Act of 2006, was signed into law. The new law aligns the Perkins program more closely with the Workforce Innovation and Opportunity Act and emphasizes the development of CTE programs that prepare students for careers in industry sectors with high job growth.

mented close to 140 CTE policy changes.²⁵ California is an example of a state that has made large investments in CTE. In 2013, for example, it launched the Career Pathways Trust, which supports the development and expansion of career pathways programs from grade 9 through the first two years of college, emphasizing employer partnerships and work-based learning.²⁶ In 2016, the state created the Strong Workforce Program, which provides \$248 million annually to California community colleges to expand CTE programs in high-demand industry sectors.

Privately funded initiatives such as New Skills for Youth — which is underwritten by JPMorgan Chase — and Jobs for the Future’s Pathways to Prosperity Network have also led to state policy changes.²⁷ For example, Louisiana, a New Skills for Youth state, has invested in an initiative called Jump Start, which aims to increase the number of students who earn industry-recognized credentials in high-growth industries before they graduate high school.²⁸

In addition, the Every Student Succeeds Act (the federal education law that replaced No Child Left Behind) provided states with opportunities to integrate CTE into their K-12 systems.²⁹ For example, states may include indicators related to career and technical education in their accountability systems (for example, participation in CTE courses and work-based learning opportunities).³⁰

The State of the Field

Today’s CTE programs take many forms, depending on the institutions that design and deliver them, the populations they serve, and the numbers and types of components they incorporate. This section describes some of the most popular programs, grouped into four categories:

1. CTE instruction and training
2. Career pathways
3. Apprenticeships
4. Career-readiness skills programs (sometimes called “soft-skills” programs)

In all these categories and across them, programs vary in the number and type of components that accompany core CTE courses. Figure 1 shows some of the most common components of multifaceted CTE interventions. For example, career pathway models may combine sequenced CTE courses aligned to a career theme, career-awareness opportunities, and work-based learning experiences — or they may combine other components in other ways.

²⁵Association for Career and Technical Education (2017).

²⁶California Community College Chancellor’s Office (2015); California Department of Education (2017).

²⁷California Community Colleges (2018).

²⁸Louisiana Department of Education (n.d.).

²⁹Advance CTE (2017).

³⁰Long (2017); Advance CTE and Education Strategy Group (2017).

In the past, CTE programs have varied in the extent to which they have addressed the needs of employers and the goal of economic competitiveness as opposed to the needs of participants and the goal of educational equity. Programs that emphasized the former tended to engage more deeply with employers, for example by seeking their opinions on the careers that career pathways programs should promote, and on the curricula they should use. These programs were also likely to have relatively narrow standards for admission, so that they can train qualified workers more reliably. At the other end of the spectrum were programs that emphasized the needs of students. These programs tended to strive more for equity through open-admissions policies and by letting students choose among a range of pathways, including some that may not have been as well aligned with employers' needs. Increasingly, in a new generation of programs now being designed, programs are aiming to balance these goals. For example, the P-TECH 9-14 schools in New York City work closely with employers to design degree pathways but offer open-access admission.³¹ And the California Partnership Academies program emphasizes equity by requiring that at least 50 percent of participants be students who meet "at-risk" criteria, while also encouraging the growth of academies with themes that correspond to employment sectors facing labor shortages in California.³²

CTE Instruction/Training

High schools and community colleges offer a wide range of CTE courses. For example, community colleges offer dozens of "CTE majors" that lead to certificates or two-year credentials. Certificates can be industry-recognized or college-issued. In high schools, CTE courses can range from a handful of options to many. The U.S. Department of Education's Career Cluster framework consists of sixteen clusters and corresponding programs of study, each of which corresponds to a type of career (for example, the health care cluster might include nursing and community health, among other areas). This framework often influences state and district decisions concerning which CTE courses and course sequences to offer. Increasingly, however, stand-alone CTE courses are giving way to more complex "career pathway" models.

Career Pathways

A career pathway is a series of structured and connected programs and support services that enable students to advance over time to higher levels of education and training.³³ They are found in both high schools and community colleges. Career pathways are multifaceted and may

³¹These schools serve grades 9 through 12 and the first two years of college. Each has an industry sponsor and allows students to earn cost-free associate's degrees in fields related to the work of the employer, at the same time as they earn high school diplomas. They have what are referred to as "limited unscreened" admissions, meaning they require only that students express interest in the school by attending an open house in order to be eligible for admission; they do not have admissions criteria related to test scores or attendance. In an effort to further encourage equity, the New York City Department of Education will eliminate the limited unscreened category of high school admissions beginning in 2019.

³²At-risk students are those who meet three of the following six criteria: (1) having a poor attendance record, (2) being behind in credits, (3) demonstrating low motivation, (4) being economically disadvantaged, (5) having low scores on state tests, and (6) having low grade point averages.

³³Career Ladders Project (2013).

combine a range of components such as career awareness, work-based learning, contextualized instruction (teaching basic concepts in the context of the career where they will be used), and small learning communities (in which students take multiple courses with the same small group of peers). Many high schools offer one or two pathways, while others offer “wall-to-wall” pathways — meaning that all students choose a career-themed pathway (typically in eighth or ninth grade). Notably, career pathways are rarely designed to move students directly into the workforce from high school. More often they are presented as pathways to college *and* career, and typically promote the idea that all students need at least some postsecondary education, although not necessarily a four-year degree.

There are at least three types of career pathway models in high schools: career academies, early college high schools, and pathway programs. The career academy model includes an overarching career theme (such as health sciences or information technology), rigorous course work designed to prepare students for college, an integrated curriculum, a sequence of CTE courses aligned with the career theme, a small learning community, and work-based learning experiences. An estimated 7,000 career academies currently operate across the country.³⁴ National Academy Foundation and the California Partnership Academies are the oldest and largest networks of career academies. Early college high schools allow students to earn as many as two years of college credits while in high school. Some of them have a CTE focus. Pathway programs combine CTE programs of study with other enhancements, such as work-based learning experiences, mentoring, or other support.

Apprenticeships

Apprenticeships for young people have long been popular in Europe; recently they have experienced a surge of interest in the United States as well. Quality apprenticeships include paid work, competency-based training for middle-skill jobs (that is, instruction that makes sure apprentices can actually demonstrate the skills they are supposed to be learning), and opportunities for full-time employment after the training. An example of a very new and high-profile youth apprenticeship program is CareerWise Colorado, which is modeled on youth apprenticeship in Switzerland. The program aims to meet employers’ needs for skilled workers while also helping young people acquire the skills and credentials necessary to find jobs with good wages and opportunities for advancement. This ambitious program is currently in its first year, but it is already operating in four regions in Colorado and has recruited over 200 high school students and nearly 100 employers. Students join the program in their junior or senior year of high school, and divide their time among high school, the workplace, and a local community college. Employers have a strong influence over CareerWise’s design and curriculum, and the program enjoys the support of elected leaders and state agencies.

³⁴National Career Academy Coalition (2018).

Career-Readiness-Skills Training

The employer community has repeatedly called for workers with strong career-readiness skills (also called twenty-first-century skills, soft skills, and employability skills): the general habits and competencies that make a person an effective employee, such as such as how to show up to work on time and how to work cooperatively with others. Many programs now therefore aim to help students develop better interpersonal and noncognitive abilities such as empathy, adaptability, and communication, and to improve their ability to solve problems. The demand for such skills is projected to grow in the future.

For example, the YouthForce NOLA career pathways program in New Orleans features internships for high school students that are accompanied by 60 hours of soft-skills training. At the postsecondary level, the California Community Colleges Chancellor's Office sponsors The New World of Work program for students in CTE programs. The program includes a curriculum covering 10 soft skills embedded in a CTE course, a work-based learning experience, and an assessment leading to a digital badge that signals competency in each of the 10 skills.

The next section reviews the evidence about the effectiveness of programs in each of these categories.

Evidence About CTE

Interpreting Evidence

Although many people are now enthusiastic about these new models of CTE delivery, the evidence behind CTE is limited, and the evidence that does exist varies in quality. The most rigorous study design is a randomized controlled trial, but only a few studies in the CTE literature are randomized controlled trials. This research design is considered the “gold standard” because the random assignment to either a program group or a comparison group ensures that any changes in program participants’ outcomes after the program are *caused* by the intervention, as opposed to other factors.³⁵ The next most rigorous studies use “quasi-experimental” designs, which seek to mimic the properties of randomized studies by creating groups that are plausibly comparable. For example, regression discontinuity design studies, which limit analyses to students who fall just to one side or another of an arbitrary “cut point” (for example, an income cutoff or a birth date), are considered some of the strongest quasi-experimental designs.³⁶ Other models, like comparative interrupted time series and propensity-score matching studies, rely on researchers to create comparison groups based on the matching of observable characteristics. The reliability of the evidence from these kinds of studies depends on the strength of the matches they are able to make between program participants and comparison groups, and on other assumptions that may be hard to verify. Finally, the weakest evidence comes from observational studies, which provide evidence of an association between characteristics and outcomes, but not of a causal relationship.

³⁵The random process may be created by purposeful random assignment or by a naturally occurring lottery.

³⁶Other common cut points include pass/fail scores, program eligibility dates, and ages of eligibility.

Yet the strength of the evidence in an area is also related to factors other than just study design: sample sizes, for example, and the number of studies that have similar findings. If results from a single study using a reliable research design cannot be replicated in subsequent studies, then one should be cautious about applying its results more broadly than its original setting. But if multiple studies find similar results in different settings and time periods, then even if those studies individually have weaker research designs, then collectively they may provide strong evidence of a relationship or trend.

Evidence About CTE Instruction and Training

CTE has been a fixture of the education system for decades, and there is a fair amount of research dedicated to its effects. However, much of the research is observational. For example, multiple studies have found a relationship between taking CTE courses and increased high school graduation rates, particularly among low-income students who tend to be overrepresented in CTE programs.³⁷ Taking CTE courses in high school has also been associated with higher wages.³⁸

Other studies have investigated questions of *dosage*, or whether students who take multiple higher-level CTE courses (known as “CTE concentrators”) have more positive outcomes than other CTE students. One study found that students who took CTE courses toward the end of high school, when the courses are more likely to be advanced, were more likely to graduate from high school.³⁹ Another study found that the wage benefits of CTE occurred entirely among students who took upper-level CTE courses.⁴⁰ CTE concentrators are more than 20 percentage points more likely to graduate from high school than similar students who do not concentrate in CTE, and are more likely to enroll in two-year colleges; these effects are strongest among young men and low-income students.⁴¹ While none of these findings was produced through a randomized controlled trial or a quasi-experimental design, the volume of similar findings across different settings and populations does suggest that positive student outcomes are strongly associated with taking CTE in high school.

Dual-enrollment programs are designed to ease students’ transitions from high school to college by allowing students to take college courses during high school for which they can earn college credit. Several studies of dual-enrollment programs that focus on career-related course work have found that students who participate in these programs have better high school grade point averages than students who do not, graduate high school at higher rates, stay enrolled in college at higher rates, and enroll in four-year degree programs at higher rates.⁴² That said, a large,

³⁷Plank, DeLuca, and Estacion (2008); Dougherty (2016).

³⁸Bishop and Mane (2005); Mane (1999).

³⁹Gottfried and Plasman (2017).

⁴⁰Kreisman and Stange (2017).

⁴¹Dougherty (2016).

⁴²Rodríguez, Hughes, and Belfield (2012); Karp et al. (2007).

national study of dual-enrollment programs found that the effects varied substantially across states.⁴³

One traditional model of CTE delivery is known as the regional vocational high school. In this model, a single school offers all the available CTE in a given district or region. Two recent rigorous studies (one using a regression discontinuity design, the other based on a random admissions lottery) found that students who enrolled in these schools were more likely to graduate from high school than comparable students who did not enroll in them. Further, one of these studies found that students who enrolled in CTE schools were more likely to enroll in postsecondary education, and the other found that they were more likely to earn industry credentials while in high school, with stronger effects among lower-income students.⁴⁴

Finally, there have also been several studies of the economic benefits students can gain by earning vocational certificates or career-focused associate's degrees. While these benefits vary widely by field, studies have found that some certificates produce large effects, particularly those related to health care and information technology.⁴⁵ Specifically, one large, multistate observational study found that men who received certificates earned \$530 more a quarter on average than men who did not, and women earned \$740 more. These earnings gains varied from field to field and from state to state, with the most positive findings concentrated among vocational certificate holders. However, the effects of certificates were found to lessen over time. Men who received associate's degrees earned \$1,160 more per quarter on average than men who did not, and women earned \$1,790 more. These effects were strongly positive in all states and were sustained over time.⁴⁶

Evidence about Career Pathways

Nationwide there are more than 7,000 career academies. The model has grown in part because of an MDRC randomized controlled trial that found that eight years after high school, academy students earned on average 11 percent more per year than nonacademy students, with the effects concentrated among young men.⁴⁷ More recently, another lottery-based study of a single career academy in North Carolina found positive effects on high school graduation and college enrollment.⁴⁸ (The study also found that in this district the academy served a different population than the academies in the original MDRC study. In this study academy students were higher-performing and more likely to be white than nonacademy students.)

The early college high school model allows students to earn credits toward an associate's or bachelor's degree, typically through a partnership with a college. Although some of these schools have a CTE focus, the evidence about them is not disaggregated into those with a CTE

⁴³Fink, Jenkins, and Yanagiura (2017).

⁴⁴Dougherty (2016); Neild, Boccanfuso, and Byrnes (2015).

⁴⁵Grossman et al. (2015); Stevens, Kurlaender, and Grosz (2018).

⁴⁶Belfield and Bailey (2017).

⁴⁷Kemple and Willner (2008).

⁴⁸Hemelt, Lenard, and Paepflow (2017).

focus and those more generally focused on college credit accumulation. The evidence that does exist is primarily for those early college high schools that serve lower-income and disadvantaged students. For example, one lottery-based randomized controlled trial examined 10 early college high school programs in five states and found that they improved high school graduation rates and the rates at which students earned postsecondary credentials. In particular, early college high school students were 20 percentage points more likely to have earned associate's degrees four years after high school than their non-early college high school counterparts.⁴⁹ Another randomized controlled trial of early college high schools found positive effects on ninth-grade outcomes, including taking and passing core college prep courses.⁵⁰ Finally, a study of all early college high school programs in North Carolina (which has the largest concentration of early college high schools of any state) also found that students in these schools were more likely to earn associate's degrees and to enroll in four-year institutions that were ranked as less selective.⁵¹

Another popular pathway model is the Linked Learning model, which has four main components: rigorous academics, sequenced CTE courses, work-based learning, and comprehensive support services. However, the evidence about Linked Learning is confined to a study with a propensity-score matching design that found that students in the program were more likely than comparison group students to graduate from high school and enroll in college. Effects were stronger among students who began high school with poor academic preparation and among African-American students.⁵²

Work-based learning is used in many pathways programs, but there is limited evidence about its effects. One randomized controlled trial of Urban Alliance's high school internship program (which combines a paid internship with professional training and mentoring) found large effects on college attendance for young men.⁵³ Another, less rigorous study of work-based learning found mixed results.⁵⁴

At the postsecondary level, evidence about pathway models is also limited. For example, a small randomized controlled trial of some of Project Quest's training (specifically, occupational-skills training related to health care at a few community colleges in Texas) found that six years after the program, Project Quest students earned close to \$5,000 a year more than control group students. The study was small, with just over 400 participants ranging in age from 18 to 64, making it difficult to isolate the effects among young adults.⁵⁵ Another study, of the I-BEST program (which includes basic skills training in vocational courses), used a propensity-

⁴⁹Berger et al. (2013).

⁵⁰Edmunds et al. (2012).

⁵¹Lauen, Fuller, Barrett, and Janda (2017).

⁵²Werner et al. (2016).

⁵³Theodos et al. (2017).

⁵⁴Darche, Arnold, and Newhouse (2004).

⁵⁵Elliott and Roder (2017).

score matching design and found that I-BEST students stayed in community college courses at increased rates.⁵⁶

Evidence About Apprenticeships

Although there has been a lot of enthusiasm for youth apprenticeship models in the United States and such programs have grown rapidly, they are relatively new to this country and therefore there has not been much evidence that they work here. However, there have been several studies of apprenticeship programs for adults. For example, one study of Registered Apprenticeship programs, which are regulated by the Department of Labor and mainly serve adults, found a positive association between program participation and higher earnings. However, the study was unable to determine whether the program itself caused higher earnings, or whether these outcomes were related to characteristics of the participants.⁵⁷ Similarly, another study of a variety of workforce programs also found that participating in apprenticeships had positive economic benefits, but the study was not explicit about how the programs involved were defined or what populations they served.⁵⁸

One recent, large, quasi-experimental study of the long-term effects of vocational education in 11 European countries found that while participants were more likely to be employed when they were young than people who enrolled in general-education programs, later in life they were more likely to struggle to adapt to technological change and to maintain employment. The pattern of findings was most pronounced in countries that emphasize apprenticeship programs, including Germany, Denmark, and Switzerland.⁵⁹ The authors did find that one reason for the pattern was that as they grew older, people who had gone through vocational education (apprenticeship-based or of some other model) were less likely to receive additional career-related training than their counterparts with general-education backgrounds. One limitation of this study was that it only included men, who tend to be employed more continuously than women. It is not known whether the pattern holds for women.⁶⁰

Evidence About Readiness Skills Training

Although there is a growing demand for workers who can combine analytic skills with strong soft skills, there is currently little to no evidence about the effects of programs that seek to develop these skills in students and young adults.⁶¹

⁵⁶Jenkins, Zeidenberg, and Kienzl (2009).

⁵⁷Reed et al. (2012).

⁵⁸Hollenbeck (2008).

⁵⁹Hanushek, Schwert, Woessmann, and Zhang (2017).

⁶⁰Hanushek, Schwert, Woessmann, and Zhang (2017).

⁶¹Deming (2017).

Summing Up the Evidence

The most evidence exists concerning CTE course work and training. In that area there are multiple studies suggesting that participation in CTE can improve students' outcomes. In addition, multiple studies find that career-related certificates and associate's degrees are linked to increased wages, supporting the notion that one way to improve students' prospects is to encourage them to complete these kinds of credentials. Several career pathway models, particularly career academies and early college high schools, are also supported by strong, rigorous studies that provide evidence of positive benefits for students. The evidence for other models and for individual program components is weaker. These models and components probably need to be evaluated further.

Conclusion

There is a growing consensus that CTE can improve economic mobility by increasing the number of students who earn career-focused postsecondary credentials and get better-paying jobs. CTE is one of the few areas of policy that enjoys bipartisan interest, and it can attract cooperation from educators, workforce policymakers, and regional and national employers. National advocacy organizations and those focused on building the capabilities of other providers also support CTE. All of this interest has contributed to an environment of entrepreneurial innovation and zeal.

The conditions are ripe for the field to create policy changes, increase public and private investment, and grow. But there are also challenges and threats. Can regional employers and educators accurately project which sectors are likely to see economic growth? Are the K-12 and postsecondary systems nimble enough to train students in the skills employers seek? How much of a threat is automation to the labor market and CTE? Will students of color and lower-performing students have access to CTE in higher-paying sectors (such as STEM)? Will employers be able to provide enough work-based learning and apprenticeship opportunities for programs to expand to a larger scale while continuing to offer the same services? Can the political and public support for CTE be sustained? And can the evidence base be expanded to determine which CTE programs have the greatest payoffs for students, local labor markets, and employers? These risks can be mitigated by astute investments in the following areas:

1. Building regions' abilities to analyze their labor markets quickly and in a sophisticated way, so that they can align CTE with sectors of the economy likely to see economic growth.
2. Expanding the evidence base of the policies and practices associated with success, especially when it comes to how involved employers should be in course design, teaching, and internships.
3. Helping successful programs expand in way that allows them to remain faithful to their models while adapting to different labor markets and contexts.

4. Building databases and computer applications to help CTE operators manage their programs. These databases and applications should be able to report on metrics such as program participation, degree attainment, labor-market outcomes, and equity.
5. Supporting broader dissemination to inform policymakers and practitioners about the investments that are most likely to achieve their education, labor-market, and equity goals.
6. Encouraging the public to engage with intermediary organizations associated with CTE, so that these organizations can learn from and communicate with the public, and vice versa.

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