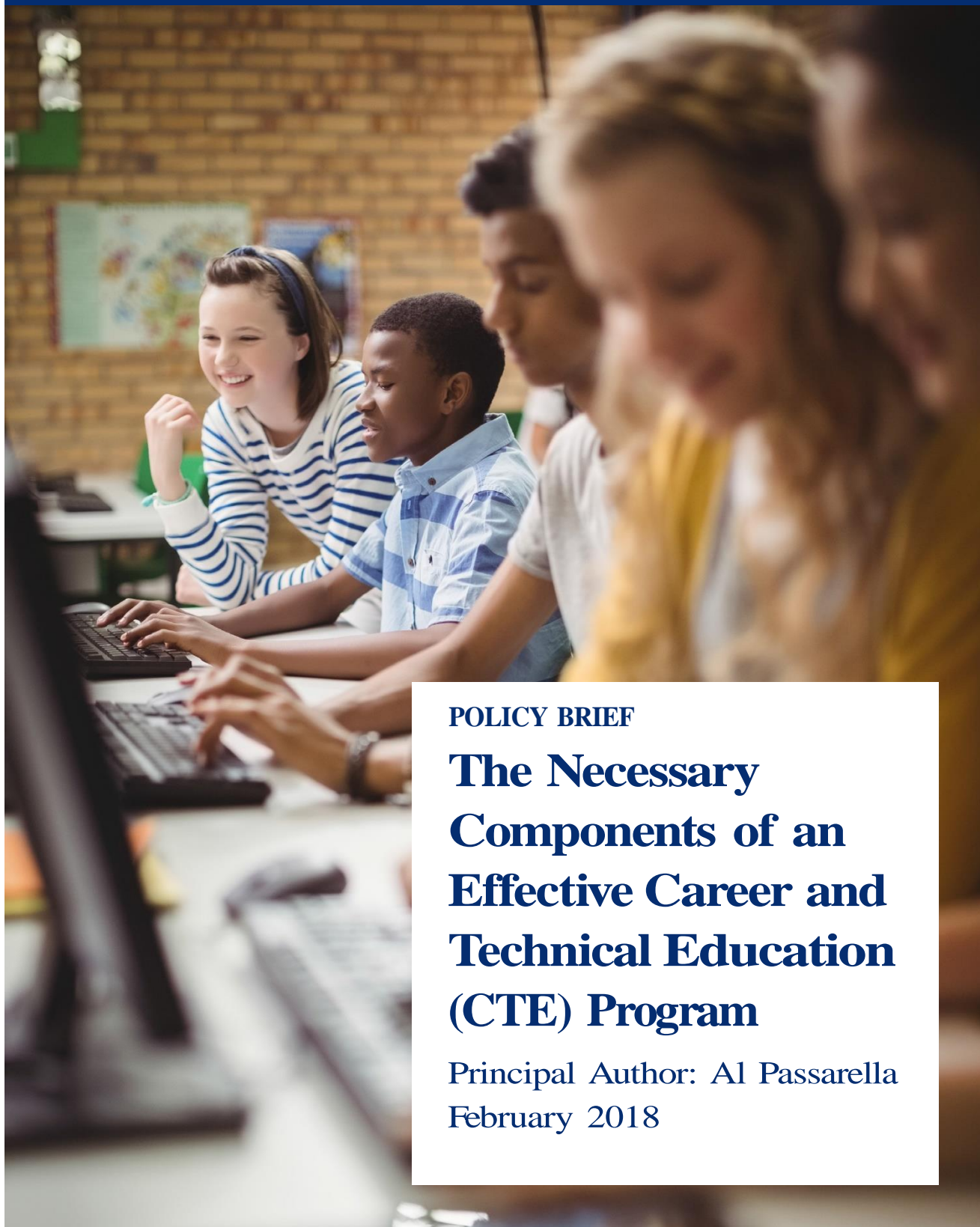




JOHNS HOPKINS
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POLICY BRIEF

The Necessary Components of an Effective Career and Technical Education (CTE) Program

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Introduction

The 21st-century economy necessitates, and rewards, *both* higher education credentials *and* skills development.¹ As such, there is a growing interest among policymakers in creating and expanding effective Career and Technical Education (CTE) programs. However, there are few research-based resources in the field to assist in guiding policy. CTE is definitionally amorphous, with multiple possible characteristics and areas of focus.² Furthermore, there is some disagreement as to whether the economy can sustain jobs that pay a median wage for skill levels that lie between strong high-school/entry level career and technical training and graduate-degree preparation.³ This report acknowledges the increased interest and the limited clarity about *what works*, and provides policymakers with the available evidence on how best to develop effective CTE programs.

Part I

Who is Enrolling in CTE? What Types of Programming Exist?

Data from the U.S. Department of Education’s Office of Career, Technical and Adult Education, indicate that slightly more than 7.4 million students are CTE participants,⁴ defined as secondary students earning at least one credit in an occupational CTE course⁵ (see Figure 1). Male enrollment in CTE courses is nearly 10 percentage points higher than female enrollment (54.1%, compared to 45.9%, respectively), with White students representing a slight demographic majority at 51.2%. Nearly one in two CTE students (46.1%) are Economically Disadvantaged.

Figure 1

Total CTE Participant Enrollment by Subgroup: SY 2014-2015		
(n= 7,406,845)		
Demographics	Total Enrollment	Percentage
Female	3,401,102	45.9%
Male	4,005,743	54.1%
African American	1,196,038	16.1%
Hispanic/Latino	1,716,138	23.2%
White	3,794,411	51.2%
Economically Disadvantaged	3,412,413	46.1%
English Language Learners	386,912	5.2%

SOURCE | 2015 U.S. Department of Education, Office of Career, Technical, and Adult Education, Consolidated Annual Report (CAR) States report data based on their definitions of CTE participant and CTE concentrator.

¹ William C. Symonds, Robert Schwartz, and Ronald F. Ferguson, “Pathways to Prosperity: Meeting the Challenge of Preparing Young Americans for the 21st Century” (Cambridge, MA: Harvard University Graduate School of Education, 2011), <https://dash.harvard.edu/handle/1/4740480>.

² Marisa Castellano et al., “Rigorous Tests of Student Outcomes in CTE Programs of Study” (Louisville, KY: National Research Center for Career and Technical Education, University of Louisville Louisville, KY, 2014), https://www.researchgate.net/profile/George_Richardson6/publication/275214131_Rigorous_tests_of_student_outcomes_in_CTE_programs_of_study_Final_report/links/553583920cf268fd0015dc95.pdf.

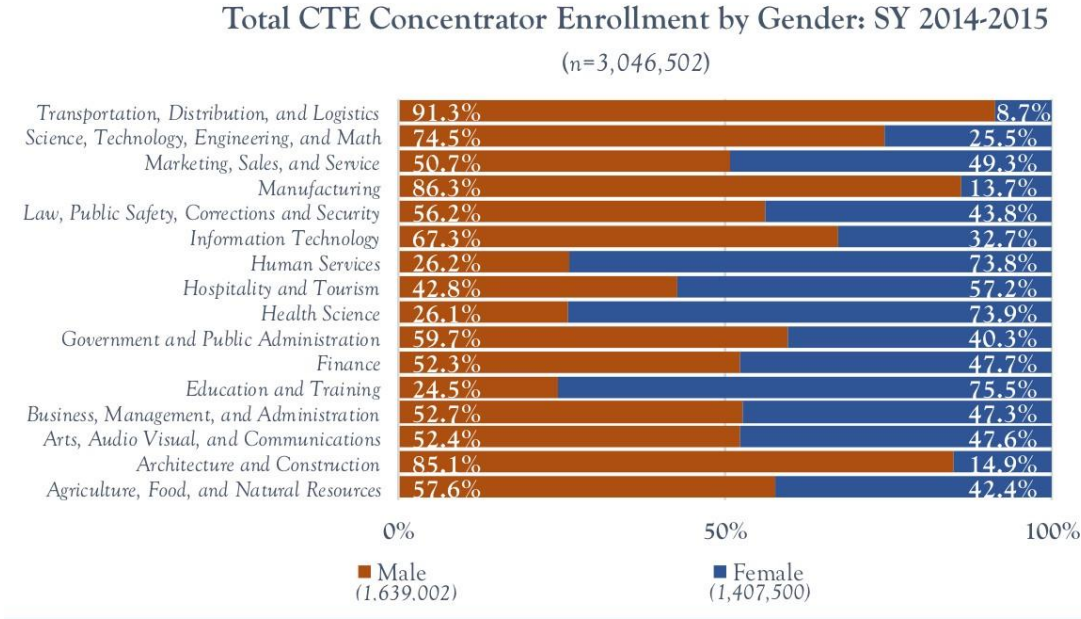
³ Eric A. Hanushek, “German-Style Apprenticeships Simply Can’t Be Replicated,” *Wall Street Journal*, June 18, 2017, sec. Opinion, <https://www.wsj.com/articles/german-style-apprenticeships-simply-cant-be-replicated-1497821588>; Thomas A. Kochan, David Finegold, and Paul Osterman, “Who Can Fix the ‘Middle-Skills’ Gap?” *Harvard Business Review*, December 1, 2012, <https://hbr.org/2012/12/who-can-fix-the-middle-skills-gap>.

⁴ 2015 U.S. Department of Education, Office of Career, Technical, and Adult Education, Consolidated Annual Report (CAR) States report data based on their definitions of CTE participant and CTE concentrator.

⁵ “National Assessment of Career and Technical Education: Final Report to Congress.” (Washington, D.C.: U.S. Department of Education, Office of Planning, Evaluation and Policy Development, Policy and Program Studies Service, 2014), <https://www2.ed.gov/rschstat/eval/sectech/nacte/career-technical-education/final-report.pdf>.

Of those 7.4 million students, 41.1% (roughly 3 million) are CTE concentrators, defined as students earning three or more credits within a single CTE pathway in one of the 16 Career Clusters (see Figure 2). Although the available CTE concentrator data set does not disaggregate by race/ethnicity or special populations, gender differences show that males account for slightly more than half (53%) of total concentrator enrollment. Female enrollment is greatest in Education and Training, comprising 75.5% of this pathway’s enrollment, followed by the Human Services (73.8% of enrollment), and Health Science (73.9% of enrollment) pathways. The Transportation, Distribution, and Logistics (91.3%), Manufacturing (86.3%), and Architecture and Construction (85.1%) pathways enroll the largest percentage of males.⁶

Figure 2



SOURCE| 2015 U.S. Department of Education, Office of Career, Technical, and Adult Education, Consolidated Annual Report (CAR) States report data based on their definitions of CTE participant and CTE concentrator.

Nationally, the most subscribed pathways are: Arts, Audio Visual, and Communications (12.3%), Business, Management, and Administration (11.5%), and Health Sciences (10.2%). Together, these three programs account for slightly more than one-third (34.1%) of all CTE concentrator enrollments.⁷ Regional labor markets help shape CTE program offerings, as evidenced by the variation in CTE pathway enrollments across states (see Figure 3). While creating regionalized labor pools is critical for economic sustainability, recent research suggest that economic prospects are best for workers in regionally neutral, skilled-service industries, such as healthcare, information technology, and financial services.⁸

⁶ 2015 U.S. Department of Education, Office of Career, Technical, and Adult Education, Consolidated Annual Report (CAR). States report data based on their definitions of CTE participant and CTE concentrator.

⁷ Ibid.

⁸ Anthony B. Carnevale et al., “Good Jobs That Pay without a B.A.” (Washington, D.C.: Georgetown University, Center on Education, and the Workforce, 2017), <https://goodjobsdata.org/wp-content/uploads/2017/05/Good-Jobs-wo-BA-final.pdf>; Sam Stringfield and James R. Stone, “The Labor Market Imperative for CTE: Changes and Challenges for the 21st Century,” *Peabody Journal of Education* 92, no. 2 (March 15, 2017): 166–79, doi:10.1080/0161956X.2017.1302209.

Figure 3

CTE Concentrator Enrollment: Regional Enrollment Comparison SY 2014-2015				
Career Cluster	California (n=346,502)	Delaware (n=9,588)	Iowa (n=52,612)	Florida (n=127,301)
Agriculture, Food, and Natural Resources	10.6%	14.1%	15.3%	7.0%
Architecture and Construction	6.3%	7.0%	10.8%	3.7%
Arts, Audio Visual, and Communications	23.7%	1.8%	0.6%	14.2%
Business, Management, and Administration	5.3%	9.0%	20.1%	6.0%
Education and Training*	5.3%	0.0%	22.4%	5.7%
Finance	2.4%	5.2%	2.2%	3.0%
Government and Public Administration	0.0%	0.0%	0.0%	0.2%
Health Science	9.6%	13.6%	3.8%	19.4%
Hospitality and Tourism	8.8%	1.6%	3.0%	9.7%
Human Services	1.3%	20.1%	0.7%	1.0%
Information Technology	5.2%	0.0%	1.3%	10.4%
Law, Public Safety, Corrections and Security	4.8%	2.0%	0.0%	3.1%
Manufacturing	2.6%	0.6%	9.0%	1.0%
Marketing, Sales, and Service	3.7%	4.6%	4.1%	2.3%
Science, Technology, Engineering, and Math	5.7%	16.3%	3.3%	9.8%
Transportation, Distribution, and Logistics	4.6%	4.1%	3.4%	3.5%

SOURCE | 2015 U.S. Department of Education, Office of Career, Technical, and Adult Education, Consolidated Annual Report (CAR) States report data based on their definitions of CTE participant and CTE concentrator.

* Education and Training cluster includes: Administration and support services, professional support services, and teacher/training services (<http://cte.ed.gov/resources/certification-crosswalk>).

Despite the increased attention to CTE, data show that CTE concentrators remain a small share of total secondary enrollment.⁹ At roughly 6%, U.S. students concentrating in CTE pathways is paltry by OECD standards: in the United Kingdom, 42% of students concentrate in CTE pathways (internationally known as vocational training), 59% in Germany, 64% in Switzerland, and 25% in Japan.¹⁰ While the vast majority of high schools (94%) in the United States offer CTE courses, only 4% of them are within specialized career/technical high schools, defined as schools in which all students participate in some form of CTE programming. In the leading OECD nations, this level of vocational and technical educational training for students is common practice, given the stronger connections between education, industry, and government in developing more robust programming.

Furthermore, data suggest that students enrolled in sequenced CTE programs in high school are more likely to come from families with lower incomes and less-educated parents, less likely to take advanced math courses in high school, and less likely to enter or complete a post-secondary educational program.¹¹ This, despite emerging evidence that the complexity of the 21st-century economy's jobs will require students graduating from CTE programs to possess both keen academic capacities and also technical skills.¹²

⁹ Dougherty, "Career and Technical Education in High School: Does It Improve Student Outcomes?" April 2016.

¹⁰ "National Assessment of Career and Technical Education: Interim Report" (Washington, D.C.: U.S. Department of Education, Office of Planning, Evaluation and Policy Development, Policy and Program Studies Service., 2013), <https://www2.ed.gov/rschstat/eval/sectech/nacte/career-technical-education/interim-report.pdf>. The 6 percent figure is an estimate of the total number of US upper secondary students for whom 25 percent or more of their total credits earned are vocational or technical related, OECD standard is for vocational or technical education programming. For US students, this equates students in grades 10-12 taking to five or six CTE credits.

¹¹ "National Assessment of Career and Technical Education: Interim Report."

¹² Anthony P. Carnevale, Tanya I. Garcia, and Artem Gulish, "Career Pathways: Five Ways to Merge College and Career" (Washington, DC: Georgetown University, Center on Education and the Workforce, 2017), <https://cew-7632.kxcdn.com/wp-content/uploads/LEE-final.pdf>; Eric A. Hanushek, "German-Style Apprenticeships Simply Can't Be Replicated," *Wall Street Journal*, June 18, 2017, sec. Opinion, <https://www.wsj.com/articles/german-style-apprenticeships-simply-cant-be-replicated-1497821588>; David Stern, "Pathways or Pipelines: Keeping High School Students' Future Options Open While

Why the disconnect? The answer may lie in how CTE has been, and continues to be, promulgated in the United States. As UC-Berkley professor David Stern notes:

The transition from 20th century vocational education to 21st century CTE is far from complete. Many high schools are still grooming some students for college and other students for work. The independent advisory panel for the 2014 National Assessment of Career and Technical Education (NACTE) observed that, “exemplary CTE programs are seen as exceptions to mainstream options. CTE is still perceived by many as an alternative to rigorous academics—a separate track for students who are not college bound.”¹³

This bifurcated system of academic and skill development has translated into many high school graduates trying to obtain a four-year bachelor’s degree, regardless of the cost or employment yield.¹⁴ According to research by James and Janet Rosenbaum,¹⁵ almost one-quarter (22%) of on-time high school graduates who begin in four-year colleges have no credentials eight years after graduation. For those students, there is no earnings payoff for their financial investment.¹⁶

Conversely, students seeking workforce entry or post-secondary credentialing outside the traditional college experience are largely underserved.¹⁷ This is evident in both the growing “skills gap” between young adults and higher-skilled (and higher-wage) employment and also in the overall decline in employment opportunities for young adults without a post-secondary credential or license.¹⁸ Furthermore, recent research suggests this curricular tradeoff better facilitates school-to-work linkages for young men rather than for young women, which likely exacerbates gender wage gaps.¹⁹

Preparing students for successful post-secondary education and career outcomes placements is a commonly articulated goal of policymakers.²⁰ Defining those successes in a real-world context, however, remains elusive.

Industry Ready or Career Ready? Competing Definitions with Recommendations on Nomenclature

The premise behind CTE is not complex: students learn skills that prepare them to meet the current needs of the labor market. As Dougherty notes, “it entails skill building for careers in fields like information

Developing Technical Skills and Knowledge,” Background paper for the Committee on The Supply Chain for Middle-Skill Jobs: Education, Training, and Certification Pathways. (Berkeley, CA: University of California, August 29, 2015), http://sites.nationalacademies.org/cs/groups/pgasite/documents/webpage/pga_167702.pdf.

¹³ Stern, “Pathways or Pipelines: Keeping High School Students’ Future Options Open While Developing Technical Skills and Knowledge,” 1.

¹⁴ James Rosenbaum et al., “The New Forgotten Half and Research Directions to Support Them” (New York, NY: William T. Grant Foundation, January 2015).

¹⁵ Rosenbaum et al.

¹⁶ James E. Rosenbaum and Caitlin Ahearn, “Florida’s College and Career Readiness Reforms: Are They Helping?” Commentary (Baltimore, MD: Johns Hopkins University School of Education’s Institute for Education Policy, June 10, 2016), <http://edpolicy.education.jhu.edu/wordpress/?p=60>.

¹⁷ Rosenbaum and Ahearn.

¹⁸ Symonds, Schwartz, and Ferguson, “Pathways to Prosperity.”

¹⁹ April Sutton, Amanda Bosky, and Chandra Muller, “Manufacturing Gender Inequality in the New Economy: High School Training for Work in Blue-Collar Communities,” *American Sociological Review* 81, no. 4 (August 1, 2016): 720–48, <https://doi.org/10.1177/0003122416648189>.

²⁰ Stern, “Pathways or Pipelines: Keeping High School Students’ Future Options Open While Developing Technical Skills and Knowledge.”

technology, aerospace engineering, health sciences, and advanced manufacturing.”²¹ At their best, CTE programs should contain the following four anchors:^{22,23}

- Student cohorts in career-themed course sequences;
- Rigorous, college-preparatory academics;
- Opportunities to earn college credits and industry-recognized credentials or certificates; and
- Work-based learning opportunities such as internships.

Research by Castellano and her colleagues suggests that industry-validated curricula resulting in an industry-specific certification or licensures – such as Programs of Study (POS), which are an aligned sequence of CTE courses that span secondary and post-secondary education that lead to an industry-recognized credential or certificate at the post-secondary level – better prepare students for entry-level employment in the workforce.²⁴ An analysis of the 2013 national CTE educator survey found that high-quality CTE programs featuring industry partnership and mentorship components can potentially enhance a student’s career readiness.²⁵ Another measure for career readiness is an individual immediate productivity within an industry.²⁶ The Association for Career and Technical Education suggests that acquiring three major skills defines career readiness:²⁷

- Core academic skills (e.g. meeting state academic standards in math and English language arts) and the ability to apply those skills in the context of the workplace;
- Employability skills (e.g. critical thinking, time management, and adaptability skills); and
- Technical, job-specific skills related to a specific career pathway (e.g. on-the-job training that leads to industry certification).

As no consensus exists, the term “industry ready” seems more apt for clearly defining career and technical education goals. While “career ready” has been the de facto term, robust CTE programming requires mastery of industry-specific skills for industry-specific work, be it a mechanical engineer, master plumber, or wind turbine service technician. Mastering these skills prepares students for industry-specific employment, which, because it is the real-world goal of most CTE programs, is a more useful term than the generic “career ready.”

²¹ Dougherty, “Career and Technical Education in High School: Does It Improve Student Outcomes?” April 2016, 2.

²² Castellano et al., “Rigorous Tests of Student Outcomes in CTE Programs of Study.”

²³ Stern, “Pathways or Pipelines: Keeping High School Students’ Future Options Open While Developing Technical Skills and Knowledge.”

²⁴ Marisa Castellano, Kirsten Ewart Sundell, and George B. Richardson, “Achievement Outcomes Among High School Graduates in College and Career Readiness Programs of Study,” *Peabody Journal of Education* 92, no. 2 (March 15, 2017): 254–74, <https://doi.org/10.1080/0161956X.2017.1302220>.

²⁵ Ilene Kantrov, “Opportunities and Challenges in Secondary Career and Technical Education” (Waltham, MA: Education Development Center, 2014), http://ltd.edc.org/sites/ltd.edc.org/files/CTE_FinalWhitePaper_0.pdf.

²⁶ Brendan McCane, “Opinion: Why Universities Are Training Industry-Ready Graduates,” *Computerworld New Zealand*, August 1, 2011, https://www.computerworld.co.nz/article/495809/opinion_why_universities_training_industry-ready_graduates/.

²⁷ “What Is Career Ready?” (Association for Career and Technical Education, 2010).

Part II

The (Limited) Research Record on Effective Programs

Although the research base is modest, several longitudinal studies have established a connection between student participation in CTE programming and either positive academic outcomes, positive career outcomes, or both. Each of the programs below exhibit key components that comprise high-quality CTE programming. Specialized regional vocational and technical high-school (RVTS) based-CTE and CTE Programs of Study yield the strongest academic outcomes, while studies of *Career Academies*, *NAF*, and *Linked Learning* demonstrate strong academic (*NAF and Linked Learning*) and career (*Career Academies*) results for academically at-risk students. Lastly, the *International Baccalaureate Career-related Programme* offers states a promising example of an academically rigorous, career prep program.

Career Academies

Pioneered in Philadelphia in 1969, *Career Academies* exists in districts throughout the country, including more than 1,200 *Career Academies* in some 500 California high schools. *Career Academies* operate as a “school-within-a-school” structure. Each academy has a career theme, such as health care, finance, technology, communications, and public service. Student cohorts receive Academy-based instruction in scheduled blocks in the morning, leaving the remainder of the day for traditional academic coursework. Academy teachers, who come from a variety academic and vocational disciplines, provided the Career-themed instruction. In most cases, student cohorts work with the same teachers, in both traditional and Academy courses, through the entirety of their high school career.

Researchers at MDRC (a social-policy, university-faculty research team in New York City) conducted an RCT (randomized control trial) evaluation²⁸ of the *Career Academies* model, measuring student outcomes at the end of the students’ projected 12th grade year.²⁹ Researchers randomly assigned 1,400 ninth-grade students across six states³⁰ and the District of Columbia to one of three conditions: enrollment in *Career Academies*, waitlisted for *Career Academies* and enrolled elsewhere, and a comparison group that was neither enrolled nor placed on a waitlist.

The analyses reveal surprising results: Students who had *Career Academies* had much stronger effects on labor market outcomes than on academic outcomes. Specifically, *Career Academies* had few impacts on academic outcomes—for example, *Career Academies* did not show a statistically significant increase in the percentage of students who graduated from high school or obtained their GED’s;³¹ there were no discernible effects found for staying in or progressing through school; and *Career Academies* students did

²⁸ Study meets WWC group design standards without reservation.

²⁹ James J. Kemple and Jason C. Snipes, “Career Academies: Impacts on Students’ Engagement and Performance in High School” (New York, NY: MDRC, March 2000), http://www.mdrc.org/sites/default/files/Career_Academies_Impacts_on_Students.pdf.

³⁰ The sample consisted of schools in each of the following states: MD, PA, FL (2), TX, and CA (3).

³¹ Note, however, that nearly all (96%) of *Career Academies* students completed secondary education within eight years of their expected graduation date, compared to 94% of the control group (Kemple & Willner, 2008). While not statistically significant, the effect size was 0.27, which is considered substantively important, based on What Works Clearinghouse calculations (See [What Works Clearinghouse Procedures and Standards Handbook](#) (Section IV. Reporting on Findings) for additional information). Further, What Works Clearinghouse rated the program’s effects [on completing school] as potential positive within the WWC’s Dropout Prevention topic area.

not show increased standardized math or reading test scores.³² However, the program produced statistically significant, positive, and sustained impacts for men on a variety of labor market outcomes.

- For example, men who participated in *Career Academies* earned 11%, or \$2,088, a year (over the eight years of follow-up) more than their non-*Career Academies* peers.
 - In addition, through a combination of increased wages, increased hours worked, and increased job stability, men in the *Career Academies* treatment group increased their real earnings by 17%, or \$3,731, per year (over eight years of follow-up).³³

These reports also show nuanced effects of the program—*Career Academies* impacted certain groups more, especially men and those at most risk for dropping out.

- For instance, the findings on increased earnings listed above were just for men— women who participated in *Career Academies* saw no impact on their labor market outcomes.³⁴ In addition, for students within the highest risk-level for school dropout, *Career Academies* produced substantial improvements in high school outcomes.³⁵
 - Specifically, these participating students were less likely to drop out of school;³⁶ more likely to complete additional credits toward graduation,³⁷ to complete more academic core courses,³⁸ to have taken three or more career or vocational courses,³⁹ and to have applied for college.⁴⁰ These findings suggest positive effects for those at highest risk of disengaging from school.^{41,42}

Specialized Regional and Technical High-School-Based CTE

Vanderbilt University professor Shaun Dougherty recently published compelling findings from a quasi-experimental⁴³ (QED) longitudinal analysis on CTE delivery in Massachusetts.⁴⁴ Massachusetts offers CTE in two distinct ways: students can either take specialized programs embedded in comprehensive high schools or attend academically selective, specialized regional vocational and technical schools (RVTS).

³² James J. Kemple, “Career Academies: Impacts on Labor Market Outcomes and Educational Attainment.” (New York, NY: MDRC, 2004), http://www.mdrc.org/sites/default/files/full_49.pdf; Kemple and Snipes, “Career Academies: Impacts on Students’ Engagement and Performance in High School.”

³³ James J. Kemple and C.J. Willner, “Career Academies: Long-Term Impacts on Labor Market Outcomes, Educational Attainment and Transitions to Adulthood” (New York, NY: MDRC, June 2008), http://www.mdrc.org/sites/default/files/full_50.pdf.

³⁴ Kemple, “Career Academies: Impacts on Labor Market Outcomes and Educational Attainment.”

³⁵ Kemple and Snipes, “Career Academies: Impacts on Students’ Engagement and Performance in High School.”

³⁶ Specifically, 21% of *Career Academies* students versus 32% of non-*Career Academies* students dropped out of high school.

³⁷ 40% of *Career Academies* students versus 26% of non-*Career Academies* students increased course completion towards graduation.

³⁸ 32% of *Career Academies* students versus 16% of non-*Career Academies* students completed academic core courses.

³⁹ 58% of *Career Academies* students versus 38% of non-*Career Academies* completed 3 or more vocational courses.

⁴⁰ Specifically, 51% of *Career Academies* students versus 35% of non-*Career Academies* students applied to college.

⁴¹ Kemple and Snipes, “Career Academies: Impacts on Students’ Engagement and Performance in High School.”

⁴² The authors urge caution when making inferences about causal relationships of the students who are at highest risk due to external factors not tested (e.g. stronger support from teachers and peers).

⁴³ QEDs use observational data, where no randomization took place, but tries to re-create randomization, as best as possible. Therefore, QED methods can provide a plausibly causal relationship between a treatment and outcome.

⁴⁴ Shaun M. Dougherty, “The Effect of Career and Technical Education on Human Capital Accumulation: Causal Evidence from Massachusetts,” *Education Finance and Policy*, October 13, 2016, 1–52, https://doi.org/10.1162/EDFP_a_00224.

The delivery of CTE instruction is the most striking difference between students enrolled in an RVTS. In a RVTS, students alternate between full-time academic courses and full-time work in their technical areas, with all students engaged in some form of CTE. Conversely, CTE students at a comprehensive high school take CTE courses as part of a normal school day, with academic classes being a mix of CTE and non-CTE students. Regarding graduation requirements, there is no difference between RVTS and comprehensive high school. As Dougherty notes:

[Students attending an] RVTS must all complete four years of English, four years of math, three years of a lab-based science, three years of history, two years of the same foreign language, one year of an arts program and five additional "core" courses such as business education, health, and/or technology.⁴⁵

As such, Dougherty sought to determine whether positive, academic impacts exist for students receiving CTE education through the RVTS model. He collected student-level data⁴⁶ for approximately 420,000 students between SY 2007-2008 and SY 2013-2014. He then compared the outcomes of students who participated in RVTS CTE programming (n=43,235) to the outcomes of students in the non-CTE (n=342,173) and Comprehensive CTE (n=31,727) control groups to determine the effectiveness of RVTS on high-school persistence, graduation, earning professional certifications, and test scores.

Dougherty employed both an ordinary least square (OLS)⁴⁷ and regression discontinuity (RD)⁴⁸ analysis method to determine effect. As he explains:⁴⁹

These dual approaches complement one another with the OLS supporting greater external validity [i.e. generalizability of results] and approximating an average treatment effect, whereas the regression discontinuity analyses have strong internal validity [i.e. evidence that a treatment caused an outcome to occur] but represent the local average treatment effect for the marginal student in an oversubscribed school.

The regression discontinuity analysis found positive effects on graduation and industry-credential attainment for students participating in CTE programming through RVTSs, relative to students in either control group. Specifically, Dougherty found:

- Admission to an oversubscribed RVTS near the acceptant threshold have substantially higher probabilities (10 percentage points) of persisting in and graduating from high school,⁵⁰ relative to their peers who just missed the offer.⁵¹

⁴⁵ <http://www.doe.mass.edu/ccr/masscore/>

⁴⁶ Dougherty collected data using the Student Information Management System (SIMS) provided by the Massachusetts Department of Elementary and Secondary Education (DESE).

⁴⁷ OLS estimates the relationship between one or more independent variables and a dependent variable.

⁴⁸ A regression discontinuity design (RDD) is "a method for estimating impacts in which candidates are selected for treatment based on whether their value for a numeric rating exceeds a designated cut-point." (Robin Jacob et al., "A Practical Guide to Regression Discontinuity" (New York, NY: MDRC, 2012), https://www.mdrc.org/sites/default/files/RDD%20Guide_Full%20rev%202016_0.pdf. The design's internal validity is comparable to randomized control trials.

⁴⁹ Dougherty, "The Effect of Career and Technical Education on Human Capital Accumulation," 13.

⁵⁰ Specifically, 80% of RVTS persisted through and graduated; compared to 70% of comparable students at traditional high school. Findings were statistically significant at the $p < .001$.

⁵¹ Shaun M. Dougherty, "New Study Finds High Quality Career and Technical Education Can Significantly Improve Student Outcomes - MassBudget," *MassBudget* (blog), May 9, 2017, http://massbudget.org/report_window.php?loc=Career-and-Technical-Education.html.

- RVTS near the acceptance threshold were also more likely (5 percentage points) to earn industry-recognized credentials,⁵² again, relative to their peers who just missed the offer.⁵³

Dougherty's findings are important for two reasons. First, the strength of his findings suggests that this model of CTE delivery can positively impact graduation and industry-recognized credential attainment. Additionally, the use of regression discontinuity, recognized as an empirically rigorous study design,⁵⁴ suggests the findings are potentially causal. Dougherty does note that the findings have limits regarding internal and external validity and urges caution in generalizing findings.⁵⁵ That said, this study offers some of the strongest evidence to date on the impact of effective delivery, and impact of, high-quality CTE programs on student academic outcomes.

CTE Programs of Study

Programs of Study, (POS), are an aligned sequence of CTE courses that span secondary and post-secondary education.⁵⁶ Upon completion, a POS should result in the acquisition of an industry-recognized credential or certificate at the post-secondary level. According the Carl D. Perkins Act (Perkins IV) of 2006, a POS must meet the following requirements:⁵⁷

- Incorporates secondary education and post-secondary education elements;
- Includes coherent and rigorous content aligned with challenging academic standards and relevant career and technical content in a coordinated, non-duplicative progression of courses that align secondary to post-secondary education;
- May include opportunity for secondary education students to gain post-secondary education credits through dual or concurrent enrollment programs or other means; and
- Leads to an industry-recognized credential or certificate at the post-secondary level or an associate or baccalaureate degree.

The National Research Center for Career and Technical Education conducted a multi-method, longitudinal, quasi-experimental (QED) study examining the impact of CTE *Programs of Study* (POS) on high school academic and technical achievement outcomes.⁵⁸ Researchers collected data on 6,638 students from three urban districts (labeled East, West, and South) across three states, over a four-year period (SY 2008-2009 to SY 2011-2012). Propensity scoring methods⁵⁹ matched program participants (n=3,356) with similar students who did not participate (n=3,102). The analysis comprised two parts: a qualitative analysis (e.g. interviews, surveys, and classroom observations) measuring student perspectives of program participation

⁵² Specifically, 8% of RVTS persisted through and graduated; compared to 3% of comparable students at traditional high school. Findings were statistically significant at the $p < .001$.

⁵³ Dougherty, "New Study Finds High Quality Career and Technical Education Can Significantly Improve Student Outcomes - MassBudget."

⁵⁴ Richard J. Murnane and John B. Willett, *Methods Matter: Improving Causal Inference in Educational and Social Science Research* (Oxford: Oxford Univ. Press, 2011).

⁵⁵ Dougherty, "The Effect of Career and Technical Education on Human Capital Accumulation," 30–32.

⁵⁶ Programs of Study, or POS, is an aligned sequence of courses spanning secondary and post-secondary education, blending rigorous academic and technical content. A true POS allows students to earn post-secondary credit while in high school and leading to an industry-recognized credential or certificate at the post-secondary level or an associate or baccalaureate degree. As such, POS's are secondary-post-secondary programs, rather than just enhanced CTE concentrators.

⁵⁷ <http://cte.ed.gov/initiatives/programs-of-study>

⁵⁸ Castellano et al., "Rigorous Tests of Student Outcomes in CTE Programs of Study."

⁵⁹ Propensity scoring is a QED method that uses observational data to create a control group so that its members are observationally like the treatment group. Researchers do this by estimating the probability that a student in the treatment group would receive the treatment, given their observable characteristics.

and a quantitative analysis estimating the effects of enrolling in POS and number of CTE credits earned on GPA and graduation. A second analysis estimated the effects of POS participation on other high school trajectories.

The findings suggest that completing a POS may boost GPA and increase the probability of graduation. Highlights of the outcomes across districts include:

- 9th grade enrollment in a POS and taking additional CTE credits improved the likelihood of graduation in the West district's intervention group (Effective Size (ES) of .12 / $p < .001$), compared to the control group.
- Completing a POS had a significant, positive effect on CTE GPA for completers in the West and South districts, compared to the control group, with substantive positive effects in the West district (.27 ES/ $p < .05$) and moderate effects in the South district (.20 ES/ $p < .05$) cohorts.
 - Castellano and her colleagues suggest the West district's strong findings may be attributable to the district's focus on advisory committee (which consist of pathway specific instructors, district CTE personnel, and business and industry partners) input, and strong relationships with higher education partners.
- High school exit survey data found POS students in both West⁶⁰ and East⁶¹ districts sought to continue their POS in a post-secondary institution. South district students did not receive an exit survey. This suggests that students who enroll in a POS may be more likely to continue their education in the same program area, potentially reaping the benefits of beginning that preparation in high school.⁶²

The overall findings are robust, with large and statistically significant positive effects, suggesting that, in certain contexts, enrolling in a POS can have a positive impact on academic and technical achievement. Given the study's lack of random design, Castellano and her colleagues urge caution when generalizing these findings in districts not closely resembling those studied.⁶³ While the primary recommendation is for districts to increase the number of CTE courses offerings, Castellano and colleagues offer two, more salient recommendations:

- The first is that districts offer CTE in POS sequences, as the findings indicate they are more impactful on student outcomes than simply taking CTE course alone; and
- Secondly, state states should consider redesigning credit-based transfer programs around modularized, career-focused certification, credential, and associate degree programs for students interested in less than a baccalaureate degree.⁶⁴

NAF Academies

NAF is a national network of education, business, and community leaders working to bridge the growing "skills gap" between young adults and higher skilled (and higher wage) employment. *NAF* aims to achieve this through its academies: small, learning communities within traditional high schools, that closely

⁶⁰ Specifically, 56.9% for the intervention group compared to 27% for the control group. This finding was statistically significant at $p < .001$ level.

⁶¹ Specifically, 63% for the intervention group compared to 44.4% for the control group. This finding was statistically significant at $p < .01$ level.

⁶² Castellano et al., "Rigorous Tests of Student Outcomes in CTE Programs of Study," 173.

⁶³ Castellano et al., 14.

⁶⁴ Castellano et al., 178.

resemble the *Career Academies* model.⁶⁵ Each *NAF* Academy features one of five “emerging” career clusters: finance, hospitality & tourism, information technology, engineering, and health sciences.⁶⁶ The *NAF* curricula, created in partnership with industry professionals, helps students acquire valuable workplace skills. Each career-themed curriculum meets industry-validated standards in effort to ensure students are learning relevant skills. In addition, *NAF* requires students to participate in internships as part of the work-based learning component. Since its inception in 1982, *NAF* has grown from one Academy of Finance in New York City to 675 academies in 36 states, as of the 2016-2017 school year.

NAF Academies have been the subject of a recent, quasi-experimental longitudinal analysis of student outcomes.⁶⁷ Researchers at ICF International collected student-and academy-level data across 10 districts for a four-year cohort, starting in SY 2011-2012. As with the above study, propensity scoring methods match participants to non-participants. Researchers then compared the outcomes of students who participated in *NAF* Academies services (n=7,367) to the outcomes of students in the control group (n=14,679) to determine the effectiveness of *NAF* on graduation rates. Highlights from the study revealed:

- Students in the *NAF* cohort were 2.9 percentage points more likely to graduate on-time than non-*NAF* students.⁶⁸ Findings were statistically significant at the $p < .001$ level.
- On-time graduation rates were also strong for Hispanic (4.2 percentage points higher) and Free and Reduced Lunch *NAF* students (4.6 percentage points). Both findings were statistically significant at $p < .001$ level. On-time graduation rates among African-American *NAF* students were 1.7 percentage points higher; however, those findings were not statistically significant.
- *NAF* students identified as at-risk of not graduating at the end of Grade 9, a critical marker for successful high school outcomes, were 4.7 percentage points more likely to graduate on time than non-*NAF* students.⁶⁹ Findings were also statistically significant at the $p < .001$.
- The pathways that produced the highest on-time graduation rates were Finance (85.4%), Health Science (83.5%), Engineering (80.0%), Information Technology (IT) (77.7%), and Hospitality & Tourism (72.7%).

The evidence supporting *NAF*’s effects on graduation is strong; however, it has limitations. Baseline data for students was unavailable prior to 9th grade, thus researchers matched students on performance at the end of Grade 9. Since this would mean treatment students had already received one year of *NAF* service, “comparisons between the *NAF* and non-*NAF* groups only describe the impact of *NAF* from the beginning of Grade 10.” Additionally, two of the ten *NAF* districts, New York City, and Miami-Dade, contained most of the sample populations. Thus, these two districts largely drive the results.

Linked Learning

Linked Learning began as an initiative of The James Irvine Foundation “that integrates college-preparatory academics, rigorous technical training, work-based learning, and supports to help students stay on track.”⁷⁰

⁶⁵ Kemple and Willner, “Career Academies: Long-Term Impacts on Labor Market Outcomes, Educational Attainment and Transitions to Adulthood.”

⁶⁶ *NAF*, “*NAF* Academy Standards,” 2015, <http://naf.org/wp-content/uploads/2015/11/standards2015.pdf>.

⁶⁷ Jing Sun and Samantha Spinney, “Transforming the American High School Experience: *NAF*’s Cohort Graduation Rates from 2011–2015” (Fairfax, VA: ICF International, May 22, 2017).

⁶⁸ Specifically, 79.2% of *NAF* students versus 76.3% of non-*NAF*.

⁶⁹ Specifically, 59.8 % of *NAF* students versus 55.1% of non-*NAF*.

⁷⁰ Linked Learning Alliance, “The Linked Learning Advantage Talking Points,” 2017, <http://www.linkedlearning.org/wp-content/uploads/2017/06/Talking->

Starting with a cohort of nine California school districts in 2009, Linked Learning is now available in more than 100 districts in California and serves roughly 65,000 students.

Linked Learning designs pathways around industry-sector themes such as engineering, health care, performing arts, and law and can take place in small, stand-alone schools or pathways within larger, more comprehensive high schools. Each pathway consists of four core components:⁷¹

- Rigorous academics that prepare students to succeed in college;
- Career and technical education courses in sequence, emphasizing real-world applications of academic learning;
- Work-based learning that provides exposure to real-world workplaces and teaches professional skills needed to thrive in a career; and
- Comprehensive support services to address individual needs of all students, ensuring equity of access, opportunity, and success.

Intertwined industry themes encourage collaboration between academic and career and technical education teachers to design interdisciplinary projects. A variety of models deliver programming, including the *California Partnership Academies*, *Career Academies* (see above), *NAF* academies (see above), charter schools, and small-themed schools. Pathways receive certified status if they attain a certain level of fidelity among the four core *Linked Learning* components, based on an external review by a *Linked Learning* partner.⁷² To facilitate and coordinate implementation and expansion, the Irvine Foundation created the *Linked Learning Alliance*. A consortium of education, industry, and community organizations who partner with district, post-secondary, industry, and community partners, the *Linked Learning Alliance* works to develop a range of communications, policy, curriculum, and technology resources to support *Linked Learning* pathways.⁷³

To date, *Linked Learning* has been the subject of one robust quasi-experimental research evaluation. A longitudinal analysis of *Linked Learning* conducted by the Center for Education Policy at SRI International finds positive outcomes associated with district participation in *Linked Learning*.⁷⁴ The evaluation consists of two parts: (1) a qualitative analysis of interviews, document and news reviews, and site visits to measure student perceptions, and (2) a quantitative analysis of secondary and post-secondary educational outcomes. Researchers then compared the original *Linked Learning* District Initiative⁷⁵ (n=25,892 students) to a non-random, traditional school control group (n= 21,646), matched for observable characteristics, during a seven-year period. The study's key findings include the following:

- On average, *Linked Learning*—certified pathway students were less likely to drop out of school and more likely to graduate than their peers in traditional high schools.⁷⁶

Points-for-LL-Y7-Report.pdf.

⁷¹ M. Warner and K. Casparly, *Access & Equity in Linked Learning: A Report on Pathway Access and Academic Outcomes for Traditionally Underserved Students* (Menlo Park, CA: SRI International, 2017), http://www.linkedlearning.org/wp-content/uploads/2017/03/LL_AccessEquity_2017Mar1.pdf.

⁷² Miya Warner et al., "Taking Stock of the California Linked Learning District Initiative: Seventh-Year Evaluation Report." (Menlo Park, CA: SRI International, Center for Education Policy, 2016), vii, <http://www.linkedlearning.org/wp-content/uploads/2017/02/LinkedLearningYear7Evaluation.pdf>.

⁷³ Linked Learning Alliance, "About the Linked Learning Alliance | Linked Learning Alliance," accessed July 10, 2017, <http://www.linkedlearning.org/en/linked-learning-alliance/>.

⁷⁴ Warner et al., "Taking Stock of the California Linked Learning District Initiative: Seventh-Year Evaluation Report."

⁷⁵ For the Linked Learning cohort, the sample size features two categories: certified pathway students (n=5,061) and noncertified pathway students (n=20,831).

⁷⁶ Specifically, researchers report a reduced likelihood of school dropout is 2 percentage points ($p<.05$) and graduate likelihood is 5.3 percentage points

- Compared to peers, *Linked Learning* students were more likely to report that a counselor or other adult encouraged them to pursue post-secondary education opportunities.⁷⁷
- *Linked Learning* students reported higher subsequent job quality (e.g. employment with paid vacation and sick time and health insurance) than their traditional high school peers.
- Among African Americans who enrolled in a post-secondary institution, students who completed a certified *Linked Learning* pathway were more likely to enroll in a four-year college than their peers. This finding was statistically significant.⁷⁸
- English language learners in certified *Linked Learning* pathways earned 11.7 more credits—equivalent to more than two courses—and one more college-prep requirement than their peers in traditional high school programs.
- On average, students who entered certified *Linked Learning* pathways with low prior achievement were more likely to graduate high school and more likely to enroll in a four-year institution than their peers in traditional high school programs.

This information offers insight to how the *Linked Learning* experience positively shapes post-secondary outcomes. That said, the evidence, while strong, is not definitive. The study’s design does not control for unobserved and unmeasured characteristics of students, such as motivation and parental support. Thus, the analysis is unable to determine whether unobserved characteristics differ between pathway and traditional high school students. For this reason, Warner and her colleagues note, the “findings cannot conclusively determine whether pathway participation improved high school outcomes for students.”⁷⁹

International Baccalaureate Career-related Programme

The *International Baccalaureate Career-related Programme* (IBCP) offers a promising example of an academically rigorous, career and technical education curriculum. IBCP launched in 2012 and is currently available in 94 high schools across the United States. IBCP students begin the program at the start of their two years of high school. The framework for IBCP consists of three components:⁸⁰

- Career-related studies from a provider such as Business and Technology Education Council (BTEC), Project Lead the Way, and other approved providers in pathways such as health science, hospitality, and IT.
- A minimum of two courses from the *International Baccalaureate Diploma Programme*; and
- IBCP core – the study of an additional language, service learning, personal and professional skills, and a reflective project (an in-depth body of work produced over an extended period).

(p<.01). For logistic models, researchers transformed the estimates into probabilities to present in the main report. Please see methodology on page A-20 and Exhibit A-12 on page A-22.

⁷⁷ Specifically, *Linked Learning* students were 11 percentage points more likely to report positive encouragement. For logistic models, researchers transformed the estimates into probabilities to present in the main report. Please see survey analysis on pages A38-A40 and exhibit 6-5 on page 85.

⁷⁸ Specifically, researchers report African American *Linked Learning* students were 12.4 percentage points more likely to enroll in four-year colleges. Statistical significance is at the p<.01 level. For logistic models, researchers transformed the estimates into probabilities to present in the main report. Please see methodology on page A-20 and Exhibit A-20 on page A-30.

⁷⁹ Warner et al., “Taking Stock of the California *Linked Learning* District Initiative: Seventh-Year Evaluation Report,” A-20.

⁸⁰ <http://www.ibo.org/programmes/career-related-programme/>

As with the *Diploma Programme* (DP), IBCP is subject to the same quality control standards. Per the *Career-related Programme: From Principles into Practice* guidebook's career-related study criteria:

- Career-related studies must be part of the student's timetable during the two-year period of the CP;
- Accreditation/recognition must meet at least one of the following options:
 - A government body recognizes the studies and assessment plan;
 - An awarding body recognizes the studies and assessment plan;
 - An appropriate employer organization or a professional body accredits/recognizes the studies and assessment plan; or
 - A further/higher education institution recognizes the studies and assessment plan; and
- The career-related study is subject to a demonstrable form of external quality assurance.⁸¹

Although the IBCP has not yet been subject to a robust research evaluation, a recent self-evaluation of the program shows promise. IB researchers analyzed student records (n=542) from the National Student Clearinghouse (NSC) to determine patterns of enrollment, persistence, and equity of access in higher education for IBCP graduates from 2013-2105.⁸² The analysis found:

- The majority IBCP graduates (87%) attended two-or-four-year post-secondary institutions full-time, with 84% continuously doing so without any gaps.
- IBCP students immediately enrolled in four-year institutions at higher rates than U.S. secondary school graduates in 2014 (59.6% compared to 43.7%).
- Overall, once IBCP graduates enrolled in a post-secondary institution, almost all (89%) return for their sophomore year, which is 17 percentage points higher than the national average (72% in 2014).
- African-American IBCP graduates enroll in a two-or-four-year post-secondary institution immediately following graduation at 6.4 percentage point (77.7%) higher than the national average for African-American students (71.3% in 2013).⁸³
 - Hispanic IBCP graduate enroll in a two-or-four-year post-secondary institution immediately following graduation at 4.2 percentage points (77.7%) higher than the national average for Hispanic students (71.3% in 2013).

The analysis offers insights into how IBCP prepares students for post-secondary education. Though promising, the evidence is not definitive. The study does not compare IBCP student outcomes to student outcomes in similar programs. Thus, the analysis is unable to determine how IBCP compares with a POS, for example. Secondly, the analysis only examines student enrollment and persistence in post-secondary institution. The analysis does not, for example, examine whether students are continuing to pursue their CTE studies at these institutions or if students acquired jobs in their fields of study. Based on these limitations, IBCP will require future research and evaluation to thoroughly examine the model's impact

⁸¹ Phillip Evans, "Requirements for IBCP," September 19, 2017.

⁸² Lori Mack, Olivia Halic, and Emma Burd, "Career-Related Programme Graduates in Higher Education," IB Global Research snapshot (Bethesda, Md.: International Baccalaureate, March 2017), <http://www.ibo.org/globalassets/publications/ib-research/cp-research-us-graduates-2017-en.pdf>.

⁸³ According to footnote six of the report, "Figures for the national cohort are taken from U.S. Department of Education, Digest of Education Statistics 2015, table 302.43. Immediate enrollment includes only individuals who enroll in higher education by October of the year they complete high school.

on academic and career outcomes. That said, these statistics bear enough evidence to further explore potential facilitation and implementation of IBCP.

The Future Economy: Forecasting Workforce Demands from Different Viewpoints

There is little debate that computers will displace some human workers in the future economy. This process has been taking place over the past several decades; computers have already replaced some occupations, such as book-keepers and telephone operators, and the process continues today.⁸⁴ However, while there is near-universal recognition that increasingly sophisticated computers will replace some human workers, there is disagreement about the effect this will have on future human employment.

One side of the debate is the view expressed by former U.S. Treasury Secretary Lawrence Summers, who wrote, “The economic challenge of the future will not be producing enough. It will be providing enough jobs.”⁸⁵ Indeed, this concern was expressed in the 1930’s by the economist John Maynard Keynes.⁸⁶ Those who subscribe to this view worry that there will not be enough jobs created in the future to compensate for the jobs that computers take over and they envision a future of high unemployment.

On the other side of the debate are people who believe that automation will create new occupations. Supporters of this view note that the labor market has dramatically changed over time—agricultural occupations, for example, have dropped from roughly 72% in 1820 to less than 2% of the population by 2010⁸⁷—and yet employment always re-centers on new occupations. Job creation, they hold, is a perpetual activity. Proponents of this view predict a future in which humans continue to work with computers and (as yet) unimaginable jobs are created.⁸⁸

Much of the debate about the role of computers and humans in the workforce of the future, however, exists at an abstract level. The discourse primarily refers to general trends in the future, as opposed to identifying the specific jobs at stake.

In contrast, the Bureau of Labor Statistics (BLS) releases employment projections for each of their pre-defined industries over a ten-year period.⁸⁹ Per these projections, approximately 9 out every 10 new jobs added between 2016 and 2026 will be in sectors that provide services. Further, of the approximately 11.5 million new jobs BLS forecasts from 2016 to 2026, 4.4 million will be in the healthcare support, healthcare practitioners and technical occupations. Indeed, the BLS projects that these two sectors will be the fastest growing, accounting for roughly one-fifth of new jobs over this period.

⁸⁴ Timothy F. Bresnahan, “Computerisation and Wage Dispersion: An Analytical Reinterpretation,” *The Economic Journal* 109, no. 456 (June 1999): 390–415, <https://doi.org/10.1111/1468-0297.00442>.

⁸⁵ Lawrence H. Summers, “Lawrence H. Summers on the Economic Challenge of the Future: Jobs,” *Wall Street Journal*, July 7, 2014, sec. Special, <http://www.wsj.com/articles/lawrence-h-summers-on-the-economic-challenge-of-the-future-jobs-1404762501>.

⁸⁶ John Maynard Keynes, “Economic Possibilities for Our Grandchildren,” in *Essays in Persuasion*, Norton Paperback (New York: Norton, 1963), 358–73.

⁸⁷ Federal Reserve Bank of St. Louis, “‘Tis the Season for Adjustment: What Difference Does Seasonality Make in the Unemployment Rate over Time? | FRED Blog,” *FRED Blog*, July 27, 2017, <https://fredblog.stlouisfed.org/2017/07/tis-the-season-for-adjustment/>; AP, “Farm Population Lowest Since 1850’s,” *The New York Times*, July 20, 1988, <http://www.nytimes.com/1988/07/20/us/farm-population-lowest-since-1850-s.html>.

⁸⁸ For examples of this view, see: Melody Guan, “Rise of the Robotic Workforce,” *Harvard Political Review*, August 26, 2015, <http://harvardpolitics.com/online/rise-robotic-workforce/>; Daniela Rus, “The Robots Are Coming,” *Foreign Affairs*, June 16, 2015, <https://www.foreignaffairs.com/articles/2015-06-16/robots-are-coming>; David Dorn and David H. Autor, “How Technology Wrecks the Middle Class,” *Opinionator*, 1377369308, <https://opinionator.blogs.nytimes.com/2013/08/24/how-technology-wrecks-the-middle-class/>.

⁸⁹ Bureau of Labor Statistics, “Occupational Outlook Handbook: 2016-2017 Edition” (Washington DC: U.S. Department of Labor, Bureau of Labor Statistics, January 30, 2018), <https://www.bls.gov/ooh/>.

Figure 4 (see below) displays the BLS's 15 fastest growing occupations. Note that only one of the 15 occupations, home health aides, has no formal education requirement; three occupations (physical therapist aides, ambulance drivers and attendants, and occupational therapy aides) typically require a high school diploma or equivalent; four occupations typically require some college or post-secondary education, but not a bachelor's degree (wind turbine service technicians, occupational therapy assistance, physical therapy assistance, and commercial divers); and the final seven occupations typically require a Bachelor's degree or more education.

While understanding the fastest-growing occupations is important, it is equally important to juxtapose this measure with the absolute number of jobs. Figure 5 (below) shows which occupations will produce the most jobs, in absolute numbers. Most of these occupations will require no formal education, with few requiring post-secondary degree awards (e.g. a state recognized credential). While there is little overlap between the two, projections call for significantly more home health aides, with no formal education, as opposed to wind turbine service technicians, which require some post-secondary education.

Figure 4

Occupation	Fastest Growing Occupations, 2016-2026				
	Number of jobs		Change	Median wage	Typical education needed
	2016	2026	%		
Solar Photovoltaic Installers	11,300	23,100	105%	\$39,240	High-school diploma or equivalent
Wind turbine service technicians	5,800	11,400	96%	\$52,260	Postsecondary non-degree award
Home health/Personal care aides	2,927,600	4,136,400	41%	\$22,170	High-school diploma or equivalent
Physician assistants	106,200	145,800	37%	\$101,480	Master's degree
Nurse practitioners	203,800	268,000	31%	\$107,460	Master's degree
Statisticians	40,300	53,800	33%	\$81,950	Master's degree
Physical therapist assistant/aide	140,300	183,000	31%	\$45,290	Associate's degree
Software developers	1,256,200	1,558,700	31%	\$102,280	Bachelor's degree
Medical Assistant	634,400	818,300	29%	\$31,540	Postsecondary non-degree award
Genetic Counselors	3,100	4,000	29%	\$74,120	Master's degree
Occupational Therapy Assistant /Aide	46,800	60,000	28%	\$56,070	Associate's degree
Information Security Analysts	100,000	128,500	28%	\$92,600	Bachelor's degree
Physical therapist	239,800	306,900	28%	\$85,400	Doctoral or professional degree
Fire Inspectors	14,100	15,500	27%	\$56,130	High-school diploma or equivalent
Massage therapist	160,300	201,978	26%	\$39,860	Postsecondary non-degree award

Source | U.S. Bureau of Labor Statistics. Notes: Median annual wage in 2016 dollars.

Figure 5

Occupation	Most New Jobs, 2016-2026				
	Number of jobs		Change	Median wage	Typical education needed
	2016	2026			
Home health/Personal care aides	2,927,600	4,136,400	777,600	\$22,170	High-school diploma or equivalent
Food prep and serving workers (including fast food)	5,122,600	5,702,500	579,900	\$19,630	No formal educational credential
Registered Nurse	2,955,200	3,393,300	438,100	\$68,450	Bachelor's degree
Software developers	1,256,200	1,558,700	302,500	\$102,280	Bachelor's degree
Janitors and cleaners (excluding housekeepers)	2,360,600	2,597,100	236,500	\$24,190	No formal educational credential
General and operations managers	2,572,000	2,765,100	193,100	\$103,950	Bachelor's degree
Laborers and material movers	3,932,000	4,203,100	271,100	\$24,800	No formal educational credential
Medical assistant	634,400	818,300	183,900	\$31,540	Post-secondary non-degree award
Construction laborers	1,449,400	1,629,900	180,500	\$32,230	No formal educational credential
Nursing assistant	1,564,600	1,742,300	177,700	\$26,590	State-approved education program (i.e. CTE pathway)
Restaurant cook	2,403,000	2,550,600	147,600	\$22,850	No formal educational credential
Accountants and auditors	1,397,700	1,537,600	139,900	\$68,150	Bachelor's degree
Market research analyst	595,400	733,700	138,300	\$62,650	Bachelor's degree
General maintenance and repair workers	1,432,600	1,545,100	112,500	\$36,940	High-school diploma or equivalent

Source | U.S. Bureau of Labor Statistics. Notes : Median annual wage in 2016 dollars.

In contrast with BLS's projections, another research team predicts which jobs computers are most likely to displace humans in the future. Frey and Osborne⁹⁰ note that, while computers can increasingly substitute for many human tasks, there are three kinds of tasks in which humans are inherently stronger than computers: occupations that require *heavy use of perception and manipulation tasks*,⁹¹ *creative intelligence tasks*,⁹² and *social intelligence tasks*.⁹³ These are less likely to become computerized within the next decade. Based on this theory, the researchers estimate a probability of computerization for each of the BLS's 702 occupations.⁹⁴ Their findings suggest that certain occupations are more susceptible to computerization than others. For example, recreational therapists, healthcare social workers, elementary school teachers, and human resources managers are less likely to be computerized; whereas real estate brokers, cashiers, payroll clerks, insurance appraisers, and telemarketers have a great likelihood of computerization.

To better understand what their findings mean for workers with various levels of education, Frey and Osborne also plot the average skill level of workers within a given occupation (measured by the fraction of workers that have obtained a bachelor's degree or higher within each occupation) and the probability of computerization. They find a strong negative relationship between education and the probability of computerization. This means that the researchers predict that computerization will mainly substitute low-skill (and low-wage) jobs soon, while high-skill (and high-wage) jobs are the least susceptible to computerization.

Part III

CTE Abroad: Effective International Models and Their Applicability to the United States

By comparison with the United States, CTE programs in other countries are far more robust systems and link to larger economic goals, especially in Switzerland, Denmark, and Germany. CTE, referred to as vocational education and training (VET) internationally, generally begins in late high school and continues for three years, with students combining work-based learning with classroom study provided by career or technical schools, that are like community colleges in the U.S. Below is a brief description of career and technical education in these three countries, followed by a consideration of their applicability within the U.S. educational structure.

Switzerland

The Swiss model is a “dual” system that integrates rigorous academic training with technical, work-based learning. Serving nearly 70% of all students ages 16-19,⁹⁵ most VET programs consist of part-time

⁹⁰ Carl Benedikt Frey and Michael A. Osborne, “The Future of Employment: How Susceptible Are Jobs to Computerisation?” *Technological Forecasting and Social Change* 114, no. Supplement C (January 1, 2017): 254–80, <https://doi.org/10.1016/j.techfore.2016.08.019>.

⁹¹ For example, manipulating and handling of different irregular objects or identifying many irregular objects and defining their properties in a cluttered environment.

⁹² The literature defines creativity as “the ability to come up with ideas or artifacts that are novel and valuable”.

⁹³ For example, tasks that include negotiation, persuasion, and care.

⁹⁴ Frey and Osborne, “The Future of Employment,” 269–78.

⁹⁵ Nancy Hoffman and Robert Schwartz, “Gold Standard: The Swiss Vocational Education and Training System. International Comparative Study of Vocational Education Systems.” (Washington, D.C.: The National Center on Education and the Economy, 2015), <https://eric.ed.gov/?id=ED570868>.

classroom instruction combined with a part-time apprenticeship at a host company.⁹⁶ The less common, full-time VET program consists entirely of classroom instruction (i.e. no apprenticeship). Trade schools or commercial schools generally offer full-time VET programs.⁹⁷

VET programs focus upon industry themes (e.g. human services, health sciences, information technology, as well as traditional trades and crafts). Students take coursework at VET schools one to two days per week and attend their apprenticeships at the host company for the remainder. Students receive compensation for training, with monthly pay ranging from \$600- \$700 initially and increasing to \$1,100- \$1,200 by the third year.⁹⁸ In addition, students may take complimentary, industry-specific courses at third-party training centers, typically with the host company or industry. When students complete the apprenticeship, they have a nationally recognized credential and the opportunity to move directly into full-time employment or further their education within the Swiss high-specialized university system.⁹⁹

Unlike the U.S., compulsory education in Switzerland ends at ninth grade, or “lower-secondary school.”¹⁰⁰ Before that point, students receive education per a national, common curriculum. This provides Swiss students entering VET with a strong academic foundation,¹⁰¹ as evidenced by Swiss performance on the most recent (2015) Program for International Student Assessment (PISA). Switzerland is among the top performing Organization for Economic Cooperation and Development (OECD) nations:¹⁰² first in Europe in math scores (521) and significantly above in the average for nations in the in science (502) and¹⁰³ literacy (492). Furthermore, students receive dedicated support and guidance when exiting compulsory education. Community-based guidance centers assist students in understanding the VET model, which career options are available, and whether students understand VET program expectations. According to the National Center on Education and the Economy “Students can access career interest inventories, get help with resume writing and portfolio development, and sample prospective apprenticeship sites.”¹⁰⁴

Switzerland’s VET system has contributed to several impressive outcomes:¹⁰⁵

- A youth unemployment rate of 8.6%, among the lowest rates in all 30 OECD countries (compared to 10.4% in U.S.);¹⁰⁶
- 30% of VET graduates go on to attain further higher education via the Swiss Professional Education and Training (PET) or Universities of Applied Sciences college degree, or Advanced Federal PET diploma; and

⁹⁶ “ACVT Workshop: Best Practice in VET: Switzerland” (Swiss Confederation: Federal Department of Economic Affairs, Education, and Research, State Secretariate for Education, Research, and Innovation, January 7, 2013), http://ec.europa.eu/dgs/education_culture/repository/education/opportunities/vocational/documents/swiss_en.pdf

⁹⁷ “ACVT Workshop: Best Practice in VET: Switzerland.”

⁹⁸ Hoffman and Schwartz, “Gold Standard.”

⁹⁹ Unlike the broad liberal arts model common in the U.S., Swiss university students focus on few, highly-specialized professions, such as lawyer, doctor, or scientific or mathematical research.

¹⁰⁰ In Europe, “Lower secondary school” is roughly the equivalent to junior high school in the U.S.

¹⁰¹ Hoffman and Schwartz, “Gold Standard.”

¹⁰² OECD, “PISA 2015: Results in Focus” (Paris: Organisation for Economic Co-operation and Development, December 2016), <https://www.oecd.org/pisa/pisa-2015-results-in-focus.pdf>.

¹⁰³ 2015 OECD averages are as follows: Math (490), Reading (493), Science (493)

¹⁰⁴ Hoffman and Schwartz, “Gold Standard,” 8.

¹⁰⁵ Jamie Traffic, “Swiss Apprenticeships – A Model for Colorado,” *Colorado Succeeds* (blog), February 22, 2016, <http://www.coloradosucceeds.org/blog/swiss-apprenticeships-a-model-for-colorado/>.

¹⁰⁶ “Unemployment - Youth Unemployment Rate - OECD Data,” Organization for Economic Cooperation and Development, 2016, <http://data.oecd.org/unemp/youth-unemployment-rate.htm>.

- Apprenticeship graduates earn an average of 30% more than individuals in equivalent professions without an apprenticeship.

Germany

Germany has a well-established system of vocational education and training. As with the two previous models, the centerpiece of the German VET is the strong alignment between educational institutions, employers, and policymakers; working together on developing curricula and meeting labor market demands.¹⁰⁷ According to the OECD, “VET is provided at upper secondary and post-secondary non-tertiary (university) levels, and dual programs are offered in more than 300 trades, with an exit exam for the dual system that does not count school performance.”¹⁰⁸

German states are the primary drivers of education systems. As with the Swiss and Danish models, German compulsory education laws require students to attend school through age 15. While both the Danish and Swiss models track students, the German model is explicitly rigid, with tracking starting at age 10, compared to the OECD average of 14.¹⁰⁹ The model offers students one of three different tracks:¹¹⁰

- *Gymnasium* (Typically eight years of university-prep school training);
- *Realschule* (A six-year combination of an academic curriculum and an option of vocational training or technical college, leading to apprenticeship or vocational career); and
- *Hauptschule* (Comprehensive school that prepares students for vocational training and work).

Germany has high post-compulsory education enrollment rates, with nearly 87% of students enrolled in the equivalent of a post-secondary institution, compared with the OECD average of 82%. Like the Swiss and Danish models, German VET programs combine work-based and in-school training, lasting approximately three years. A second, entirely school-based training model also exists, with students receiving work placements. The most recent enrollment figures (2016) show that slightly more than half (49%) enroll in the VET system, with many students (43%) enrolled in the dual system that combines school-based and work-based education.¹¹¹ Both models conclude with students earning nationally recognized, industry qualifications. The major difference between the two is the cost-sharing arrangements. In the first version, companies pay for most of the training and the apprentice wages; in the second, state governments pay for the training in schools.¹¹² While many VET students pursue further education (e.g. master craftsmen’s certificates; company-based “train the trainer” certification),¹¹³ the German VET system offers little opportunity for upper-secondary VET students to move into post-secondary education, despite recent efforts to create more VET-to-tertiary education pathways.¹¹⁴

¹⁰⁷ OECD, “Education Policy Outlook- Germany” (Paris, France: Organisation for Economic Cooperation and Development (OECD), 2014), http://www.oecd.org/edu/EDUCATION%20POLICY%20OUTLOOK%20GERMANY_EN.pdf.

¹⁰⁸ OECD.

¹⁰⁹ OECD.

¹¹⁰ “NCEE | Germany Overview,” accessed August 21, 2017, <http://ncee.org/what-we-do/center-on-international-education-benchmarking/top-performing-countries/germany-overview/>.

¹¹¹ OECD, “Education Policy Outlook- Germany.”

¹¹² Rose Jacobs, “Germany’s Apprenticeship Scheme Success May Be Hard to Replicate,” *Financial Times*, April 21, 2017, <https://www.ft.com/content/1a82e8e0-04cf-11e7-aa5b-6bb07f5c8e12>.

¹¹³ Tamar Jacoby, “Why Germany Is So Much Better at Training Its Workers,” *The Atlantic*, October 16, 2014, <https://www.theatlantic.com/business/archive/2014/10/why-germany-is-so-much-better-at-training-its-workers/381550/>.

¹¹⁴ “Vocational Education and Training in Germany Strengths, Challenges and Recommendations” (Organisation for Economic Co-operation and Development (OECD), 2010), <https://www.oecd.org/education/skills-beyond-school/45938559.pdf>.

From a United States perspective, the German VET, while promising, is not easily transportable. Despite some of the highest average PISA scores among OECD nations,¹¹⁵ “nearly a quarter of those who enter training courses only qualify for “prevocational” training, a fallback that leaves many unprepared for anything other than unskilled, unstable, poorly paid jobs.”¹¹⁶ Furthermore, the German model relies heavily on the state to regulate industry standards. Per a 2014 *Atlantic* article on the German VET, “the standardized occupational profiles, or curricula, are developed by the federal government in collaboration with employers, educators, and union representatives (another missing element in the U.S.).”¹¹⁷ Thus, VET students learn multiple methods within an industry, offering the student a transferable set of skills should they chose to switch companies. Such collaborative partnerships are rare in the United States, thus making replication of such an arrangement, on a large scale, difficult to envision.

Denmark

Like Switzerland, Denmark operates a “dual” system, with students alternating between work-based and school-based learning. The Danish VET model is a hybrid between Germany and Switzerland’s dual system and the school-based models of other Nordic countries (e.g., Sweden and Finland). According the USDOE’s Office of Career, Technical and Adult Education’s *U.S. Denmark Partnership for Vocational Education*, “[in] the Danish VET system there is more theoretical teaching than [other European] VET programs. Conversely, there is far more [work-based learning] than in the Swedish system; for example, this makes up 15% of the training period, compared with 60-75% in Denmark.”¹¹⁸

Compulsory schooling serves students through age 16, culminating in ninth grade. After ninth grade, nearly all students (80%) enter an upper-secondary (youth-education) program,¹¹⁹ either general upper secondary education or vocational programs.¹²⁰ Vocational training typically lasts four years, and students attend vocational college for a maximum of 80 weeks. Students spend the majority (roughly two-thirds) of their time in work-based learning with one or more Danish Trade Committee approved companies.¹²¹ The general education portion comprises the remaining programmatic learning time, in which students learn a mix of general knowledge and intra-professional, or soft, skills. Recent research by Jørgensen notes that “around one-third of each youth cohort in Denmark completes an apprenticeship in the dual system of VET, although this share has been declining during the last decade.”¹²² Like the Swiss model, the Danish model features high alignment between companies, government, and technical colleges, working collaboratively to develop programs that meet industry standards.¹²³

¹¹⁵ 2015 German scores (former compared to OECD averages (latter) are as follows: Math (506/490), Reading (509/493), Science (509/493).

¹¹⁶ Jacobs, “Germany’s Apprenticeship Scheme Success May Be Hard to Replicate.”

¹¹⁷ Jacoby, “Why Germany Is So Much Better at Training Its Workers.”

¹¹⁸ “U.S. Denmark Partnership for Vocational Education,” Abstracts; Conference Papers/Proceedings; Programs; Projects, September 12, 2008, <https://www2.ed.gov/about/offices/list/ovae/pi/usdnmrk/dksys.html>.

¹¹⁹ “60% of Danish students enter in the optional 10th grade year. The 10th grade is intended as an option for young people in need of further academic competence and clarification regarding their future choices before entering youth education (either general or vocational upper secondary education).” - European Centre for the Development of Vocational Training, ed., *Vocational Education and Training in Denmark: Short Description* (Luxembourg: Publications Office of the European Union, 2012), 15.

¹²⁰ OECD, “Education Policy Outlook-Denmark” (Paris, France: Organisation for Economic Cooperation and Development (OECD), 2014), https://www.oecd.org/edu/EDUCATION%20POLICY%20OUTLOOK%20DENMARK_EN.pdf.

¹²¹ “U.S. Denmark Partnership for Vocational Education.”

¹²² Christian Helms Jørgensen, “From Apprenticeships to Higher Vocational Education in Denmark – Building Bridges While the Gap Is Widening,” *Journal of Vocational Education & Training* 69, no. 1 (January 2, 2017): 64, <https://doi.org/10.1080/13636820.2016.1275030>.

¹²³ European Centre for the Development of Vocational Training, *Vocational Education and Training in Denmark*.

Once regarded as one the most effective models for vocation education,¹²⁴ the Danish model is beginning to show fissures. Over the last decade, VET enrollment fell from nearly 50% to below 30%. The quality of programming, however, does not appear to have declined.¹²⁵ Rather, the problem is a growing perception that vocational education is a “dead end” that closes the opportunities for progression to higher education.¹²⁶ Furthermore, the Danish system has seen a shifting in academic credentials required for upper-tier programs. Consider the following example of *Teknikum* engineering program, once closely aligned with the technical school:

The *Teknikum* engineering education is an example of how this process has taken place. The *Teknika* were separated from the vocational schools, and all, except one, have been integrated into the universities. Due to this vertical segmentation, the recruitment base of the *Teknika* (now ‘Diploma engineers’) has shifted from the apprenticeship system to the gymnasiums [academic upper secondary programs] and the learning environment has become characterized by the academic culture. In the Danish transition system, the value of vocational qualifications has been reduced, and academic qualifications have become the main currency for vertical mobility in the education system.¹²⁷

This shift has negatively impacted the perception of the vocational training program. Perhaps unsurprisingly, as students who would have previously attended VET programs enroll in academic upper schools, the latter are experiencing higher dropout rates, with academic upper school graduates persistently underemployed or unemployed.¹²⁸ Declining recruitment to apprenticeships is troubling to Danish policymakers. As in the U.S., Danish labor market forecasts predict a serious shortage of skilled labor within the next decade.¹²⁹ Innovative programming, such as the *eux-programme* – a hybrid pathway that integrates eligibility for higher education with a certificate for employment as a skilled worker – is one attempt by Danish policymakers to improve the image of VET while meeting short- to mid-term labor market demands.¹³⁰

Contextual Relevance for the United States

For all their important merits, these international programs cannot yet be directly translated into the American context. First, in Switzerland, Germany, and Denmark, high alignment exists between education, industry, and government both at the national and local level. Unlike most CTE programs in U.S., employers and trade associations are deeply involved in supporting and developing VET programs. For instance, these stakeholders ensure that “quality control for industry standards are met, determining when new occupational programs need to be developed to take account of projected changes in the economy, and existing programs need to be closed or radically revised.”¹³¹ Likewise, in Switzerland, to become certified as an VET instructor, an individual must successfully complete a government-specified,

¹²⁴ Nancy Hoffman, “Let’s Get Real: Deeper Learning and the Power of the Workplace,” Deeper Learning Research Series (Boston, MA: Jobs for the Future; Harvard Graduate School of Education, 2015), <https://eric.ed.gov/?id=ED559676>.

¹²⁵ Hoffman and Schwartz, “Gold Standard.”

¹²⁶ Jørgensen, “From Apprenticeships to Higher Vocational Education in Denmark – Building Bridges While the Gap Is Widening.”

¹²⁷ Jørgensen, 77–78.

¹²⁸ Hoffman and Schwartz, “Gold Standard.”

¹²⁹ Jørgensen, “From Apprenticeships to Higher Vocational Education in Denmark – Building Bridges While the Gap Is Widening.”

¹³⁰ Christian Helms Jørgensen, “Recent Innovations in VET in Denmark—Responses to Key Challenges for VET” (Roskilde, Denmark: Roskilde University, Department of Psychology & Educational Studies, 2015), http://nord-vet.dk/indhold/uploads/report1c_dk.pdf.

¹³¹ Hoffman and Schwartz, “Gold Standard,” 10.

industry approved training program.¹³² Although interest in scaling and replicating these models in the U.S. has increased,¹³³ actionable movement on that front to date has been modest.

Secondly, economies in these countries are more specialized than that of the broad and diverse United States' economy. All three countries, particularly Switzerland, "benefit from a highly-developed service sector and a manufacturing industry that specializes in high-technology, knowledge-based productions."¹³⁴ Additionally, the German and Danish models are largely dependent on heavily regulated and unionized labor markets; an economic model that is mostly absent in the U.S.¹³⁵

Lastly, the cost of such comprehensive programming will give policymakers and industry leaders pause. In Germany for instance, costs range from \$25,000 to \$80,000 per apprentice. The costs in the U.S. would likely be considerable greater, given the need to build and design these programs from the ground up. The aforementioned *Atlantic* article on the German apprentice model puts this into perspective:

The apprenticeship program at the Siemens USA plant in Charlotte, North Carolina reportedly spends some \$170,000 per apprentice. And even the most generous policy proposals on the table in Washington would cover only a fraction of these costs. In the U.S., as in Germany, the lion's share will fall to business.¹³⁶

All that said, there are efforts underway to pilot these models at the state level. Starting in the fall 2017, Colorado will implement the Swiss-inspired, pilot CTE program *CareerWise Colorado*. Financed with \$9.5 million in start-up funding from Bloomberg Philanthropies and JP Morgan Chase, the public-private collaboration utilizes the Swiss "dual system, "where students split their school day between work-based and classroom learning. The initial cohort of 250 junior and senior high school students will partner with 17 companies in technology, financial services, advanced manufacturing, and hospitality. Participants will earn a training wage and credit toward high school graduation and post-secondary credentials.¹³⁷ Following graduation, students complete one additional year of apprenticeship, which will prepare students to enter the workforce or continue their education at a community or four-year college.¹³⁸ The program aims to recruit and train 1,000 high school students and place them with 500 employers by 2020.¹³⁹

Similarly, the *Pathways in Technology Early College High School* (P-TECH) model shares the dual enrollment and industry alignment characteristics found in the three European models. P-TECH is part early college and part industry-recognized certification, designed to provide students a seamless transition to post-secondary education by connecting education with employment for "new-collar," 21st century careers.¹⁴⁰

¹³² Marc Tucker to David Steiner, "CTE - Switzerland and Montgomery County," September 6, 2017.

¹³³ Kathy Gurchiek, "U.S.-Swiss Collaboration Planned for Apprenticeships," Society for Human Resource Management, July 7, 2015, <https://www.shrm.org/resourcesandtools/hr-topics/talent-acquisition/pages/us-swiss-apprenticeships.aspx>; "U.S. Denmark Partnership for Vocational Education."

¹³⁴ Central Intelligence Agency, "The World Factbook — Switzerland," August 1, 2017, <https://www.cia.gov/library/publications/the-world-factbook/geos/sz.html>.

¹³⁵ Eric Hanushek, "Emulating Germany's Apprenticeship System Won't Make America Great Again," *Huffington Post* (blog), June 23, 2017, http://www.huffingtonpost.com/entry/germany-apprenticeship-america-trump_us_594be9ebe4b0a3a837be16b5.

¹³⁶ Jacoby, "Why Germany Is So Much Better at Training Its Workers."

¹³⁷ Emilie Rusch, "\$9.5 Million in Grants Back Apprenticeship Program for Colorado High School Students," *The Denver Post*, September 15, 2016, <http://www.denverpost.com/2016/09/15/9-5-million-grants-apprenticeship-program-for-colorado-high-school-students-careerwise/>.

¹³⁸ Rusch.

¹³⁹ <http://www.mdrc.org/project/careerwise-colorado-study#agenda-scope-goals>

¹⁴⁰ Ginni Rometty, "We Need to Fill 'new Collar' Jobs That Employers Demand: IBM's Rometty," *USA TODAY*, December 13, 2016, sec. Opinion, <https://www.usatoday.com/story/tech/columnist/2016/12/13/we-need-fill-new-collar-jobs-employers-demand-ibms-rometty/95382248/>.

Launched in 2011, the original P-TECH is a private-public collaboration between NYC DOE, The City University of New York (CUNY), New York City College of Technology (City Tech), and IBM. The model operates on a grade 9-14 system in which students enroll at P-TECH for six years and earn both a high school diploma and an associate degree.¹⁴¹ Students take core courses found in traditional high schools, as well as courses toward earning an Associates in Applied Science (AAS) in either computer systems technology or electromechanical engineering technology. Students in the program take college courses at no additional expense, which includes tuition, books, and fees. Additionally, the program provides opportunities for paid internships, mentorships, and job shadowing.

Since its initial launch, the P-TECH model has expanded. Chicago partnered with IBM, Cisco, Microsoft, Motorola, and Verizon to open five P-Tech High Schools in SY 2012-2013,¹⁴² which recently witnessed the first cohort of early graduates complete their A.A.S in 2017. Two Baltimore City high schools just completed their first year of implementation, with the Maryland Department of Education expanding the program to suburban Washington, D.C., and the state's rural Eastern Shore for SY 2017-2018. Texas has also shown interest in adopting the model, with 2017 legislation authorizing \$5 million in planning grants so that Texas districts can begin developing P-Tech models.¹⁴³

Only one cohort has completed the full six years, so the available evidence on student outcomes is necessarily constrained. Nevertheless, the early figures suggest that the P-Tech model may offer a potentially promising return on investment. Of the original cohort of 97 students, 54 (56%) finished their high school and associate degree early, including 18 students from the 2012 cohort. Of those who completed early, eight took jobs directly with IBM, 25 students are currently pursuing a bachelor's degree, and 15 others are applying to four-year colleges.¹⁴⁴ With regard to college readiness standards, "Brooklyn's P-TECH high school graduates are on the whole among the most college-ready in [New York] city, according to IBM data: 90 percent of black high school graduates and 88 percent of all students met the state's college readiness benchmarks, placing the school in the 84th percentile citywide."¹⁴⁵

Part IV

Strengthening Standards: Building More Meaningful CTE Programming

Thus far, the evidence suggests that, aside from possibly raising students' interest in staying in school and doing some academic work, taking a course or two in CTE for a couple of hours a week won't do much for job preparation or for academics. States, policymakers, and educational leaders should not sacrifice quality and content for quantity when developing CTE programming. It is equally important that they incentivize the participation of industry partners to ensure that programming is tightly integrated with real-world, commercial standards.

¹⁴¹ "The 9-14 School Model / Home," accessed May 2, 2017, <http://www.ptechnyc.org/domain/43>.

¹⁴² Joanne Jacobs, "Chicago High School/College Hybrids to Offer College, Job Training," US News & World Report, March 16, 2012, <https://www.usnews.com/education/best-colleges/articles/2012/03/16/chicago-high-schoolcollege-hybrids-to-offer-college-job-training>.

¹⁴³ Maressa Nicosia, "Texas Next Stop for P-TECH, Popular High-School-to-Career Program Born in Brooklyn," Education News, www.the74million.org, May 30, 2017, <https://www.the74million.org/article/texas-next-stop-for-p-tech-popular-high-school-to-career-program-born-in-brooklyn>.

¹⁴⁴ Maressa Nicosia, "After Six Years, Brooklyn's P-TECH to Graduate First Class as the Model Expands Worldwide," Education News, www.the74million.org, March 2017, <https://www.the74million.org/article/after-six-years-brooklyns-p-tech-to-graduate-first-class-as-the-model-expands-worldwide>.

¹⁴⁵ Nicosia.

Ideally, states would adopt the Swiss model of CTE education: strong standard curricula with high minimum goals for academic achievement; assessment at the end of 10th grade conferring achievement; and a path into full-time CTE or upper academic tracts.¹⁴⁶ As previously mentioned, there are significant barriers to fully implementing Swiss-style CTE, including cost, resistance to student tracking, and a strong, standardized academic curriculum principal among them. That said, if the goal of CTE is to develop an industry-ready workforce possessing the knowledge and skills for industry-specific tasks, enhancing CTE programming to meet Programs of Study standards offers a practical way to achieve this.

An ideal full CTE program rests on a structure built for grades 10-14: integrated on-the-job and course work preparation; meaningful assessment after two years; an additional two years spent in part at a technical or community college leading to a credential or certification. Federal mandate, as noted above, require POS's to provide many of these traits. In practice, however, earning early college credit or an industry-recognized certificate in most CTE programs doesn't always ensure college-readiness or fully meeting industry standards for entry-level employment. That said, if the goal of CTE is to develop an industry-ready workforce possessing the knowledge and skills for industry-specific tasks, states and districts do have practical options available.

To achieve better academic outcomes, states could borrow from the Swiss model and build strong 10th-grade assessments (at minimum in Math and ELA) that determine which students are ready for the rigorous academic work required for a strong CTE program or for rigorous academic course work leading to four-year degree program readiness.¹⁴⁷ Prior to 10th grade, the system would generate early-warning indicators for students who were off-track for graduating from high school on time. In turn, this would trigger intense summer and after-school programs and in-class interventions for those so identified.¹⁴⁸ Massachusetts's use of the OECD's PISA examination as a quality indicator is one approach states could adopt to developing strong, 10th grade assessments.¹⁴⁹

Additionally, states should ensure that all CTE (including POS) program design and assessments – both for the first two years and the second two years – are in close concert with the relevant industries, and that the industries sign-off on the final assessment as signaling full job-readiness or readiness for further training. For example, officials from the Delaware Department of Education, higher education, and industry worked together to select CTE career areas for *Delaware Pathways* programming (see below). The partnership analyzed labor data to forecast which sectors were fast-growing, required some postsecondary training, and provided livable wages. The partners then designed a course of study (including assessments) that would develop the skills necessary for entry-level employment into these fields.

Furthermore, states and districts can employ a variety of unique mechanisms to enhance the quality of CTE programming:

¹⁴⁶ Hoffman and Schwartz, “Gold Standard.”

¹⁴⁷ Hoffman and Schwartz.

¹⁴⁸ Ann-Marie Faria et al., “Getting Students on Track for Graduation: Impacts of the Early Warning Intervention and Monitoring System after One Year” (Washington, DC: U.S. Department of Education, Institute of Education Sciences, National Center for Education Evaluation and Regional Assistance, Regional Educational Laboratory Midwest., April 2017), <http://ies.ed.gov/ncee/edlabs>; Robert Balfanz, Lisa Herzog, and D.J. MacIver, “Preventing Student Disengagement and Keeping Students on the Graduation Path in Urban Middle-Grades Schools: Early Identification and Effective Interventions.,” *Educational Psychologist* 42, no. 4 (2007): 223–35.

¹⁴⁹ Jacqueline Reis, “Massachusetts Students Score among World Leaders on PISA Reading, Science and Math Tests,” Massachusetts Department of Elementary and Secondary Education, December 6, 2016, <http://www.doe.mass.edu/news/news.aspx?id=24050>.

- *Adopt strong national standards*— The *Common Career Technical Core* (CCTC) is a “a state-led initiative to establish a set of rigorous, high-quality standards for CTE.”¹⁵⁰ Forty-two states,¹⁵¹ the District of Columbia, and the federal territory of Palau supported the development of the CCTC standards. Participating state and district working groups of industry experts, educational leaders, and researchers developed a universally recognized set industry and educational CTE benchmarks. The standards define what knowledge and abilities students should possess upon completing a POS for each of 16 Career Clusters and their corresponding pathways.¹⁵²
- *Incentivize districts to go above minimum standards*— Massachusetts designates specific programs that surpass federal Perkins standards as *Chapter 74*¹⁵³ approved programs.¹⁵⁴ The object of *Chapter 74* is to develop public-private partnerships designed to keep training relevant and offer programming consistent with local labor-market demands.¹⁵⁵ Programs that meet more stringent requirements receive additional state funding.
- *Ensure seamless transition to post-secondary education* — Two ways states can promote post-secondary credentialing are: 1) formalized, statewide credit transfer agreements between secondary and post-secondary institutions and 2) the utilization of early-college high school frameworks. Delaware and South Carolina are examples of states with strong credit transfer agreements. Participating students in Delaware’s *Pathways* program (see below) are eligible to transfer earned college credits to any of the state’s two or four-year institutions. Similarly, students participating in South Carolina’s *Youth Apprenticeship Carolina* (see below) can transfer any earned credits to schools within the South Carolina Technical College system.

Early college programs often are “schools within a school,” offering a wide-ranging curriculum of college and high school course work woven into a single program. The best of example of this is the P-TECH model (see above), where students enroll in a comprehensive, six-year CTE program, that concludes with the student earning both a high school diploma and an Applied Associates of Science degree. The advantage here is that students ease into college course work starting in high school, with all college credits earned automatically transferred to the partnering post-secondary institution.

- *Provide financial incentives to entice industry participation*— *Youth Apprenticeship Carolina*, the youth component of South Carolina’s *Apprenticeship Carolina* program, uses tax credits to entice public-private partnership.¹⁵⁶ The program, which combines on-the-job training at the workplace and job-related technical instruction at a local community or technical college, offers employers a tax credit of \$1,000 for every apprentice hired from the program.¹⁵⁷ Since the program’s inception in 2007, the percentage of employers offering apprenticeships has expanded by over 873% (from

¹⁵⁰ “The Common Career Technical Core | Advance CTE,” accessed September 7, 2017, <https://careertech.org/cctc>.

¹⁵¹ The complete list of states is available here: <https://careertech.org/CCTC-states>

¹⁵² https://cte.careertech.org/sites/default/files/CCTC_Standards_Formatted_2014.pdf

¹⁵³ Chapter 74 refers specifically to the Massachusetts General Law Chapter 74, which governs vocational education: <https://malegislature.gov/Laws/GeneralLaws/PartI/TitleXII/Chapter74>

¹⁵⁴ <http://www.doe.mass.edu/cte/>

¹⁵⁵ Dougherty, “The Effect of Career and Technical Education on Human Capital Accumulation.”

¹⁵⁶ Alan Berube and Joseph Parilla, “Building One of America’s Fastest-Growing Apprenticeship Programs: A Q&A with Brad Neese of Apprenticeship Carolina | Brookings Institution,” *The Avenue: Brookings Institution* (blog), April 7, 2015, <https://www.brookings.edu/blog/the-avenue/2015/04/07/building-one-of-americas-fastest-growing-apprenticeship-programs-a-qa-with-brad-neese-of-apprenticeship-carolina/>.

¹⁵⁷ Joseph Parilla, Jesus Leal Trujillo, and Alan Berube, “Skills and Innovation Strategies to Strengthen U.S. Manufacturing: Lessons from Germany” (Washington, DC: Brookings Institution; Metropolitan Policy Program, 2015), <https://www.brookings.edu/wp-content/uploads/2016/06/LessonsFromGermany.pdf>.

90 in 2007 to 876 in 2016),¹⁵⁸ with one in three employers offering apprenticeships in more than one occupation.¹⁵⁹

- *Provide professional development and training for CTE instructors*— Alabama’s *CTE Teacher Certification Program* provides pedagogical training to CTE program-specific instructors credentialed through alternative certification.¹⁶⁰ Completed during the instructors’ first classroom year, the program provides teaching and classroom management training, with instruction taking place during school hours. Additionally, program participants receive mentorship from an expert instructor who provides coaching and guidance during the first year. Instructors who successfully complete the program and meet the state’s other requirement qualify for a five-year Bachelor’s Equivalent Technical Education license.
- *Ensure statewide recognition of credentials* —New York State has adopted a pathway to high school graduation that combines a core academic program with industry-approved experience, demonstrated knowledge, and skill development in relevant industry domains. The *Career Development Occupational Studies* pathway (CDOS) provides students with an opportunity to graduate with an enhanced high school diploma that signifies demonstrated career and industry readiness. To cite the state regulations:

“The requirements are rigorous in that the student must receive instruction that supports the achievement of the CDOS learning standards through access to career and technical education (CTE) coursework and have opportunities to engage in school supervised work-based learning experiences, either in school and/or in the community. In addition, students must participate in career planning and preparation and have an employability profile demonstrating readiness for entry-level employment.”¹⁶¹

The CDOS commencement credential is a NYS Board of Regents- endorsed certificate, which conveys that the holder possesses the knowledge and skills necessary for entry level employment.¹⁶² In addition to meeting the New York State standards for a high school diploma (including replacing the World History Regents exam requirement¹⁶³), students seeking the CDOS commencement credential must complete the following activities:

- *Develop a Career Plan* - The Career plan must contain the student’s self-identified career interests; career-related strengths and needs; career goals; and career and technical coursework and work-based learning experiences that the student plans to engage in to achieve those goals.

¹⁵⁸ “Apprenticeship Carolina,” accessed May 9, 2017, <http://www.apprenticeshipcarolina.com/by-the-numbers.html>.

¹⁵⁹ Angela Hanks and Ethan Gurwitz, “How States Are Expanding Apprenticeship,” *Center for American Progress* (blog), 2016, <https://www.americanprogress.org/issues/economy/reports/2016/02/09/130750/how-states-are-expanding-apprenticeship/>.

¹⁶⁰ “The State of Career Technical Education: Increasing Access to Industry Experts in High Schools” (Washington, D.C.: Center on Great Teachers & Leaders at the American Institutes for Research, December 2016), https://cte.careertech.org/sites/default/files/files/resources/State_of_CTE_Industry_Experts_2016_0.pdf.

¹⁶¹ Angelica Infante-Green, “Career Development Occupational Studies Graduation Pathway Option,” New York State Department of Education, June 2016, <http://www.p12.nysed.gov/ciai/multiple-pathways/memos/cdos-graduation-pathway-option.html>.

¹⁶² <http://www.p12.nysed.gov/ciai/gradreq/Documents/CurrentDiplomaCredentialSummary.pdf>

¹⁶³ CDOS students may meet the fifth assessment required for graduation by passing a Department-Approved Pathway Assessment in Career and Technical Education (CTE) following successful completion of a CTE program: <https://www.nysut.org/resources/special-resources/sites/research-and-educational-services/articles/multiple-pathways-to-graduation-changes-to-part-100>

- *Demonstrate competency* - CDOS students must demonstrate competency across three learning areas – career development, integrated learning, and universal foundation skills.¹⁶⁴ Students must also complete 216 hours of CTE coursework and/or work-based learning experiences (of which a minimum of 54 hours must be in work-based learning experiences).
- *Complete (at least) one employability profile* - The profile documents the student’s achievement and knowledge, as it relates to employability skills and experience and attainment of each of the CDOS learning standards. If applicable, students must also demonstrate attainment of technical knowledge and work-related skills, work experiences, performance on industry-based assessments, and other work-related and academic achievements.

Implications for Perkins Reauthorization

The primary sources of federal CTE funding to states and approved grantees are The *Carl D. Perkins Career and Technical Education Act* (Perkins), and to a lesser degree, the *Workforce Innovation and Opportunity Act* (WIOA). Perkins funding is tasked with “developing more fully the academic, career, and technical skills of secondary and post-secondary students who elect to enroll in career and technical education program. WIOA includes specific funding for addressing the educational needs of “opportunity youth”—those young people who are neither in school nor working.”¹⁶⁵

The last congressional reauthorization of Carl D. Perkins Vocational and Technical Education Act occurred 12 years ago with the Carl D. Perkins Act of 2006 (“Perkins IV”), which was in place through 2012. Since then, states and grantees have relied on short-term resolutions. This changed on July 31st, 2018, when the *Strengthening Career and Technical Education for the 21st Century Act* (Perkins V) became law. With an effective date of July 1, 2019 and a commitment of roughly \$1.3 billion over six years, states are now able to submit CTE transition plans to cover requirements for the July 2019 - June 2020 program year; four-year plans will likely be due sometime in early 2020.¹⁶⁶

Perkins V largely maintains the structure of Perkins IV, with some significant changes to the implementation of CTE programs and certain administrative processes.¹⁶⁷ Among the most noteworthy changes, states are free to create academic performance goals for CTE programs without U.S. Secretary of Education approval.¹⁶⁸ The elimination of the negotiation process leaves the determination of performance targets for CTE largely up to states and CTE stakeholders, a departure from previous iterations of Perkins. Furthermore, Perkins V has removed restrictions that previously barred states from developing career exploration and activities in the middle grades,¹⁶⁹ and has provided federal funding to develop

¹⁶⁴ CDOS students may also work toward developing competencies in one of six career majors: Business/Information systems; Health Services; Engineering/Technologies; Human and Public Services; Natural and Agricultural Sciences; and Arts/Humanities.

¹⁶⁵ Clive R. Belfield, Henry M. Levin, and Rachel Rosen, “The Economic Value of Opportunity Youth,” *Corporation for National and Community Service*, 2012, <http://eric.ed.gov/?id=ED528650>.

¹⁶⁶ Jarrod Nagurka, “President Signs New Perkins Law,” *CTE Policy Watch: A Blog for CTE Advocates* (blog), August 1, 2018, <http://ctepolicywatch.acteonline.org/>.

¹⁶⁷ Advance CTE and Association for Career and Technical Education, “Perkins V: Strengthening Career and Technical Education for the 21st Century Act” (Advance CTE, July 2018), https://cte.careertech.org/sites/default/files/PerkinsV_One-Pager_082418.pdf.

¹⁶⁸ Andrew Ujifusa, “Donald Trump Signs First Major Education Policy Bill of His Presidency - Education Week,” *Education Week*, July 31, 2018, <https://www.edweek.org/ew/articles/2018/07/31/donald-trump-signs-career-technical-education-bill.html>.

¹⁶⁹ The *Every Student Succeeds Act* (ESSA) defines middle grades as being between fifth and eighth grades. Previous iterations of Perkins restricted funding for activities below seventh grade.

comprehensive guidance and academic counseling in the upper grades, for all students, regardless of CTE participation.¹⁷⁰ In addition to those changes, other potentially influential changes to the law include:¹⁷¹

- *Revisions to the local application for eligible entities to request CTE funds* - The most noteworthy change to the local application is the introduction of a comprehensive, local, CTE needs assessment. The assessment requires applicants to use a data-driven decision-making approach on local CTE spending and involves significant stakeholder consultation and a minimum bi-annual update. Furthermore, each assessment must include reviews of the following items:
 - Student achievement on the performance targets, including reporting on special populations (e.g. homeless individuals, foster youth, youth with a parent(s) that are active duty in the armed forces) and demographic subgroups;
 - Updates on the implementation of new CTE pathways and Programs of Study and whether they are of sufficient size, scope, and quality to meet both student and labor market needs;
 - Localized efforts to recruit, retain, and train CTE instructors, including underrepresented groups; and
 - Progress toward equal student access to high-quality CTE courses and Programs of Study.
- *The introduction of formal definitions for “CTE Concentrator” at the secondary and postsecondary level*- Previously, states established definitions for the term CTE Concentrator, with up to nine accepted terms circulated among states.¹⁷² Perkins V establish a national standard by defining a CTE Concentrator as “a student who completes at least two courses in a single program or program of study.”¹⁷³ For post-secondary programs, a CTE Concentrator is now defined as “a student who earns 12 credits in a single CTE program or program of study or completes a CTE program if that program encompasses fewer than 12 credits.”¹⁷⁴
- *The elimination of the technical skill attainment measure as part of the Secondary Core Indicators of Performance*- Perkins V requires states to measure “CTE program quality,” by reporting on of the following three measures: the percentage of students participating in work-based learning; the percentage of students attaining postsecondary credits their CTE program/program of study; or the percentage of students attaining postsecondary credential.
- *Updates to the federal-to-state Perkins funding formula*- Perkins V ensures that states receive no less than their FY 2018 funding levels, so long as overall funding does not receive cuts. For FY 2021 and beyond, states shall receive no less than 90% of their allotment from the preceding fiscal year.¹⁷⁵

¹⁷⁰ USDOE, Office of Career, Technical, and Adult Education, “Strengthening Career & Technical Education for 21st Century Act Signed,” *ED. Gov Blog* (blog), August 2, 2018, <https://blog.ed.gov/2018/08/strengthening-career-technical-education-21st-century-act-signed-law/>.

¹⁷¹ Association for Career and Technical Education, “Strengthening Career and Technical Education for the 21st Century Act (Perkins V): Legislative Summary & Analysis” (Washington DC, August 6, 2018), https://www.acteonline.org/wp-content/uploads/2018/08/AdvanceCTE_ACTE_P.L.115-224Summary_Updated080618.pdf.

¹⁷² “National Assessment of Career and Technical Education: Final Report to Congress.” (Washington, D.C.U.S. Department of Education, Office of Planning, Evaluation and Policy Development, Policy and Program Studies Service, 2014), <https://www2.ed.gov/rschstat/eval/sectech/nacte/career-technical-education/final-report.pdf>.

¹⁷³ Association for Career and Technical Education, “Strengthening Career and Technical Education for the 21st Century Act (Perkins V): Legislative Summary & Analysis.”

¹⁷⁴ Association for Career and Technical Education, 5.

¹⁷⁵ Glenn Thompson, “H.R.2353 - 115th Congress (2017-2018): Strengthening Career and Technical Education for the 21st Century Act,” Pub. L. No. H.R. 2353/ S.3217 (2018), <https://www.congress.gov/bill/115th-congress/house-bill/2353>.

- *A five percent increase (from 10 to 15 percent) in the amount states may place in CTE Reserve Funds-* The reserve fund is a funding mechanism that allows states to set aside a percentage of Perkins funds to target specific initiatives on a competitive basis. To be eligible for these funds, initiatives must meet the following criteria: focus on rural areas or areas with high numbers or percentages students in CTE programs. Furthermore, the law adds a third group eligible to receive reserve funds: geographic areas with significant achievement gaps or disparities in student performance.

Another legislative plan that would bolster H.R.2353, the *Leveraging and Energizing America's Apprenticeship Programs* (LEAP) bill (H.R. 3061), encourages companies to use apprenticeship programs by extending federal tax credits. Effectively a federal version of the South Carolina apprenticeship tax credit (see above), the legislation would amend the IRS code of 1986 to extend tax credits of up to \$1,500 for each apprentice hired under the age of 25 (over the age of 25 is \$1,000), for up to two taxable years. As of June 2017, the bill is with the House Ways and Means committee,¹⁷⁶ with current projections suggesting the bill has little to no chance of passage.¹⁷⁷

President Trump's 2017 Executive Order¹⁷⁸ to expand apprenticeship programs in high schools could potentially change the CTE secondary landscape. According to a June 2017 *EdWeek* report, "the order would allow trade associations, labor unions, industry, and third-party training providers to set their own standards and criteria for apprenticeship programs and then seek expedited approval from the Labor Department."¹⁷⁹ The Order will redirect \$90 million in funding from The ApprenticeshipUSA program to cover the cost of the expansion. Additionally, the administration will also seek similar funding amounts for next year, in addition to the administration's request that Congress to provide \$100 million in workforce development spending.¹⁸⁰ Furthermore, the Executive Order seeks to reduce the financial aid barriers that currently bar students from using aid outside of specific circumstances.¹⁸¹

While these measures suggest an expansion of CTE funding, the President's fiscal 2018 budget offers a mixed message on the level of prioritization CTE receives. For instance, the administration is reportedly seeking an additionally \$100 million from Congress for workforce development while the budget reflects a 40% decrease (from \$2.7B to \$1.6B) in job training grants funded by WIOA.¹⁸² Likewise, the administration seeks to expand the use of financial aid (which would require congressional approval) while budgeting a \$140 million in cuts to the student loan program and failing to extend inflation-adjusted provisions for the Pell Grant.¹⁸³ The president's budget calls for \$168 million in budget cuts to state

¹⁷⁶ Tom Reed, "H.R.3061 - 115th Congress (2017-2018): LEAP Act," webpage, June 26, 2017, <https://www.congress.gov/bills/115/congress/house-bills/3061>.

¹⁷⁷ "LEAP Act (H.R. 3061)," GovTrack.us, accessed September 5, 2017, <https://www.govtrack.us/congress/bills/115/hr3061>.

¹⁷⁸ "Presidential Executive Order Expanding Apprenticeships in America," whitehouse.gov, June 15, 2017, <https://www.whitehouse.gov/the-press-office/2017/06/15/presidential-executive-order-expanding-apprenticeships-america>.

¹⁷⁹ Catherine Gewertz, "Trump Wants More Apprenticeships—Starting in High School - Education Week," *Education Week*, June 21, 2017, 1.

¹⁸⁰ Currently, financial aid may only be under the following conditions: Only for programs eligible under federal law: higher education institutions or post-secondary vocational institution; exclusive to programs leading to associates, bachelors, professional, or graduate degrees lasting at least two years; provides full credit towards a bachelor's degree; and programming must last at least one academic year and yield a certificate or other recognized credential that leads to employment- Gewertz, "Trump Wants More Apprenticeships—Starting in High School - Education Week."

¹⁸¹ "Presidential Executive Order Expanding Apprenticeships in America."

¹⁸² Sharon Parrott, "Contrary to Rhetoric, Trump Budget Would Make It Harder for Many to Climb Economic Ladder," Center on Budget and Policy Priorities, *Contrary to Rhetoric* (blog), May 30, 2017, <https://www.cbpp.org/research/federal-budget/contrary-to-rhetoric-trump-budget-would-make-it-harder-for-many-to-climb>.

¹⁸³ Parrott.

Perkins grants for CTE¹⁸⁴ even as the House passed new Perkins reauthorization legislation that shifts new spending to states.

Budget proposals are, of course, subject to a series of negotiations and compromise. Congress, for example, has committed to fund state CTE grants at the current levels for fiscal 2018.¹⁸⁵ That said, juxtaposing the importance of CTE with significant funding cuts makes it difficult to develop sustainable funding solutions, such as public-private ventures,¹⁸⁶ or to garner the necessary financial commitments from industry.¹⁸⁷

Innovative Funding Strategies

Developing sophisticated and comprehensive CTE programming, as Betsy Brand of the *American Youth Policy* forum notes, “involves multiple partners and requires significant instructional change but there is no dedicated funding stream that supports this type of education reform model.”¹⁸⁸ While there are federal funds for CTE (see above), it is subject to political volatility.¹⁸⁹ As such, districts must explore ways to create innovative and sustainable funding streams if they are to undertake whole-sale changes to CTE educational programming. Three states, Delaware, California, and New York, provide strong examples of innovative funding and allocation for CTE.

Delaware

Delaware offers a unique private-public funding initiative that links CTE and workforce development opportunities. Supported by the Pathways for Prosperity¹⁹⁰ network, *Delaware Pathways* seeks to integrate the state’s labor market needs into academic instruction.¹⁹¹ The initiative serves roughly 5,800 students in 38 (of 44) Delaware high schools.¹⁹² Students choose from a variety of pathways,¹⁹³ (e.g. engineering, culinary arts & hospitality management, manufacturing, biomedical sciences) each offering an industry-recognized credential, early college credit, and relevant work experience, in addition to a high school diploma.¹⁹⁴ Pathway curriculums are vetted by private-sector partners (e.g. Delaware Manufacturing Association for the advanced manufacturing pathway) to ensure the skills learned are meeting industry

¹⁸⁴ Andrew Ujifusa, “Trump Spending Plan Triggers Many Negative Reactions From K-12 World,” *Politics K-12* (blog), May 23, 2017, http://blogs.edweek.org/edweek/campaign-k-12/2017/05/trumps_proposed_budget_strong_reaction_education.html?cmp=SOC-SHR-FB.

¹⁸⁵ Paul Cook, “Consolidated Appropriations Act, 2017,” Pub. L. No. Pub. L. 115-31, 1 (2017), <http://www.politico.com/f/?id=0000015b-c2b2-de92-a17b-cef29f920000>.

¹⁸⁶ Alia Wong, “Trump’s Education Budget Takes Aim at the Working Class,” *The Atlantic*, May 23, 2017, <https://www.theatlantic.com/education/archive/2017/05/trumps-education-budget-takes-aim-at-the-working-class/527718/>.

¹⁸⁷ Gewertz, “Trump Wants More Apprenticeships—Starting in High School - Education Week.”

¹⁸⁸ Betsy Brand, “High School Career Academies: A 40-Year Proven Model for Improving College and Career Readiness” (American Youth Policy Forum, Washington, D.C.: National Career Academy Coalition, 2009), 6, <http://www.aypf.org/documents/092409CareerAcademiesPolicyPaper.pdf>.

¹⁸⁹ Andrew Kreighbaum, “White House Budget Includes Tens of Billions in Cuts to Student Aid and Research,” *Higher Education* news, Inside Higher Ed, May 24, 2017, <https://www.insidehighered.com/news/2017/05/24/white-house-budget-includes-tens-billions-cuts-student-aid-and-research>.

¹⁹⁰ Pathways to Prosperity is a partnership between states, Jobs for the Future, and the Harvard Graduate School of Education. The initiative seeks to increase opportunities for youth to attain skills and credentials necessary to competitively enter the labor market (<http://www.jff.org/initiatives/pathways-prosperity-network/resources-pathways-prosperity-network-states>).

¹⁹¹ The program centers on five core priorities: A comprehensive system of career preparation that aligns with the state and regional economies; scale and sustain meaningful work-based learning experiences; integrate education, workforce development efforts, and data systems; coordination of financial support for Delaware Pathways; and engage employers, educators, and service providers to support Delaware Pathways.

¹⁹² Delaware Pathways, “Learning to Work: Delaware Pathways Strategic Plan,” Delaware Pathways, 2017, <http://delawarepathways.org/wp-content/uploads/2017/05/Delaware-Pathways-Strategic-Plan-March-2017-1.pdf>.

¹⁹³ The full list of pathway options can be found here: <http://delawarepathways.org/>

¹⁹⁴ Delaware Pathways, “Learning to Work: Delaware Pathways Strategic Plan.”

needs.¹⁹⁵ Additionally, any early college credits earned are transferable to all two and four-year institutions within the state.¹⁹⁶

In addition to the program-based state funding formula and federal Perkins funds allocation (\$4.7 million in total funding, \$500,000 in grants to participating schools),¹⁹⁷ the *Pathways* program receives partial funding through the following streams:¹⁹⁸

- \$3.5 million-dollar grant to the Delaware Technical Community College as part of the U.S Department of Labor’s America’s Promise grant program;
- \$800,000-dollar grant to the Delaware Department of Labor as part of the ApprenticeshipUSA state expansion program.
- Additionally, the initiative recently received a \$1.95 million-dollar grant from J. P. Morgan and Chase New Skills for Youth initiative to expand the program. The funds will help to enhance student work-based learning opportunities, with specific focus on at-risk students and students with disabilities.¹⁹⁹

The program began in 2015 and has thus not yet been subject to a research evaluation. Early self-reported student outcome data shows promise. Delaware Pathways’ 2016 *Prosperity Network Outcomes Report* shows 60% of Pathways’ students reached college- and career-readiness benchmarks, and 93% of students successfully completed work-based learning courses.²⁰⁰

California

Representing the largest CTE investments made by a state, the *California Career Pathways Trust* (CCPT) distributes grants to regional public-private partnerships²⁰¹ for CTE programming that trains students for high-skilled and high-wage careers. As part of California Assembly Bill 86,²⁰² the legislature allocated \$500 million in CCPT funding for two cohorts: Cohort 1 (FY 2014–2018) and Cohort 2 (2015–2019):

Cohort 1 funded 12 regional consortia with up to \$15 million each, 16 regional consortia with up to \$6 million each, and 11 local projects with up to \$600,000 each, totaling \$282 million. Cohort 2 supported 10 regional consortia of up to \$15 million each, 4 regional consortia of up to \$6 million

¹⁹⁵ Mark T. Brainard, “How Delaware Is Creating a Pipeline of Skilled Workers in Manufacturing | Brookings Institution,” *Brown Center Chalkboard: Brookings Institution* (blog), November 6, 2015, <https://www.brookings.edu/blog/brown-center-chalkboard/2015/11/06/how-delaware-is-creating-a-pipeline-of-skilled-workers-in-manufacturing/>.

¹⁹⁶ Delaware Pathways, “Learning to Work: Delaware Pathways Strategic Plan.”

¹⁹⁷ Robert Schwartz, “Memo to President Elect-Trump on Career and Technical Education” (Brown Center on Education Policy at Brookings, December 13, 2016), https://www.brookings.edu/wp-content/uploads/2016/12/browncenter_20161213_cte.pdf.

¹⁹⁸ Alison May, “Delaware Awarded \$2 Million to Improve Career Education,” January 11, 2017, <https://www.doe.k12.de.us/site/default.aspx?PageType=3&DomainID=232&ModuleInstanceID=20&ViewID=047E6BE3-6D87-4130-8424-D8E4E9ED6C2A&RenderLoc=0&FlexDataID=19310&PageID=1791>.

¹⁹⁹ Scott Goss, “Delaware’s Career Pathways Program Lands \$2M Grant,” *Delaware News Journal*, January 11, 2017, <http://www.delawareonline.com/story/news/education/2017/01/11/delawares-career-pathways-program-lands-2m-grant/96445078/>.

²⁰⁰ Pathways to Prosperity Network, “Delaware Pathways Outcome Report,” 2016, https://ptopnetwork.jff.org/sites/default/files/DE-PATHWAYS-OUTCOMES-REPORT-V9%203_0.pdf (accessed July 14, 2017).

²⁰¹ Partnerships consist of secondary public schools, community colleges, labor agencies, and local and regional employers.

²⁰² “Bill Text - AB-86 Education Finance: Education Omnibus Trailer Bill,” accessed August 23, 2017, http://leginfo.ca.gov/faces/billNavClient.xhtml?bill_id=201320140AB86.

each, 20 local projects of up to \$6 million each, and 6 local projects of up to \$600,000 each—a commitment of \$297.6 million.²⁰³

Grants support a diverse range of strategies, from modifying existing programs to creating entirely new pathways based on current and projected labor market demand. Examples of CCPT funded initiatives include:

- Santa Ana Unified School District used its \$6 million award to develop an eight-week internship program at NASA’s Jet Propulsion laboratory. Students work alongside NASA engineers and web developers on various projects, earning a \$4,000 stipend at the end of the program.²⁰⁴
- Burbank Unified School District purchased 23 3-D printers to enhance the district’s digital manufacturing pathway course offerings.²⁰⁵
- Paramount Agriculture Career Academy (PACA) – a San Joaquin Valley regional collaborative of Paramount Academy charter school in Delano, CA, four school districts, three community colleges, six major agriculture production and processing companies, and Paramount Education Program – developed three agriculture-themed pathways: Agricultural Business Management, Agricultural Mechanics, and Plant Science.²⁰⁶ Agriculture in the San Joaquin Valley is a \$45 billion industry, employing one in five Valley residents.

While CCPT represents a strong financial commitment to CTE programming, the fact remains that these funds are a one-time investment by the state. In some instances, K-12 districts have included key CCPT staff in their CTE budgets to protect those positions.²⁰⁷ More mature programming, such as the strong partnership between the local workforce development board and the Long Beach Unified School District, and the Orange County Regional Consortium, have been able to leverage established relationships to help develop financial sustainability.²⁰⁸ Sustainable funding will require stronger measures beyond short-term cash infusions, such as developing long-term public-private partnerships or including programming into district education budgets.²⁰⁹

New York

New York State’s CTE delivery system consists of more than 1,100 CTE providers who serve over one million students in school districts, *Boards of Cooperation Education Services* (BOCES), and post-secondary institutions. BOCES allocates CTE funds using a formula that accounts for service, administrative, and facilities costs.²¹⁰ The five largest school districts, which operate outside of the

²⁰³ Milbrey McLaughlin, Valerie Lundy-Wagner, and Barry Groves, “Two Years in CCPT: Many Challenges & Great Promise California Career Pathways Trust Implementation Research Report” (Boston, MA: Jobs for the Future, March 15, 2017), 5, http://www.jff.org/sites/default/files/publications/materials/CCPTImplementationReport_03717_0.pdf.

²⁰⁴ Fermin Leal, “Career Pathways Trust Allowing Students to Explore the Universe,” EdSource, 2015, <https://edsource.org/2015/career-pathways-trust-allowing-students-to-explore-the-universe/83224>.

²⁰⁵ Fermin Leal, “\$1.5 Billion Helping Career Pathways Take off in California’s High Schools,” EdSource, 2016, <https://edsource.org/2016/1-5-billion-helping-career-pathways-take-off-in-californias-high-schools/93950>.

²⁰⁶ Jazmin Ortega, “Career Pathways Trust Awardees - Year 2014 (CA Dept. of Education),” May 30, 2014, <http://www.cde.ca.gov/nr/ne/yr14/yr14rel58.asp>.

²⁰⁷ McLaughlin, Lundy-Wagner, and Groves, “Two Years in CCPT: Many Challenges & Great Promise California Career Pathways Trust Implementation Research Report.”

²⁰⁸ McLaughlin, Lundy-Wagner, and Groves.

²⁰⁹ John Fensterwald, “When \$500 Million Career Pathways’ Grants Ran Dry, so Did Regional Collaboration,” EdSource, December 6, 2018, <https://edsource.org/2018/when-500-million-career-pathways-grants-ran-dry-so-did-regional-collaboration/605815>.

²¹⁰ Laura R. Foster, Steve Klein, and Barbara Elliot, “State Strategies for Financing Career and Technical Education” (Washington, D.C.: U.S. Department of

BOCES model, receive funding through a weighted formula based on enrollment called Special Services Aid. The SSA funds career education programs, computer services, and enhanced academic services for Big Five City and other school districts which are not components of a BOCES.²¹¹ These aid categories receive supplemental funding via an additional wealth-adjusted amount calculated as Academic Improvement Aid. The aid for 2017-2018 will total \$265 million, of which approximately \$51 million is Perkins CTE funds.²¹²

Potential Barriers to Effective CTE Implementation

CTE programs have immense potential to help prepare high school students for industry readiness. However, policy makers must mediate significant barriers to implementation:

- *Inconsistent program goals:* Leaders need to determine the depth and breadth of what they are trying to achieve in developing high quality CTE program. Does achieving the state or district's goal require light-touch technical assistance to enhance current pathways, or does it require full-scale reinvention of secondary career and technical education? Strong vision and commitment by school leadership is essential for building and implementing effective CTE programs.
- *Acquisition of finite skills:* There is emergent evidence that prioritizing vocational training over general education may do more harm to students' long-term workplace prospects.²¹³ Recent research of the much-lauded German apprentice model (see above) suggests that many of the skills learned by students have a limited shelf life. The shorter-term technical training in the German model often comes at the expense of longer-term cognitive skill development; thus, early career gains can potentially limit opportunities later in life.²¹⁴ That said, the need for middle-skilled workers is immediate, and growing. Per the *Harvard Business Review*, "while no aggregate estimates exist, the problem is most acute in the utilities and aerospace sectors—50% to 60% of whose workforces are eligible to retire by 2020 or likely to leave for other reasons."²¹⁵ Policymakers, education and industry leaders must determine how to balance rigorous academics with technical skill acquisition to meet both short- and also long-term economic needs.
- *Ambivalent public perception-* Leaders must manage the public perception and politics that may arise from restructuring the traditional model of high school. Academically rigorous CTE programs are competitive, and school principals may be resistant to expanded opportunities that may pilfer top, college-bound students.²¹⁶ Likewise, programming that embraces the "9-14 model" – where students are enrolled for six years, earning both a high school diploma and an associate's degree – are multifaceted and require long-term state investment.²¹⁷ City and district leaders will need to

Education, Office of Career, Technical, and Adult Education; National Center for Innovation in Career and Technical Education, October 2014), http://s3.amazonaws.com/NCICTE/pdf/NCICTE_CTE_Finance_Study.pdf.

²¹¹ Education Unit, "Description of the 2017-2018 Executive Budget Recommendations for Elementary and Secondary Education" (New York State Division of the Budget, 2017), 7, <https://www.budget.ny.gov/pubs/executive/eBudget1718/fy18localities/schoolaid/1718schoolaid.pdf>.

²¹² Perkins Collaborative Resource Network, "PCRN: State Profile - New York," 2016, <http://cte.ed.gov/profiles/new-york>.

²¹³ Eric A Hanushek and Ludger Woessmann, "Apprenticeship Programs in a Changing Economic World," *Brookings* (blog), June 28, 2017, <https://www.brookings.edu/blog/brown-center-chalkboard/2017/06/28/apprenticeship-programs-in-a-changing-economic-world/>.

²¹⁴ Hanushek, "German-Style Apprenticeships Simply Can't Be Replicated," June 18, 2017.

²¹⁵ Kochan, Finegold, and Osterman, "Who Can Fix the 'Middle-Skills' Gap?"

²¹⁶ Catherine Gewertz, "Can a Career Tech Ed. School Be Too Popular? - Education Week," *Education Week*, May 17, 2017, <http://www.edweek.org/ew/articles/2017/05/17/can-a-career-tech-ed-school-be.html>.

²¹⁷ Charlotte Cahill et al., "State Strategies for Sustaining and Scaling Grades 9-14 Career Pathways: Toward a Policy Set for Pathways to Prosperity." (Boston, MA: Jobs for the Future; Harvard Graduate School of Education, October 2014), http://www.jff.org/sites/default/files/publications/materials/State-Strategies_Sustaining_Scaling%2092414.pdf.

determine if the necessary political will (and capital) exists to implement such comprehensive initiatives.

Part V

Case Study: The Ongoing Reform Efforts in Tennessee's CTE Programs

The Tennessee Division of College, Career, and Technical Education (CCTE) is responsible for providing specialized education courses and support to the state's middle-and-high school students for post-secondary education, industry certifications, and careers. The state's *Basic Education Program* (BEP) formula determines how the CCTE allocates funds.²¹⁸ The current formula is set at 1 full time CTE instructor per 16.67 career and technical education students.²¹⁹ State funding for CTE is \$6.8 million for FY17,²²⁰ in addition to \$13.7 million in Perkins funds.²²¹

Historical Context

Since 2007, policy makers in Tennessee have focused on establishing education-to-career learning pathways. Both the current (Haslam) and previous (Bredesen) governors have prioritized closing the technical skills gap and addressing the workforce needs of state and regional industries. Three sequential policy priorities form the foundation for Tennessee's CTE reform efforts.

The *Complete College TN Act of 2010*²²² began the process by redefining the state's higher education master plan. With two key provisions related to career and technical education: The first allowed institutions to redirect funds from under-producing programs to those that more directly anticipate employment of graduates per findings from the UT Center for Business and Economic Development's labor market analysis. The second establishes dual and concurrent enrollment programs at two- and four-year institutions. While these do not directly create CTE programs, they did create the conditions for a conversation addressing highly skilled labor shortages across regional industries.²²³

The 2013 *Drive to 55 Plan*²²⁴ seeks to increase the percentage of individuals earning two- or four-year degrees or industry-recognized certificates from a projected 39% by 2025 to 55%. Regarding CTE specific provisions, the plan includes \$16.5 million for equipment and technology for workforce development programs at Tennessee colleges of applied technology and community college. Additionally, the *Drive to*

²¹⁸ Tennessee Department of Education, "Operating Career & Technical Education (CTE) Programs: A Guide for CTE Directors," 7–9, accessed June 1, 2017, https://www.tn.gov/assets/entities/education/attachments/cte_res_director_manual.pdf.

²¹⁹ Tennessee State Board of Education, "Tennessee Basic Education Program BEP 2.0," 2016, <http://www.comptroller.tn.gov/Repository/RE/bepadequacy.pdf>.

²²⁰ State of Tennessee; Department of Finance and Administration, "FY 2017 Budget for the State of Tennessee," February 2016, <https://www.tn.gov/assets/entities/finance/budget/attachments/2017BudgetDocumentVol1.pdf>.

²²¹ Tennessee Commission on Children and Youth, "Resource Map of Expenditures for Tennessee Children" (Nashville, TN, April 2017), <http://tn.gov/assets/entities/tccy/attachments/MAP-rpt17.pdf>.

²²² <http://www.ncsl.org/research/education/bill-spotlight-complete-college-tennessee-act916.aspx>

²²³ Hans Meeder and Thom Suddreth, "Common Core State Standards & Career and Technical Education: Bridging the Divide between College and Career Readiness." (Washington, D.C.: Achieve, 2012), <http://achieve.org/files/CCSS-CTE-BridgingtheDivide.pdf>.

²²⁴ <http://advocacy.tennessee.edu/2013/09/04/drive-to-55-initiative/>

55 plan supports the Labor Education Alignment Program (LEAP), which provides \$10 million grants to communities to develop CTE programs that target skills gaps in sectors with large workforce deficits.²²⁵

Lastly, the 2015 *Tennessee Promise*²²⁶ initiative provides last dollar scholarships to cover additional costs for students attending community or technical colleges. Students may receive Promise funds for up to five semesters to complete a two-year associates degree or credentialing program.

Pathways Tennessee

*Pathways Tennessee*²²⁷ represents a public-private partnership between the department of education, local schools, and industries. This framework aims to remove barriers to improve education to support community and local business needs.

Starting in middle school, students can explore current and emerging careers and industries, based on state and regional economic trends. Industry leaders and representatives attend career fairs, serve as mentors, and come in as guest speakers to provide overviews of their businesses and the necessary knowledge and skills. In high school, students, with the help of counselors and mentors, select a program of study²²⁸ from a cluster of 16. In their POS, students accrue the necessary coursework to earn either industry certification in high school or post-secondary courses via dual or concurrent enrollment with partnering technical, and two-or four- year colleges and universities.²²⁹ Additionally, students participate in work-based learning (e.g. apprenticeships and internships) relevant to their chosen pathways.

Tennessee policymakers have also recognized the historical underinvestment in career guidance for non-traditional students. To address this, the Tennessee Department of Education revised school counseling standards to include specific standards on career development. Another initiative, *AdviseTN*,²³⁰ a partnership between the Tennessee Higher Education Commission and specific high schools, pays for college counselors who assist students in identifying the appropriate post-secondary option by which to earn an industry-recognized credential.²³¹ Furthermore, the Tennessee Department of Education and Tennessee Colleges of Applied Technology signed an MOU in 2016 to permit capstone industry certification to count towards early credits for post-secondary education.

The sum total of this activity has undergirded CTE programming. Per the TN Education Report Card from 2015-2016, almost 200,000 students enrolled in a CTE course out of the one million students in the TN school system. Almost 20 percent of the CTE students represent CTE concentrators, or those students who earn three or more credits in a single program area.

Rural and Urban CTE Programming

²²⁵ <http://www.tn.gov/assets/entities/thec/attachments/LEAPReport2017.pdf>

²²⁶ <http://tnpromise.gov/>

²²⁷ https://www.tn.gov/assets/entities/education/attachments/pathways_tn_overview.pdf

²²⁸ In 2015-2016, Tennessee revamped CTE courses/programs of study around 16 nationally recognized Career Clusters, adopting 117 new courses based on labor market need, teacher, and industry input.

²²⁹ The 2014 Labor Education Alignment Program provides nearly \$10 million in funding to facilitate and expand dual or concurrent enrollment for secondary students: <http://driveto55.org/initiatives/tennessee-leap/>

²³⁰ The program receives \$2.45 million in funding as part of the *Drive to 55* initiative, serving 10,000 students in 30 public schools: https://www.tn.gov/assets/entities/thec/attachments/Advise_TN_Call_for_Proposals_.pdf

²³¹ “State Policies Impacting CTE: 2016 Year in Review” (Alexandria, VA: Association for Career and Technical Education, 2016), https://cte.careertech.org/sites/default/files/files/resources/2016_State_Policy_Year_in_Review.pdf.

According to the Tennessee Department of Health,²³² in 70 of Tennessee’s 95 counties, half of the population, live in rural areas. Given those demographics, a “one-size-fits-all” approach to CTE programming implementation simply isn’t feasible. Tennessee’s CTE leaders recognized the state’s geographical diversity and introduced several measures to address both rural and urban student’s educational needs. The following offers two examples of such programs.

The *Northeast Tennessee College and Career Readiness Consortium*,²³³ helps high school students in rural areas become ready to enter post-secondary career training programs. Initially funded through an i3 grant, the partnership between secondary and post-secondary institutions and the Niswonger Foundation awards grants to partner schools to enhance or establish CTE programming – including Automotive Technology, Additive Manufacturing, Agricultural Engineering, Drafting, Electro-Mechanical Engineering, Greenhouse Management, and Robotics. Upon exhaustion of the i3 grant funding, the Niswonger Foundation, along with Care Foundation of America, created the *NiswongerCare Partnership* to further support the CTE program funding. With over \$2.1 million in funding, the initiative currently funds CTE programming in 31 high schools, serving 30,000 students in Northeast Tennessee.²³⁴ Additionally, the Niswonger Foundation also launched *Career Connect* in 2017 to further support rural Tennessee under the *Drive to 55* plan. This program assists students with exploring career paths and academic options and offers stipends and credentials for participation.²³⁵

Located in the four core urban regions of the state (Chattanooga, Nashville, Knoxville, and Memphis) the Tennessee Colleges of Applied Technology (TCAT)²³⁶ represent 27 statewide schools and colleges that provide work-specific training to students in surrounding areas. TCAT currently offers dual enrollment options for high school students that includes face-to-face and online courses and programs. TCAT, formerly known as the Tennessee Technology Centers, started in the early 1960s to offer vocational training in the state. In the 1980s, the Tennessee legislature passed a bill granting oversight to the Board of Regents. This unified each technology center under one organizing entity and created an integrated approach to addressing the workforce development needs of the state. Given the diversity of each area, TCAT offers programs and courses to address the unique, local economic needs.

Lessons Learned

Tennessee’s work on CTE suggests several elements that make for success: (1) Stakeholders with a variety of interests worked together to develop and implement these programs; (2) Government leaders across several election cycles maintained the state’s commitment to CTE; (3) all levels of education participated; and (4) programs diversified rather than a “one-size-fits-all.” Tennessee’s commitment to develop processes that identify regional economic diversity and tailor programming to meet those needs, offers one example of how state’s and districts can advance viable CTE programming.

Guiding Thoughts

²³² <https://www.tn.gov/health/article/healthy-places-rural-areas>

²³³ <http://www.niswongerfoundation.org/pdf/CNA%20Report.pdf>

²³⁴ <http://www.niswongercare.com/about-us.html>

²³⁵ Gregory, Sarah (January 2017). “Niswonger Foundation Launches Career Connect”, The Greenville Sun, retrieved from http://www.greenvillesun.com/features/education/niswonger-foundation-launches-careerconnect/article_0658e9b6-e5d4-5c42-a79b-42dea6d42f33.html

²³⁶ <https://www.tbr.edu/institutions/colleges-applied-technology>

The programs and models reviewed above have real potential to reduce the skill/wage gap and produce better career opportunities for young adults. Education leaders and policymakers must exercise caution in choosing a way forward, however, as not all programming is equally effective, nor is the research base on CTE yet robust.

State and district school leaders and policymakers should focus on the relevant characteristics of high-quality programs, which include: student cohorts in career-themed course sequences; rigorous, college-preparatory academics; opportunities to earn college credits and industry-recognized credentials or certificates; and work-based learning opportunities such as internships. They also should work with industry and philanthropy to develop long-term funding streams able to sustain programs and grow talent-development pipelines.

About

The Johns Hopkins Institute for Education Policy (the Institute) believes that building partnerships across different constituencies is necessary to advance excellence and equity for all of America's children. The Institute operates on the understanding that education policy must be informed both by real-world conditions and also by excellent research; that it is possible to translate the technical vocabularies of research into a language that is accessible and useful to policy experts, principals, teachers, and parents; and that in our richly diverse nation, education must be driven and sustained by evidence about what works and what does not. Learn more at <http://edpolicy.education.jhu.edu>.

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